



PLANT PURCHASING SPECIFICATION BHOPAL

BP 12082

REV NO. 07

PAGE 1 of 3

SUPERSEDES

BP 12082 Rev 06

HIGH CONDUCTIVITY COPPER TUBES

1. GENERAL

This specification governs the quality requirements of high conductivity copper tube, up to 125mm outside diameter.

2. APPLICATION :

For use in Traction Motor /Current Transformers.

3. CONDITION OF DELIVERY:

The tube shall be supplied in solid drawn condition in straight lengths.

Ends shall be cut clean and square with the axis of the tube.

4. COMPLIANCE WITH NATIONAL STANDARDS

There is no Indian standard for this material. However assistance has been drawn from IS: 2501/BSEN 13600.

5. DIMENSIONS AND TOLERANCES:

5.1. Sizes

These tubes shall be designated by outside diameter and thickness. The material shall be supplied to the dimensions as specified in purchase order.

The sizes shall be selected from IS 5493.

5.2. Tolerances

The tolerances shall comply with IS: 5493, as detailed below.

5.2.1 Diameter:-

The mean diameter of the tube shall not vary from the specified diameter by more than the amount of tolerance given below. The mean diameter is half the sum of two diameters measured at right angles at any section of the tube.

Revision : Reviewed & Brought up to date.

Issued by :

STANDARDS AND MATERIALS GROUP
TECHNICAL SERVICES DEPTMENT

Rev. 07

Date : 12.03.2022

Date of first Issue: Feb. 1984



PLANT PURCHASING SPECIFICATION BHOPAL

BP 12082

REV NO. 07

PAGE 2 of 3

Outside Diameter Specified (mm)	Tolerances Nominal (\pm mm)
Up to 10	0.08
Over 10 to 18	0.10
Over 18 to 32	0.12
Over 32 to 50	0.15
Over 50 to 80	0.20
Over 80 to 125	0.25

5.2.2 Thickness:

The mean thickness of the tube shall not vary from the specified thickness by more than $\pm 12.5\%$ of the specified wall thickness. However total weight of the tubes should not differ by more than $\pm 5\%$ from the nominal dimensions.

5.2.3 Length

The tube ordered in the specified length shall be within the tolerances as specified below:

Specified Length (metres)	Tolerances on Specified Length (mm)
Upto & including 3	+4
Over 3 upto 6	+6
Over 6 upto 10	+8

*Note: Minus tolerances are not permissible.

5.3 Straightness :

For the acceptable straightness of the tubes, the permissible max. deflection shall not exceed 2 mm per meter.

6. MANUFACTURE:

The tubes shall be solid drawn; temper annealed and in no case shall be redrawn from used tubes.

7. FREEDOM FROM DEFECTS:

The tubes shall be round, straight, smooth, clean, uniform in diameter and free from cracks, seams, slivers, scales, deleterious film in the bore and other harmful defects.

The ends shall be cut clean and square with the axis of the tube.

8. CHEMICAL COMPOSITION:

The chemical composition of the material shall be as follows :

Copper including silver : 99.9% Min.



PLANT PURCHASING SPECIFICATION BHOPAL

BP 12082

REV NO. 07

PAGE 3 of 3

Note: These elements need not be determined when the material supplied confirms with Electrical & Mechanical properties specified in this specification. However, the supplier shall ensure that the composition of material confirms the specified limits.

9. TEST SAMPLES:

One sample per size, per batch, per consignment, shall be selected for test.

10. MECHANICAL PROPERTIES:

10.1 Tensile :

Test pieces when tested in accordance with IS : 1608 shall show a tensile strength of 245N/mm², Min.

10.2 Hardness :

The material when tested in accordance with IS : 1501 shall show a vicker's hardness of 75-90 HV.

11. ELECTRICAL CONDUCTIVITY:

The electrical conductivity of the material when tested at 20°C in the "As Received" condition shall be 97% min. of IACS standard which is equivalent to resistivity of 0.01777 Ohm mm²/ meter max. The material shall be tested in accordance with IS 3635. Alternatively, the eddy current probe method as per ASTM E1004 is also acceptable. Refer Appendix B of IS: 613 for temperature correction factor.

12. TEST CERTIFICATE:

Unless otherwise stated on the order, three copies of the test certificate 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 :

BP 12082 (Rev. 07) : High conductivity Copper tubes.

BHEL Order No.

Manufacturer's / Supplier's Name.

Size and number of tubes.

Batch No.

Results of Tests: Test results obtained for Electrical and Mechanical Properties and Dimensional tolerances as per this specification.

13. PACKING AND MARKING

The tubes shall be suitably Hessian wrapped and packed to prevent damage during transit. Each package shall bear the following information

BP 12082: High conductivity Copper tubes.

Manufacture/Supplier's Name.

Size and weight of the material.



CORPORATE PURCHASING SPECIFICATION

AA 120 23

Rev. No. 08

PAGE 1 OF 5

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.

Revisions :

Cl: 24.1 of MOM of MRC-NFCW+HE

APPROVED :

INTERPLANT MATERIAL RATIONALISATION
COMMITTEE-MRC (NFCW+HE)

Rev. No.08

Amd.No.

Reaffirmed

Prepared

Issued

Dt. of 1st Issue

Dt:06.06.2012


Dt :

Year :

BHOPAL

Corp. R&D

Nov, 1978

AA 120 23		CORPORATE PURCHASING SPECIFICATION		
Rev. No. 08				
PAGE 2 OF 5				

5.2.3 Length - Rod/Sections:

Tolerance on length shall be as follows:

Length, mm		Tolerances, ± 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 ± 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



CORPORATE PURCHASING SPECIFICATION

AA 120 23

Rev. No. 08

PAGE 3 OF 5

- 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
Over	Upto & incl.	Round	Square/ Hexagonal	Rect- angular	Round	Square/ Hexagonal	Rect- angular	HV, min.
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.

AA 120 23	CORPORATE PURCHASING SPECIFICATION	
Rev. No. 08		
PAGE 4 OF 5		

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

	CORPORATE PURCHASING SPECIFICATION	AA 120 23 Rev. No. 08 PAGE 5 OF 5
---	---	--

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:

Place:

Signature &

Seal of Supplier



CORPORATE PURCHASING SPECIFICATION

AA 120 03

Rev. No. 04

PAGE 1 OF 5

COPPER STRIP – HARD

1.0 GENERAL:

This specification governs the quality requirements of bright annealed bare Copper strip of thickness over 0.15 mm and upto 10 mm and widths upto 800 mm with radiused edges.

2.0 APPLICATION:

Used for general electrical purposes such as bus bars, transformers, switchgears etc.

3.0 CONDITION FO DELIVERY:

The strip shall be supplied in annealed condition, in coils or straight lengths as specified in BHEL order. The strips shall be supplied with their edges radiused as per clause 5.3.

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: 1897 – 2008 : Copper strips - for Electrical Purposes.

Gr.HD – Hard

5.0 DIMENSIONS AND TOLERANCES:

5.1 Sizes: Copper Strips shall be supplied to the dimensions specified in BHEL order:

5.2 Tolerances:

Tolerances on width, thickness, length and straightness shall be as per IS:3052, reproduced below.

5.2.1 Width:

5.2.1.1 Tolerance on width for rotary sheared strip upto 4mm thickness shall be as follows:

Width, mm				Tolerance, ±mm			
Over	upto and incl.	upto and incl. 0.25 thick	over 0.25 upto & incl 0.55 thick	over 0.55 upto & incl. 1.0 thick	over 1.0 upto & incl. 2.0 thick	over 2. upto & incl. 4.0 thick	
-	10			By agreement			
10	50	0.10	0.15	0.2	0.3	-	
50	100	0.15	0.20	0.3	0.5	0.6	

Revisions :

Cl: 24.1 of MOM of MRC-NFCW+HE

APPROVED :

INTERPLANT MATERIAL RATIONALISATION
COMMITTEE-MRC (NFCW+HE)

Rev. No. 04

Amd.No.

Reaffirmed

Prepared

Issued

Dt. of 1 st Issue

Dt: 06.06.2012

Dt :

Year :

BHOPAL

Corp. R&D

December, 1978

CORPORATE PURCHASING SPECIFICATION



100	200	0.20	0.30	0.5	0.6	0.8
200	400	0.30	0.50	0.6	0.8	1.0
400	600	0.50	0.60	0.8	1.0	1.4
600	800	0.60	0.80	1.0	1.4	1.6

5.2.1.2 Tolerance on width for guillotine sheared strip above 4 mm thick shall be as follows:

Width, mm		Tolerance, \pm mm	
Over	upto & Incl.	over 4.0 upto & incl.5.0 thick	over 5.0 upto & incl.10.0 thick
---	500	2	3
500	800	3	4

5.2.2 Thickness:
Tolerance on thickness shall be as follows:

Thickness, mm			Tolerance, \pm mm			
Over	upto and incl.	upto and incl. 160 wide	over 160 upto & incl. 300 wide	over 300 upto & incl. 450 wide	over 450 upto & incl. 630 wide	over 630 upto & incl. 800 wide
0.16	0.20	0.015	0.020	0.025	0.03	0.04
0.20	0.63	0.020	0.025	0.03	0.04	0.05
0.63	0.90	0.025	0.030	0.04	0.05	0.06
0.90	1.20	0.030	0.04	0.05	0.06	0.07
1.20	2.00	0.040	0.05	0.06	0.07	0.09
2.00	2.80	0.050	0.05	0.07	0.09	0.11
2.80	3.50	0.060	0.07	0.09	0.11	0.14
3.50	4.50	0.070	0.09	0.11	0.14	0.17
4.50	6.00	0.090	0.11	0.14	0.17	0.20
6.00	8.00	0.110	0.14	0.17	0.20	0.25
8.00	10.0	0.140	0.17	0.20	0.25	0.30

5.2.3 Length (Rotary Sheared):

Length, mm		Tolerance, \pm mm
Over	upto & incl.	
160	1000	3
1000	2000	6
2000	4000	9

5.2.4 Straightness:
The edges of strips supplied in straight lengths shall not vary from a straight line by more than 3 mm in any 1000 mm length.



CORPORATE PURCHASING SPECIFICATION

AA 120 03

Rev. No. 04

PAGE 3 OF 5

5.3 Radius on Edges:

The strip shall be supplied with edges radiused as per IS:1897, reproduced below:

Thickness, mm		Nominal radius on edge, mm	Tolerance on radius, mm
Over	up to & incld.		
--	1.00	semi-circular	± 0.06
1.0	1.60	0.60	+ 0.15 - 0.10
1.6	2.25	0.80	± 0.15
2.25	3.55	1.00	± 0.20
3.55	10.00	1.25	± 0.25

6.0 MANUFACTURE:

The material shall be manufactured from copper of ETP grade conform to IS:191.

The conductor shall be manufactured from ETP grade copper conforming to BHEL specification: AA 12024: 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 material shall be clean, bright, smooth and free from harmful defects.

8.0 CHEMICAL COMPOSITION:

The analysis of copper when analysed in accordance with IS: 440 or any other conventional/instrumental methods shall be as follows:


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

* These elements need not be determined when the material supplied conforms with 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:

One sampling 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.

AA 120 03	CORPORATE PURCHASING SPECIFICATION	
Rev. No. 04		
PAGE 4 OF 5		

10.0 MECHANICAL PROPERTIES:

10.1 Tensile strength (For sizes over 0.5mm to 10mm thick):

The test samples, when tested in accordance with IS:1608 shall show the following properties:
IS:1608 , shall show the following properties:

Thickness mm		Tensile Strength, N/mm ² Minimum	
		For widths	
Over	upto & incl.	Upto & incl.3000 mm	Over 300 mm & Upto & Incl. 800 mm.
0.50	2.50	310	285
2.50	10.00	295	275

10.2 Bend Test:

The strip shall not be subjected to transverse bend test.where this is not possible, it shall be subjected to a longitudinal bend test. The strip when tested in accordance with IS: 1897 shall withstand a close bend test, through an angle of 180°, without showing any sign of cracks or failures upon the convex surface of the bend.

10.3 Hardness (Vickers):

When tested in accordance with IS:1501, the strips shall have a Vickers hardness not exceeding
90 HV, min.

11.0 ELECTRICAL RESISTIVITY (AS RECEIVED):

When measured in accordance with IS: 3635, the electrical resistivity at 20° C shall not be greater than 0.01777 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.

12.0 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.



CORPORATE PURCHASING SPECIFICATION

AA 120 03

Rev. No. 04

PAGE 5 OF 5

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 BHEL reserves the right to test the material at BHEL'S works and the final acceptance of the 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 otherwise specified, three copies of test certificates shall be supplied along with 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 120 03, Rev 04: Copper strip – 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 called for in this specification.

14.0 PACKING AND MARKING:

The material shall be supplied in coils or drums or in straight length as ordered. The minimum eye of coil or barrel diameter of drums shall be 250 mm.

The material not supplied in drums shall be hessian wrapped and tied with string and not with wire and shall be suitably protected to with wire and shall be suitably protected to avoid damage in transit. Each coil or drum or bundle shall be legibly marked or labeled with the following information.

Each coil or drum or bundle shall be legibly marked or labeled with the following information:

AA 12003 : Copper strip – Hard

BHEL Order No.

Manufacturer's/Supplier's Name :

Lot/Identification/Batch/Melt No.

Sizes and Quantity Supplied

15.0 REFERRED STADARDS (Latest Publications Including Amendments):

1. IS:191

2. IS:440

3. IS:613

4. IS: 1501

5. IS:1897

6. IS:1608

7. IS:3052

8. IS:3635

9. ASTM E 1004