



## CORPORATE PURCHASING SPECIFICATION

AA 121 41

Rev. No. 03

PAGE 1 OF 3

### PHOSPHOR BRONZE RODS AND BARS FOR ELECTRICAL MACHINES

#### 1.0 GENERAL:

This specification governs the quality requirements of Phosphor bronze rods and bars greater than 6 mm and upto and including 100 mm.

#### 2.0 APPLICATION:

Electrical machines.

#### 3.0 CONDITION OF DELIVERY:

As manufactured. The material shall be suitably stress relieved, if required.

#### 4.0 COMPLIANCE WITH NATIONAL STANDARDS:

The material shall comply with the requirements of the following national standard and also meet the requirements of this specification.

IS: 7811 - 1985 : Phosphor Bronze Rods and Bars.

#### 5.0 DIMENSIONS AND TOLERANCES:

The dimensions shall be as specified in the order. The tolerances shall be as given in IS:2826:

Dimensions and tolerances for copper & copper alloy rods, bars for general engineering purposes.

#### 6.0 FREEDOM FROM DEFECTS:

The material shall be free from porosity and other defects of a nature that may interfere with normal commercial operation.

#### 7.0 CHEMICAL COMPOSITION:

The analysis of copper when analysed in accordance with IS:4027 (Method for chemical analysis of bronzes) or any other conventional/Instrumental methods shall be as follows:

Element	Percent, min.	Percent, max.
Tin	4.2	5.5
Phosphorus	0.02	0.40
* Lead	--	0.02
* Zinc	--	0.03
* Total Impurities (including Zinc)	--	0.05
Copper	Remainder	

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AA 121 41	<b>CORPORATE PURCHASING SPECIFICATION</b>	
Rev. No. 03		
PAGE 2 OF 3		

**Note:** These elements need not be determined, when the material supplied conform with the mechanical properties specified. However, the supplier shall ensure that the composition of the material lies within the limits specified above.

#### 8.0 TEST SAMPLES:

For conducting tests all rods/bars of same dimensions and manufactured under similar conditions of production shall be grouped in batches as follows;

Specified size (diameter or width across flats) in mm		Mass of batch in kg
Upto and including	12	250
Over 12 & upto and including	40	500
Over 40 & upto and including	80	1000
Over 80 & upto and including	100	2000

One sample shall be selected from each batch or part thereof to provide necessary test pieces for chemical, Mechanical, Electrical resistivity and Mercurous Nitrate tests.

#### 9.0 MECHANICAL PROPERTIES:

When tested in accordance with IS 1608, (Mechanical testing of metals-Tensile testing), the material shall show the following properties in as received condition:

Cross sectional thickness, mm		0.2% proof stress, min., in N/mm <sup>2</sup>	Tensile strength min., N/mm <sup>2</sup>	Elongation on G.L. of 5.65 $\sqrt{S_0}$ , min., percent
Over	upto & incld.			
6	18	410	500	12
18	38	380	460	12
38	70	315	380	16
70	100	235	315	20

#### 10.0 ELECTRICAL RESISTIVITY:

The electrical resistivity at 20°C of a rod of 1 meter in length and uniform cross sectional area of 1 mm<sup>2</sup> shall be 0.108 ohm  $\pm$  10%.

#### 11.0 RETEST:

Should any of the test pieces first selected, fail to pass the prescribed tests mentioned under various clauses in this specification, two further samples from the same batch shall be selected for testing one of which shall be from the same component from which the original test sample was taken, unless that component has been withdrawn by the supplier.

Should the test pieces from both these additional samples pass, the batch represented by the test sample shall be accepted. Should the test pieces from either of these additional samples fail, the batch represented by the test samples shall be rejected.

	<b>CORPORATE PURCHASING SPECIFICATION</b>	AA 121 41
		Rev. No. 03
		PAGE 3 OF 3

## 12.0 INSPECTION AT SUPPLIER ' WORKS:

When ever 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 works, the supplier shall make necessary arrangements for carrying out the prescribed test 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.

## 13.0 TEST CERTIFICATES:

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

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

The test certificate shall bear the following information:

AA 121 41, Rev.03: Phosphor bronze rods and bars for electrical machines

BHEL Order No.

Manufacturer 's/Supplier's Name:

Consignment/Identification No.

Sizes and Quantity Supplied

Results of dimensional inspection, chemical analysis, mechanical, electrical and all other tests as called for.

## 14.0 PACKING AND MARKING:

The material shall be supplied in bundles weighing about 50 kg and strapped with loops and suitably packed in wooden crates to prevent corrosion and damage during transit.

Each package or crate shall be legibly marked with the following information:

AA 121 41 : Phosphor bronze rods and bars for electrical machines

BHEL Order No.

Identification No:

Weight

Supplier's Reference and Name


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

1. IS: 1608

2. IS 2826

3. IS: 4027

4. IS: 7811

	CORPORATE PURCHASING SPECIFICATION		AA 121 17		
			Rev. No. 03		
			PAGE 1 OF 3		
<h2 style="text-align: center;">HIGH TENSILE BRASS RODS AND SECTIONS (HT-2)</h2> <p><b>1.0 GENERAL:</b> This specification governs the quality requirements of high tensile brass rods and sections.</p> <p><b>2.0 APPLICATION:</b> For drop forging, stamping, machining and general engineering purposes (Switchgear, control gear).</p> <p><b>3.0 CONDITION OF DELIVERY:</b> Cold worked and stressed relieved.</p> <p><b>4.0 COMPLIANCE WITH NATIONAL STANDARDS:</b> The material shall comply with the requirements of the following National standard and also meet the requirements of this specification. IS: 320 – 1980: Specification for high tensile brass rods and sections Gr.: HT - 2 (OTHER THAN FORGING STOCK)</p> <p><b>5.0 DIMENSIONS AND TOLERANCES:</b></p> <p><b>5.1 Sizes:</b> The material shall be supplied as per the dimensions specified in the order.</p> <p><b>5.2 Tolerances:</b> Tolerances for round, square, rectangular and hexagonal rods shall be “Normal”, as given in Tables 1, 2, 3 and 4 respectively of IS:2826 : Dimensions and tolerances for copper and copper alloy rods and bars for General Engineering purposes.</p> <p><b>6.0 MANUFACTURE:</b> Cold worked and stress relieved.</p> <p><b>7.0 FREEDOM FROM DEFECTS :</b> The material shall be clean, smooth, free from surface defects, reasonably straight and free from twists.</p> <p><b>8.0 CHEMICAL COMPOSITION:</b> The chemical composition of the material, when analyzed in accordance with IS : 3685 (Methods for chemical analysis of brasses ) or any other conventional/ instrumental methods shall be as follows:</p>					
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AA 121 17	CORPORATE PURCHASING SPECIFICATION	
Rev. No. 03		
PAGE 2 OF 3		

Element	Percent, min.	Percent, max.
Copper plus incidental Nickel	56.0	61.0
*Tin	--	1.0
*Lead	0.5	1.5
Iron	0.20	1.5
Manganese	0.50	2.0
Aluminium	0.30	2.0
*Antimony	--	0.02
*Other elements	--	0.5
Zinc		Remainder

**\*Note :** These elements need not be determined when the material conforms with mechanical properties.

## 9.0 TEST SAMPLES:

9.1 One sampling per heat shall be taken for chemical analysis.

9.2 One sample per heat per size shall be taken for other tests.

Material of the same type, size and temper shall be grouped in batches as follows and one sample shall be selected from each batch or part thereof to provide the necessary test pieces :

## 10.0 MECHANICAL PROPERTIES:


### 10.1 Tensile:

When tested in accordance with IS : 1608, the material shall show the following properties. The fractured test piece shall be free from pipes and such other defects.

Size mm	Tensile strength in N/mm <sup>2</sup> , min.	%Elongation on 5.65 $\sqrt{S_0}$ gage length min.
For upto and including 40 mm	520	12.0
Over 40 mm	500	15.0

## 11.0 MERCUROUS NITRATE TEST:

The test shall be carried out on a piece cut from each brass tube selected for testing. When tested in accordance with IS : 2305, the test piece shall not show any sign of cracking. Should any specimen fail under this test, all brass tubes submitted for inspection shall be withdrawn but may be resubmitted for inspection after stress relieving.

	<b>CORPORATE PURCHASING SPECIFICATION</b>	<b>AA 121 17</b>
		<b>Rev. No. 03</b>
		<b>PAGE 3 OF 3</b>

**12.0 RETEST:**

Should any of the test pieces first selected, fail to pass the prescribed tests mentioned under various clauses in this specification, two further samples from the same batch shall be selected for testing, one of which shall be from the same component from which the original test sample was taken, unless that component has been withdrawn by the supplier.

Should the test pieces from both these additional samples pass, the batch represented by the test sample shall be accepted. Should the test pieces from either of these additional samples fail, the batch represented by the test sample shall be rejected.

**13.0 INSPECTION AT SUPPLIER'S WORKS**

Tests and inspection are to be conducted in the presence of the customer's representative. The representative shall have the access at all times while the work on the contract is being performed, to all parts of the manufacture's works. The supplier shall offer the purchaser'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 works, the supplier shall make necessary arrangement for carrying out the prescribed test elsewhere.

**14.0 TEST CERTIFICATES :**

The supplier shall submit 3 copies of test certificates along with each consignment.

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

The test certificate shall bear the following information:

BHEL Order No,  
AA 121 17, Rev 03: High Tensile Brass Rods and sections – HT -2  
Supplier's Reference and Name  
Batch / Heat No.  
Results of chemical analysis, mechanical and all other tests as called for in this specification/ order.  
Consignment / Identification No.

**15.0 PACKING AND MARKING:**

The material shall be suitably packed in crates to prevent corrosion and damage during transit. Each package or crate shall be legibly marked with the following information:

BHEL Order No.  
CPS No.12117: High Tensile Brass Rods and sections – HT -2  
Batch No.  
Identification Mark/No.  
Weight  
Supplier's Reference and Name

**16.0 Referred standards(Latest publications Including Amendments):**

1. IS:320	2. IS:1608	3. IS:2305	4. IS:2826
5. IS:3685			



## CORPORATE PURCHASING SPECIFICATION

AA 107 21

Rev. No. 07

PAGE 1 OF 4

## STAINLESS STEEL BARS (MARTENSITIC) Gr:X 20 Cr 13, HARDENED AND TEMPERED

### 1.0 GENERAL :

This specification governs the quality requirements of Stainless Steel Bars (Martensitic), Hardened and Tempered.

### 2.0 APPLICATION :

For general engineering purposes involving stresses under corrosive conditions.

### 3.0 CONDITION OF DELIVERY :

Hot rolled and hardened and tempered.

For size above 100 mm, forgings in H&T condition are also acceptable.

Bars shall be supplied in the descaled condition.

The ends of bars shall be square and true.

The bars shall be supplied in straight lengths without twists and bends.

### 4.0 COMPLIANCE WITH NATIONAL STANDARDS :

The material shall comply with the requirements of the following National standard and also meet the requirements of this specification.

EN 10088-3, Gr. X 20 Cr 13 : General Purpose Semi-finished Products, Bars,  
Hardened and Tempered : Rods and Sections

### 5.0 DIMENSIONS AND TOLERANCES :

**5.1 Sizes:** The bars shall be supplied to the dimensions specified in BHEL order.

#### 5.2 Tolerances:

**5.2.1 For Forged bars:** The tolerances shall be + 8 mm - 0 mm.

**5.2.2** Tolerances on rolled bars shall comply with following specifications:

EURONORM 58: Hot rolled flats for general purposes

EURONORM 59: Hot rolled square bars for general purposes

EURONORM 60: Hot rolled round bars for general purposes

Tolerances as per equivalent IS Standards are also acceptable

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AA 107 21	CORPORATE PURCHASING SPECIFICATION	
Rev. No. 07		
PAGE 2 OF 4		

**5.3 Length :**

Unless otherwise specified, hot rolled bars shall be supplied in lengths of 3 to 6 meters or in multiples with maximum of 10% shorts down to 1 meter.

Forged bars shall be supplied in lengths of 1.5 to 3 metres.

**6.0 MANUFACTURE :**

Process used for the manufacture of the bars is left to the discretion of the manufacturer. Material shall be manufactured from fully killed steel. Sufficient reduction and discard shall be made from each ingot to ensure freedom from pipe, harmful segregation and other defects.

**7.0 HEAT TREATMENT :**

The recommended heat treatment is as follows:

Harden in oil / air at temperature of 950-1050°C.

Temper at suitable temperature between 650-750°C.

Details of the actual heat treatment cycle followed shall be specified in the test certificate.

**8.0 FREEDOM FROM DEFECTS :**

The bars shall be free from internal and surface defects. Bars shall be free from twist and bends.

**9.0 CHEMICAL COMPOSITION :**

The melt analysis of steel and the permissible variation in the composition of the material from the melt analysis shall be follows :

Element	Melt analysis, percent		Permissible variation, percent,
	min.	max.	
Carbon	0.16	0.25	- 0.01 + 0.02
Silicon	--	1.00	+ 0.05
Manganese	--	1.50	+ 0.04
Chromium	12.00	14.00	± 0.20
Sulphur	—	0.030	+ 0.005
Phosphorus	—	0.040	+ 0.005

**Note:** Elements not listed in this table shall not be intentionally added to the steel without the agreement of the purchaser except for finishing the cast. All appropriate precautions are to be taken to avoid the addition of such elements from scrap and other materials used in production which would impair mechanical properties and the suitability of the steel.





## CORPORATE PURCHASING SPECIFICATION

AA 107 21

Rev. No. 07

PAGE 3 OF 4

**10.0 TEST SAMPLES :**

The test samples shall be selected as per EN 10088 Part 3.

**11.0 MECHANICAL PROPERTIES :****11.1 Tensile and impact:**

The test pieces shall show the following properties:

Ruling section, mm	Tensile strength, N/mm <sup>2</sup>	Yield strength, min N/mm <sup>2</sup>	Percent Elongation, min	Impact Strength at Room Temperature, ISO – V, Joules	Hardness BHN
Upto 160mm ( Inclusive )	700-850	500	13	25	208-252

**Note:**

1. The mechanical properties required for sizes above 160 mm shall be as per mutual agreement between BHEL and manufacturer.
2. The tensile test shall be carried out in accordance with IS: 1608 or any reputed National Standard.
3. The charpy impact test shall be performed in accordance with IS: 1499 or any reputed National Standard.

An impact test shall consist of three specimens from a single test location, the average value of which shall be as specified above.

Only one value of the three can be below the specified minimum but in no case below 2/3 of the specified minimum value.

- 4 Hardness shall be informed in the test certificates for information.

**12.0 ULTRASONIC TEST:**

- 12.1 Each bar above 100 mm shall be tested ultrasonically in accordance with BHEL standard AA 085 01 18 to ensure freedom from internal defects. The norms of acceptance shall be as per category 2 of the above standard.

**12.2 Optional tests:**

If specified in order, each bar > 40 to 100mm shall be tested ultrasonically in accordance with BHEL standard AA 085 01 18 to ensure freedom from internal defects and the norms of acceptance shall be as per category 2.

AA 107 21	CORPORATE PURCHASING SPECIFICATION	
Rev. No. 07		
PAGE 4 OF 4		

### 13.0 TEST CERTIFICATES :

Three copies of test certificates shall be supplied, unless otherwise stated in the 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:

#### **BHEL References:**

AA 107 21 (Rev. No. 07) : Stainless steel bars (martensitic), Gr: X 20 Cr 13, H&T  
BHEL order No.

#### **Supplier's References :**

Name  
Identification No.  
Melt No.  
Details of heat treatment.

#### **Result of Tests:**

Dimensional inspection.  
Results of chemical analysis, mechanical tests and Hardness check called for in this specification.

### 14.0 PACKING AND MARKING:

The material shall be suitably packed in bundles-Hessian wrapped-to prevent sagging and damage during transit.

Each bar/flat 50 mm in diameter/width across flats shall be stamped with 'AA 107 23', melt No., BHEL order No., at one end or on the end face.

Bars bar/flat upto and including 50 mm in diameter/width across flats shall be bundled together and tied with wire at 3 to 4 places along the length of the bars.

A metal label shall be securely attached to each bundle and shall bear the following information :

AA107 21 : Stainless steel bars (martensitic), Gr: X 20 Cr 13, H&T  
BHEL Order No.  
Consignment/Identification No.  
Melt No.  
Size and Weight.  
Supplier's Name.

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

1. EN 10088-3
2. AA 0850118
3. EURONORM 58, 59 & 60