



INSULATION SYSTEMS ENGINEERING

IN. SK. 46056

Rev. No.: 01

Rev. Dt.: 03/01/2023

Sht. 1 of 5 shts.

Hard Glass Mat Sheets

Insulation Class: F

1.0 General

This specification governs the quality requirement of hard glass mat sheets which are manufactured by laminating pre-impregnated chopped strand glass mat sheets under temperature and pressure.

2.0 Application

Various slot filling, support & packing applications in VPI stator/rotor windings.

3.0 Materials**3.1 Glass Mat**

0.8 mm tk. 450 gsm Chopped : BP 25691 / In. Sk. 46088
Glass Strand Mat

3.2 Adhesive

: Mowital Varnish

3.3 Thinner

: IS-324/IS-170

Methyl alcohol and Acetone

3.4 Release film

: AA22801 / PP-SSR / In. Sk. 30350

Polyester film / Polypropylene film

3.5 Teflon/PTFE coated glass cloth

: In.Sk. 46114

3.6 Stoppers for maintaining thickness : Suitable thickness of steel/epoxy glass strips**4.0 Composition****4.1** Varnish 3.2 shall be supplied by BHEL, Bhopal/ manufactured by the vendor after signing NDA with BHEL. Viscosity of the varnish should be maintained at 13-14 sec in FC 4 cup at R/T using thinner Methylated alcohol and acetone to get the required bond content in the sheet.

| Distribution: | Date of Rev. 00: 07/05/2010 | Name | Signature |
|--------------------------|-----------------------------|------------------|-----------|
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4.2 Construction of sheets for pressing

| | | | | | | | | |
|--------------------------------------|-----|-----|-----|-----|-----|---|---|----|
| Sheet thickness (mm) | 0.5 | 1.0 | 1.5 | 2.0 | 2.5 | 3 | 4 | 5 |
| No. of layers of varnished glass mat | 1 | 2 | 3 | 4 | 5 | 6 | 8 | 10 |

5.0 Equipments

5.1 The sheet shall be manufactured on suitable horizontal machine.

5.2 A multi-platen (multi-daylight) press of suitable capacity with heating arrangement.

6.0 Manufacture

6.1 Preparations Prior to building

6.1.1 The roll of polyester film (Cl. 3.4) shall be mounted on the roller under the building table and the free end of the polyester film shall be drawn along the surface of the table, through all the heating zones and finally fed through the pair of driving rollers at the rear end of the table and secured to the batching rollers.

6.2 Speed of the Machine

The speed of the Machine shall be adjusted to 350 ± 10 mm per minute.

6.3 Temperature of the heating zones

The temperature of the heating zones of the Machine shall be adjusted as detailed below and the thermostats set to control the heating zones at the specified temperature.

M/c Temperature Zone

Temperature

| | |
|-----------------------------------|------------|
| 1 st | 60 - 70 °C |
| 2 nd | 65 - 70 °C |
| 3 rd & 4 th | 80 - 90 °C |

6.4 Main Operations

6.4.1. When the specified temperature has been attained, the machine shall be started.

6.4.2 Glass Mat (Cl. 3.1) shall then be coated with uniform coat of Mowital adhesive varnish (Cl. 3.2) as prepared in clause 4.1. It shall be ensured that the glass Mat is not creased or wrinkled. The composite shall be allowed to pass through the heating zones (6.3), then the driving rollers and finally cut to the size 550 x 900 mm or any other suitable size.

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6.5 Pressing

6.5.1 The release film on the varnished glass mat shall be removed before pressing. Number of layers of glass mat shall be laminated in the same way as specified above (Cl. 4.2) depending upon the thickness of sheet to be manufactured.

6.5.2 Teflon coated glass cloth (Cl.3.5) is laid over and under the laminated glass mat sheets.

6.5.3 Place the stoppers (Cl.3.6) of suitable height to achieve the required thickness within the specified tolerance of sheet, stoppers shall be placed at both sides of the loaded stack on the platen of day light press i.e. outside the stack-length wise.

6.5.4 The assembly is then pressed in the hydraulic press between the platen for 45 ± 2 mts at 160°C to 180°C temperature and at a pressure of $40\text{--}50\text{ kg/cm}^2$ and then cooled to below 70°C temperature before releasing the pressure.

Note: During pressing, stoppers (i.e. pressing strips of steel / epoxy glass) shall be used to get the required thickness as above.

6.5.5. Components to the desired size are cut with the shears.

7.0 Properties

7.1 Thickness

Nominal Tolerance on different thickness of sheets shall be as under

- Less than or equal to 2 mm thick sheet is $\pm 0.3\text{ mm}$
- More than or equal to 3 mm thick sheet is $\pm 10\%$ of the specified thickness

7.2.1 Total Substance

Total substance shall be determined on minimum 2 numbers of samples with total area not less than 50 cm^2 . Total substance shall be as per the following table :

| Nominal thickness in mm | 0.5 | 1.0 | 1.5 | 2.0 | 2.5 | 3 | 4 | 5 |
|---|-----|-----|------|------|------|------|------|------|
| Total substance in $\text{gm/m}^2 \pm 10\%$ | 510 | 950 | 1425 | 2000 | 2375 | 3000 | 4100 | 4750 |

7.2.2 Bond Content

This is determined by calcination of the sample at $575 \pm 25^\circ\text{C}$ till constant weight is attained. Sample area for this test shall be as per clause 7.2.1.

Bond content (percentage by weight) = 12 to 19

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7.3 Pressure resistance after cure for 16 Hrs at 140 °C temp, parallel to layers – 200 N/mm², min.
(Type test to be conducted only on request)

7.4 *Contamination Effect on Impregnation Resin (to be done by BHEL)*

(Type test to be conducted only on request)

Contamination effect of the material on epoxy resin anhydride hardener impregnating mix shall be determined by the following method.

5 pieces of sample of size 40 ± 1 mm x 40 ± 1 mm and thickness 3 mm shall be cut with a total surface area of approximately 160 cm². In case, the nominal thickness of the material is more than 3 mm, thickness of the sample shall be split to a thickness of 3 mm or less.

Before carrying out the test, sample specimen shall be dried at 100 - 110 °C for 16-20 hours, and then allowed to cool in dessicator.

These dried pieces are then dipped in 120 ± 1 gm freshly prepared mixture of epoxy resin to BP-27664 and anhydride hardener to BP-27669 in the ratio 100:120 in a beaker and is kept at 70 ± 2 °C for 4 hours under sealed condition. While keeping the samples in resin hardener mix, the two pieces are separated from each other by means of a glass rod or strips. Subsequently the resin is transferred to another test tube, sealed and is stored at 100 ± 2 °C for 20 hours. Viscosity of the resin hardener mix at 70 ± 2 °C is measured at following stages:

- i) Initial value (Freshly prepared varnish)
- ii) After 4 hours at 70 ± 2 °C storage
- iii) After 20 hours at 100 ± 2 °C storage

Above test is carried out on 2 samples of resin-hardener mix with pieces of the material and 1 sample of resin hardener mix without any test material.

The difference in viscosity of the resin hardener mix with sample pieces, with respect to the blank sample of resin hardener mix shall not be more than 5 cP.

8.0 Storage Life

5 years at ambient temperature under packed condition.

9.0 Packing

The material shall be suitably packed so that it is protected from dust, dirt, moisture and damage.

10.0 Marking


Each packet shall be labeled clearly stating.

- i) Manufacturer's name
- ii) Nomenclature and grade
- iii) Date of manufacture/Batch no.
- iv) Quantity and size

11.0 Test Certificate

Unless otherwise specified three copies of test certificates shall be supplied.

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| <p>In addition, the supplier shall ensure to enclose one copy of test certificate along with their dispatch documents to facilitate quick clearance of the material.</p> <p>The test certificate shall bear the following information:</p> <p>IN.SK.46056 : Hard Glass Mat Sheets</p> <p>BHEL Order No.</p> <p>Manufacturer's/ Supplier's Name.</p> <p>Batch No. /Lot No.</p> <p>Date of Manufacture.</p> <p>Test results obtained for the Cl. 7.1, 7.2.1 & 7.2.2 of this specification</p> <p>12.0 Changes Due to Revision</p> <p>Spec. reviewed & updated. Cl. 3.1, 3.2, 3.3, 3.5, 4.1, 7.2.1, 7.2.2, 7.3, 7.4 modified.</p> | | |
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