

**MATERIAL AND EQUIPMENT STANDARD**

**FOR**

**GLASS - FIBER MAT (INNER WRAP)**

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## 1. SCOPE

This Standard specification covers the minimum requirements for machine applied Glass-Fiber Mat (Inner Wrap) for reinforcement of hot bitumen and/or coal-tar enamel coatings.

## 2. REFERENCES

Throughout this Standard the following standards and codes are referred to. The editions of these standards and codes that are in effect at the time of publication of this Standard shall, to the extent specified herein, form a part of this Standard. The applicability of changes in standards and codes that occur after the date of this Standard shall be mutually agreed upon by the Company and the Vendor:

### **ANSI (AMERICAN NATIONAL STANDARDS INSTITUTE)**

ANSI/AWWA	"Coal-Tar Protective Coating and Linings for Steel
C 203-86	Water Pipelines-Enamel and Tape-Hot Applied"

### **ASTM (AMERICAN SOCIETY FOR TESTING AND MATERIALS)**

D146	"Methods of Sampling and Testing Bitumen-Saturated Felts and Woven Fabrics for Roofing and Waterproofing" (Revision A)
D689	"Test Method for Internal Tearing Resistance of Paper"
D737	"Test Method for Air Permeability of Textile Fabrics"

### **IPS (IRANIAN PETROLEUM STANDARDS)**

IPS-E-TP-270	"Coatings"
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### **ISO (INTERNATIONAL ORGANIZATION FOR STANDARDIZATION)**

ISO 5256	"Steel Pipes and Fittings for Buried or Submerged Pipelines-External and Internal Coating by Bitumen or Coal-Tar Derived Materials"
ISO 719	"Glass-Hydrolytic Resistance of Glass Grains at 98°C Method of Test and Classification"

### **TAPPI(US) (TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY)**

TAPPI T-414	"Test for Internal Tearing Resistance of Paper"
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## 3. DEFINITIONS AND TERMINOLOGY

For this Standard the following definitions shall apply:

**BINDER**

Material (s) applied to staple fibers and to strands in order to hold them in a desired arrangement.

**BOROSILICATE GLASS**

Any silicate glass having at least 5% of boron oxide ( $B_2O_3$ ).

**FILAMENT**

A single textile element of a small diameter and a very long length, considered as continuous.

**GLASS - FIBER MAT (MAT)**

A uniform porous mat which is reinforced by strands of glass yarn to give longitudinal tensile strength.

The whole being bonded with a thermosetting resin.

**PLIABILITY**

The quality or state of being flexible in bending or creasing.

**POROSITY**

Porosity as related to air permeability is the rate of air flow through a mat under a differential pressure between the two fabric surfaces.

**TENSILE STRENGTH**

The maximum resistance of material to deformation in a tensile test carried to rupture;  
That is, the breaking load, or force per unit cross-sectional area of the unstrained specimen.

**TEAR STRENGTH**

The force required either (1) to start or (2) to continue a propagate a tear in a fabric under specified condition.

**THERMOSETTING RESIN**

A plastic that, after having been cured by heat or other means, is substantially infusible and insoluble.

**4. UNITS**

International System of Units (SI) in accordance with IPS-E-GN-100 shall be used.

**5. DESCRIPTION**

The glass-fiber mat shall be a thin, flexible, non woven uniform mat which is longitudinally reinforced across the full sheet width by continuous uniform glass filament spaced at 30 mm. max. The whole shall be bonded with a thermosetting resin.

The glass used shall be of chemically resistant borosilicate glass.

The mat shall be designed to give the degree of porosity required to ensure good "bleed through" of the enamel, during the coating process.

At the time of unrolling at ambient temperature, the successive layers of the mat shall not stick to one another.

It shall be suitable for application by line-travel equipment or in pipe mills and coating yards on fixed head coating machine.

## **6. PROPERTIES**

The finished glass-fiber mat shall meet the requirements of Table 1 and 6.1 to 6.10 inclusive.

### **6.1 Appearance**

The finished mat shall have a smooth surface free from visible defects such as holes, slits, folds, thin areas, leafing, frayed or uneven edges, presence of foreign bodies (oily matter, mud, etc.).

### **6.2 Binder**

The binder shall be a thermosetting resin which can resist the action of micro-organisms and shall have a temperature resistance of 280°C (unaffected under load in hot enamel at 280°C for one minute).

The binder content shall be such that complete impregnation with the coating material is obtained during normal application.

### **6.3 Classification**

The glass used shall be of hydrolytic class III (HGB3) as a maximum. The classification of glass as specified by ISO 719 is shown in Table 2 which is related to the consumption of acid and its equivalent of alkali [expressed as sodium oxide ( $\text{Na}_2\text{O}$ )], when tested by the method specified in that standard.

### **6.4 Elmendorf Tear Strength**

The mat shall have an Elmendorf tear strength in the longitudinal direction of not less than 100 g and in the transverse direction of not less than 100 g by test method ASTM D689 or test method TAPPI T414.

To test, use an Elmendorf tear tester, Thwing-Albert Model 60-16 or equivalent, capacity 0-1600 g. The instrument shall be securely anchored to a table and leveled. The pendulum shall be tested for zero by moving it to the left or the pendulum stop and then released. Adjustments shall be made if the pointer does not read zero after the pendulum stop has been released. The friction of the apparatus and the condition of the knife shall be verified and adjusted, if required, as provided in ASTM D689. Make tests at a temperature of  $23^\circ\text{C} \pm 2^\circ\text{C}$  and  $50 \pm 10$  percent relative humidity. Cut 10 specimens from the mat using either a sample cutter or template notching machine direction (MD) and machine direction plus cross direction (MD plus CD). Sample size shall be  $76 \text{ mm} \pm 2 \text{ mm}$  wide  $\times$   $63 \text{ mm} \pm 2 \text{ mm}$  high. The test shall initially be performed using two plies. The number of plies may subsequently have to be varied as indicated in ASTM D689. The pendulum is moved to the left until the stop is engaged. After the specimen has been clamped into the apparatus with the 63 mm slit in the vertical direction, the knife is depressed to make the slit and the stop depressed to release the pendulum. Record the number of piles, the reading of the pointer, and whether MD or MD plus CD tear. The entire procedure is repeated to obtain 10 individual readings, and then readings are averaged. This average, divided by the number of piles tested, gives the Elmendorf tear strength.

## 6.5 Pliability

There shall be no cracking of glass-fiber mat when bent over a 6.4 mm. diameter mandrel at  $23^{\circ}\text{C} \pm 1^{\circ}\text{C}$  for approximately 2 seconds, as determined by ASTM D146, modified. Cut five specimens, 25 mm  $\times$  200 mm with the long dimension parallel to the length of the roll and immerse in water at  $23^{\circ}\text{C} \pm 1^{\circ}\text{C}$  for 10-15 min. Remove each specimen individually and bend over a 6.4 mm diameter mandrel through a  $90^{\circ}$  arc at uniform speed in approximately 2s. Examine each specimen for cracks or breaks.

## 6.6 Porosity

When related to pressure difference across the sample, the glass-fiber mat shall have a porosity of not less than 0.60 mm and not more than 1.9 mm of water at an average air velocity of 60 m/min, as determined by ASTM D737, modified. Provide five specimens, at least 250 mm  $\times$  250 mm, representative of the unsaturated glass-fiber mat to be tested, or test five places on the unsaturated glass-fiber mat as widely separated as possible without cutting.

The apparatus shall consist essentially of a suction fan for drawing air through a known area of unsaturated glass-fiber mat, a circular orifice over which the mat to be tested can be clamped, a means of measuring the pressure drop across the mat, and a means of measuring the volume of air flowing through the mat. The clamp shall effectively eliminate edge leakage. The apparatus shall be capable of testing unsaturated glass-fiber mats of different thicknesses and of testing large pieces of glass-fiber mat without cutting. The instrument shall be calibrated directly with a precision instrument. Make all tests at  $23^{\circ}\text{C} \pm 1^{\circ}\text{C}$  and 50 percent  $\pm$  2 percent relative humidity. Mount the test specimen between the clamp and the circular orifice with sufficient tension to draw the unsaturated glass-fiber mat smooth. It shall not be distorted in its own plane. Draw conditioned air through the known area of the mat and through the calibrated flow meter at the rate of 60 m/min and record the pressure drop across the mat in millimeters of water. Report the average of the test results for the five test specimens or the five different locations on the glass-fiber mat as the porosity.

## 6.7 Thickness

The mat shall have a thickness of not less than 0.3 mm, as determined by ASTM D146, modified. At 10 equally spaced areas selected by sampling, measure the thickness with an Ames dial reading in units of 0.25 mm (ten thousandths of an inch). Use a circular foot and anvil, both 645 mm<sup>2</sup> in area, exerting a pressure of 13.8 kPa. Make all measurements in an atmosphere of 50 percent relative humidity and at  $23^{\circ}\text{C} \pm 1^{\circ}\text{C}$ .

## 6.8 Tensile Strength

In the case of reinforced glass wrap, the breaking strength in the longitudinal direction shall be no less than 118 N/50 mm width. In either case, the breaking strength in the transverse direction shall be no less than 36 N/50 mm width, as determined by ASTM D146, modified. Cut 10 specimens of 75 mm  $\times$  560 mm with the longer dimension along the roll and 10 specimens with the longer dimension across the roll. In those instances where the wrapper width is less than 560 mm, the specimen length shall be that of the wrapper length. Impregnate both ends of each specimen with a protective coating of shellac or methacrylate for a distance of 64 mm and allow to dry. Test all specimens at  $23^{\circ}\text{C} \pm 1^{\circ}\text{C}$  using a tension-testing machine of adequate capacity in which the clamps are attached to swivels that are free to move in any direction. The clamps shall be 25 mm  $\times$  75 mm and shall be covered with masking tape. Grip the specimen 50 mm from each end, leaving 457 mm between the clamps. This gage length may have to be adjusted, depending on wrapper width. However, the length should be a maximum consistent with good clamping. Increase the breaking of the load by causing the lower clamps of the machine to travel at a uniform speed of 300 mm/min. Disregard the reading on any specimen that breaks nearer than 13 mm from either clamp, and test an additional specimen in its place. Report the average of the results of 10 individual tests on specimens cut along the roll as the longitudinal breaking strength and the average of the results of 10 individual tests on specimens cut across the roll as the transverse breaking strength.

## 6.9 Color

The color of mat shall be light color preferably white.

## 6.10 Roll Sizes

The roll sizes, as specified by the purchaser, shall be as follows:

Roll length: 122 m (400 ft.), 244 m (800 ft.).

Roll Width: 102 mm ( 4 in.), 152 mm ( 6 in.),  
229 mm ( 9 in.), 304 mm (12 in.),  
457 mm (18 in.).

**TABLE 1- PHYSICAL CHARACTERISTICS OF GLASS-FIBER MAT**

CHARACTERISTICS	UNITS	VALUES	TEST METHODS
WEIGHT (Min.)	g /m <sup>2</sup>	41	ASTM D146
THICKNESS (Min.)	mm	0.3	ASTM D146, MODIFIED. (SEE 6.7 OF THIS STANDARD)
TENSILE STRENGTH: LONGITUDINAL (Min.)	N/50 mm WIDTH	118	ASTM D146, MODIFIED. (SEE 6.8 OF THIS STANDARD)
TRANSVERSAL (Min.)	N/50 mm WIDTH	36	
ELMENDORF TEAR STRENGTH: LONGITUDINAL (Min.)	gr.	100	ASTM D689, MODIFIED. (SEE 6.4 OF THIS STANDARD)
TRANSVERSAL (Min.)	gr.	100	
PLIABILITY	-----	SHALL PASS TEST	ASTM D146, MODIFIED. (SEE 6.5 OF THIS STANDARD)
POROSITY	mm/h <sub>2</sub> O	0.6-1.9	ASTM D737, MODIFIED. (SEE 6.6 OF THIS STANDARD)

**TABLE 2 - CLASSIFICATION OF GLASS**

<b>CLASS (1)</b>	<b>CONSUMPTION OF HYDROCHLORIC ACID SOLUTION [c(HCl)=0.01 mol/l] PER GRAM OF GLASS GRAINS ml/g</b>	<b>EQUIVALENT OF ALKALI EXPRESSED AS MASS OF SODIUM OXIDE (Na<sub>2</sub>O) PER GRAM OF GLASS GRAINS µg/g</b>
HGB 1	UP TO AND INCLUDING 0,10	UP TO AND INCLUDING 31
HGB 2	Fm. 0,10 UP TO & INCL. 0,20	Fm. 31 UP TO & INCLUDING 62
HGB 3	Fm. 0,20 " " " " 0,85	Fm. 62 " " " " 264
HGB 4	Fm. 0,85 " " " " 2,0	Fm. 264 " " " " 620
HGB 5	Fm. 2,0 " " " " 3,5	Fm. 620 " " " " 1085

1) "HGB" stands for the hydrolytic resistance of glass grains according to the boiling water test method.

## 7. STORAGE LIFE AND PACKAGING

### 7.1 Storage Life

The product shall meet the requirements of clause 5, after storage for 24 months from date of delivery, in a full, tightly covered container.

### 7.2 Packaging

The mats purchased according to this standard shall be rolled on a cardboard tubes with internal diameter of 76 mm (nominal) and packaged in suitable and approved containers so that, during stocking and transport, full quality of performance is retained.

Packing shall be weather-proof and strapped on pallets suitable for long distance shipment.

## 8. INSPECTION AND TESTING

**8.1** All materials supplied under this standard specification shall be subject to timely inspection by the purchaser or his authorized representative.

The purchaser shall have the right to reject any material(s) supplied which is (are) found to be defective under this standard specification. In case of dispute, the arbitration, or settlement procedure, established in the procurement documents shall be followed.

**8.2** Purchaser's inspector(s) shall have free access to the Supplier's works to follow up the progress of the materials covered by this standard and to check the quality of materials. The Supplier shall place free of charge at the disposal of the Purchaser's inspector (s) all means necessary for carrying out their inspection: results of tests, checking of conformity of materials with this standard requirements, checking of marking and packing and temporary acceptance of materials.

**8.3** The supplier shall set up and maintain such quality assurance and inspection systems as are necessary to ensure that the materials comply in all respects with the requirements of this standard specification.

**8.4** Samples submitted to the purchaser will be tested in the purchaser's laboratory or in a responsible commercial laboratory designated by the purchaser.

**8.5** The supplier shall furnish the purchaser with a certified copy of results of tests made by the manufacturer covering physical and performance characteristics of each batch of material to be supplied under this standard specification. The



supplier shall furnish, or allow the purchaser to collect, samples of the material representative of each batch of mat. Certified test reports and samples furnished by the supplier shall be properly identified with each batch of material.

**8.6** Prior to acceptance of the supplier's material, samples of material submitted by the supplier will be tested by the purchaser. If any sample is found not to conform to this standard, material represented by such sample will be rejected. If samples of the supplier's materials that have been previously accepted are found not to conform to this standard, all such material will be rejected.

**8.7** Unless otherwise specified in this standard specification the methods of sampling and testing shall be in accordance with applicable methods of the American Society for Testing and Materials, (ASTM) and ISO 5256.

## **9. LABELING**

### **9.1 Marking of Rolls**

Each roll shall be clearly marked with the following:

- a) The name or trade mark of the supplier;
- b) The length of the roll ( in m);
- c) The net weight of the roll (in kg);
- d) The width of the mat ( in cm).

### **9.2 Marking of Containers**

Each container shall be legibly marked with the following information:

**Name: GLASS - FIBER MAT (INNER WRAP)**

**Specification: IPS-M-TP-300**

**Order No: .....**

**MESC No: .....**

**Roll Size: Length .....Width .....**

**Max. Temperature resistance °C: .....**

**Batch or lot No: .....**

**Stock No: .....**

**Date of manufacture: .....**

**Quantity (Number of rolls): .....**

**Manufacturer's Name and Address: .....**

**Design Guide: For guidance on the usage of this material reference should be made to IPS-E-TP-270.**