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**SECTION - C**

**TECHNICAL SPECIFICATIONS OF STORES AND DRAWINGS.**

*Manufacturing, Testing and Supply*  
*Of*  
Oxygen Free Copper (OFC) Plate

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**1.0. SCOPE OF WORK:**

Manufacturing, inspection, testing, packing and supplies of Oxygen Free Copper (CW 008A/UNS C10200/UNS10100.)

**2.0. ORDERING INFORMATION:**

OFC-Cu rectangular plates shall be supplied as per below mentioned details:

<i>Plate Size (Length x Width x Thickness) in m<sup>3</sup></i>	<i>Quantity (Piece/ Nos.)</i>
1x0.6x0.012	1
1x0.6x0.013	1
1x0.6x0.015	2
0.6x0.5x0.012	1
0.7x0.5x0.013	1
0.3x0.15x0.002	25
0.3x0.15x0.004	25
0.3x0.15x0.006	25

**3.0. REFERENCE STANDARDS:**

EN 13599 : Copper and copper alloys - Copper plate, sheet and strip for electrical purposes

EN 1655 : Copper and copper alloys — Declarations of conformity

EN 10002-1 : Metallic materials — Tensile testing — Part 1: Method of test (at ambient temperature).

EN 10204 : Metallic products — Types of inspection documents.

EN ISO 7438 : Metallic materials — Bend test

ISO 1811-2 : Copper and copper alloys — Selection and preparation of samples for chemical

analysis -Part 2: Sampling of wrought products and castings.

ASTM B577: Standard Test Methods for Detection of Cuprous Oxide (Hydrogen Embrittlement Susceptibility) in Copper

Relevant ASME / ASTM standard in lieu of EN/ISO/DKI is acceptable for all places in this specification.

**4.0. MANUFACTURING REQUIREMENTS:**

The product shall be manufactured by cold working so as to produce a uniform micro-structure in the finished product and to meet the properties defined in this specification. Material shall be supplied with designation 'R240' of EN13599, & EN 10204 3.1 test certificates i.e Material shall be certified by Minimum values of Tensile strength and Elongation requirements.

#### **5.0. CHEMICAL PROPERTIES & TEST METHODS:**

The analytical methods used shall be in accordance with EN / ISO standards and at the discretion of the material manufacturer. Acceptable chemical composition shall be as per CW 008A/UNS C10200/UNS10100.

#### **6.0. MECHNAICAL PROPERTIES & TEST METHOD:**

Tensile testing shall be done in accordance with EN 10002-1. Gauge length for measuring elongation properties shall be as per below:

- a) For thickness over 2.5 mm, gauge length  $l_0 = 5.65 \sqrt{S_0}$  (elongation A);
- b) for thickness from 0.10 mm up to and including 2.5 mm, a fixed gauge length of 50 mm (elongation  $A_{50\text{mm}}$ ).

*Required mechanical properties @room temperature:*

Tensile Strength,  $R_m$ : 240 (Min) -300 (Max) N /  $\text{mm}^2$

0.2% Proof Strength,  $R_{p0.2}$ : 180 N/  $\text{mm}^2$  (Min.)

Min. Elongation: 8 % ( $A_{50\text{mm}}$  for thk 0.1 to 2.5mm); 15% (A for thk over 2.5mm)

#### **7.0. BENDING CHARACTERISTICS & TEST METHOD:**

EN ISO 7438 is applicable with the bending edge parallel to the direction of rolling (see Clause 8.4 and Figure 2 of EN 13599 for details). The bending edge shall show no evidence of cracks on the tension side.

#### **8.0. ELECTRICAL PROPERTIES & TEST METHOD:**

The test method used shall be left to the discretion of the supplier, e.g. eddy current method or Resistance Bridge. The electrical resistivity shall be determined by direct measurement either at  $20 \text{ }^\circ\text{C} \pm 1 \text{ }^\circ\text{C}$  or at another temperature, when the result shall be corrected to the equivalent value at  $20 \text{ }^\circ\text{C}$ , on the product in the as delivered condition. Electrical properties measured shall conform to below mentioned details:

*Volume Resistivity ( $\Omega \text{ mm}^2 / \text{m}$ ): 0.01754 Max.*

*Mass Resistivity ( $\Omega \text{ g} / \text{mm}^2$ ): 0.1559 Max.*

*Conductivity: 57 MS/m; 98.3 IACS Min.*

#### **9.0. TESTING AGAINST HYDROGEN EMBRITTLEMENT:**

Hydrogen embrittlement test shall be done in accordance with Method C of ASTM B 577. Test pieces shall be of convenient dimensions, but machined test pieces shall retain some part of the original surface to be on the outside of the bend. Any edges shall be rounded and smoothed.

After heating the test pieces in at least 10% hydrogen, as described in ASTM B 577 Method C, the test pieces shall be subjected to the close bend test described in Method C of ASTM B 577. Test piece shall show no evidence of cracking.

#### **10.0. DIMENSIONS AND TOLERANCES WITH SURFACE CONDITION:**

Please refer to table 5 to table 8 of EN13599. The products shall be clean and free from injurious defects.

#### **11.0. SAMPLING**

##### **11.1. Chemical Analysis:**

The sampling rate shall be in accordance with ISO 1811-2. A test sample, depending on the analytical technique to be employed, shall be prepared from each sampling unit and used for the determination of the composition.

*NOTE 1: When preparing the test sample, care should be taken to avoid contaminating or overheating the test sample. Carbide tipped tools are recommended; steel tools, if used, should be made of magnetic material to assist in the subsequent removal of extraneous iron. If the test samples are in finely divided form (e.g. drillings, millings), they should be treated carefully with a strong magnet to remove any particles of iron introduced during preparation.*

*NOTE 2: In cases of dispute concerning the results of analysis, the full procedure given in ISO 1811-2 should be followed.*

*NOTE 3: Results may be used from analyses carried out at an earlier stage of manufacturing the product, e.g. at the casting or master coil stage, if the material identity is maintained and if the quality management system of the manufacturer is certified as conforming to EN ISO 9001.*

##### **11.2. Mechanical and Electrical Properties:**

The sampling rate shall be one test sample per master coil. Sampling units shall be selected from the finished products. The test samples shall be cut from the sampling units. Test samples, and test pieces prepared from them, shall not be subjected to any further treatment, other than any machining operations necessary in the preparation of the test pieces.

#### **12.0. Non-Destructive Examination:**

##### **12.1. Visual Examination:**

All external surfaces of plates shall be examined by a visual examination in accordance with ASME Sec. V Article 9. The surface shall be plane, uniform and free from wrinkles, buckles, blowholes, tears, cracks and inclusions.

### **12.2. Ultrasonic Examination :**

All plates shall be 100% ultrasonically examined in accordance with the Material Test Specification No. 831 of the DKI (Deutsches Kupferinstitut Berufsverband e.V. / German Institute for Copper) in order to verify absence of voids, cracks or inclusions. 100 % Examination on the plates shall be performed by hand on both sides before pre-milling. Each signal shall be fully recorded. The acceptance criteria for Ultrasonic examination shall be as per Level I as defined in the table of specification no. 831 of DKI, but with a diameter of the reference hole of 2 mm instead of 5 mm as proposed by Material manufacturer and agreed by Contractor and purchaser. The qualification of personnel for performing UT shall be ASNT NDT Level II or EN or equivalent. If in case, they are using DGS/AVG technique, separate procedure shall be submitted for approval.

### **13.0. RETEST:**

If there is a failure of one, or more than one, of the tests in 8.1 to 8.6, two test samples from the same inspection lot shall be permitted to be selected for retesting the failed property (properties). One of these test samples shall be taken from the same sampling unit as that from which the original failed test piece was taken, unless that sampling unit is no longer available, or has been withdrawn by the supplier. If the test pieces from both test samples pass the appropriate test(s), then the inspection lot represented shall be deemed to conform to the particular requirement(s) of this standard. If a test piece fails a test, the inspection lot represented shall be deemed not to conform to this standard.

### **14.0. MATERIAL TEST REPORT:**

The Contractor shall provide the Inspection certificate type 3.1 in accordance with EN 10204, which include at least the following information.

- Material designation and Marking
- Heat Number
- Purchase order No.
- Identification of product
- Identification of Manufacturer
- Melting process
- Heat Treatment record, if applicable (i.e Heat treatment temperature range, soaking time and Heating and cooling cycle characteristics)
- Chemical & Mechanical Properties
- Result of Electrical conductivity test
- Result of Embrittlement test
- Dimension report
- Record of nondestructive examination.
- Indication from where the specimens have been taken for all specific tests.

### **15.0. Pre-Dispatch Clearance**

Vendor must obtain a pre-dispatch clearance from IPR prior to dispatch of material. Dispatch clearance would be given by IPR only after successful validation of test certificates conforming the acceptance criteria required as per section 5.0, 6.0, 7.0, 8.0 and 9.0 of this technical specification.

IPR may ask for a test coupon of size 50x100 mm<sup>2</sup> in quantity 5 nos prior to dispatch clearance on which IPR would conduct a third party test of his own to be witnessed by representatives of Purchaser and Supplier both. The results so obtained on test coupon must conform the results displayed in supplied test certificates and requirements mentioned in section 5.0.6.0, 7.0,8.0&9.0. In case of mismatch on these results the IPR reserves right to reject the lot of material/or even cancel the purchase order/ or.

**16.0. PACKAGING AND TRANSPORTATION:**

The packing provided on the material shall be air/sea worthy and suitable for repeated handling. Corrugated sheets shall be provided in between to prevent any possible rubbing, scratch etc. All material finally covered with polythene sheets and packed in purpose built containers made of high quality tough material to avoid damage during handling and transport and to provide medium term storage up to 2-3 months. All opening in the crates shall be protected to prevent any entry of dirt and moisture during shipment and storage at site each crate shall be stencilled in bold letter with indelible paint to indicate shipping details, packing number, and dimension, gross & net weight and purchase order number.

**17.0. Delivery Time:**

**05 months** from date of release of PO/WO.



## Compliance Sheet

### Compliance Statement for Manufacturing, Testing and Supply of Oxygen Free Copper (OFC) Plates

**Vendor must filled and submit the compliance statement with official seal and signature with offer.**

Sl. No.	Item Description	IPR Requirement	Vendor Specifications
1	Essential Eligibility requirement	Vendor shall be a stockiest or a manufacturer. In both cases, vendor must have supplied / manufactured OF Copper as per CW 008A of EN 13599 or UNS C10200 / UNS C10100 of ASTM B152 in hardened condition.	
2	Reference standards	Relevant ASME / ASTM standard in lieu of EN/ISO/DKI shall be acceptable for all places in this specification.	
3	Manufacturing requirement	The product shall be manufactured by cold working so as to produce a uniform micro-structure in the finished product and to meet the properties defied in this specification. Material shall be supplied with designation 'R240' of EN13599, & EN 10204 3.1 test certificates	
4	Chemical Properties and Test methods	The analytical methods used shall be in accordance with EN / ISO standards and at the discretion of the material manufacturer. Acceptable chemical composition shall be as per CW 008A/UNS C10200/UNS10100.	
5	Mechanical Properties and Test methods	<i>Required mechanical properties @room temperature:</i>  Tensile Strength, $R_m$ : 240 (Min) -300 (Max) N / mm <sup>2</sup> 0.2% Proof Strength, $R_{p0.2}$ : 180 N/ mm <sup>2</sup> (Min.) Min. Elongation: 8 % (A50mm for thk 0.1 to 2.5mm); 15% (A for thk over 2.5mm)	
6	Bending characteristics and test methods	EN ISO 7438 is applicable with the bending edge parallel to the direction of rolling (see Clause 8.4 and Figure 2 of EN 13599 for details). The bending edge shall show no evidence of cracks on the tension side.	
7	Electrical properties and test methods	Electrical properties measured shall conform to below mentioned details: <i>Volume Resistivity (<math>\Omega</math> mm<sup>2</sup> / m): 0.01754 Max.</i> <i>Mass Resistivity (<math>\Omega</math> g / mm<sup>2</sup>): 0.1559 Max.</i> <i>Conductivity: 57 MS/m; 98.3 IACS Min.</i>	
8	Testing against hydrogen embrittlement	Hydrogen embrittlement test shall be done in accordance with Method C of ASTM B 577.	
9	Dimensional Tolerance and surface condition	Please refer to table 5 to table 8 of EN13599. The products shall be clean and free from injurious defects.	
10	Non- Destructive examination	a. All external surfaces of plates shall be examined by a visual examination in accordance with ASME Sec. V Article 9. b. All plates shall be 100% ultrasonically examined in accordance with the Material Test Specification No. 831 of the DKI (Deutsches Kupferinstitut Berufsverband e.V. / German Institute for Copper) in order to verify absence	

		of voids, cracks or inclusions.	
11	Pre-Dispatch clearance	Vendor must obtain a pre-dispatch clearance from IPR prior to dispatch of material. Dispatch clearance would be given by IPR only after successful validation of test certificates conforming the acceptance criteria required as per section <u>5.0, 6.0, 7.0, 8.0</u> and 9.0 of this technical specification. IPR may ask for a test coupon of size 50x100 mm <sup>2</sup> in quantity 5 nos prior to dispatch clearance on which IPR would conduct a third party test of his own to be witnessed by representatives of Purchaser and Supplier both. The results so obtained on test coupon must conform the results displayed in supplied test certificates and requirements mentioned in section 5.0.6.0, 7.0,8.0&9.0. In case of mismatch on these results the IPR reserves right to reject the lot of material/or even cancel the purchase order/ or.	
12	Delivery schedule	05 months from date of release of PO/WO.	

**Authorised Signatory**

**Official Seal**

**Date :-**