	संस्थान क्रय विनिर्देश (हीप : हरिद्वार) PLANT PURCHASE SPECIFICATION (HEEP: HARIDWAR)	HW12086	
		मुख्य पृष्ठ PREFACE SHEET	

BARE RECTANGULAR HOLLOW COPPER CONDUCTOR

केवल आंतरिक प्रयोग हेतु
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COMPARABLE STANDARDS / CATALOGUES ETC. } NIL

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SUGGESTED / PROBABLE SUPPLIERS AND GRADES. } REGISTERED VENDORS OF PMD TG060

कोई अन्य जानकारी
ANY OTHER INFORMATIONS } NIL

Reaffirmed year 2024			संस्थान मानकीकरण समिति APPROVED : PLANT STANDARDIZATION COMMITTEE		Gr. No. 2.88
REV.NO.	5		निर्मित PREPARED : EME	जारी ISSUED : TSX	दिनांक DATE: 02-03-1982
DL	15-01-2019				

INVENTORY NO. P-2443

संस्थान क्रय विनिर्देश (हीप : हरिद्वार)

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BARE RECTANGULAR HOLLOW COPPER CONDUCTOR

1. GENERAL:

This specification covers high conductivity soft copper conductors of hollow rectangular section for stator windings of Turbo-generators.

2. APPLICATION:

Used for manufacturing of water cooled stator windings bus bars of turbo-generators.

3. COMPLIANCE WITH INTERNATIONAL STANDARD:

This standard is based on BS EN 13600:2013 and BHEL experience.

4. DIMENSIONS AND TOLERANCES:

4.1 Dimensions & Permissible tolerances: According to figure-1 on Page 5.

4.2 Length of Profile: In straight length of 7000mm (Min. acceptable)

4.3 The conductor shall have radiused corners, both inside and outside as figure-1 on Page 5.

5. No joints shall be made in hollow copper conductor after it is drawn or extruded.

6. CONDUCTOR:

6.1 **Conductor Material:** The hollow copper conductor shall be made of copper of Cu-HCP (CW021A) grade as per BS EN 13600:2013 and chemical composition as per clause 8.1 of this specification.

6.2 **Freedom from defects:** External and internal surface of the rectangular hollow copper conductor shall be bright, free from dirt and smooth without cracks, blisters and pits. The rectangular hollow copper conductor shall have shining surface free of doubling, cracks, chips, scabbing/scaling, metal dust and oxidation products. The inner surface of rectangular hollow copper conductor must be reasonably clean, degreased, free of copper pitting, copper chips, wrinkles and oxidation products on and directly below the surface.

				NAME	SIGNATURE & DATE
TSX	D. Ganguli	24/1/19	TRANSLATED BY		
PSC Member	R.K. Sharma	16/1/19	WORKED BY	SATENDER KUMAR	15/1/19
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AGREED DEPTT.	NAME	DATE & SIGNATURE	SUPERVISED BY	A.K. GOYAL	15-1-19

Reaffirmed Year 2024 CKD BY

APPROVED : संस्थान मानकीकरण समिति PLANT STANDARDIZATION COMMITTEE — Gr. NO. 2.65

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SUPERSEDES INVENTORY NO. P2443

7. DEVIATION OF PROFILE ALIGNMENT:

The broad side of tubing cannot curve inward (concave). An outward curved shape(convex) is permissible but is limited by the dimensional tolerances. The radii must be tangential to the rectangular tubing surface and must blend smoothly with these surfaces without any sharp corners.

The allowable center line deviation is 10% of the wall thickness.

8. PROPERTIES & TESTING

8.1 CHEMICAL COMPOSITION:

The hollow copper conductor shall be manufactured from copper of Cu-HCP (CW021A) grade as per BS EN 13600:2013 with the following composition:

Constituents	Composition, in % by weights
Cu	99.95[a] Min.
Bi	Max. 0.0005
P	0.002 to 0.007
O	--[b]
Pb	0.005
Other elements	Total 0.03 (excluding Ag, P)

[a] Including silver, up to a maximum of 0.015%.

[b] The oxygen content shall be such that the material conforms to the hydrogen embrittlement requirements as per EN 1976. Hydrogen Embrittlement Test as per ISO 2626.

NOTE: The total of other elements (excluding Cu, Ag, P) is defined as the sum of As, Bi, Cd, Co, Cr, Fe, Mn, Ni, O, Pb, S, Sb, Se, Si, Sn, Te and Zn, subject to the exclusion of any individual elements indicated.

8.2 MECHANICAL PROPERTIES:

The mechanical properties shall conform to the appropriate requirements as per BS EN 13600 -2013 given in the table below:

Material condition	Tensile Strength (R_m) N/mm^2	0.2% proof strength ($Rp_{0.2}$) N/mm^2	Elongation A % (Min.)
R200	200-250	Max. 120	35

8.3 ELECTRICAL PROPERTIES (at 20° C):

The electrical properties shall conform to the appropriate requirements as per BS EN 13600-2013 given in the table below:

Material condition	Volume Resistivity (Max) $\frac{\Omega X mm^2}{m}$	Conductivity	
		MS/m (Min.)	% IACS (Min.)
R200	0.01724	57.0	98.3
[a] IACS: International Annealed Copper Standard			

Determination of electrical conductivity should be carried out as per IS3635. Alternatively, the method of measurement employing Eddy current probes as per ASTM-E 1004 is also acceptable.

8.4 DIMENSIONAL CHECK: Window dimensions of the hollow copper conductor is to be checked by shadowgraph method on the sample copper as mentioned in "selection of test sample" at serial no. 9 of this specification. Supplier has to supply a copy of shadowgraph along with test certificates, in support of dimensional accuracy of the window dimensions of the hollow copper conductor.

8.5 TESTING FOR DOUBLING FREEDOM: - The sample will be cut from one tube taken randomly from every charge and test for flattening and doubling will be done as per IS:2501.

8.6 TESTING FOR ERROR FREEDOM OF THE INNER SURFACE: - The flat pressed cutting or samples are to be cut in longitudinal direction for the proof of error freedom of tube inner surface and subjected to a visual inspection below the microscope.

9. HYDROGEN EMBRITTLEMENT TEST:

Hydrogen embrittlement test shall be performed on each finished tube.
Testing should be as stipulated in EN ISO 2626 and EN13600.

10. SELECTION OF TEST SAMPLES

For the testing, a sample of approximately 3 meters is taken from every 500Kg and all the tests stipulated in the specification are to be conducted. If the results are not up to the stipulated standards as mentioned in this specification, a second sample of 3 meters is taken and all the tests has to be repeated. If the results are still not up to the standards set in, the whole lot of 500Kg is rejected.

11. TEST CERTIFICATES

Three copies of test certificates on the obtained test results shall be supplied along with following information: -

- HW 12086
- BHEL P.O. No.
- Size and Quantity
- Batch no.
- Supplier's Name.
- Certificate for electrical and mechanical properties.
- Certificate for chemical composition and hydrogen embrittlement test.
- Certificate for test for doubling freedom and error freedom.
- Certificate for Dimensional report along with window dimension of rectangular hollow copper conductor.
- Certificate for Grease freedom on inner surface.

12. PACKING

The tubes shall be suitably packed to prevent damage during transit. Each piece is to be legibly marked or labelled with the following information.

i) Size
ii) BHEL P.O. No.
iii) Supplier's name
iv) Length and weight of material in packing

13. REJECTION AND REPLACEMENT

If the material does not comply with the requirements of this specification after receipt and inspection at BHEL or if any defects found during further processing. BHEL reserves the right to reject the whole consignment and supplier shall replace the material free of cost.

14. LIST OF CROSS REFERRED STANDARDS

BS EN 13600:2013
EN 1976
ISO 2626
IS 3635
ASTM E 1004
IS 2501

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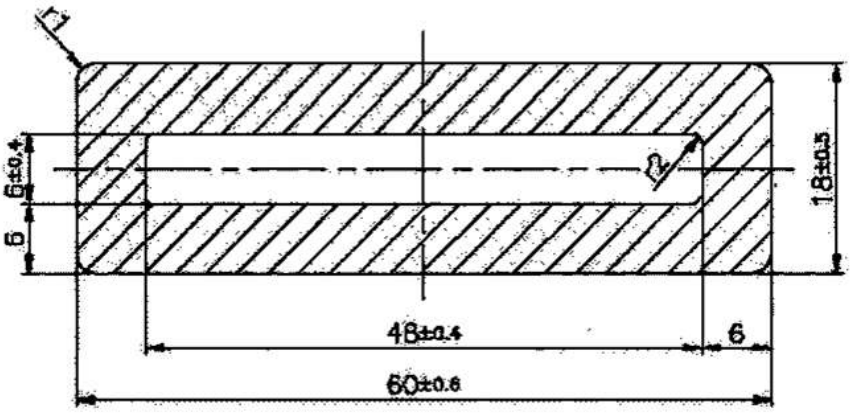

r1=1.3 TO 1.6
r2=0.5 TO 0.8
Wt. in Kg./Meter=7
Cross Section in mm^2=790.7

BARE RECTANGULAR COPPER CONDUCTOR

FIGURE -1

REV. NO. 5		निर्माणकर्ता WORKED BY	SATENDER KUMAR	सतेन्द्र	15-01-19
		जांचकर्ता CHECKED BY	AJAY KUMAR GUPTA	अजय	15-01-19

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