



CORPORATE PURCHASING SPECIFICATION

AA 120 17

Rev. No. 02

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OXYGEN FREE HIGH CONDUCTIVITY COPPER TUBES - MEDIUM HARD

1.0 GENERAL:

This specification governs the quality requirements of oxygen free high conductivity copper tube, solid drawn Square/ Rectangular/Circular/ in medium hard condition.

2.0 APPLICATION:

Used in switchgear, transformers and traction motors.

3.0 CONDITION OF DELIVERY:

The material shall be supplied in medium hard condition in straight lengths as specified in BHEL order.

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

4.0 COMPLIANCE WITH NATIONAL STANDARDS:

There is no Indian Standard covering this material. However, assistance has been drawn from the following national standard.

BS: 1977-1976 : Specification for High Conductivity

Gr : C 103 Copper Tubes for Electrical Purposes.

Medium hard

5.0 DIMENSIONS AND TOLERANCES:

5.1 Sizes:

The tubes shall be supplied to the dimensions as specified in BHEL order.

5.2 Tolerances:

5.2.1 Thickness:

Tolerance on thickness shall be as follows:

Thickness, mm		Tolerance, + mm
Over	upto & incl.	
0.75	1.60	0.15
1.60	2.25	0.20
2.25	4.30	0.35
4.80	7.00	0.45
7.00	9.50	0.60
9.50	15.00	0.80
15.00	25.00	1.00

Revisions: Ref: CL31.2.1 of MOM of MRC –E
& 15.27 of MRC-NFCW+HE

APPROVED:
INTERPLANT MATERIAL RATIONALISATION
COMMITTEE-MRC (NFCW +HE)

Rev. No. 02

Amd.No. 01

Reaffirmed

Prepared
HYDERABAD

Issued
Corp. R&D

Dt. Of 1st Issue
01-11-78

Dt.: 01-02-97

Dt: 01-05-99

Year:

**5.2.2 Length:**

Tolerance on length of the tubes ordered in specified length shall be as follows:

Length, metre		:	Tolerance, ± mm
over	upto & incl.		
--	3.0		1.5
3.0	6.0		3.0

For sizes not included in this specification, tolerance shall be as stated in BHEL order.

5.2.3 Circular Tubes Diameters:

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.

Nominal Diameter mm		Tolerance mm	
over	up to & incl.	plus	minus
	15	0.0	0.13
15	50	0.0	0.20
50	100	0.0	0.25

5.2.4 Square & Rectangular Tubes:

The tolerances on square and Rectangular tubes shall be as agreed between BHEL and the suppliers.

6.0 MANUFACTURE:

The tubes shall be manufactured from copper of ETP grade conform to IS:191, except that oxygen content shall not exceed 0.001% .

7.0 FREEDOM FROM DEFECTS:

The material shall be clean, bright, smooth and free from spills, sealing, blisters, cracks, lappings, shaving, splinters, metal dust, oxidation and other harmful defects. However, such surface marks caused during drawing or rolling that are barely noticeable to the naked eye are allowed

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

8.0 CHEMICAL COMPOSITION:

The analysis of copper when analysed in accordance with IS: 440, shall be as follows.



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Element	Percent	
	Min	Max
Copper and Silver	99.90	
Bismuth *	-	0.001
Lead *	-	0.005
Oxygen	-	0.001
Total of all impurities excl.silver and oxygen	-	0.040
Silver present will be counted as Copper.		

* 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 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 material when tested in accordance with IS: 1608 shall show a tensile strength of 245 N/mm² Minimum.

10.2 Hardness(Vickers):

When tested in accordance with IS: 1501,(Part 1), the material shall have a vickers hardness in the range of 75 - 90 HV.

10.3 Hydraulic Test:

The tubes shall withstand, when hydraulically tested to a test pressure of 20 kg/cm² for one hour in water, and shall not show any sign of leakage or sweating or permanent increase in diameter at any point.

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 shall also be acceptable

**12.0 OPTIONAL TESTS:**

Whenever specified in BHEL order the following tests shall be conducted on the norms of acceptance shall be as specified there in.

12.1 Hydrogen Embrittlement Test:

The test pieces cut from the tube (either full section or strips from the tubes) is exposed to hydrogen atmosphere at 825°C - 875°C for 30 minutes. After cooling down to room temperature the pieces are tested. In case of full section sample, the tube shall be flattened to close. In case of a strip cut from the tube, it shall be bent 180°. In no case the copper shall exhibit any crack.

12.2 Metallographic Examination:

After subjecting the material to the hydrogen embrittlement test, the test pieces shall be examined under an optical microscope at a magnification of at least 200. Test pieces shall show no fissures or cracks and inclusions, particularly cuprous oxide shall be absent.

12.3 Hydrogen Resistance-Round Tubes:

Tube specimens of 10 to 20 mm length are annealed for 30 minutes at 800 to 850° C in a reduced atmosphere (hydrogen or fuel gas) cooled and then compressed between two parallel platens until the specimen shall not show any incipient cracks or fracture at the bend. In case of thick-walled tubes or tubes of larger cross-section, a strip of about 10 mm wide can be taken as test specimen.

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 works, the supplier shall make necessary arrangements for 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 certificates shall be supplied along with each consignment.



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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 12017 (Rev.No.02) : Oxygen Free High Conductivity Copper
Tube - Medium Hard.

BHEL Order No

Manufacturer's/Suppliers'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 supplied shall be suitable packed to avoid damage during transit.

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

AA 12017 : Oxygen Free High Conductivity Copper
Tube - Medium Hard.

BHEL Order No

Manufacturer's/Supplier's Name

Lot/Idetification/Batch/Melt No. Size and Quantity
supplied

16.0 REFERRED STANDARDS (Latest Publications Including Amendments)

- 1) IS: 191 2) IS:440 3) IS: 613 4) IS: 1501 (Part 1) 5) IS: 1608
6) IS: 3635 7) BS: 1977 8) ASTM E 1004.