Technical specifications, dimensions & quantity of OFE Copper Bars

1. GENERAL

This specification lists the technical requirements for the supply of Oxygen Free Electrolytic copper (ASTM B224-98 Oxygen Free Electrolytic, Cu-OFE, UNS C10100) conforming to ASTM B170-99, grade 1 intended for ultra-high vacuum and electron device applications (ASTM F 68 Class 1). The material will be used for making vacuum envelope of linear accelerators for physics research. The important properties required are machinability in order to achieve high dimensional accuracies and surface finish, brazeability in hydrogen and vacuum furnace, ultra high vacuum compatibility and homogeneity of microstructure.

2. SCOPE OF SUPPLY

Sl. No.	Description and dimension	Quantity	Total nominal weight in kgs
2.1	Oxygen Free Electrolytic Copper **[C10100]** bar Cross section – Rectangle **300 (W) X 150 (H)X 1200 mm (L)** conforming to ASTM B170-99, grade 1	**16 bars**	**7,680**
2.2	Oxygen Free Electrolytic Copper **[C10100]** bar Cross section – Rectangle **100 (W) X 150 (H) x 1200 (L) mm** conforming to ASTM B170-99, grade 1	**16 bars**	**2,560**
Note:- The actual supply quantity should be 16 bars for each size having total supply weight within ±10% of the total nominal weight.			

3. Applicable standards

Technical conditions for material shall conform to the documents list given below.

Sl. No.	ASTM number	Year	Description
1.	ASTM B224 -98	1998	Standard classification of copper
2.	ASTM B170-99	1999	Standard specification for oxygen-free electrolytic copper-refinery shapes
3.	ASTM F68-99	1999	Standard specification for oxygen-free copper in wrought forms for electron devices.
4.	ASTM B193-02	2002	Standard test method for resistivity of electrical conductor materials.
5.	ASTM B577-93	1993	Standard test methods for detection of cuprous oxide (hydrogen embrittlement susceptibility) in copper.
6.	ASTM E112-96	1996	Standard test methods for determining average grain size.
7.	ASTM B152M	2000	Standard Specification for Copper Sheet, Strip, Plate and Rolled bar
8.	ASTM B248M	2001	Standard Specification for general requirements for wrought Copper and Copper-Alloy Plate, Sheet, Strip, and Rolled Bar
9.	ASTM E8M	2002	Test Methods for Tension Testing of Metallic Materials

4. PROPERTIES

4.1 Physical Properties (conforming to ASTM B193-02)

Sl. no.	Property	Value
1.	Density at 20°C (approx.)	≥8.89 g/cm^3
2.	Minimum electrical conductivity at 20°C	101% IACS (equivalent to maximum mass resistivity 0.15176 Ω g/m^2)

4.2 Chemical Properties (conforming to ASTM B170-99)

The chemical composition of the material should meet the requirements as per ASTM B170 Grade 1 specified in table below.

Sl. No.	Element	Weight Percentage (%)
1.	Copper	≥99.99
2.	Antimony	≤0.0004
3.	Arsenic	≤0.0005
4.	Bismuth	≤0.0001
5.	Cadmium	≤0.0001
6.	Iron	≤0.0010
7.	Lead	≤0.0005
8.	Manganese	≤0.00005
9.	Nickel	≤0.0010
10.	Oxygen	≤0.0005
11.	Phosphorous	≤0.0003
12.	Selenium	≤0.0003
13.	Silver	≤0.0025
14.	Sulphur	≤0.0015
15.	Tellurium	≤0.0002
16.	Tin	≤0.0002
17.	Zinc	≤0.0001

4.3 Mechanical properties (conforming to ASTM B152M)

Sl. No.	Property	Value
1.	Temper	Hot Rolled – M20
2.	Ultimate strength	200 MPa (min) and 260 MPa (max)
3.	Elongation	25% (min)

Testing to be done as per ASTM E8M – 02

4.4 Embrittlement:

Material shall be accepted in accordance with Test Method B or D as per standard ASTM B 577-93 (1998)

4.5 Microporosity:

In accordance with standard ASTM F68. Products whose samples have an appearance conforming to Class 1 would be accepted.

4.6 Internal defects:

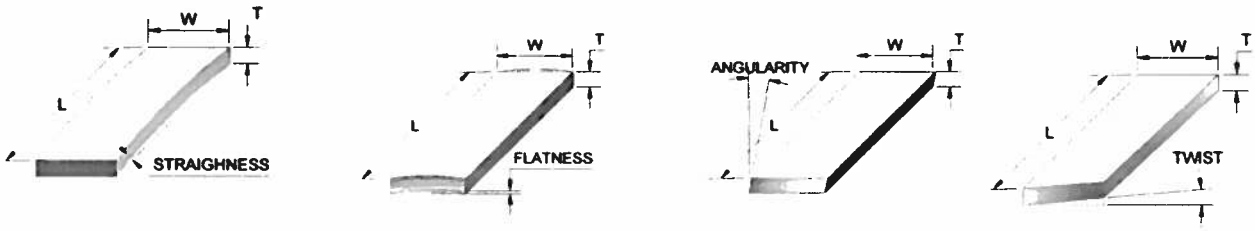
Bar shall be ultrasonically inspected solely to detect internal defects such as cracks, voids and other structural discontinuities which may or may not be exposed to the surface. The ultrasonic inspection shall be done as per AMS 2630B (Aerospace Material Specification) continuity faults. Each copper bar shall be ultrasonically tested at frequencies > 4.0 MHz, depending on the thickness. It would be rejected; if the attenuation is > 20 %

5. QUALITY ASSURANCE PLAN

Quality control shall be carried out in accordance with a quality plan which should be approved by the purchaser. Following are the QA requirements:

- Below mentioned original manufacturer's mill test certificate for material shall be submitted before effecting bulk supply of material.
  - i. **Test certificate confirming chemical composition for Grade 1 OFE Copper [UNS C10100]**
  - ii. **Test certificate confirming Class 1 OFE Copper**
  - iii. **Test certificate confirming specified physical properties**
  - iv. **Test certificate indicating specified mechanical properties**
  - v. **Test certificate for embrittlement test**
  - vi. **Test certificate for micro-porosity and average grain size**
  - vii. **Test certificate for ultrasonic inspection**
- ***Bulk supply of material shall be effected only after getting material acceptance report from RRCAT, Indore.***
- For tolerances on thickness, width, length, straightness, flatness, angularity, twist etc., for the material supplied should be within the limits prescribed in the table below.

Sl. no.	Entity	Tolerance value
1.	Length (L)	+ 5 mm
2.	Width (W)	+ 5 mm
3.	Thickness (T)	+ 5 mm
4.	Straightness	< 1 mm
5.	Flatness	< 0.5 mm
6.	Angularity	$< 1^0$
7.	Twist	$< 0.5^0$



- Materials shall bear the distinct markings of the manufacturer, heat, and cast numbers.
- Workmanship, finish, and appearance shall be as per applicable standard.

6. IDENTIFICATIONS

Each bar shall be marked with batch number, bar number, supplier's name. The marking shall be shown at least on one side and to be repeated after every 30 – 50 cm of length. Markings should not be erasable using solvents like thinner, acetone, isopropyl alcohol etc.

7. PACKING

Efficient protection shall be provided to prevent the possibility of scratching any face of the material. To prevent any damage to the surface and geometry of the material, packing should be seaworthy as per ASTM WAZ 3.1 acc. to EN 10204.

8. DELIVERY

The material shall be delivered in packed condition at IRPSU, RRCAT Indore, India within a period of 8 – 10 weeks from the date of acceptance of purchase order.

9. VALIDITY

The offer shall be valid for at least 2 months from the opening date of the tender.

10. BIDDER'S QUALIFICATION CRITERIA

Only OFE Copper manufacturers or their authorized representatives are eligible to bid. The bidder must meet the following criteria to qualify for the bid.

10.1 The OFE Copper manufacturer shall operate under a quality management system (ISO 9001:2000 or equivalent) with having facilities to carry out all material tests asked in tender.

10.2 The OFE Copper manufacturer shall have experience and capacity in the field manufacturing OFE Copper bars of similar sizes of tender specification with documentary proof. Customers list should clearly indicate about organization's name, item supplied, year of supply, contact details etc.

10.3 The offer must be submitted on the basis of fixed price. The prices should remain firm throughout the currency of the contract.

11. GENERAL NOTE

11.1 The price must be quoted on Duly Packed Ex-works / FOB basis in price part only. Prices quoted other than these terms shall be rejected. Testing charges (if any) should be quoted separately in price part only.

11.2 Quality assurance plan for manufacturing of the above items may be submitted along with the offers.

12. GUARANTEED TECHNICAL PARTICULARS

(Bidder / supplier must fill in the following chart and enclose with the tender)

Sl. No.	Description of item	Tender Specifications	Bidder's specification	Documentary proof in tender as applicable (indicate page no.)	Deviation if any – justifications for deviation
1.	Copper bars	Oxygen Free Copper conforming to ASTM B170-99, grade 1 & Class1 as per ASTM F68			
2.	Size of bar as per sl. no. 2.1	300 (W) X 150 (H)X 1200 mm (L)			
3.	Size of bar as per sl. no. 2.2	100 (W) X 150 (H)X 1200 mm (L)			
4.	Length tolerance	+ 5 mm			
5.	Width tolerance	+ 5 mm			
6.	Thickness tolerance	+ 5 mm			
7.	Straightness tolerance	< 1 mm			
8.	Flatness tolerance	< 0.5 mm			
9.	Angularity tolerance	< 10			
10.	Twist tolerance	< 0.50			
11.	Density	≥8.89 g/cm3			
12.	Electrical conductivity	101% IACS			
13.	Chemical Properties for pt. no. 4.2	Conforming to ASTM B170-99 Grade 1			
14.	Mechanical properties	Conforming to pt. no. 4.3			
15.	Certificates as asked in pt. no.5	Mill Test Certificate			
16.	Delivery Period	Within 8 – 10 weeks			
17.	Validity of offer	Minimum 2 months			
18.	Quality management system for manufacturer	ISO 9001:2000 or equivalent			
19.	Experience and capacity in the field manufacturing OFE Copper bars	Customers list to be attached			
20.	Basis of prices offered	Fixed price			

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