

Government of India  
Bhabha Atomic Research Centre  
**Electromagnetic Applications & Instrumentation Division**

Ref : BARC/EmA&ID/KS/2021/ 47817

Date : 03.06.2022

**Sub : Minor fabrication job of “Fabrication, assembly, qualification and supply of cryogenic bus bar assembly for high current applications”**

Dear Sirs,

1. Quotations are invited for the minor fabrication job of “Fabrication, assembly, qualification and supply of current lead assembly with stacked copper flags as per the technical specifications TSP/KS/2022-23/02.
2. Bidder shall quote for the machining and fabrication along with raw materials involved in the technical specification. Taxes shall be quoted separately.
3. The quotation must reach Head, EmA&ID by due date **17.06.2022** and must be sent in a sealed envelope **super scribed with the reference number & the due date given above.**
4. The address on the envelop should read:

**Head,  
Electromagnetic Applications &  
Instrumentation Division,  
RCnD Building,  
BARC, Trombay,  
Mumbai - 400 085.  
(Kind Attn: Smt Kumud Singh)**
5. Any modification required during the fabrication process shall be made after approval from our engineer.
6. The bidder shall complete the same within 15 weeks from the date of firm work order issued to the bidder.
7. Head, EmA&ID reserves the rights to accept / reject any or all quotations without assigning any reason.
8. Delivery charges if any must be clearly mentioned in the offer.
9. Quotation must also indicate the validity of offer.
10. Quotation should be submitted on printed format along with PAN, GSTIN. Computer generated format and without PAN & GSTIN, the quotation will be rejected.

Encl.:

**01)** Technical specification : TSP/KS/2022-23/02

Kumud Singh,  
SO(F),EmA&ID

**Technical Specifications for minor fabrication job of “Fabrication, assembly, qualification and supply of cryogenic bus bar assembly for high current applications”**

Specification no.	Revision no.	Date of Issue	Total Number of pages
TSP/KS/2022-23/02	0	03.06.2022	4

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## 1.0 INTRODUCTION

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High purity gold plated bus bar assemblies for cryogenic applications needs to undergo surface cleanliness and precise coating along with tight machining tolerances. Assembly shall pass high voltage test. The dimensional accuracy of the parts and surface finish is very critical aspect for its thermal and mechanical interface with the cryostat parts. Gold plating required on parts for environmental protection. This specification covers the technical specification for the above mentioned application.

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## 2.0 SCOPE OF SUPPLY

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The successful bidder shall deliver the “**Fabrication, assembly, qualification and supply of cryogenic bus bar assembly for high current applications**” and all relevant documentation as defined in this technical specification.

### 2.1 Supplier’s Responsibility:

The supplier is responsible for:

- (a) The procurement of raw materials and subcomponents.
- (b) The design and construction of the plating bath & rectifier.
- (c) Factory acceptance tests on the plating rectifier;
- (d) The Quality Control Records (QCR), Inspection and test plans records (ITP)
- (e) The packing of the plating in plastic /wooden boxes for ease in transportation and storage;

### 2.1 Deliverables included in the supply:

Sr. No	Job description	Quantity
1.	Gold plated Current lead assembly	2 No.s
2.	Gold plated Diode bracket -U assembly	2 No.s
3.	Gold plated Diode Bracket-L lead assembly	2 No.s
4.	Bus-Bar disks	20 No.s
5.	G-10 Insulator disks 70 mm dia 0.5mm thickness	45 No.s
6.	6 mm braided round gold coated ropes with 12mm x 12mm square terminals and cryogenic grade insulation (fibre glass insulation) – 250mm length	50 No.s

## 2.2 Free Issue material

No free issue material is involved. Raw material shall be arranged by the supplier.

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## 3.0 TECHNICAL REQUIREMENTS

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### 3.1 Raw materials:

#### a) OFHC copper

Chemical Composition:

Copper (inclusive of silver) min %	Min 99.995# (copper purity 4N or higher)
Oxygen (max %)	Max 0.0010

# Copper will determined by the difference of total impurities from 100

Physical Properties:

Density (nominal)	8.94 g/cm <sup>3</sup>
Specific heat [J/(kg.K)]	385
Melting temperature	1083

Electrical and thermal Properties

Electrical Conductivity @200C %IACS	≥ 100%
Thermal Conductivity @200C %IACS	≥ 391 W/m-K

#### c) Machining operation

Pure copper has only fair machinability due to the softness of the alloy. The half-hard temper increases the hardness over the annealed/soft base alloy but is not free chipping compared to more hardened, alloyed aluminium products. It is recommended that aluminium geometry cutting tools running at a reasonable speed shall be used to avoid the edge build-up, which can occur at lower cutting speeds. High-speed steel tools may be more economical than carbide, particularly with the possibility of a large rake angle on machines which cannot reach carbide cutting speeds.

#### d) FABRICATION AND CLEANING

- Cleanness is the foundation in achieving UHV and required vacuum system performance.
- Cleanness starts with vacuum component material selection, and fabrication.
- Proper fabrication processes leads to easier and less aggressive post -machining cleaning.
- Cleanness requires a development of UHV practice and culture, besides the adequate facilities.
- UHV clean and Particle-free are very different requirements, though most modern accelerator vacuum systems demanding both.

When machining will not produce the required surface finish, polishing may be permitted. When polishing, care should be taken to avoid excessive rubbing or contact pressure.

The following abrasives are acceptable for UHV components.

3M Scotch -Type S, Silicon Carbide (color: gray), 500 grit

Brite-Type A, Aluminum Oxide (color: maroon), 240 grit

3M Wet or Dry Fabricut Cloth - Aluminum oxide or silicon carbide, 600 grit

Mineral oil suspended diamond pastes

Metal tools must be degreased. After degreasing, tools should be kept in clean trays and handled with clean gloves.

- No cadmium plated, lead, or painted tools should be permitted. Chrome and nickel plated tools are permitted.

- Aluminum foil shall be in accordance with ASTM B479, type designated as DRY ANNEAL A, (oil free).Each piece of foil should be used only once and then discarded.

- Aluminum foil and lint-free tissue should be stored in clean boxes with lids.

Packaging:

Packaging of each of the component shall be done carefully to avoid any scratches while handling. Wrapped in Aluminium foil the parts must be packed in plastic boxes with suitable cushions and shock absorbers to avoid multiple part rubbing each other.

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### 3.0 PERFORMANCE OF THE CONTRACT

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#### ***3.1 Fabrication and Delivery Schedule***

Delivery of plating rectifier is expected in **about fifteen (15) weeks after the contract is awarded.**

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### 4.0 CONFORMANCE TESTS

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#### ***4.1 Responsibility for testing and inspection***

The contractor shall be responsible for performing all required inspections, analyses, and tests designated as factory acceptance tests herein. The Subcontractor shall provide space, personnel, and test equipment to meet all inspection requirements. All testing and inspection shall be performed at the Subcontractor's facilities, or at the facilities of a mutually acceptable Designated Test Agency (including Purchaser's site). The Subcontractor shall notify the Purchaser 15 calendar days in advance of scheduled commencement of any tests and inspections required by this Scope of Work to allow the Purchaser to arrange for witnessing the inspection, if elected. Results of inspections, analyses, and tests performed by the Subcontractor shall be reported in the Traveler. Inspections specified herein are not intended to supplant any controls, examinations, inspections, or tests that the Subcontractor shall perform to assure the quality of the final product.

Purchaser is responsible for performing site acceptance tests and communicates to the supplier of any modification required in series vessel assembly. The conformance tests required to be performed are as stated below:

<b>Factory acceptance tests</b>			
<b>Sr. no</b>	<b>Qualification</b>	<b>Acceptance criteria</b>	<b>Scope</b>

1.	Visual inspection	Visual signs of damage, deterioration and oxidation shall not be present on any component of the assembly,	Purchaser Representative shall inspect the vessel assembly at suppliers premises
2.	Physical property tests	Hardness, Tensile strength and elongation on a sample piece from the supply lot	Supplier shall carry out these inspection tests and a report shall be given for approval. Purchaser reserves the right to be present during these tests.
3.	Thermal conductivity properties	Thermal conductivity shall be demonstrated on a sample piece from supplied lot	Supplier shall carry out these inspection tests and a report shall be given for approval. Purchaser reserves the right to be present during these tests.

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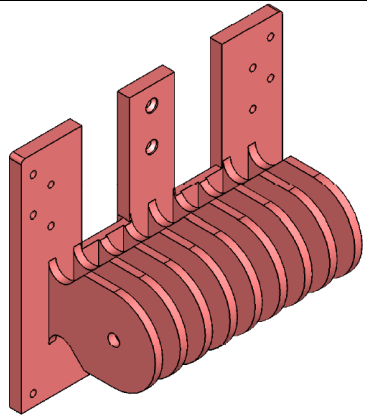
## 5.0 GENERAL DESCRIPTION

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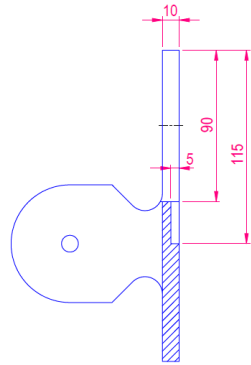
- Supplier shall quote with material; no free issue material is involved in this tender.
- Overall cost will be compared and include packaging, forwarding and safe delivery to BARC at RCZ stores.
- Suppliers shall give complete details of their product, facilities, list of users and compliance certificates form users for technical evaluation. Quotations submitted with incomplete details are viable for rejection.
- Vendors with test facilities for qualification of plating rectifier will be given preference. Supplier Qualification: (Requirements of Supplier Qualifications)
  - **Human resources**
  - The supplier must give the details of qualified human resources including draughtsmen, welding technicians, Quality control personnel.
  - **Infrastructure:**
  - The supplier must give the details of infrastructure suitable for this job such as Floor Space availability, machining, testing facilities, welding equipment's, leak check and pressure testing equipment's etc.
  - **Past experience:**
  - The supplier must give their past three year turnover and similar jobs executed by them with reference, volume of work and completion schedule, present commitments and anticipated commitments inside and outside India. Vendors who have in past executed similar projects for

similar applications will be given preference. Vendors should have in past executed, should have knowledge about superconducting magnets and cryogenic materials.

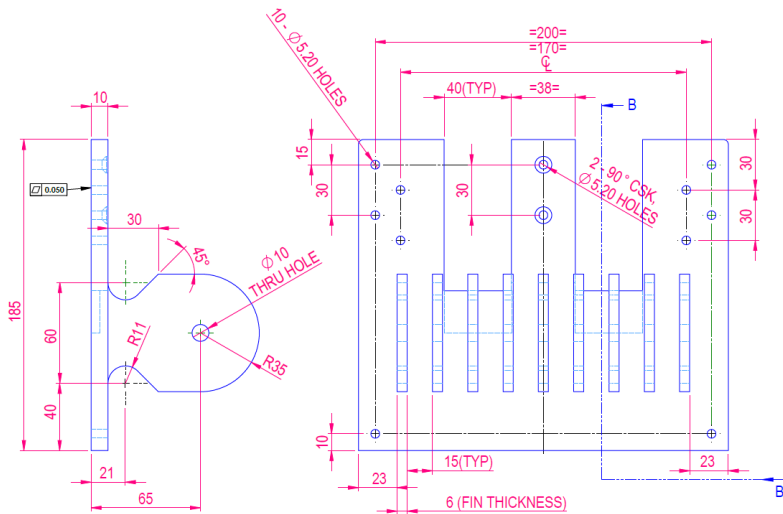
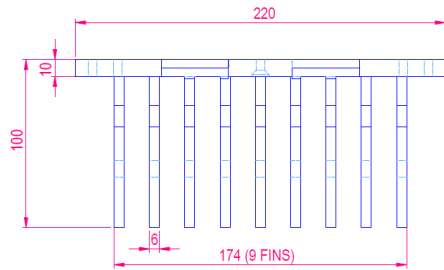
- ***Sub-contractors:***
- Supplier should list the jobs, which they want to sub-contract. They should also produce the list of sub-contractors and their infrastructures and facilities.



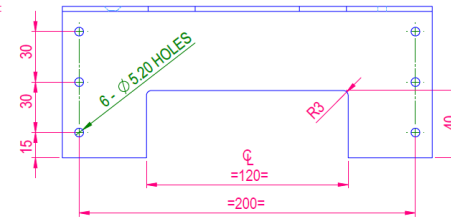
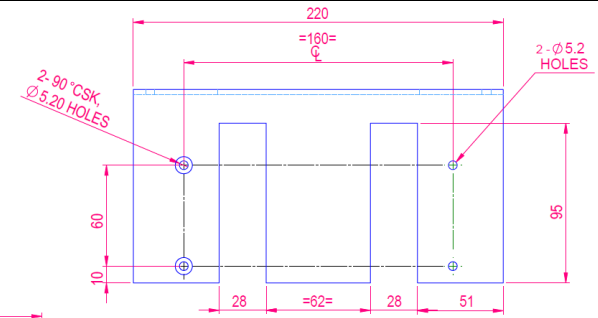
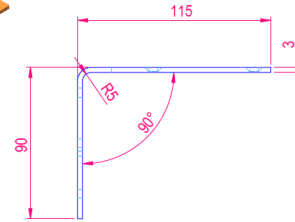
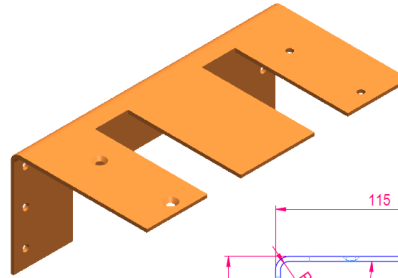
**CL HEAT SINK**  
 MATERIAL : OFHC COPPER  
 QUANTITY : ONE



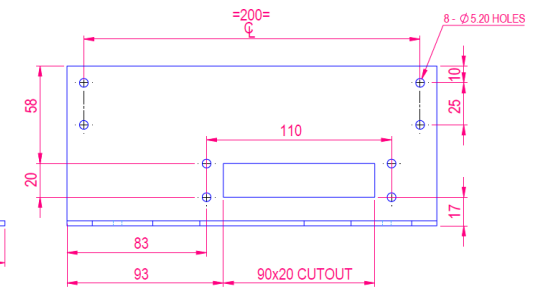
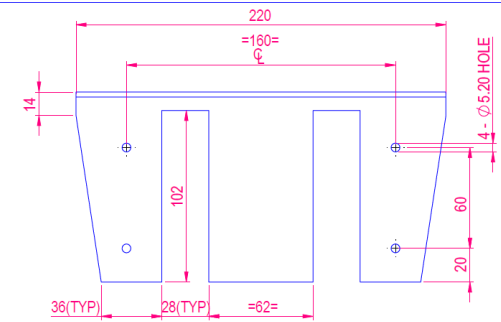
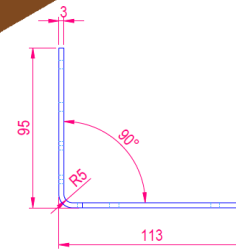
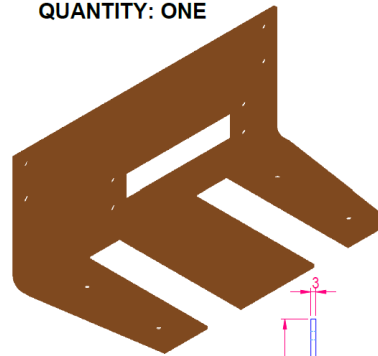
SECTION B-B



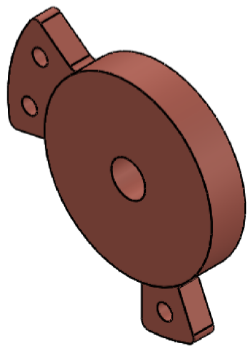
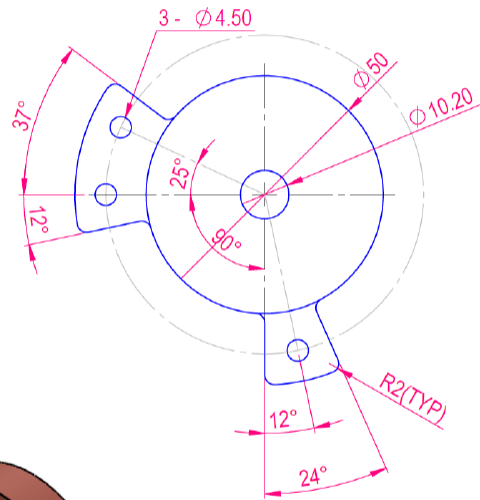
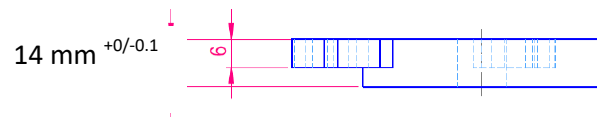
**DIODE BRACKET- U**  
 MATERIAL : OFHC COPPER  
 QUANTITY : ONE



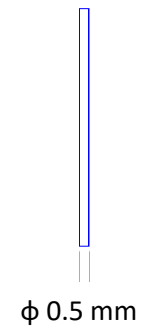
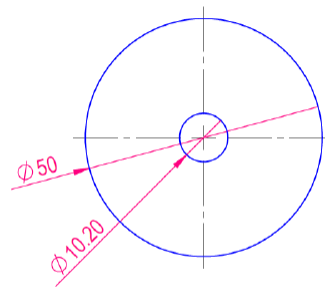
**DIODE BRACKET - L**  
 MATERIAL : OFHC COPPER  
 QUANTITY : ONE



NO.	REV.	DATE	BY	CHKD.	APP'D.



OFHC Bus-Bar disks -  
20 No.s



G-10 disks -45 No.s