



## CORPORATE PURCHASING SPECIFICATION

**AA 109 15**

**Rev. No. 08**

**PREFACE SHEET**

### COLD ROLLED NON-GRAIN ORIENTED SHEET STEEL – Gr: 270

**FOR INTERNAL USE ONLY**  
**REMOVE THIS PREFACE BEFORE ISSUE TO SUPPLIERS**

#### Comparable Standards:

1. INDIAN : IS: 648 - 1994 (Reaffirmed 1998)  
 Gr: 50 C 270 for 0.50 mm thick  
 Gr: 65 C 270 for 0.65 mm thick
2. GERMAN : DIN EN 10106 – 1996  
 Gr: M 270 – 50A for 0.50mm thick  
 Gr: M 270 – 65A for 0.65mm thick
3. International : IEC 404 - 8.4 - 1986  
 Gr: 270 – 50A5 for 0.50mm thick  
 Gr: 270 – 65A5 for 0.65mm thick

#### Suggested/Probable suppliers and grades:

1. M/S Preussag Handel GMBH : Gr: M 270 – 50A for 0.50 mm thick  
 M 270 – 65A for 0.65 mm thick
2. M/S Thyssen Krupp Electrical Steel : Gr: M 270 – 50A  
 M 270 – 65A
3. M/S EBG India, Nasik :
4. M/S Arcelor International :

#### User Plant References:

1. BHOPAL : ---
2. HEEP, HARDWAR : ---
3. HYDERABAD : ---

#### Revisions :

33.5.3 of MOM of MRC-E

#### APPROVED :

**INTERPLANT MATERIAL**  
**RATIONALISATION COMMITTEE -MRC (E)**

**Rev. No. 08**

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### COLD ROLLED NON-GRAIN ORIENTED SHEET STEEL – Gr: 270

#### 1.0 GENERAL:

This specification governs the quality requirements of Un-insulated and insulated (double side) cold rolled, non-grain oriented magnetic steel sheet or coil in finally annealed condition in 0.50 and 0.65 mm thickness.

#### 2.0 APPLICATION: Laminations of Electrical Machines.

#### 3.0 CONDITION OF DELIVERY:

##### 3.1 Cold rolled, finally annealed.

##### 3.2 The material shall be supplied in straight lengths (sheet form) or in coils, to the ordered thickness as specified in BHEL order.

##### 3.3 Magnetic steel sheets or coils shall be supplied with or without insulation coating, as detailed below, and as called for on BHEL order.

##### a) 0.50mm/0.65mm thick - insulated:\*

Double side insulated with an average of  $6 \pm 1$  micron thickness coating on each side with varnish as per BHEL specification AA 27541. The insulation thickness of any individual point shall lie between 4.5 to 9 microns and points shall be uniformly distributed.

##### b) 0.50mm/0.65mm Thick – Un-insulated:\*

Un-insulated, protected on both sides by rust preventive coating of thickness  $2 \pm 1$  microns.

#### \* NOTE:

i) The supplier shall furnish the details of such coatings alongwith the quotation. (for insulation coating, these details shall be furnished as per Annexure-1 of BHEL standard AA 085 17 11) for approval of BHEL prior to the first time supply and / or as when the type of coating is changed subsequently with the prior approval of BHEL.

ii) The surface finish of the material shall be such as to allow subsequent uniform varnishing, if required, without any problem.

#### 3.4 Type of Insulation Coating:

The insulation coating used for the steel sheets referred in clause 3.3 (a) above, shall be uniformly applied, tightly adherent and shall be suitable for fully impregnated electrical machines (VPI) and shall meet the requirements detailed in cl. 8.6.

#### Revisions :

33.5.3 of MOM of MRC-E

#### APPROVED :

INTERPLANT MATERIAL RATIONALISATION  
COMMITTEE (MRC -E)

Rev. No. 08

Amd.No.

Reaffirmed

Prepared  
HARDWAR

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Corp. R&D

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#### 4.0 COMPLIANCE WITH NATIONAL STANDARDS:

Material shall comply with the requirements of the following national standards and also meet the requirements of this specification.

IS 648-1994 (Reaffirmed 1998)		Non-oriented electrical steel sheets and strips for
Gr: 50C270 for 0.50mm thick		magnetic circuits
Gr: 65C270 for 0.65mm thick		

Material offered to DIN EN 101 06-1996, Gr:M270-50A for 0.50mm thick and Gr: M 270-65A for 0.65mm thick is also acceptable.

#### 5.0 DIMENSIONS AND TOLERANCES:

##### 5.1 Sizes:

Magnetic steel sheet shall be supplied to the dimensions and coatings specified on BHEL order.

##### 5.2 Tolerances:

##### 5.2.1 Thickness:

The permissible deviation in nominal thickness shall be  $\pm 8\%$ . The variation in thickness in a direction parallel to the direction of rolling shall not exceed  $\pm 8\%$  of the nominal thickness.

The variation in thickness in a direction perpendicular to the direction of rolling shall be  $\pm 0.020\text{mm}$  for a nominal thickness of 0.50mm and  $\pm 0.030\text{mm}$  for 0.65 thick. The measuring points should be at least 40mm away from the edges of the sheets.

##### 5.2.2 Width:

The tolerance for width of material supplied with trimmed edges shall be as follows:

Width (mm)		Tolerance,(mm)	
Over	Upto & incld.	Plus	Minus
-	150	0.3	0
150	500	0.5	0
500	1250	1.5	0

##### 5.2.3 Length:

When supplied in sheet form the tolerance on length shall be  $+ 1\%$ , but shall not exceed  $+ 10\text{mm}$ ,  $- 0$ .

##### 5.2.4 Straightness/Edge camber:

The straightness tolerances for the longitudinal edge (edge camber) over a gauge length of 2000mm shall not exceed 4mm for width upto and including 150mm and 2mm for widths exceeding 150mm.

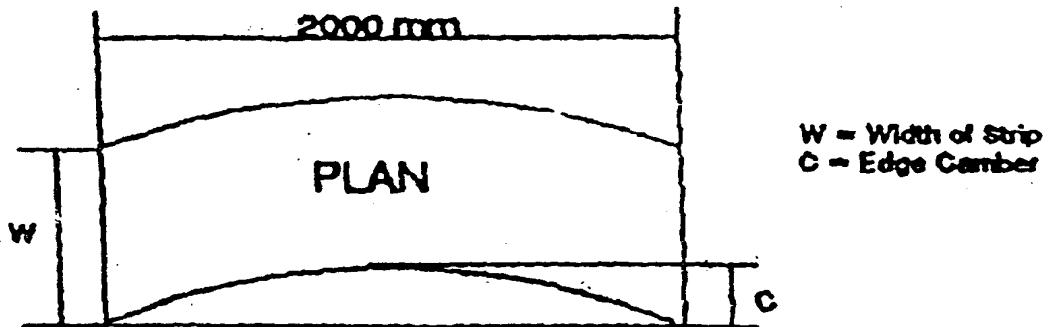


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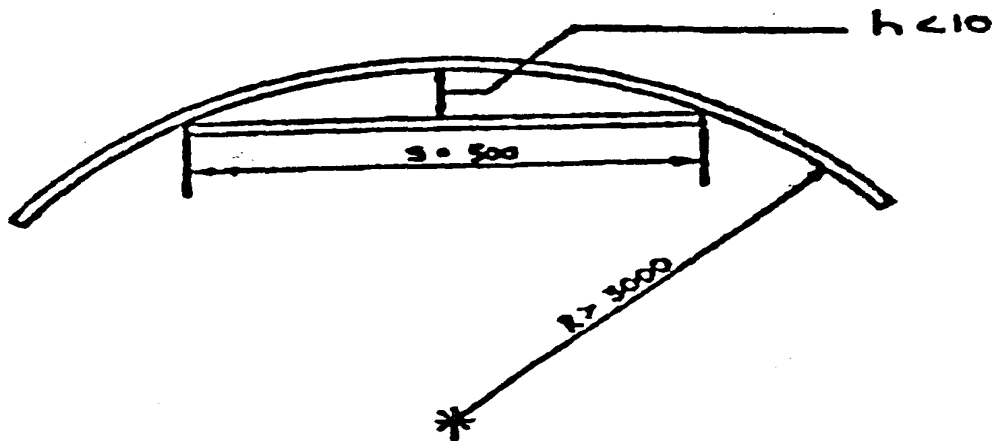


### 5.2.5 Edge Burr:

The height of edge burr shall not exceed 50 microns.

### 5.2.6 Bowing - Coils:

The material when unwound from a coil shall be placed flat on a level smooth surface (surface plate) such that it has a radius not less than 3000 mm. The specimen should be stood upright and free from constraint with one longitudinal edge on the surface of the plate. A straight edge with a length of 500 mm, when placed against the specimen and when measuring the greatest distance 'h' between the straight edge and the product should not be more than 10 mm as detailed below:



### 5.2.7 Waviness/Flatness

The Waviness/Flatness shall not exceed 1.5% (i.e the ratio of the wave height to wave length).

**6.0 FINISH:**

The material shall have a smooth surface and shall be free from loose scale, buckle or dents, waviness and internal stresses.

**7.0 TEST SAMPLES:**

The test samples of the same heat/melt & thickness shall be selected from the consignment as follows:

Upto 30 tonnes	: 1 sample
Above 30 to 60 tonnes	: 2 samples
Above 60 tonnes	: 3 samples

The test samples shall be sufficient in size to provide the necessary test pieces.

**8.0 PROPERTIES (AS RECEIVED):****8.1 Bend Test:**

A test piece of 30mm width X 60mm long taken in rolling direction in the ordered thickness shall withstand the minimum number of bends specified below, without fracture, through 180° over a 5mm radius jaws, when tested to IS:649/DIN EN 10106.

0.50mm thick	: 2 bends
0.65mm thick	: 2 bends

**8.2 Stacking Factor:**

The surface quality of the sheets when measured in terms of stacking factor as per IS:649 (on a minimum of 16 samples under a pressure of 35 N/cm<sup>2</sup>) shall be as follows:

0.50mm and 0.65mm thick double side coating (insulated)	: 95.5% , minimum
0.50mm and 0.65mm thick un-insulated	: 97% , minimum

**8.3 Total Specific Loss:**

The total specific loss on aged specimens ( a specimen which has been heated for 24 hrs. at 225±3°C) for 0.50mm thick and on unaged specimen for 0.65mm thick sheet shall be as follows, when tested as per IS:649/DIN 50462 at a frequency of 50 Hz for the specified flux density.

2.70 watts/kg, Maximum – At 1.5 Tesla

**8.4 A.C. Magnetization:**

When tested to IS:649/DIN 50462, the AC magnetic field (H) in ampere/metre (Peak), shall show the following minimum corresponding values of magnetic induction (B) in Tesla (Peak) for 0.50mm and 0.65mm thick material.

AC Magnetic field Strength 'H' A/m (Peak)	Magnetic Induction Min. (B) Tesla (Peak)
2500	1.49
5000	1.60
10000	1.70

**8.5 Anisotropy of Losses:**

When tested to IS:649/DIN 10106 as detailed below, the Anisotropy losses shall not exceed  $\pm 18\%$ .

To determine the loss ANISOTROPY the specific total loss should be measured separately on specimens taken parallel and perpendicular to the rolling direction. The loss Anisotropy, in percent, is found from the following expression:

$$\frac{P_q - P_l}{P_q + P_l} \times 100 \text{ where,}$$

$P_q$  denotes specific total losses perpendicular to the rolling direction.

$P_l$  denotes the specific total losses parallel to the rolling direction.

**8.6 Testing Of Insulation Coating:**

The insulation coating when tested in accordance with BHEL standard AA 0851711: Test Methods for Insulation Coating on Magnetic Steel Sheets, shall show the following properties:

**8.6.1 Selection of Test Samples For Insulation Coating:**

The outermost and innermost turn of coil or the topmost and bottommost of a stack of sheets, shall be considered as wrapping and not representing the properties of the remaining material and hence shall not be considered for test specimen.

In case of coils, the test specimens shall be preferably taken from the first external turn excluding the wrapping turn and in 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.

The test specimen shall extend over the entire sheet width and can be about  $350 \pm 2\text{mm}$  long. In case of sheet width, below 400mm, the specimen shall be  $500 \pm 2\text{mm}$  long.

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 insulation coating.

**8.6.2 Coating Layer Thickness:**

Both sides of the sheet shall be coated and shall have an average thickness of  $6 \pm 1$  microns on each side. At least 15 readings shall be taken on each side at equal intervals. 90% of the readings shall be between the above specified value.

The thickness of any pre-coating shall not be accounted for.

**8.6.3 Surface Insulation Resistivity:**

When tested as per ASTM, A 717 (Franklin's method) at a pressure of  $2\text{N/mm}^2$  at room temperature or any other international standard (in that case, approval to be taken by the supplier). The minimum average of 10 non-overlapping resistance measurements (5 on each side) shall be  $30 \text{ ohm-cm}^2$  with a minimum allowable individual value of  $10 \text{ ohm-cm}^2$ .

**8.6.4 Type Tests: \*****8.6.4.1 Adherence Test:**

The surface coating shall be sufficiently adherent so that it does not get detached during insulation and shearing. In the reverse bending test with a bending radius of 5mm, the surface coating shall not be detached after bending through 90°.

**8.6.4.2 Thermal Effect On Coating:**

Twelve specimens of the coated strip shall be clamped together under a pressure of 1 N/mm<sup>2</sup> approximately and heated in a laboratory oven at a temperature of 180±3°C for a period of 7 days. After cooling to room temperature, the surface insulation resistivity values of the middle ten specimens shall not be less than the minimum specified values mentioned in CI 8.6.3.

**8.6.4.3 Resistance To Solvents, Oils & Ammonia:**

The specimens shall be kept in a container filled with any of the following solvents/oil and boiled for 5 minutes. After removal and cooling to the room temperature, the coating shall not get soft enough so that it can be wiped off. The insulation coating film shall be resistant to conventional organic solvents like trichloroethylene, methylated spirit, acetone, benzene, and oil, etc. In special cases and when specified on BHEL order, the insulating film shall be resistant to ammonia also.

**\* Note:**

'Type tests' shall be carried out when, 'Type Approval' to a supplier is given and repeated once in five years for the approved supplier.

**9.0 TEST CERTIFICATES:**

Three copies of test certificates shall be supplied, unless otherwise specified on order. In addition, the supplier shall ensure to enclose one copy of the test certificate along with their dispatch documents to facilitate quick clearance of the material.

The test certificate shall bear the following information:

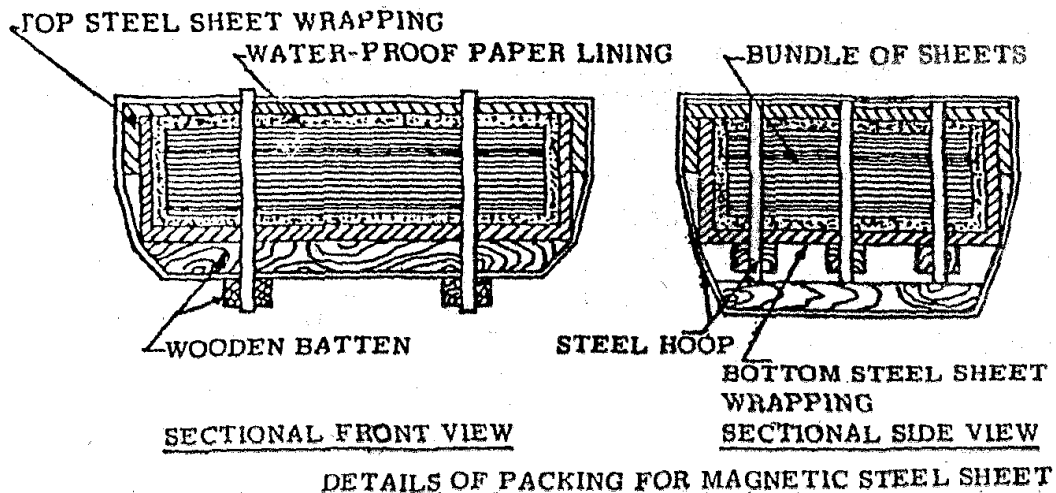
AA 10915-Rev 08 / IS:648;Gr:50C270/Gr:65C270/DIN EN 10106; Gr:M270-50A/Gr:M270-65A, BHEL Order No, Supplier's Name/Grade/Identification No., Size & Weight, Melt No., Packet/Bundle No. **Test results of** a) Dimensions & Tolerances, b) Properties as per the concerned National standards & Insulation coating, as above. Also type test certificates, not older than 5 years, shall be submitted along with each consignment.

**10.0 PACKING AND MARKING:****10.1 Material Supplied in Straight Length:**

Magnetic steel sheets shall be supplied in bundles. The packing shall be seaworthy and shall protect the material from damage during transit. A typical packing which would be suitable is shown below.

Each sheet shall be marked with supplier's grade/reference.

These markings shall be along the rolling direction.



**Note:**

- Water proof paper lining shall be preferably Volatile Corrosion Inhibitor (V.C.I.) Coated Paper with an additional polythene (100 micron) enveloped.
- Approximate weight of each bundle shall be 2 to 3 metric tonnes. Bundle weighing 2 Metric tonnes is however preferred.
- The packing should ensure that there is no seepage of moisture and the sheets reach BHEL in completely rust free condition. It shall be strong enough to withstand handling at the docks, at sea and on the road.

**10.2 Material Supplied In Continuous Coil :**

The nominal weight of each coil shall be 1800-2000kg.  
The nominal internal diameter of coil shall be 508mm.

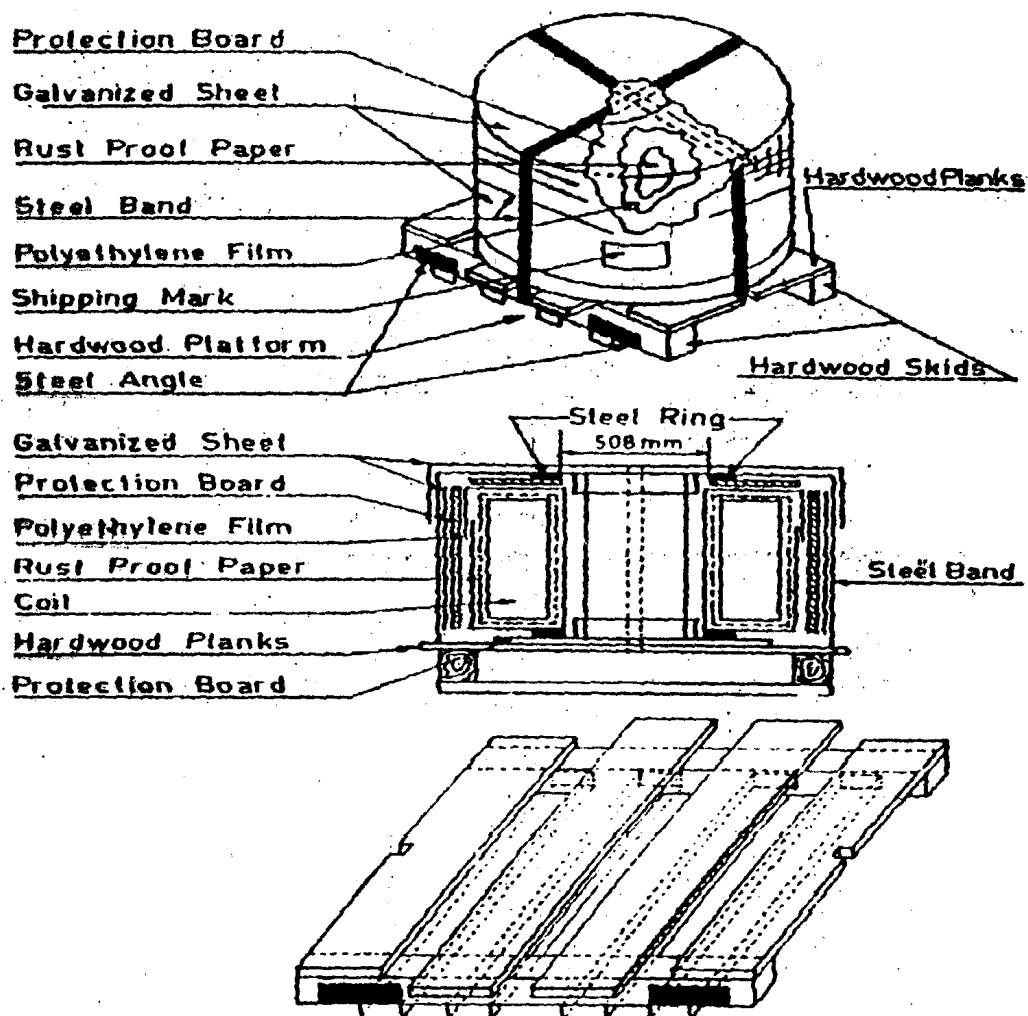
Packing shall be sea-worthy and shall protect the coils from damage and rusting during transit. The supplier's grade/reference shall be marked at every one metre intervals throughout the coil length.

Coils shall be vertically packed according to the instructions and drawing given below:

- An annular protection board shall be placed at either end of coil.
- The coil shall then be wrapped with waterproof anti-rust proof paper by lapping axially all around the circumference.
- The coil shall then be covered by polythylene sheet or anti-rust waterproof paper and the ends sealed properly.
- A galvanized sheet shall be wrapped on the outside of the coil and the top and bottom of the coils. Care shall be taken to ensure that the ends of the top and bottom of the coils extend sufficiently over the inside diameter of the coil.



- e) A galvanized sheet shall be wrapped on the inside of the coil. Care shall be taken that it overlaps sufficiently over the ends of the sheet mentioned in (d) above.
- f) Steel ring made from thick angle sheets shall be placed on the rim of the inner diameter at both ends of the coil. The rings shall be held at either ends at four points by steel bands.
- g) The coil should then be mounted on wooden skids held together by steel bands. Wooden skids must have cutouts to house the steel bands for tight fit and to avoid slippage.
- h) The packing shall ensure that there is no seepage of moisture and the coils reach BHEL in completely rust free condition. It shall be strong enough to withstand handling.
- i) Coils shall be sufficiently tight-wound to prevent collapse to an extent that would preclude their being mounted on a mandrel appropriate to the ordered internal diameter.
- j) Each package should indicate the , Sling Position, for lifting without damage. It is preferable to fix a suitable size of, 'Sheet Steel Angle', at the position where the Sling Rope is to be fitted to avoid slippage/damage/breakage of the wooden skid at four places.





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### 10.3 Marking:

A metal label/tag shall be securely attached with each bundle outside its wrapping and shall be legibly marked with the following information.

AA 10915, BHEL Order No, Supplier's Name/Grade/Identification No., Size & Weight, Melt No., Packet/Bundle No.

### 11.0 REFERRED STANDARDS ( Latest Publications Including Amendments):

- |               |                 |               |              |
|---------------|-----------------|---------------|--------------|
| 1) AA 0851711 | 2) AA 27541     | 3) IS: 648    | 4) IS:649    |
| 5) DIN 50462  | 6) DIN EN 10106 | 7) ASTM A 717 | 8) AISI, C-6 |

### GENERAL INFORMATION FOR CALCUALTION (NOT MANDATORY/TYPICAL VALUES)

Density	: 7.60 kg/dm <sup>3</sup>
Total specific loss at 1.0 tesla	: 1.10 watts/kg for 0.50mm and 0.65mm thick
Magnetic induction (B) (Peak) at 30,000 A/M	1.89 tesla
AC magnetic field strength (H) (Peak)	
<u>Mechanical Properties:</u>	
Tensile strength	: 530 N/mm <sup>2</sup>
Yield strength	: 400 N/mm <sup>2</sup>
Elongation on 5.65 √So GL	: 18%