



# CORPORATE PURCHASING SPECIFICATION

AA10108

Rev No. 11

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## STRUCTURAL STEEL-STANDARD QUALITY

(PLATES, SECTIONS, STRIPS, FLATS &amp; BARS)

(ORDERING DESCRIPTION)

### 1.0 GENERAL:

This specification governs the quality requirements of structural steel plates, strips, flats, bars and sections such as angles, beams, channels and tees etc. of IS: 2062 – 2011, Gr: E250, Quality A

### 2.0 APPLICATION:

For general engineering purpose.

### 3.0 CONDITION OF DELIVERY:

Plates, Bars & Sections: Hot rolled in straight lengths without twists & Bends

### 4.0 COMPLIANCE WITH NATIONAL STANDARDS:

Material shall comply with the requirements of IS: 2062 – 2011, Gr: E250, Quality A

Material offered to EN 10025-2:2004 Gr. S275JR is also acceptable. The tolerance on dimensions for plates shall comply with EN 10029.

### 5.0 DIMENSIONS AND TOLERANCES:

#### 5.1 DIMENSIONS:

##### 5.1.1 Sizes

Material shall be supplied to the dimensions specified on BHEL Order.

##### 5.1.2 Length

Unless otherwise specified, hot rolled bars and sections shall be supplied in 3 to 6 metres length.

#### 5.2 Tolerances:

5.2.1 The tolerances on hot rolled material shall comply with IS: 1852. However, no plate shall be under the specified thickness at any point.

Revisions:  
As per Cl. No. 38.1 of MOM of MRC-S&GPS

**APPROVED:**  
INTERPLANT MATERIAL RATIONALISATION  
COMMITTEE – MRC(S&GPS)

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## 5.2.2 Straight for hot rolled bars:

Unless otherwise specified, the permissible deviation in straightness shall not exceed 5 mm in any 1000 mm length.

## 6.0 HARDNESS (BRINELL):

When tested in accordance with IS: 1500, the material shall show a brinell hardness in the range of 120-156 HB.

Note: Hardness test shall be conducted only when tensile test cannot be performed.

## 7.0 TEST CERTIFICATES:

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

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.

AA10108 Rev.11 / IS:2062 Grade: E250 Quality A / EN 10025-2 Gr. S275JR,

BHEL order no., Melt no. Size, Results of chemical analysis and Mechanical tests, Supplier's name, Identification no. TC no., Signature of competent authority etc.

## 8.0 PACKING AND MARKING:

Plates shall be transported suitably to avoid damage during transit.

For plates below 10 mm thick, each pile (preferably of 16 plates) and each plate 10 mm thick & over shall be marked with melt no. AA10108, BHEL order no., Supplier's name, Identification no., Size & weight on any one corner and encircled with paint preferably of white colour.

## 9.0 REFERRED STANDARDS (Latest publications including amendments):

1) IS: 1500

2) IS: 1852

3) EN 10029



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**STAINLESS STEEL SHEETS AND PLATES - ANNEALED**  
**(IS:6911, X12Cr12 / ASTM A240M, TYPE 410 / EN10088-2, X12Cr13)**

(ORDERING DESCRIPTION)

**1 GENERAL**

The sheets and plates shall conform to the latest version of IS:6911, X12Cr12 / ASTM A240M, Type 410 / EN10088-2, X12Cr13, and comply with the following additional requirements.

**2 APPLICATION**

For general engineering purposes, where corrosion resistance is essential.

**3 CONDITION OF DELIVERY**

Hot Rolled, annealed and descaled.

Cold rolled, annealed and dull / bright finish.

**4 DIMENSIONS AND TOLERANCES**

Material shall be supplied to the dimensions specified in BHEL order.

**5 CHEMICAL COMPOSITION, MECHANICAL PROPERTIES AND OTHER REQUIREMENTS**

As per IS:6911, X12Cr12 / ASTM A240M, Type 410 / EN10088-2, X12Cr13, as applicable.

**6 TEST CERTIFICATES**

Three copies of test certificates shall be supplied along with the following information:

- **BHEL References:**
  - AA10738 -Rev. No.08 / Material Grade as applicable
  - BHEL order No
- **Supplier's References:**
  - Name
  - Identification No.
  - Melt No.
  - Process of manufacture
  - Details of heat treatment.
- **Result of Tests:**
  - Dimensional inspection.
  - Results of chemical analysis, mechanical tests

**Revisions:**

Cl. 42.5 of MOM of MRC-S&amp;GPS

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## 7 PACKING AND MARKING

Sheets shall be supplied in bundles or in packages each weighing up to a maximum of 3000kg. Plates shall be suitably packed to prevent damage during transit.

For plates below 25mm thick, each pile (preferably of 16 plates) shall be marked with suppliers identification mark, 'AA10738 / Material grade, melt No., BHEL order No., on the top plate.

Each plate of 25mm thickness and above shall be stamped/painted with the suppliers identification mark, 'AA10738 / Material Grade', melt No., BHEL order No., on the top plate.

## FOR INFORMATION ONLY

(ACTUAL VALUES TO BE TAKEN FROM IS / ASTM / EN AS APPLICABLE)

## CHEMICAL COMPOSITION

C	Si	Mn	Ni	Cr	S	P	Al
≤ 0.08-0.15	≤ 1.0	≤ 1.0	≤ 0.75	11.5-13.5	≤ 0.030	≤ 0.040	--

## MECHANICAL PROPERTIES

Hardness Max		0.2% PS min N/mm <sup>2</sup>	UTS min N/mm <sup>2</sup>	% El min	Cold Bend
BHN	HRB				
217	96	205	450	20	as per applicable IS/ASTM/EN



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**BRASS SECTIONS – HALF HARD****1.0 GENERAL:**

This specification governs the quality requirements of Hard drawn Trapezoidal brass section and rectangular section with half round edge in half hard condition.

**2.0 APPLICATION:**

Used in electrical purposes such as rotor bars of synchronous machines and squirrel cage rotor.

**3.0 CONDITION OF DELIVERY:**

Half hard. The material shall be supplied in specified length, as stated in BHEL order.

**4.0 COMPLIANCE WITH NATIONAL STANDARDS:**

The material shall comply, in general, with requirements of the following National standards and also meet the requirements of this specification.

DIN 17672, Part I-1983, Gr.:CuZn37-F-37: Bars of copper and wrought copper alloys.

**5.0 DIMENSIONS AND TOLERANCES:****5.1 Sizes:**

The profile number of trapezoidal and rectangular section shall be specified in BHEL order.

**5.2 Trapezoidal Section:**

Dimensions and tolerance of rectangular section shall be as per Annexure – I.

**5.3 Rectangular Section:**

Dimensions and tolerance of rectangular section half hard edge shall be as per Annexure – II.

**6.0 FREEDOM FROM DEFECTS:**

The material shall be clean, smooth, free from fins, spills, scaling, blisters, cracks and other defects.

**7.0 CHEMICAL COMPOSITION:**

The analysis of copper when analyzed in accordance with IS 3685: Methods for chemical analysis of brasses, or by any other Conventional/ Instrumental method shall be as follows:

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Letter from HW

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Element	Percent, min.	Percent, max.
Copper	62.0	65.0
Zinc	Remainder	
<b>* Permissible impurities:</b>		
Iron	--	0.20
Tin	-	0.10
Aluminium	-	0.10
Manganese	-	0.10
Nickel	-	0.50
Lead	-	0.20
Antimony	-	0.01
Other impurities	-	0.10

\* These elements need not be determined when the material supplied conforms with the mechanical and electrical properties specified in this specification. However, the supplier shall ensure that the composition of the material lies within the limits specified above.

## 8.0 TEST SAMPLES:

### 8.1 For Chemical Analysis:

One sample per size per heat shall be taken for chemical analysis.

### 8.2 For Mechanical Tests:

One sample per size per heat shall be taken for mechanical testing.

The sample shall be cut off cold and shall receive no further treatment before being tested .

### 8.3 For Electrical Resistivity Test:

One sample per size per heat shall be taken for electrical resistivity test.

## 9.0 RETESTS:


Should any of the test pieces first selected fail to pass the tests, two further samples from the same batch shall be selected for testing, one of which shall be from the original test sample. Should the test pieces from both these additional samples pass, the batch represented by the test samples shall be deemed to comply with this specification. Should the test pieces from either of these additional samples fail, the batch represented by the test samples shall be deemed not to comply with this specification.

## 10.0 MECHANICAL PROPERTIES:

### 10.1 Tensile Strength:

When tested in accordance with IS: 1608, the material shall show the following properties:

Tensile strength, N/mm <sup>2</sup>	0.2% Proof stress, N/mm <sup>2</sup>	% Elongation on 5.65√So, gauge length
370 – 440	250, min.	27, min.

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**10.2 Hardness – Brinell (For information only):**

When tested in accordance with IS:1500, the material shall have a brinell hardness of 110 HB (Approx.).

**11.0 ELECTRICAL CONDUCTIVITY:**

The electrical conductivity of the material when tested at 20<sup>0</sup>C in the 'As received' condition shall be between 25 to 29% of IACS.

**12.0 CHECK LIST:**

The supplier shall fill up the enclosed checklist as per Annexure-A and submit the same along with each batch.

**13.0 INSPECTION AT SUPPLIER'S WORKS:**

Whenever specified, tests and inspection are to be conducted in the presence of BHEL'S representative .

The supplier shall offer BHEL's representative all reasonable facilities, without charge to satisfy the latter that the material is being furnished in accordance with this specification. The supplier shall prepare and provide necessary test specimens for testing to be carried out at his premises. If facilities are not available at his carrying out the prescribed tests elsewhere. The supplier shall notify BHEL in advance about the readiness of the material for inspection and testing.

BHEL reserves the right to test the material at BHEL'S works and the final acceptance of the material shall be based on these test results.


**14.0 TEST CERTIFICATES:**

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

In addition, the supplier shall ensure to send one copy of test certificates along with the despatch documents to facilitate quick clearance of the material.

The test certificate shall bear the following information:

AA 121 16, Rev. No. 03 : Brass sections – Half hard.  
BHEL Order No.  
Manufacturer 's / Supplier 's Name  
Lot / Batch No.  
Sizes and quantity supplied  
Date of manufacture  
Results of dimensional inspection, Chemical analysis, Mechanical and electrical tests as per this specification.

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**15.0 PACKING AND MARKING:**

The material shall be suitably packed to prevent damage during transit.

Each package shall be legibly marked or labeled with the following information.

AA 12116 : Brass sections – half hard.

BHEL Order No

Manufacturer's/ supplier's Name

Lot/ Batch No.

Size and quantity supplied.

Date of manufacture

**16.0 REFERRED STANDARDS( LATEST PUBLICATION INCLUDING AMENDMENTS):**

1) DIN 17672    2) IS:1500    3) IS:1608    4) IS: 3685    5) IS: 4519

6) AA 120 19    7) AA 121 15





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## ANNEXURE - I

## DIMENSIONS AND TOLERANCES TRAPEZOIDAL BRASS SECTION

## 1. Sizes:

The dimension or the trapezoidal section shall be as per Table-I and fig. Below. BHEL order shall state the profile number of the trapezoidal section required.

FIG 1 TRAPEZOIDAL SECTION

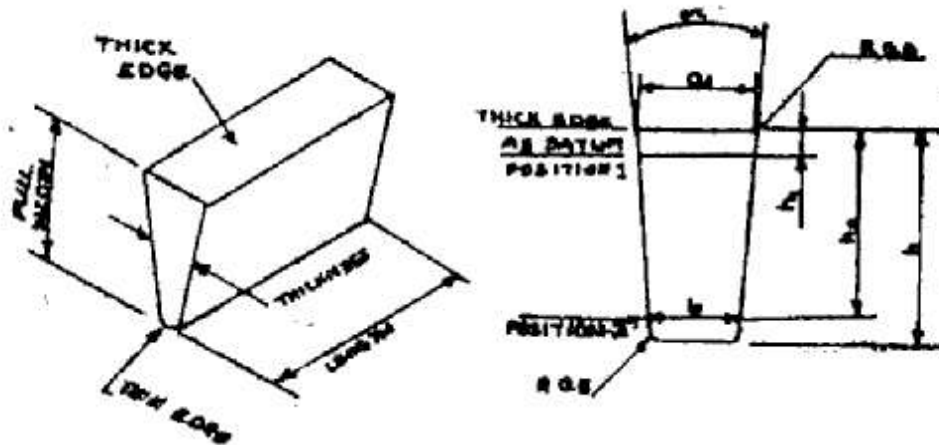


Table 1

Profile  Nos	Width  mm, h	T hickness, mm				Thick edge  mm, a1	Angle  degrees
		Position 1		Position 2			
		Dimen - sions, a	Distance from thick edge, h1	Dimen - sions, b	Distance from thick edge, h2		
1	35	11.98	3	4.03	32	12.8	15 <sup>0</sup> 36'
2	38	15.03	3	4.67	35	16.0	18 <sup>0</sup> 23'
3	55	20.36	6	6.44	49	22.3	18 <sup>0</sup> 23'
4	60	18.80	6	9.19	54	20.0	11 <sup>0</sup> 24'
5	30	8.40	3	3.60	27	9.0	11 <sup>0</sup> 25'
6	32	10.255	3	3.77	29	11.0	14 <sup>0</sup> 13'
7	35	11.73	3	4.29	32	12.5	14 <sup>0</sup> 37'
8	40	13.235	3	4.555	37	14.0	14 <sup>0</sup> 33'
9	45	15.20	3	4.80	42	16.0	15 <sup>0</sup> 11'
10	50	16.31	3	6.11	47	17.0	13 <sup>0</sup> 13'
11	57	17.63	6	7.35	51	19.0	13 <sup>0</sup> 02'

**Note:** The profiles with dimensions as given in Table-1 above have also been included in BHEL specification AA 120 19: Trapezoidal Copper Rods hard for electrical purposes.

If any change or addition is made in this specification, similar change/addition shall be made in BHEL specification AA 120 19 also.

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**2. TOLERANCES:**

**2.1 Tolerance on Length:**

<u>Specified Length, m</u>		Tolerances, $\pm$ mm
Over	Upto & incl.	
--	2.5	+ 6.4
2.5	6.0	+ 12.7
6.0	--	To be specified on order.

**2.2 Tolerance on Width:**

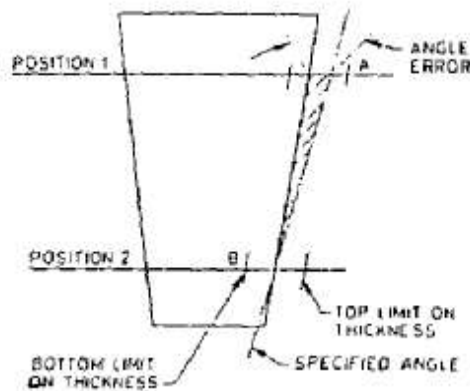
Tolerance on width shall be as given below:

<u>Specified width, mm</u>		Tolerance, mm
Over	Upto and incl.	
-	60	+ 0.20

**2.3 Tolerance on Angle:**

Tolerance on angle shall be as given below:

<u>Specified width, mm</u>		Tolerance, mm
Over	Upto and incl.	
6	20	- 0.0181
20	40	- 0.025
40	125	- 0.038
125 and above		To be specified in BHEL order





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**2.4 Tolerance and Thickness:**

When measured bars to normal tolerance shall not exceed the specified thickness by more than 0.013 mm and shall be not less than the specified thickness by more than an amount such that the total tolerance bend would not exceed the appropriate amount specified in Table 2.

Table 2

<u>Specified width, mm</u>		<u>Number of segments</u>		Total tolerance
Over	Upto & incld.	Over	Upto & incld.	
6	25	--	--	1 percent of the specified position 1, thickness expecting that in no case shall it be less than 0.038mm nor more than 0.064mm.
25	125	--	200	1 percent of the specified position 1, thickness expecting that in no case shall it be less than 0.051mm nor more than 0.076mm.
25	125	200	--	1 percent of the specified position 1, thickness expecting that in no case shall it be less than 0.038mm nor more than 0.064mm.
125	--	--	--	As specified in BHEL order.

**2.5 Edge Bow:**

The edge bow shall not exceed 5mm in any 1000mm.

**2.6 Asymmetry:**

The asymmetry with vertical axis 0 – 0 shall not exceed 0.01 mm.

**2.7 Radius on corners – Trapezoidal section:**

The bars shall show radiused corners, the radius of curvature shall be 0.50 to 0.75 mm.

The arc shall merge smoothly into the flat and the conductor shall be free from sharp, rough and projection edges.

**2.8 Straightness:**

Limits of convexity, concavity, squareness of ends, edge bow, side face bow and twist of side face for trapezoidal bars shall be in accordance with the relevant clauses of IS:4519.

For bars ordered in longer lengths twist of the side face shall be checked after cutting the bars to the required lengths for assembly. Limits of twist of side face as given in relevant clauses of IS:4519 shall apply.

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## ANNEXURE - II

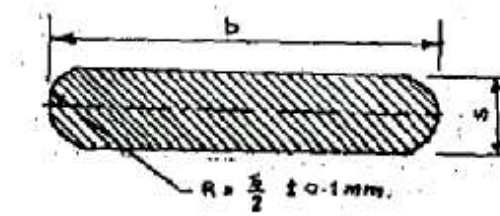
### DIMENSIONS AND TOLERANCES – OVAL SECTIONS HALF ROUND EDGE

#### 1. Sizes:

The dimensions of the rectangular section half round edges shall be as specified in the order.

#### 2. Tolerance:

Tolerance on width and thickness shall be as stated below:




Width b, mm Permissible Tolerances	Thickness s, mm			
	> 3 to 6	> 6 to 10	> 10 to 18	> 18 to 20
> 6 to 10    ± 0.07	± 0.04	± 0.07	--	--
> 10 to 18    ± 0.1			± 0.10	--
> 18 to 30    ± 0.15	± 0.06	± 0.08	± 0.12	± 0.15
> 30 to 50    ± 0.20	± 0.08	± 0.10	± 0.15	± 0.18
> 50 to 80    ± 0.25	± 0.10	± 0.12		

**Note:** For making the rounds, the centre must be on the thickness and a circle must pass tangentially on the flat sides.

#### 3. Length:

The straight lengths as called for in the drawing /order.

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**ANNEXURE - A (Clause 12.0)**

**CHECK LIST FOR AA 121 16: BRASS SECTIONS – HALF HARD**  
**(To be filled by Supplier)**

A. Name of Principal Supplier :

B. Name of Indian Agent :

1. Grade of material as per specification : Yes/No

2. Tolerance on profiles/ Width/thickness/ length /straightness  
Edge bow/asymmetry corner radius and angle  
as per specification and drawing : Yes/No

3. Chemical composition as per specification : Yes/No

4. Mechanical properties as per specification : Yes/No

5. Electrical Resistivity : Yes/No

6. Tests : (1) Tensile

7. Details of previous experience enclosed : Yes/No.  
(For New suppliers only)

C. Deviations taken (Please specify clearly, if any ) : Yes/No.

1

2

3

Date:

Place:

Signature &

Seal of Supplier



## CORPORATE PURCHASING SPECIFICATION

AA 224 15

Rev. No. 02

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## EPOXY LAMINATED GLASS FABRIC BASE SHEET (TEMPERATURE INDEX 155)

**1.0 GENERAL:**

This specification governs the quality requirements of laminated sheet made from layers of fine and plain woven glass fabric (non-alkaline glass type E) having suitable silane/volan finish with good electrical properties using thermosetting epoxy resin as the bonding medium. The material has a temperature index of at least 155.

**2.0 APPLICATION:**

This material may be used with discretion for insulating spacers, wedges, packers and pressed parts of electrical machines.

**3.0 COMPLIANCE WITH NATIONAL STANDARDS:**

The material shall comply, in general, with the requirements of the following standards and also meet the requirements of this specification.

NEMA-LI-1: 1989, Gr. G-11.

**4.0 DIMENSIONS AND TOLERANCES:****4.1 Sizes:**

Thickness, width and length shall be as stated on BHEL order.

**4.2 Preferred thickness (mm):**

0.5, 1, 1.5, 2, 3, 4, 5, 6, 8, 10, 12, 15, 20, 25, 30, 40, 50 and 70.  
Other thickness can also be ordered.

**4.3 Tolerances:****4.3.1 Thickness:**

Thickness of the sheet shall not depart at any point from the nominal thickness by more than the appropriate value as shown in the following table:

**Revisions :**

Cl: 32.4.43 of MOM of MRC-E

**APPROVED :**

INTERPLANT MATERIAL  
RATIONALISATION COMMITTEE-MRC ( E )

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Thickness, mm		Permissible variation from nominal thickness, mm
Above	upto & including	
-	0.5	0.10
0.5	2	0.20
2	3	0.25
3	5	0.50
5	7	0.75
7	10	0.90
10	15	1.10
15	20	1.25
20	25	1.40
25	30	1.50
30	40	1.75
40	50	2.00
50	60	2.50
60	70	3.00

#### 4.3.2 Width and Length:

Size, mm	Tolerance, $\pm$ mm
Below 1000	35
Above 1000	50

#### 4.4 Flatness (for sheets 3.0mm and above):

The flatness of sheets shall be such that when a sheet is placed without restraint on a flat surface, concave side, if present, up, departure at any point of the surface from a light straight edge laid in any direction upon it shall not exceed the following:

- 0.50 mm under a 300 mm straight edge.
- 3.00 mm under a 600 mm straight edge.
- 6.00 mm under a 1000 mm straight edge.

#### 5.0 FINISH:

The surface of the sheets shall be even, smooth, free from visible defects like blisters, loose fibres, resin concentration, delamination, wrinkles, local deformation and dents. The materials shall be supplied with trimmed edges.

#### 6.0 TEST METHODS:

Unless otherwise specified the tests shall be conducted in accordance with the relevant methods of BHEL standard AA 085 17 01.



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**7.0 SAMPLING AND ACCEPTANCE:****7.1 Routine and Acceptance Tests:**

Unless otherwise stated, one sheet chosen at random out of every 20 sheets of a supply shall be subjected to routine tests. One sheet of 300 X 300 mm of 10 mm thickness shall be supplied with each consignment.

The arithmetic mean of the test results for an individual test shall meet the requirement of this specification.

The lowest value obtained for any test shall not be less than 90% at the specified value.

**7.2 Type Tests:**

Type tests shall be carried out at the time of first approval and subsequently once in two years and whenever doubt arises, on the quality of the material.

**8.0 PHYSICAL PROPERTIES:**

**8.1 Specific Gravity** :  $1.8 \pm 0.1$

**8.2 Marten's Heat distortion Temperature (Type test)**  
(For thickness 10mm and above) :  $240^{\circ}\text{C}$ , min

**8.3 Water Absorption at  $20^{\circ}\text{C}$  for 24 hours (Type test):**


<b>Thickness (mm)</b>		<b>Water absorption %, max.</b>
<b>Above</b>	<b>upto &amp; including</b>	
-	1	0.40
1	1.5	0.30
1.5	3	0.20
3	10	0.15
10	25	0.10
More than	25*	0.10

\* Thickness above 25 mm shall be machined to 25 mm keeping one side intact.

**8.4 Texture of Glass Fabric:**

For laminates upto 20 mm thickness a fine woven glass cloth of 0.18mm thick shall be used. For laminates above 20mm thickness a glass cloth of not more than 0.255 mm thick shall be used. This shall be checked by burning the bonding at  $600^{\circ}\text{C}$  for sufficient time.



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**8.5 Heat Shock Test:**

A specimen of size 100x100 of ordered thickness is kept in an oven maintained at 250±5<sup>0</sup> C for 15 minutes. The specimen is removed directly to ambient conditions (ie. Room temperature) after this period and observed. The material is considered satisfactory in this test, if no delamination, cracks, splitting, blistering or resin oozing is observed at the end of the test.

**9.0 MECHANICAL PROPERTIES:**

**9.1 Tensile Strength (For sheets 1.5 mm thick and above) (Type test):**  
250 N/mm<sup>2</sup> (25.5 kg/mm<sup>2</sup> ), min.

**9.2 Cross Breaking Strength (For sheet 1.5 mm thick and above):**

**9.2.1 As received condition:** 350 N/mm<sup>2</sup> (35.6 kg/mm<sup>2</sup> ), min.

**9.2.2** After heating at 150<sup>0</sup>C for 1 hour and tested at 150<sup>0</sup>C. The reduction shall not be more than 50% of the value obtained in received condition.

**9.3 Shear strength (for sheets 1.5 mm thick and above) (Type test):**  
100 N/mm<sup>2</sup> (10.2 kgf/mm<sup>2</sup>), min.

**9.4 Compression strength proof (For sheets 5 mm thick & above) (Type test):**  
400 N/mm<sup>2</sup> (40.8 kgf/mm<sup>2</sup>).

**9.5 Impact strength Charpy - Flatwise (For sheets 2.5 mm & above) (Type test):**

Below 10 mm thick	:	75 kJ/m <sup>2</sup> , min.
10 mm thick & above	:	150 kJ/m <sup>2</sup> , min.

**9.6 Splitting load, Edgewise (For sheets 10 mm thick and above ): 2.94 kN (300 kg), min.**

**9.7 Punching (For sheets below 2.5 mm) (Type test):**  
When the sheet under test is pierced in a single operation with a pattern shown in IS: 1998. There shall not be excessive lifting or cracking around the holes.

**9.8 Machinability (For sheets 3.0mm and above) (Type test):**  
The sheet shall be capable of being sawn, milled, drilled and tapped with a M3.5 tap and shall be capable of being shaped in a shaping machine without showing any sign of cracking or chipping.

**10.0 ELECTRICAL PROPERTIES:**

**10.1 Insulation Resistance after 24 hours immersion in water at 27<sup>0</sup>C (Type test):**  
10<sup>4</sup> Megohms, min.



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**10.2 Electric Strength - Proof in oil at 90°C:**

**10.2.1 Flatwise:** Thickness upto & including 5mm : 14 kV/mm  
 above 5mm\* : 12 kV/mm

**10.2.2 Edgewise (For 5 mm and above)** : 40 kV

\* Thickness above 5mm shall be machined down to 5 mm keeping one surface intact.

**10.3 Dissipation Factor (Tan delta) at 50 Hz (Type test)** : 0.02, max.

**10.4 Comparative Tracking Index (Type test)** : 250, min.

**11.0 TEST CERTIFICATES:**

Unless otherwise specified, three copies of test certificates shall be supplied alongwith each Consignment.

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

The test certificate shall bear the following information:

AA 22415 (Rev.No 02): Epoxy Laminated Glass Fabric Base Sheet.

BHEL Order No.

Supplier's Reference:

Batch/Lot No.

Test values obtained/Certificate for compliance for clauses 8.0 to 10.0 for all routine tests.

**12.0 PACKING AND MARKING:**

Identification slips shall be pasted suitably on all four corners of each board giving the size of the board and manufacturer's code number/grade. The boards shall be suitably packed in wooden case lined with water proof paper from inside. Each sheet should be separate from other sheet by a thick paper or card-board.

Each package shall be marked with the following information:

AA 22415: Epoxy Laminated Glass Fabric Base Sheet.

BHEL order No.

Manufacturer's / Supplier's Name

Batch/Lot No.

Thickness, Width and Length.

No. of sheets:

Net weight and Gross weight:

Test Certificate No.

**13.0 REFERRED STANDARDS (Latest Publications Including Amendments) :**

1) AA 085 17 01

2) IS;1998

3) NEMA - L1-1



## CORPORATE PURCHASING SPECIFICATION

AA 251 01

Rev. No. 04

PAGE 1 OF 7

## RESIN RICH EPOXY NOVOLAK BONDED GLASS BACKED MICA PAPER TAPE

### 1.0 GENERAL:

This specification governs with the quality requirements of resin Rich Epoxy Novolak Bonded Glass Backed Micapaper Tape and folium. The material shall be made from mica paper with a woven glass fabric backing adherent to one side and evenly impregnated with a B-stage epoxy novolak resin. The homogenous insulation produced after pressing and curing shall have temperature index of at least 155.

### 2.0 APPLICATION:

Used as main slot insulation of stator and other parts of electrical machines.

### 3.0 COMPLIANCE WITH NATIONAL STANDARDS:

There is no national standard covering this material.

### 4.0 DIMENSIONS AND TOLERANCES:

#### 4.1 Sizes:

Thickness, width and length shall be as stated on BHEL order.

#### 4.1.1 Standard Thickness:

0.10, 0.18, 0.20, 0.24 and 0.28 mm.

#### 4.1.2 Width:

15, 20, 25, 300 and 400mm.

#### 4.1.3 Length/Roll:

50 meters. However, for special applications any other size may also be ordered.

#### 4.2 Tolerances:

##### 4.2.1 Tolerance on Thickness:

Average value	: $\pm 0.02\text{mm}$ .
Individual value	: $\pm 0.03\text{mm}$

Revisions :

CI 32.4.65 of MOM of MRC-E

APPROVED :

INTERPLANT MATERIAL  
RATIONALISATION COMMITTEE-MRC (E)

Rev. No. 04

Amd.No.

Reaffirmed

Prepared

Issued

Dt. of 1st Issue

Dt.:15.01.2003


Dt :

Year :

BHOPAL

Corp. R&amp;D

JANUARY, 1980

AA 251 01	CORPORATE PURCHASING SPECIFICATION	
Rev. No. 04		
PAGE 2 OF 7		

**4.2.2 Tolerance On Width:**

For widths 15, 20 and 25mm : ± 0.5mm.

For widths 300 and 400 mm : ± 1.0mm.

**5.0 MATERIALS:**

**5.1 Mica paper:**

The type of mica paper used shall be disclosed to BHEL and prior approval obtained. Once approved, it shall not be change without the concurrence of BHEL.

**5.2 GLASS FABRIC:**

The glass fabric backing shall be 0.04 - 0.05 mm, thick with suitable finish, compatible with the resin system used. The type of finish shall be disclosed to BHEL and prior approval obtained.

**5.3 Resin Bond:**

The resin used for bonding shall be catalysed epoxide novolak, and more specifically a polyglycidyl ether of phenolformaldehyde novolak, of epoxide equivalent value approximately 180.

The epoxide novolak shall be catalysed with suitable hardener to comply with the given curing schedule.

Departures from the formulation may be permitted but the fact of variation must be disclosed to BHEL and it must be supported by appropriate test data before such material is got approved. BHEL reserves the right to test the uncured resin from any lot by any instrumental methods for consistency of supplies.

**6.0 TEST METHODS:**

Unless otherwise specified, all the tests shall be conducted as per the relevant clauses of IEC -371-2 .

**7.0 PROPERTIES OF TAPE:**

**7.1 Surface Conditions And Unreeling Characteristics:**

The material shall be tack free but a minor degree of tackiness is acceptable. The material shall not be blocking after storing at 27°C ± 2°C for 24 hours and it shall be capable of being unreeled in a manner so as not to allow separation of mica paper from the glass cloth. Material shall not stick to the adjacent layers in the absence of interleaving. The tape shall be suitable for applications of hand taping, machine taping or wrapping.

**7.2 Flexibility:**

The tape shall be sufficiently flexible. When wound on a 3 mm dia mandrel with glass side up, at 27°C, there shall be no sign of cracks occurring in the mica paper.



## CORPORATE PURCHASING SPECIFICATION

AA 251 01

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PAGE 3 OF 7

**7.3 Substance ( Annexure I ):**

The substance of the tape shall be as given below:

Thickness	Total substance, g/m <sup>2</sup>	Mica, g/m <sup>2</sup>	Glass fabric, g/m <sup>2</sup>
0.10	125±15	50±3	25±2
0.18	265±25	120±10	35±3
0.20	310±25	150±10	35±3
0.24	350±25	180±12	35±3
0.28	460±50	250±19	35±3

**7.4 Resin-Flow (Annexure II):**

The resin flow shall be within the limits as given below:

Temperature °C	Resin flow, %
90 <sup>0</sup>	20 - 60
160 <sup>0</sup>	40 - 70

- 7.5 Volatile Content** : 0.4% to 0.8%.
- 7.6 Bond Content** : 40±4%
- 7.7 Acetone Solubility** : 95% of resin content, minimum.
- 7.8 Gel Time (Annexure-III)** : 2 to 4 minutes.
- 7.9 Tensile Strength** : 150 N/cm width, minimum

**8.0 CURING SECHEDULE:**

The material shall cure into a homogenous mass at a pressure of 1.0 N/mm<sup>2</sup> and 165<sup>0</sup> ±5C for one hour.


**Note:** For attaining the required electrical properties, post curing at 130<sup>0</sup>C-140<sup>0</sup>C may be necessary. The exact curing schedule shall be fixed on the basis of supplier's recommendations and keeping in view the specific requirements of the application, process facilities etc.

**9.0 PROPERTIES OF CURED LAMINATE:**

The laminate is prepared by curing the layers of tape at 165±5<sup>0</sup>C under a pressure of 1 N/mm<sup>2</sup> for one hour, followed by post curing at 140<sup>0</sup>±2<sup>0</sup>C for 16 hours. The laminates thus prepared, shall show the following properties:

**9.1 Electric Strength (BDV) at Room Temperature:**

40 kV/mm, min. (Tested on approximately 1 mm thick laminate).

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Rev. No. 04		
PAGE 4 OF 7		

**10.0 TYPE TEST:**

The cured laminate prepared as per clause 9.0 shall show the following properties.

**10.1 Loss Tangent at 1 kV/mm-50 Hz On 1 mm thick Laminate (AA 085 17 10)**

-----

10.2 Temperature °C	Loss Tangent (tanδ),max
Room Temp.	0.01
130	0.05
155	0.10

-----

**10.3 Flexural Strength** : 145 N/mm<sup>2</sup> , minimum

**10.4 Thermal Conductivity (For information only):**

0.28 k cal/m/h/°C, minimum

Temperature range 20-155°C.

The thermal conductivity shall be measured on specimen with guarded hot plates (metal coated) and double cold plate method as per DIN 52612 or with any alternative equivalent method.

Dielectric Constant is 4.5, minimum.

**Note:** Periodicity is once in two years.

**11.0 INTERLEAVING:**

A suitable grade plain polythene film shall be used as an interleaving between the turns of the tape.

**12.0 JOINTS:**

The material shall be supplied in continuous lengths as stated on BHEL order.

Only one joint per roll is permitted subjected to the following conditions:  
90% of the consignment shall be without joints. Material used for jointing shall have no adverse affect on the properties of the cured insulation. If the material used for jointing is not compatible with the insulation, the supplier shall notify accordingly

Rolls having joint shall be packed separately and appropriately marked.

**13.0 TEST CERTIFICATES:**

Unless otherwise stated, three copies of test certificates shall be supplied along with each consignment giving following information:

In addition, the supplier shall ensure to send one copy of test certificate along with the dispatch documents to facilitate quick clearance of the materials.



# CORPORATE PURCHASING SPECIFICATION

AA 251 01

Rev. No. 04

PAGE 5 OF 7

AA 25101 (Rev 04): Resin rich epoxy novolak bonded glass backed mica paper tape  
BHEL order No.

Manufacturers/suppliers Name:

Trade name/mark, if any:

Batch/Lot No.;

Quantity supplied

Date of manufacture and expiry

Test results of clauses 4.0, 7.0, 8.0, 9.0 and 12.0.

Manufacturer should give compliance certificate for clause 5.0.

## 14.0 KEEPING PROPERTY:

The material shall retain the properties prescribed in this specification for a period of not less than 6 months when stored at 20°C and not less than 12 months when stored at 5°C under cover in a dry place in a original sealed container after the date of manufacture which shall not be earlier than one month of the scheduled delivery date mentioned in BHEL order.

## 15.0 PACKING AND MARKING:

The tape shall be supplied wound tightly on rigid plastic bobbins with rounded edges with ID 25 or 55mm as specified on the order. The rolls shall be kept in a polythene bag which in turn packed in polystyrene container as indicated in the figure given below.

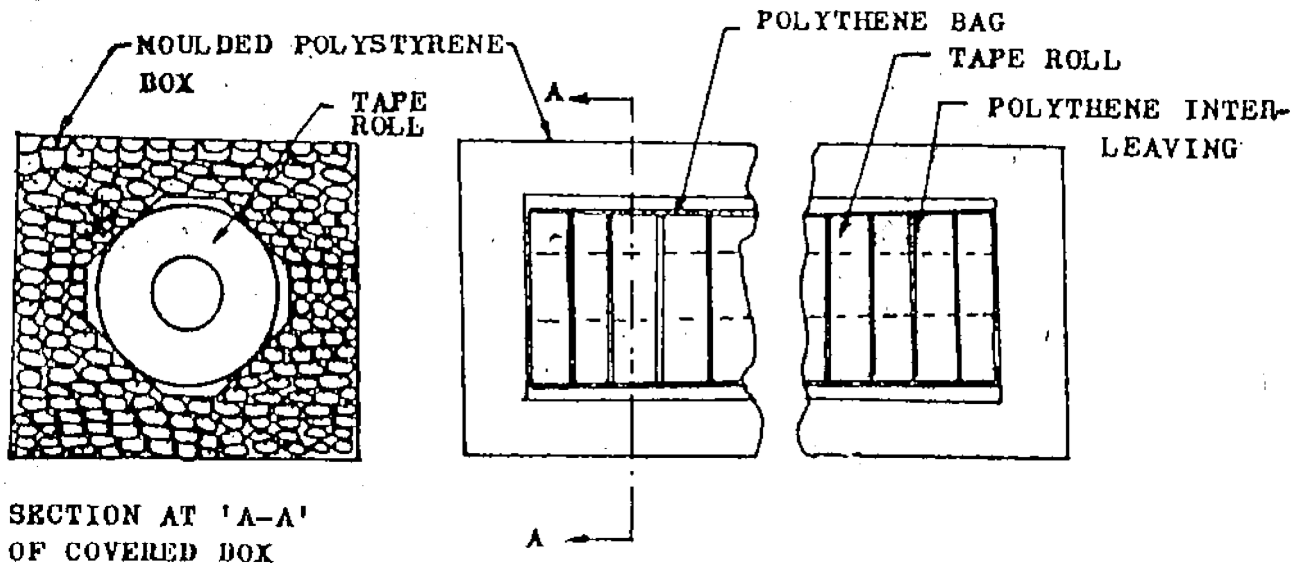
## 16.0 REFERRED STANDARDS (Latest Publications Including Amendments):

1) IEC 371-2

2) DIN - 52612

3) AA 085 17 01

FIGURE



AA 251 01	CORPORATE PURCHASING SPECIFICATION	
Rev. No. 04		
PAGE 6 OF 7		

### VIEW SHOWING THE ARRANGEMENT OF TAPE ROLLS IN BOTTOM HALF OF THE BOX

Each container shall be labeled with the following:

AA 25101: Resin rich epoxy novolak bonded glass backed mica paper tape

Manufacturer's/ Supplier's Name

BHEL Order No.

Batch No./Lot No.

Quantity supplied.

Date of Manufacture and expiry

## ANNEXURE I

### METHOD FOR THE DETERMINATION OF SUBSTANCE, VOLATILE MATTER, RESIN, MICA, AND GLASS CONTENT

#### 1. PREPARATION OF THE SAMPLE:

20cm x 10cm of sample shall be cut and weighed (W1) to the nearest milligram. The sample shall be cut into 40 mm x 5 mm.

#### 2. SUBSTANCE: Weight (gm/sq.metre)=50 W1

#### 3. VOLATILE MATTER CONTENT:

About 3 g of the above prepared sample shall be weighed in a tarred ignited 6 cm dia crucible (W2) and shall be placed in an air oven at 115+2°C for 4 hours at atmospheric pressure. It shall then be cooled in a desiccator and the loss in weight (L) shall be determined.

$$\text{Volatile matter \%} = \frac{100 L}{W 2}$$

#### 4. BOND AND MICA CONTENT:

The crucible and the contents from the above determination shall be heated over a low flame until the resin is reduced to carbon, taking care to prevent ignition. It shall then be transferred to a muffle furnace and shall be ignited at 500+25°C for 6 hours and then allowed to cool in a desiccator and the weight of residue (W3) shall be determined. With the aid of forceps all the glass cloth shall be removed and its weight (W4) shall be determined.

$$\text{Resin content, on a loss free basic \%} = \frac{(W2-L) - W3}{W2-L} \times 100$$

$$\text{Mica content (gm/sq.metre)} = \frac{50 W1 (W3 - W4)}{W 2}$$

$$\text{Glass content (gm/sq.metre)} = \frac{50 W1 (W4)}{W2}$$





## CORPORATE PURCHASINGSPECIFICATION

AA 251 01

Rev. No. 04

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**ANNEXURE II****METHOD FOR RESIN FLOW TEST**

Ten squares of 50 mm x 50 mm material shall be cut and stacked. For tape, the equivalent number of cross plied butted layers shall be cut as necessary to give the same size laminate. The assembled test pieces shall be weighed (M1). The bond content percentage (Cb) shall be recorded.

The press temperature shall be adjusted to  $90 \pm 2^{\circ}\text{C}$  or  $160 \pm 2^{\circ}\text{C}$  as required. The test piece shall be placed in the centre between cawl plates shall be immediately closed and a pressure of  $1 \text{ N/mm}^2$  is maintained for  $15 \pm 1$  minute. The test pieces shall be taken out of the press. The resin flash shall be removed and the test pieces shall be reweighed (M2).

$$\text{Resin Flow at } 90^{\circ}\text{C or } 160^{\circ}\text{C} = \frac{M1 - M2}{M1 \times Cb} \times 10^4$$

**ANNEXURE III****METHOD FOR GEL TIME AT  $160^{\circ}\text{C}$** 

The equivalent of 10 cm long tape shall be cut and stacked to form 1 to 1.5mm thick after consolidation. The test pieces shall be placed in the centre between cawl plates (1.5 mm thick) and inserted into the press heat at  $160 \pm 2^{\circ}\text{C}$  such that one longer edge of the stack and one top and bottom edge of cawl plates are in line but approximately 5mm away from the edge of platens. The contact pressure shall be applied immediately and at the elapse of 1.5 minutes, the pressure shall be increased to  $1 \text{ N/mm}^2$ . The gel time shall be taken when the stack was placed in the press at  $160^{\circ}\text{C}$  until gelation of the resin takes place.



# CORPORATE STANDARD

AA7151145

Rev. No.07

PAGE 1 of 3

## THIN NUTS, HEXAGON, PRODUCT Gr: A COARSE PITCH, BRASS (M1.6 - M16)

### 1 DESIGNATION

A product Gr. A hexagon, brass thin nut, nominal diameter 4mm, coarse pitch shall be designated as

#### 1.1 On drawings

- i) Material specification column : AA7151145
- ii) Description column : THIN NUT HEX A M4 - BR

#### 1.2 On indents

Thin Nut Hex A M4 - Brass; AA7151145

#### 1.3 For issuing enquiries and on purchase orders

While issuing enquiries and purchase orders, enclose a copy of this BHEL standard.

### 2 COMPLIANCE WITH STANDARDS

#### 2.1 Dimensions, Tolerances & General Requirements

As per BHEL standard AA7151145

#### 2.2 Material

Brass with minimum tensile strength 395 N/mm<sup>2</sup> (395 MPa) as specified in IS 319, Gr.1 or Gr.2, Half hard (HB)

#### 2.2.1 These items are to be manufactured from extruded / drawn sections only.

#### 2.3 Threads

- Pitch - coarse to IS 4218, Part 2
- Tolerance quality - Medium
- Tolerance class - 6H

#### 2.4 Identification Marking

As stated in clause 10 of IS 1367 : Part 6

#### 2.5 Surface Discontinuity

As per IS 1367, Part 9 /Sec 1, for General Application.

IS 1367, Part 9 /Sec 2, for Special Application.

#### 2.6 Finish

As specified in BHEL order.

Revisions:

APPROVED:

INTERPLANT MATERIAL RATIONALISATION  
COMMITTEE – MRC(F)

Rev. No.07

Amd. No.

Reaffirmed

Prepared

Issued

Dt. of 1<sup>st</sup> Issue

Dt:22-03-2021

Dt:

Year:

HEEP, Haridwar

Corp. R&amp;D

01-01-1977

AA7151145

Rev. No.07

PAGE 2 of 3

**CORPORATE STANDARD****3 NOTE**

- 3.1** For screw threads, general (Metric) refer to BHEL standard AA0231800.
- 3.2** For tolerance grade, position and class refer to BHEL standard AA0230201.
- 3.3** Thin nuts to this standard would be un-plated, divisions wishing to have plated nuts would have to get them plated.
- 3.4** Weights given in this standard are for general reference only and are not meant for commercial transactions.
- 3.5** When fasteners are to be tested with in BHEL, the following sampling plan shall be followed as detailed below, for physical properties

Lot Size	Sample size	Acceptance No.
Upto 1000	5	0
1001 – 3000	8	0
3001 – 10000	13	0
10001 – 35000	20	0
Over - 35000	32	1

**4 REFERRED STANDARDS (Latest publications including amendments)**

- 1) AA0230201
- 2) IS 4218 Part 2
- 3) AA0231800
- 4) IS 319

**EXPLANATORY NOTE**

This revision issued with the following changes:

- In Clause 2.4, clause 10 in place of clause 9.

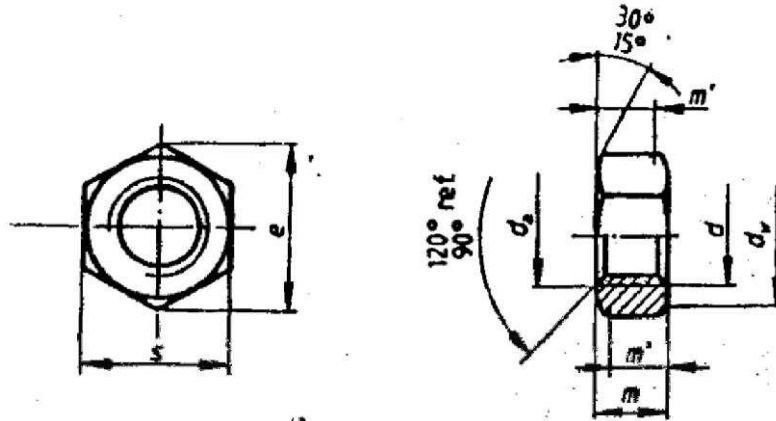


## CORPORATE STANDARD

AA7151145

Rev. No.07

PAGE 3 of 3



Note:


- 1) Corporate sub-code Numbers are given in the Table-1
- 2) Weights have been shown in kg per 1000 Nos.

Table 1

All dimensions are in mm

Thread d	Flats s		Corner e Min.	Thickness m		Wrench Height m' Min.	Dia. d <sub>w</sub> Min.	Dia. d <sub>a</sub>		Sub-code weight
	Max.	Min.		Max.	Min.			Max.	Min.	
M 1.6	3.2	3.02	3.41	1	0.75	0.6	2.1	1.84	1.6	080
M 2	4	3.82	4.32	1.2	0.95	0.8	3.1	2.3	2	098
M 2.5	5	4.82	5.45	1.6	1.35	1.1	4.1	2.9	2.5	101
M 3	5.5	5.32	6.01	1.8	1.55	1.2	4.6	3.45	3	110
M 4	7	6.78	7.66	2.2	1.95	1.6	5.9	4.6	4	012 0.55
M 5	8	7.78	8.79	2.7	2.45	2	6.9	5.75	5	020 0.83
M 6	10	9.78	11.05	3.2	2.9	2.3	8.9	6.75	6	039 1.46
M 8	13	12.73	14.38	4	3.7	3	11.6	8.75	8	047 3.55
M 10	16	15.73	17.77	5	4.7	3.8	14.6	10.8	10	055 7.82
M 12	18	17.73	20.33	6	5.7	4.6	16.6	13	12	063 12.93
M 16	24	23.67	26.75	8	7.42	5.9	22.5	17.3	16	071 22.10

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	CORPORATE STANDARD		AA7161002		
			Rev. No. 04		
			PAGE 1 of 3		
WASHERS, MACHINED, BRASS					
1 DESIGNATION					
A machined washer of size 4.3 mm made of brass shall be designated as:					
1.1 On drawings					
i) Material specification column: AA7161002					
ii) Description column: WASHER MCD 4.3 - BR					
1.2 On indents					
Washer Machined 4.3 - Brass: AA7161002					
1.3 For issuing enquiries and on purchase orders					
While issuing enquiries and purchase orders, delete BHEL standard number from the above description and add the information given under clause 2.					
2 COMPLIANCE WITH STANDARDS					
2.1 Dimensions, Tolerances and General requirements					
As per IS 2016-1967, Table-1, Reaffirmed 2011					
2.2 Material					
Brass as stated in IS 2016					
2.3 These items are to be manufactured from extruded/drawn sections only.					
2.4 Finish					
As specified in BHEL order.					
3 NOTE					
3.1 For machined washers of steel, refer to BHEL standard AA7161001.					
3.2 For machined washers of copper, refer to BHEL standard AA7161004.					
3.3 Washers to this standard would be un-plated, divisions wishing to have plated washers would have to get them plated.					
3.4 For general requirements of washers, refer BHEL standard AA0230408.					
3.5 Weights given in this standard are for general reference only and are not meant for commercial transactions.					
Revisions: As per clause 33.5.a) of MOM of MRC-Tools			APPROVED: INTERPLANT MATERIAL RATIONALISATION COMMITTEE – MRC (F)		
Rev. No. 04	Amd. No.	Reaffirmed	Prepared HPEP, Hyderabad	Issued Corp. R&D	Dt. of 1 <sup>st</sup> Issue 01-01-1977
Dt: 14-03-2016	Dt:	Year:			

AA7161002

Rev. No. 04

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**CORPORATE STANDARD**

- 3.6** When fasteners are to be tested with in BHEL, the following sampling plan based on IS: 6821 (Table-1), shall be followed for physical properties.

LOT SIZE	SAMPLE SIZE	ACCEPTANCE NO
Up to 1000	5	0
1001 - 3000	8	0
3001 - 10000	13	0
10001 - 35000	20	0
Over 35000	32	1

**4 REFERRED STANDARDS (Latest publications including amendment)**

- 1) IS 6821
- 2) AA0230408
- 3) AA7161001
- 4) AA7161004

**EXPLANATORY NOTE**

The following changes have been made in this revision:

- Clause 2.1, year of reaffirmation is added as IS: 2016-1967, Table-1, Reaffirmed 2011.
- Page-3: Table-1; Sub-code against nominal size 2.7 mm is added.

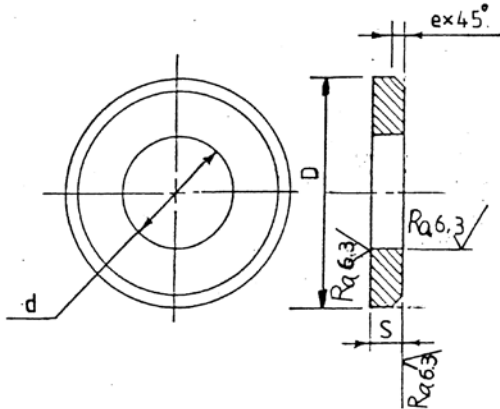


## CORPORATE STANDARD

AA7161002

Rev. No. 04

PAGE 3 of 3



NOTE:

- 1) Corporate sub-code numbers are shown below.
- 2) Weights have been shown in kg. / 1000 No.

Table 1

All dimensions are in mm

SIZE NOM. d H12	OUTSIDE DIAMETER (D)		THICKNESS (s)		e Nom.	FOR BOLT OR SCREWS SIZE	Sub – Code Weight
	BASIC	TOL	BASIC	TOL			
1.7	4	+0 -0.3	0.3	± 0.1	0.1	M1.6	
2.2	5	+0 -0.3	0.3	± 0.1	0.1	M2	
2.7	6.5	+0 -0.3	0.5	± 0.1	0.2	M2.5	125
3.2	7	+0 -0.3	0.5	± 0.1	0.2	M3	010 0.12
4.3	9	+0 -0.3	0.8	± 0.1	0.3	M4	028 0.31
5.3	10	+0 -0.3	1.0	± 0.1	0.4	M5	036 0.45
6.4	12.5	+0 -0.4	1.6	± 0.2	0.6	M6	044 1.15
8.4	17	+0 -0.4	1.6	± 0.2	0.6	M8	052 2.22
10.5	21	+0 -0.5	2	± 0.2	0.6	M10	060 4.26
13	24	+0 -0.5	2.5	±0.3	0.6	M12	079 6.69
17	30	+0 -0.5	3	± 0.3	0.6	M16	087 11.90
21	37	+0 -0.8	3	± 0.3	1.0	M20	095
25	44	+0 -0.8	4	± 0.3	1.0	M24	109
31	56	+0 -1.0	4	± 0.3	1.0	M30	
37	66	+0 -1.0	5	± 0.6	1.6	M36	117
43	78	+0 -1.0	7	± 1.0	1.6	M42	
50	92	+0 -1.5	8	± 1.0	1.6	M48	
58	105	+0 -1.5	9	± 1.0	1.6	M56	
66	115	+0 -1.5	9	± 1.0	2.0	M64	
74	125	+0 -1.8	10.0	± 1.0	2.0	M72	
82	140	+0 -1.8	12.0	±1.2	2.5	M80	
93	160	+0 -1.8	12.0	±1.2	3.0	M90	
104	175	+0 -1.8	14.0	±1.2	3.0	M100	
114	185	+0 -2	14	±1.2	3.0	M110	
129	220	+0 -2	16	±1.2	3.0	M125	
144	240	+0 -2	18	±1.2	4.0	M140	

	<b>CORPORATE STANDARD</b>	AA7164001
		Rev. No. 05
		PAGE 1 of 3

## WASHERS, SPRING LOCK, SINGLE COIL, RECTANGULAR SECTION, TYPE - A (WITH BENT ENDS) STEEL

### 1 DESIGNATION

A single coil, rectangular section, spring lock washer, Type-A (with bent ends) for right hand threads, of nominal size 5 mm, and made of steel shall be designated as:

#### 1.1 On Drawings

- i) Material specification column: AA7164001
- ii) Description column: WASHER SPRING LOCK SC A 5-ST

#### 1.2 On Indents

Washer Spring Lock A 5- AA7164001

#### 1.3 For issuing enquiries and on purchase orders

While issuing enquiries and purchase orders, delete the corporate standard No, from the above description and add the information given under clause 2.

### 2 COMPLIANCE WITH STANDARDS

#### 2.1 Dimensions, Tolerances & General Requirements

To IS 3063-1994, Type A (Table-1A) Reaffirmed 2010

#### 2.2 Material

Spring steel Gr. 3 to Gr.6 as specified in IS 4072

#### 2.3 Heat Treatment and Hardness

Spring Lock washer after coiling shall be suitably heat treated, so as to result in the finished washer having a hardness in the range of 430 - 530 HV

#### 2.4 Finish

As specified in BHEL order.

Revisions: As per clause 33.5.a) of MOM of MRC-Fasteners			<b>APPROVED:</b> INTERPLANT MATERIAL RATIONALISATION COMMITTEE – MRC (F)		
Rev. No. 05	Amd. No.	Reaffirmed	Prepared	Issued	Dt. of 1 <sup>st</sup> Issue
Dt: 14-03-2016	Dt:	Year:	HPEP, Hyderabad	Corp. R&D	01-04-1993



AA7164001

Rev. No. 05

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**CORPORATE STANDARD****3 NOTE**

- 3.1** For washers spring lock (Type-B) refer corporate standard AA7164002.
- 3.2** Lock washers to this standard would be un-plated, divisions wishing to have plated washers would have to get them plated.
- 3.3** Weights given in this standard are for general reference only and are not meant for commercial transactions.
- 3.4** When the fasteners are to be tested within BHEL, the following sampling plan shall be followed for physical properties.

LOT SIZE	SAMPLE SIZE	ACCEPTANCE No.
Up to 1000	5	0
1001 – 3000	8	0
3001 - 10000	13	0
10000 – 35000	20	0
Over 35000	32	1

**4 Referred Standards (Latest Publications including amendments)**

- 1) AA7164002
- 2) IS 4072

**EXPLANATORY NOTE**

The following changes have been made in this revision:

- Clause 2.1, year of Reaffirmation of **IS** changed as IS 3063-1994, Reaffirmed 2010

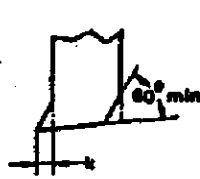


## CORPORATE STANDARD

AA7164001

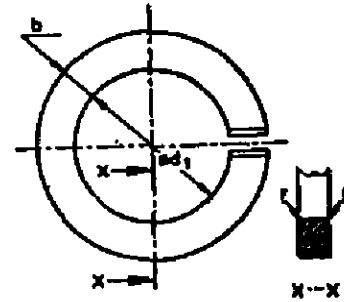
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TYPE A

FIG . 1



$$b = 2s + 2k$$

Note :

1. Corporate sub-code Numbers only are shown in Table 1
2. Weights have been shown in kg per 1000 No.

Table 1

All dimensions are in 'mm'

Nom. size	Internal Diameter $d_1$		Outside Dia $d_2$ Max.	Width $b$		Thickness $s$		Radius $r$ Nom.	Bent End $k^*$	For Bolt Nut or Screw Size	Sub code	Weight
	Basic	Tol. +		Basic	Tol. ±	Basic	Tol. ±					
2	2.1	0.3	4.4	0.9	0.1	0.5	0.1	0.1	-	M2		0.033
2.2	2.3	0.3	4.8	1.0	0.1	0.6	0.1	0.1	-	M2.2		0.050
2.5	2.6	0.3	5.1	1.0	0.1	0.6	0.1	0.1	-	M2.5		0.052
3.0	3.1	0.3	6.2	1.3	0.1	0.8	0.1	0.2	0.15	M3	014	0.11
4.0	4.1	0.3	7.6	1.5	0.1	0.9	0.1	0.2	0.15	M4	022	0.18
5.0	5.1	0.3	9.2	1.8	0.1	1.2	0.1	0.2	0.15	M5	030	0.36
6.0	6.1	0.4	11.8	2.5	0.15	1.6	0.1	0.3	0.2	M6	049	0.83
8.0	8.1	0.4	14.8	3.0	0.15	2.0	0.1	0.5	0.3	M8	057	1.60
10.0	10.2	0.5	18.1	3.5	0.2	2.2	0.15	0.5	0.3	M10	065	2.53
12.0	12.2	0.5	21.1	4.0	0.2	2.5	0.15	1.0	0.4	M12	073	3.82
16.0	16.2	0.8	27.4	5.0	0.2	3.5	0.2	1.0	0.4	M16	081	8.91
20.0	20.2	1.0	33.6	6.0	0.2	4.0	0.2	1.0	0.4	M20	090	15.2
24.0	24.5	1.0	40.0	7.0	0.25	5.0	0.2	1.6	0.5	M24	103	26.2
30.0	30.5	1.2	48.2	8.0	0.25	6.0	0.2	1.6	0.8	M30	111	44.3
36.0	36.5	1.2	58.2	10.0	0.25	6.0	0.2	1.6	0.8	M36		67.3
42.0	42.5	1.2	68.2	12.0	0.25	7.0	0.25	2.0	0.8	M42		111
48.0	49.0	1.5	75.0	12.0	0.25	7.0	0.25	2.0	0.8	M48		123
52.0	53.0	1.5	83.0	14.0	0.25	8.0	0.25	2.0	1	M52		182
56.0	57.0	1.5	87.0	14.0	0.25	8.0	0.25	2.0	1	M56		193
60.0	61.0	1.5	91.0	14.0	0.25	8.0	0.25	2.0	1	M60		203
64.0	65.0	1.5	95.0	14.0	0.25	8.0	0.25	2.0	1	M64	120	218

The bend "k" shall be made on the last length of the washer circumference without any sharp angle.

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TSD 6200

# PLANT PURCHASING SPECIFICATION BHOPAL

**BP 22899**

REV NO. 06

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SUPERSEDES  
BP22899 Rev05

## POLYTETRAFLUOROETHYLENE (PTFE) MOULDINGS

### 1. GENERAL:

This specification governs the quality of poly tetra fluoroethylene mouldings manufactured from a suitable grade of PTFE which shall not contain fillers or additives. Reprocessed materials shall not be used under any circumstances. The material shall be capable of use upto maximum operating temperature of 250°C.

NOTE : Whenever PTFE bush with sodium etching on inside surface is required, the same shall be stated on the drawing/order. The sodium etching of a surface improves its adhesion to other material.

### 2. APPLICATION:

Used as insulators in brush gear assembly, bush on mica V-ring, sleeve, washer etc. in Traction & Electrical Machines.

### 3. COMPLIANCE WITH NATIONAL STANDARDS:

There is no Indian Standard covering this material. However assistance has been drawn from Type E, Grade 1 of BS EN ISO 13000-1 : 2021 "Plastics poly tetra ethylene (PTFE) semi finished products".

### 4. DIMENSIONS AND TOLERANCES:

Bushes, insulators and mouldings shall be supplied as per our drawings.

### 5. FINISH & INTERNAL DEFECTS:

5.1 Mouldings shall be substantially homogenous and free from internal defects, inclusions and surface defects, edge defects, cracks.

5.2 PTFE bushes shall be supplied with sodium etching on Inside surface, if called in Drawing / order. The sodium etched surface shall be uniformly dark brown in colour.

### 6. TEST METHODS:

Unless otherwise specified, the tests shall be conducted in accordance with relevant methods as mentioned against each clause

#### Revision:

Reviewed & brought up to date.

#### Issued by:

STANDARDS AND MATERIALS GROUP  
TECHNICAL SERVICES DEPTMENT

Rev. 06

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Date of first Issue : Oct.' 1974



TSD 6206 A

## PLANT PURCHASING SPECIFICATION BHOPAL

**BP 22899****REV NO. 06****PAGE 2 of 4**

### 7. SAMPLE FOR TEST:

The set of test specimens prepared from the same batch and in same manner as the consignments; shall be supplied for testing and approval as given below:

a) For BUSHES WITH SODIUM ETCHING (Bush As per drawing/order) : 2 Nos.

b) FOR INSULATORS (Insulators as per drawings/order) : 3 Nos

Sheets of size 2.5 mm tk x 200 mm x 200 mm: 2 Nos

c) FOR OTHER MOULDINGS

Sheets of size 2.5 mm tk x 200 mm x 200 mm: 2 Nos

0.75 mm tk x 200 mm x 200 mm: 2 Nos

### 8. PHYSICAL PROPERTIES:

8.1 Density at 27°C (BS:7663-1993): 2.13 to 2.23 g / cc.

8.2 Dimensional Stability

Shall not show a dimensional change of more than 0.5% after heating at  $300 \pm 5^\circ\text{C}$  for 6 hours.

8.3 Resistance to Heat

Shall show no signs of melting and the loss in weight shall not exceed 0.5% after heating at  $300 \pm 5^\circ\text{C}$  for 6 hours.

### 9. MECHANICAL PROPERTIES:

9.1 Breaking Load of Single lap Joint (For Bush with Sodium etching)

200 N / cm width, Min.

Breaking load shall be determined when a single lap joint of size 25 x 25 mm is formed with sodium etched sides using National Epoxy - Kit 2 A-440 of M/S National Electric Coil Co., USA or its equivalent.

9.2 Tensile Strength (Type test) ( BS 7663-1993) : 24 N/mm<sup>2</sup>, Min.

9.3 Elongation at Break (TYPE TEST) BS 7663-1993) : 300%, Min.

### 10. ELECTRICAL PROPERTIES:

10.1 Electric Strength

10.1.1 For Insulators and Bushes (20 sec. step by step method) (Annexure I)

10.1.1.1 After Tropical conditioning: 6 kV



# PLANT PURCHASING SPECIFICATION BHOPAL

**BP 22899****REV NO. 06****PAGE 3 of 4**

10.1.1.2 After Reconditioning : 5 kV

10.1.2 For other Mouldings (1 minute value): 24 kV/mm, when tested on 0.75 mm thick sheet as per IS:2584.

10.2 Surface Resistivity (Appendix I B) Applicable to moulded items only.  
1 x 10<sup>12</sup> ohms, Min.

11. CHEMICAL PROPERTIES:

11.1 Identification of Material:

The material shall be PTFE when identified by Infra-red spectrophotometer or by any conventional method.

12. TEST CERTIFICATE:

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

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.

The test certificate shall bear the following information: -

BP 22899 (Rev.06) : Polytetrafluoroethylene (PTFE) Mouldings

BHEL Order No.

Batch No./Lot No.

Manufacturer's / Supplier's Name

Drawing No. & Item No. if any.

Test values obtained/certificate for compliance for Clause 4, 5 and 8 to 11.

13. PACKING AND MARKING:

The material shall be suitably packed to avoid contamination and damage during transit. Each package shall be legibly and indelibly marked with the following:

BP 22899: Polytetrafluoroethylene (PTFE) Mouldings.

BHEL order No.

Batch No.

Manufacturer's/Supplier's Name and Grade

Drawing and Item No. if any.

Size & Quantity Supplied

Net & Gross Weight.



## PLANT PURCHASING SPECIFICATION BHOPAL

BP 22899

REV NO. 06

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### ANNEXURE-I

#### A. TEST PROCEDURE FOR H.V. TEST AFTER TROPICAL CONDITIONING

1. The surface of PTFE insulators & bushes is to be covered with carbon dust, fine iron filling, grease/oil at few places.
2. The insulator/bush is to be conditioned at 55°C and 95-100% R.H. for 8 hours and at room temperature for 16 hours. The condition of the moulding is to be observed.
3. The above conditioned component is to be wiped out with the help of a dry cloth and wrapped with two Aluminum foils such that a gap of 10 mm is obtained. Apply high voltage across the gap, using step by step method starting from 4.5 kV in the steps of 0.5 kV maintaining the voltage for 20 seconds at each step.
4. The component should withstand 6 kV for 20 secs. The voltage should further be increased step by step till moulding is flashed over. The flash over voltage is to be recorded. After the test, surface of the component should not get affected.
5. The flashed over component is to be wiped out clean with a dry cloth and Cl. 1 to 3 to be repeated.

The component should withstand 5 kV for 20 secs.

#### B. TEST PROCEDURE FOR SURFACE RESISTIVITY

1. The moulding is to be wrapped with two Aluminum foils such that a gap of 10 mm is obtained.
2. Apply  $500 \pm 5$  V D.C across the gap for one minute. The current is to be measured with a suitable current measuring device.
3. The resistance/cm length between two Aluminum foils one cm apart gives the surface resistivity.



## PLANT PURCHASING SPECIFICATION BHOPAL

BP 25785

REV NO. 03

PAGE 1 of 3

**SUPERSEDES**  
BP 25785 Rev. 02

### EPOXY RESIN IMPREGNATED GLASS EPOXY PREPREG

1. GENERAL:

This specification governs the requirements of glass epoxy prepreg which is produced by impregnating E-glass cloth with a special designed tracking resistant B stage epoxy resin. The resin has a temperature index of at least 155.

2. APPLICATION:

Used for pressing laminates and shaped insulation parts for electrical machines.

3. DIMENSIONS AND TOLERANCES :

3.1 Preferred Thickness & Tolerance :

0.22 mm, with tolerance of  $\pm 0.02$  mm.

However any other thickness can also be ordered.

3.2 Width & Tolerance:

1100 mm with Tolerance of  $\pm 10$  mm.

3.3 Length Per Roll:

100 metres.

4. TEST METHODS:

Testing shall be done as per relevant methods of BS : 2782 unless otherwise stated.

5. SAMPLE FOR TEST :

3 square metre shall be supplied for testing and approval.

6. SHELF LIFE & STORAGE:

At 5 deg.C : 12 Months, Max.

At 23 deg.C : 4 Months, Max.

Revision:  
Reviewed & brought up to date.

Issued by

**STANDARDS AND MATERIALS GROUP  
TECHNICAL SERVICES DEPARTMENT**

Rev. 03

Date : 12.02.2022

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## PLANT PURCHASING SPECIFICATION BHOPAL

BP 25785

REV NO. 03

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### 7. PROPERTIES :

- 7.1 Density :  $1.9 \pm 0.1 \text{ gm/cm}^3$
- 7.2 Glass Cloth (Base) :  $210 \pm 5 \text{ gm/m}^2$
- 7.3 Total Substance :  $360 \pm 20 \text{ gm/m}^2$
- 7.4 Volatile Content : 1.0 % Max.
- 7.5 Resin Flow : 15 -3 / +8 %

Test shall be carried out by pressing 3 layers of prepreg at a temperature of 150 deg.C under a pressure of  $20 \times 10 \text{ N/m}^2$  for 10 minutes.

### 8. PROPERTIES OF LAMINATE (3 mm tkns) - AA 085 17 01

#### 8.1 Physical Properties:

- 8.1.1 Water Absorption : 20 mg, Max.

#### 8.2 Electrical Properties:

##### 8.2.1 Electric Strength (Proof) on 3 mm tk Laminate.

Flat-wise: 40 kV for one minute.

Edgewise: 40 kV for one minute.

##### 8.2.2 Comparative Tracking Index : 600, Min.

#### 8.3 Mechanical Properties

- 8.3.1 Tensile Strength:  $150 \text{ N/mm}^2$ , Min.

- 8.3.2 Flexural Strength:  $300 \text{ N/mm}^2$ , Min

### 9. CURING SCHEDULE:

The material shall cure into a homogenous mass at a pressure of  $20 \times 10 \text{ N/m}^2$  at  $160 \pm 5 \text{ deg.C}$  for 2 hours. However the exact curing schedule shall be furnished by the supplier.

### 10. TEST CERTIFICATES:

Unless otherwise specified, three copies of Test certificate shall be supplied.

In addition, the supplier shall ensure to enclose one copy of test certificate alongwith their dispatch documents to facilitate quick clearance of the material.





## PLANT PURCHASING SPECIFICATION BHOPAL

BP 25785

REV NO. 03

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The test certificate shall bear the following information.

BP 25785(Rev.02): Epoxy Resin Impregnated Glass Epoxy Prepreg.

Our Order No.

Batch / Lot No.

Test values obtained/certificate for compliance for clauses 3, 6, 7 & 8.

### 11. PACKING AND MARKING :

Rolls shall be packed in sealed wrappers and supplied in crates to prevent from any damage.

#### 11.1 On Rolls

Each roll shall be legibly marked with the following information

Batch / Lot No.

Manufacturer's and / or supplier's Name and Grade.

Thickness, Width & Length

Date of Manufacture

#### 11.2 On Crate

Each crate shall be marked with the following information.

BP 25785 : Epoxy Resin Impregnated Glass Epoxy prepreg.

Our Order No.

Manufacturer's and/or supplier's.

Name and Grade.

Batch/Lot No.

Thickness, Width & Length of roll.

Quantity of Rolls.

Date of Manufacture.

Test certificate Reference