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COPPER RODS AND SECTIONS - HARD		
1.0 GENERAL: This specification governs the quality requirements of copper rods/bars and sections. 2.0 APPLICATION: Used for general electrical purposes in Transformers, switch gears, Bus - bars, HT/MT caps and control equipment. 3.0 CONDITION OF DELIVERY: The copper rods shall be supplied in hard condition in straight lengths. Rectangular rods shall be supplied with radiused edges to clause 5.3. 4.0 COMPLIANCE WITH NATIONAL STANDARDS: The copper rods and bars shall comply with the requirements of the following national standard and also meet the requirements of this specification. IS: 613- 2000 : Copper Rods and Bars For Condition : Hard Electrical purposes - specification. 5.0 DIMENSIONS AND TOLERANCES: 5.1 Sizes. Copper rods and sections shall be supplied to the dimensions specified in BHEL order / drawing. 5.2 Tolerances: 5.2.1 The tolerances for round, square, rectangular and hexagonal rods / bars shall be as given below : [Table - 2 of IS: 613] 5.2.2 Sections: Shall be as per BHEL drawing accompanying the order.		
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5.2.3 Length - Rod/Sections:

Tolerance on length shall be as follows:

Length, mm		Tolerances, $\pm$ mm
Over	Upto & incl.	
-	150	1.2
150	1200	1.5
1200	2400	2.5
2400	-	5.0

5.2.4 Straightness:

The straightness and/or edgewise curvature (edge bow) shall not exceed 3 mm for every 1000 mm length.

5.2.5 Radius on Edges - Rectangular & Squares:

Thickness, mm		Edges Radius, mm	Tolerance in Radius $\pm$ mm
Over	Upto and incl .		
6	25	2.5	0.25
25	50	3.2	0.25
50	-	as agreed to between BHEL & manufacturer.	

6.0 MANUFACTURE:

The copper rods shall be manufactured from copper of ETP grade conforming to IS: 191. The conductor shall be manufactured from ETP grade copper conforming to BHEL specification AA 120 24:: Electrolytic Tough Pitch Copper Wire/Bars/Ingots/Continuously cast wire rods.

Note: It is preferable to manufacture conductor from continuously cast copper rods provided all other parameters and conditions remain same."

7.0 FREEDOM FROM DEFECTS:

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

8.0 CHEMICAL COMPOSITION:

The analysis of copper when analyzed in accordance with IS 440 or by any other Conventional/ Instrumental method shall be as follows:

Element	Percent, min.	Percent, max.
Copper and Silver	99.90	-
*Bismuth	-	0.001
*Lead	-	0.005
*Total of all impurities excl. silver and oxygen.	-	0.030



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- 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.

9.0 TEST SAMPLES:

9.1 Tests shall be conducted as follows:

Rods and bars : Mechanical and Electrical.
Sections : Hardness and Electrical.

9.2 One sample per size per melt per consignment of 3 tonnes or part thereof shall be taken for chemical, mechanical and electrical tests.

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

10.0 MECHANICAL PROPERTIES:

10.1 Tensile Strength:

The test samples, when tested in accordance with IS: 1608 shall show the following properties and hardness as per IS:1501.

10.1.1 Round: TABLE FOR HD

Dia., Width, Across flats or Thickness, mm		Tensile strength, N/mm ² , min.			Elongation on 5.65√So of gauge length, % min.			Hardness for all shapes HV, min.
Over	Upto & incl.	Round	Square/ Hexagonal	Rect- angular	Round	Square/ Hexagonal	Rect- angular	
6.0	10.0	330	-	-	-	-	-	90
10.0	12.0	320	310	270	6	6	8	
12.0	25.0	290	280	260	8	8	8	
25.0	90.0	260	250	250	12	12	10	
> 90.0	As agreed between BHEL and manufacturer.							

10.1.2 Rods /Bars other than rectangular:

For material over 30 mm dia, thickness or width a cross flats, the test piece shall be turned with its centre 14mm from the surface of the material for material of smaller dia or width, which may not be tested in the condition as manufacture of the test pieces shall be turned from the centre of the material.

10.1.3 Rectangular Bars/Rods:

The test piece shall be taken from the centre of the rod/bar.

10.2 Bend Test:

The material shall be tested for bend test in accordance with IS:1599, if specified in BHEL order.

11.0 ELECTRICAL RESISTIVITY (As Received):

When measured in accordance with IS: 3635, the electrical resistivity of the sample in as received condition at 20⁰ C shall not be greater than 0.0177 ohm. mm² / metre, which is equivalent to an electrical conductivity of 97% minimum of IACS standard. (Refer Appendix B of IS: 613 for temperature correction factor.) Alternatively, the method of measurement employing eddy current probes as per ASTM E 1004 is also acceptable.

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12.0 CHECK LIST:

The supplier shall fill up the enclosed checklist as per Annexure-A and submit the same alongwith 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 12023 (Rev. No. 08) : Copper Rods and sections - Hard

BHEL Order No.

Manufacturer 's / Supplier 's Name

Lot /Identification / Batch /Melt No.

Sizes and Quantity Supplied

Results of dimensional inspection, Chemical analysis,

Mechanical and electrical tests as per this specification.

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 12023 : Copper Rod and sections - Hard

BHEL Order No

Manufacturer's/ supplier's Name

Lot/Identification/ Batch /Melt No.

Size and Quantity supplied.

16.0 REFERRED STANDARDS(LATEST PUBLICATION INCLUDING AMENDMENTS):

1) IS:191
2) IS:440
3) IS:613
4) IS:1501

5) IS:1599
6) IS:1608
7) IS: 2826
8) IS: 3635
9) ASTM E 1004



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ANNEXURE - A (Clause 12.0)

CHECK LIST FOR AA 120 23: COPPER RODS AND SECTIONS - 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 diameter/ Width/thickness/ length
and flatness 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) Bend
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:

Signature &

Place:

Seal of Supplier