



## CORPORATE PURCHASING SPECIFICATION

AA 109 05

Rev. No. 08

PREFACE SHEET

### COLD ROLLED GRAIN ORIENTED SHEET STEEL, Gr: 27G051

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

#### Comparable Standards:

1. AMERICAN : ASTM A 876-2003  
Gr: 27G051, Condition:F5  
Ductility: Class 1
2. IEC : 404 - Section 8.7

#### Suggested/Probable suppliers and grades:

- |    |                            |           |                   |
|----|----------------------------|-----------|-------------------|
| 1. | Nippon Steel Corporation   | - Japan   | : Orientcore 27M4 |
| 2. | Kawasaki Steel Corporation | - Japan   | : Orientcore 27M4 |
| 3. | British Steel Corporation  | - UK      | : 27 M4           |
| 4. | ARMCO                      | - USA     | : 27 M4           |
| 5. | Ugine De Cahttilon         | - France  | : 27 M4           |
| 6. | Thyssen                    | - Germany | : 27 M4           |
| 7. | Ilva                       | - Italy   | : 27 M4           |
| 8. | Allegheny                  | - USA     | : 27 M4           |
| 9. | Dofasco                    | - Canada  | : 27 M4           |

#### User Plant References:

- |           |            |
|-----------|------------|
| 1. BHOPAL | : PS 10905 |
| 2. JHANSI | : -----    |

#### Revisions :

Ref: TRE/CRGO/SKM dt:28.07.2005

#### APPROVED :

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

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### COLD ROLLED GRAIN ORIENTED SHEET STEEL, Gr: 27G051

#### 1.0 GENERAL:

This specification governs the quality requirements of Double side Insulated, Grain oriented, Silicon-Iron Electrical Steel Sheet, Gr: 27G051, Fully processed, in 0.27 mm thick.

#### 2.0 APPLICATION: Used in Transformer Cores.

#### 3.0 CONDITION OF DELIVERY:

The material shall be supplied in side trimmed, continuous coils, coated on both sides in the cold rolled and annealed condition.

#### 4.0 COMPLIANCE WITH NATIONAL STANDARDS:

Material shall comply with the requirements of ASTM A 876 -2003 Gr:27G051, Condition: F-5, Ductility : Class 1.

#### 5.0 DIMENSIONS AND TOLERANCES:

##### 5.1 Sizes:

The steel sheet shall be supplied to the dimensions specified in BHEL order.

##### 5.1.1 Thickness:

The thickness of the sheet shall be 0.27mm.

##### 5.1.2 Width:

The nominal standard width of the coil shall be 790, 840, 915 or 1000mm.

BHEL order shall clearly specify the width of the coil required.

##### 5.1.3 Weight:

The nominal weight of the coil shall be between 1800 to 2500kg.

#### Revisions :

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**5.2 Tolerances:****5.2.1 Thickness:**

Tolerance on thickness when measured with a contact micrometer at any location, not less than 9.5mm from an edge shall not deviate by more than  $\pm 0.025\text{mm}$  from the average thickness of the test lot or coil. The outer limits of acceptable thickness shall be within the range of 0.241 to 0.305mm.

**5.2.2 Camber:**

The deviation of a side edge from a straight line over 2440mm length or fraction thereof shall not exceed 3.2mm.

**5.3 Width & Waviness:**

- Width for side-trimmed coils: - 0 and + 3mm

- **Waviness:**

Sharp, short waves and buckles are extremely determined to the effective use of grain oriented electrical steel in flat laminations and shall be avoided in the delivered materials.

For material of width greater than 150mm, the deviation from flatness (Wave Factor) expressed as a percentage shall not exceed 1.5%.

**6.0 MANUFACTURE:**

The sheet shall be of low carbon, silicon steel having silicon content around 3.15%. High permeability and low core-loss in the direction of rolling is to be achieved by appropriate metallurgical processes.

The thermally flattened material shall be coated with an inorganic surface coating - Type C2, and an inorganic surface coating -Type C5, applied over the inherent - Type C2 coating to provide extra surface insulation resistance on both sides as per ASTM A 876 , condition:F5.

The steel sheets shall be uniformly coated on both sides with an insulation as stated above, as part of its manufacturing process which will withstand stress-relief annealing without deterioration of its adhesion or electrical insulation value at a temperature of 790 to 840°C. There shall be no change in colour of the insulation after annealing.

The insulation coating shall be uniform throughout the length of the coil. There shall be no line marks, rough spots, shade difference, dots and patches, etc.

**7.0 FREEDOM FROM DEFECTS:**

The material shall be clean, bright, smooth and free from dents and surface defects such as holes, scabs, pits, blisters, slivers, mill marks, etc., and also free from oil, grease, dust, scale and rust.

The sheet surface shall not exhibit any of these defects even after stress-relief annealing at 790 to 840°C.



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### 8.0 TEST SAMPLES:

Test samples shall be selected from the consignment as follows:

#### 8.1 Maximum Specific Total Loss:

One from each coil.

#### 8.2 Electrical and Mechanical Tests:

One sample per consignment/lot for Mechanical Tests and Electrical Tests (Surface Insulation Resistivity and Magnetic Permeability Tests).

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

### 9.0 TEST METHODS:

Unless otherwise specified, the test shall be conducted in accordance with the relevant method specified in ASTM A 876.

### 10.0 MECHANICAL TESTS:

#### 10.1 Ductility:

Material shall possess good shearing and punching properties and shall be sufficiently ductile to permit normal working.

The bend test shall be carried on transversely cut test specimen of 60mm long and between 10mm and 30mm wide.

The test specimen shall be initially bent through  $90^{\circ}$ , this bend not being counted. The specimen shall then be bent backward and forward through  $160^{\circ}$ . The specimen shall complete one bend without fracture.

#### 10.2 Stacking Factor:

The surface quality of the sheets when measured in terms of stacking factor (viz. a minimum of 16 samples under a pressure of 0.35 MPa) shall be 94.5%, minimum.

### 11.0 ELECTRICAL TESTS:

#### 11.1 Surface Insulation Resistivity:

When tested as per ASTM A 717 -Franklin's method, the surface insulation resistivity per lamination (two surfaces) of single strip specimens (5 on each side) shall show the following readings:

Average value : 10 Ohm-cm<sup>2</sup>, minimum

Individual value : 5 ohm-cm<sup>2</sup>, minimum.

**11.2 Maximum Specific Total Loss:**

0.85 watts/kg at 1.5 T and at 50Hz.

**11.2.1 Cutting of Test Specimen:**

Epstein test specimens measuring 30mm wide and not less than 300mm long, shall be cut from the sample with sharp shears. All the strips shall be cut parallel to the direction of rolling.

**11.2.2 Stress - Relief Annealing:**

The Epstein test specimens cut as described above, shall be annealed at a temperature of 790 to 840°C for approximately 1 hour in an atmosphere comprising of a combination of pure Nitrogen and pure Hydrogen (2 to 15%). Provision shall be made for obtaining essentially perfect flatness in the magnetic test specimen in the stress-relief annealing process.

**11.2.3 Testing:**

When tested in accordance with ASTM A 343M, the specimens prepared as described in clause 11.2.1 and 11.2.2 shall be tested at a peak magnetic flux density of 1.5 T and a frequency of 50 Hz. The specific total loss shall not be greater than 0.85 watt/kg.

**11.3 Magnetic Permeability Test:**

When tested in accordance with ASTM A 343M, the Magnetic Permeability at AC Magnetizing Force of 800 A/m shall not be less than 1880 using 25cm Epstein Test frame on 50 Hz.

Alternatively the induction value of 800 A/m magnetizing force shall not be less than 1.81 Tesla.

**12.0 TYPE TEST - AGEING: \***

When tested at a peak Magnetic Flux Density of 1.5T and at a frequency of 50 Hz, the specific total loss of the specimen which has been heated at a temperature of 225° C for 24 hours shall not deteriorate by more than 4% of the measured specific total loss of the coil concerned.

\* **Note:** Type tests shall be carried out when "**Type Approval**" to a supplier is given and repeated once in two years for the approved supplier.

**13.0 TEST CERTIFICATES:**

Unless otherwise stated, three copies of test certificates shall be supplied along with each consignment.

In addition, the supplier shall ensure to enclose one copy of test certificate along with their despatch documents for quick clearance of the material.

The test certificate shall bear the following information:



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AA 10905-Rev 08 / ASTM A 876:Gr:27G051, Condition: F-5, Ductility: Class 1, BHEL Order No, Supplier's Name/Grade/Identification No., Size & Weight, Packet/Bundle No. Test results of Dimensions & Tolerances, Freedom from defects, Details of insulation coating, Type test, Properties of (a) Specific Total Loss of each coil (b) Mechanical & Electrical properties for one random coil of each lot/consignment. (c) Results of chemical composition for information only.

### 14.0 PACKING AND MARKING:

#### 14.1 Packing:

The material shall be supplied in coils of continuous length. However, if it becomes unavoidable 5% of the coils of the order can be supplied with maximum of two butt weld joints and 95% of the coils shall be in continuous length. The supplier shall ensure that the welds are made in such a manner without causing damage to the areas of the coil adjacent to the weld. The welds shall be clearly marked by suitable tags projecting outside the coil.

Nominal weight of the coil shall be between 1800 and 2500 kg.

The nominal internal diameter of the coil shall be 508mm.

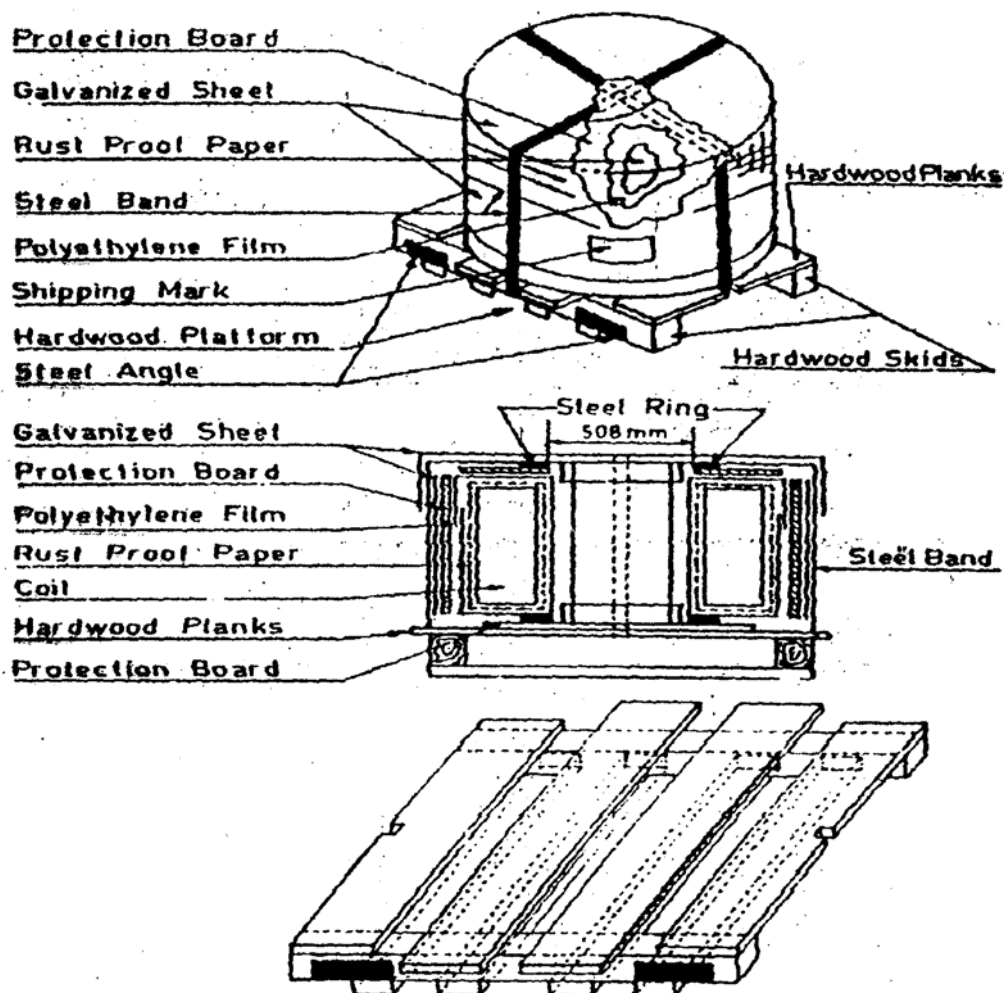
Packing shall be sea-worthy and shall be protected to prevent damage and rusting during transit.

Suppliers Grade/References shall be marked at every one meter intervals throughout the coil length.

Material shall be packed vertically according to the instructions given below and as per drawing detailed in Annexure-I.

#### **DETAILED INSTRUCTIONS FOR PACKING:**

- a) An annular protection board shall be placed at either end of coil.
- b) The coil shall then be wrapped with waterproof anti-rust proof paper by lapping axially all around the circumference.
- c) The coil shall then be covered by polythylene sheet or anti-rust waterproof paper and the ends sealed properly.
- d) 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.



### 14.3 Marking:

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

AA 10905, BHEL Order No, Supplier's Name/Grade/Identification No., Size & Weight, Melt No., Packet/Bundle No.



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

- |                |                          |
|----------------|--------------------------|
| 1) ASTM A 343M | 2) ASTM A 876            |
| 3) ASTM A 717  | 4) IEC 404 : Section 8.7 |

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### GENERAL INFORMATION FOR CALCUALTION (NOT TO FORM ACCEPTANCE CRITERION)

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Density : 7.65 kg/dm<sup>3</sup>