TEST METHODS FOR INSULATION COATING ON MAGNETIC STEEL SHEETS

1. GENERAL:

This standard stipulates the test methods for insulation (varnish) coating on magnetic steel sheets. These test methods are applicable for the finished varnish coating applied by the manufacturer before processing the magnetic steel sheets.

The test results shall be furnished in the test certificate formate as per DIN 50049, given in Annexure I.

2. VARNISH COATING:

The type and thickness of insulation coating shall conform to the respective purchase specification of magnetic steel sheets.

3. PREPARATION OF TEST SPECIMEN:

3.1 Number Of Test Specimens:

One test specimen of the same quality and the same nominal thickness per test unit is required. DIN 46400 - Part 1 • - Section 7.2 & 7.3 is applicable for classification of test units and number of test specimens.

3.2 Sampling And Preparation Of Specimens:

3.2.1 The outermost and innermost turn of a coil or the top most and bottom most of a stack of sheets shall be considered as wrapping and are not representative of the properties of the remaining material and hence, shall not be considered for test specimen.

3.2.2 In case of coils, the test specimens shall preferably be taken from the first external turn excluding the wrapping turn and in the case of sheet, it shall be from the upper part of the stack. In special case, it can be taken from any other part also.

3.2.3 The test specimen shall extend over the entire sheet width and can be about 350 ± 2 mm long. In case of sheet width below 400 mm, the specimen shall be 500 ± 2 mm long.

3.2.4 The surface of the strip shall be free from contaminations and damages and shall be cut without deformation and as far as possible, without burrs. Any cleaning done shall not damage the insulating coating.

4. TEST METHODS:

4.1 CURING OF THE VARNISH:

The test to check whether the varnish is completely cured, shall be done by rubbing the insulation with a pad dipped in methylated spirit with force by hand.

The varnish shall not dissolve by this rubbing.

4.2 Varnish Layer Thickness:

4.2.1 The test method shall be as per DIN 50981 and DIN 50982 - Part 1 and Part 3 with the following :

4.2.2 Methods Of Measurement:

The varnish layer thickness of the magnotic steel sheet shall be determined by the principle of magnetic induction. Conventional measuring instruments shall be used. The instruments shall be calibrated using comparison specimens (2 - point adjustment), before measuring.

4.2.3 Calibration Of The Instrument:

The base material of the sheet to be tested shall be used as the comparison specimen, after the removal of its varnish layer by dissolution in a suitable solvent (e.g. by potassium Hydroxide - 21 weight % KOH) without any change in the surface of the base material. An unvarnished test specimen of the magnetic steel sheet can also be used for this purpose, if available. A non-ferro-magnetic foil of know thickness, approximately same as that to be measured is used as the standard for layer thickness.

4.2.4 Test Procedure:

The varnish thickness is measured at least at 10 points of the test specimen, distribute evenly on the sheet width. The arithmetic mean value of all measurements and double the standard deviation "2S" are given as the layer thickness of varnish coating.

Each side shall measured separately at the corresponding positions and each test specimen has to fulfill the thickness requirements.

The thickness of any precoating shall not be accounted for.

4.3 Inter-Laminar Resistance:

The inter-laminar resistance shall be measured as per ASTM A-717 / IEC 404 (Franklin Test Method).

4.4 Surface Quality:

The surface quality of the magnetic sheets, when measured in terms of Stacking Factor as per IS - 649 / BS 601 - part 5 - Clause 3 (on a minimum of 16 samples under a pressure of 35 ± 1% N/cm^2) shall comply with the values specified in the material purchase specification.

The stacking factor shall be calculated from the following relationship :

$$\text{Stacking Factor} = \frac{m}{p \times h \times l \times w} \times 10^{11} \%$$

where
m = Total mass of test specimen (kg)
p = Density of material (kg/m^3)
h = Height of stack (mm)
l = Mean length of test specimen (mm)
w = Mean width of test specimen (mm)

4.5 Adherence:

The insulation coating shall not peel off when cutting the sheet with a sharp cutting tool (except from the edges). It shall withstand the reverse bending test, specified in the material purchase specification, without damage to the insulation.

5. TYPE TESTS:

The following type tests are to be carried out for varnish type once only. Unless otherwise stated, the specimens are coated with a standard layer thickness of 7 Microns on each side ± 1.5 Microns. However total deviation on both sides of the varnish coating shall not be more than 2.6 mm.

5.1 Thermal Effect On Coating:

Three specimens of varnished strip shall be clamped together under a pressure of 1± 1% N/mm^2 and heated in a laboratory oven at a temperature of 130 ± 3°C for a period of one week. After cooling to room temperature, the interlaminar resistance value of the middle specimen shall not be less than the minimum values specified in the material purchase specification.

5.2 Resistance To Oil, Solvent And Ammonia:

5.2.1 Resistance To Solvent:

When tested as per DIN 53168, a cotton plug soaked with the test liquid is placed on the conventionally applied and cured varnished layer and covered with a glass shell and left for one hour.

The varnished layer is compared with an untested specimen after 5 minutes and again after one hour after the test. No visible changes shall appear on the varnished layer.

5.2.2 Resistance To Oil:

When tested as per DIN 46456 - Part 1 - Clause 6.3.10, a test specimen of the varnished sheet shall be stored in Transformer Oil (to IS 335) at a temperature of 105 ± 3°C. There should not be any change in the colour of the oil (as compared to its original colour) and varnished layer of the specimen.

5.2.3 Resistance To Ammonia:

This test shall be carried out when specifically mentioned in the order or material purchase specification.

Test specimens shall be of 100 mm x 100 mm size cut from the varnished strip. The edges of the specimen are sealed with paraffin and are kept horizontally (with about 1 cm distance) in a closed vessel at a room temperature of 25 ± 5°C. The bottom of the vessel is filled with 25% aqueous Ammonia solution so that the specimens are exposed to a water vapour ammonia atmosphere.

After storage for four weeks, the varnish coating shall not peel off when scratched by a finger nail.

6. Retests:

As per DIN 46400 - Part 1 - Section 7.6.

7. REFERRED STANDARDS:

The following is the list of the latest standards, as published by the respective issuing bodies, referred to in this speccification.

1. IS:649 2. IS:335 3. B.S.601 Part 5. Cl.3.
4. ASTM A-717 5. DIN 46400 -Part 1, Sec 7.2. and Sec 7.6
6. DIN 46456 Part 1.cl 6.3.10
7. DIN 50981 8. DIN 50892-Part 1 and 3 9. DIN 53168

ANNEXURE I

TEST CERTIFICATE FORMAT (Clause 1)

1.	Name of Varnish Manufacturer	:	
2.	Type of Varnish	:	
3.	**PROPERTIES OF THE VARNISH**		
3.1	Type of resin	:	
3.2	Type of filler	:	
3.3	Type of Solvent	:	Wt. %
3.4	Water content in case of water thinnable varnish	:	Wt. %
3.5	Solid content	:	Wt. % Vol. %
3.6	Resin content	:	Wt.% w.r.t. solids
3.7	Filler content	:	Wt.% w.r.t. solids
3.8	Density of varnish	:	g/ml
3.9	Viscosity as per DIN 53211 (4mm, 23°C)	:	s
3.10	Flame point as per DIN 53213	:	°C
4.	**PROPERTIES OF THE CURED VARNISH FILM AFTER PROCESSING, AS PER SPECIFICATION**		
4.1	Surface weight of a 7 μ thick varnish layer (Dry weight)	:	g/m^2
4.2	Interlaminar resistance to ASTM A 717/IEC 404 (Franklin Method)	:	ohm-cm^2
4.3	Surface quality	:	%
4.4	Thermal effect on coating	:	°C
4.5	Influence on the punching quality of the sheet	:	
4.6	Resistance to oil, organic solvents, water and ammonia.	:	
5.	**DATA OF THE VARNISH PROCESSOR:**		
5.1	Name of the varnish processor	:	
5.2	Mode of application	:	
5.3	Drying temperature	:	°C

5.4 The insulating varnish _____
supplied by _____
is used for our magnetic steel sheet insulation. The varnish is used without any change and as specified by the manufacturer

Date and Signature of the supplier

Note:

Any change in the composition of the varnish or individual substances shall be communicated to BHEL without delay.