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

Ref : BARC/EmA&ID/KS/2021/ P-22079 Date : 03.01.2022

Sub : Minor fabrication job of "Fabrication, assembly, thermal qualification of customized high current connecting links and spacers for interconnection of bus-bars"

Dear Sirs,

1. Quotations are invited for the minor fabrication job of "Fabrication, assembly, thermal qualification of OFHC copper flags for interconnection of bus-bars TSP/KS/2021-22/30.

2. Bidder shall quote for the machining and fabrication along with raw materials involved in the technical specification. Taxes shall be quoted separately. ***Chemical test certificate : Mandatory with the offer***

3. The quotation must reach Head, EmA&ID by due date **15.01.2022** 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 10 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/2021-22/30

Kumud Singh,
SO(F),EmA&ID

Technical Specifications for minor fabrication job of "Fabrication, assembly, thermal qualification of customized high current connecting links and spacers for interconnection of bus-bars"

Specification no.	Revision no.	Date of Issue	Total Number of pages
TSP/KS/2021-22/30	0	31.12.2021	7

1.0 INTRODUCTION

Copper links mentioned in this specification shall be used as interconnections for superconducting magnet power supply. Thermal qualification and electrical qualification is mandatory to be carried out.

2.0 SCOPE OF SUPPLY

The successful bidder shall deliver the "**Fabrication, assembly, thermal qualification of customized high current connecting links and spacers for interconnection of bus-bars**" and all relevant documentation as defined in this technical specification. Supplier shall submit the chemical composition test certificate for the material to be supplied (test certificate for the sample material along with quotation and of the supplied material at the time of supply)

2.1 Supplier's Responsibility:

1. Supplier needs to make manufacturing design of the thermal links based on the requirements stated in this specification. Certain interaction with the Purchaser during the initial stage of the design activity must be made possible. The design must be approved by the Purchaser before fabrication starts.

The supplier is responsible for:

(a) A complete Manufacturing File, containing detailed information about the design, the production and quality control;
(b) The procurement of raw materials and subcomponents as per para 4.0
(c) The design and construction of all necessary tooling for the manufacture, assembly, and qualification.
(d) Jigs and fixture for welding of parts.
(e) Factory acceptance tests on the as per para 7.1;
(f) The Quality Control Records (QCR), Inspection and test plans records (ITP) as per para 5.1;

2.1 Deliverables included in the supply:

Sr. No	Job description	Quantity
1.	1.5 meter long insulated braided silver plated copper links for 100A capacity with rectangular terminals	20 No.s
2.	Thermally qualified gold plated OFHC copper circular flag 50 mm dia 10 mm thick	5 no.s
3.	Thermally qualified gold plated OFHC copper circular flag 70 mm dia 10 mm thick	5 No.s
4.	Thermally qualified gold plated OFHC copper circular flag 70 mm dia 10 mm thick	5 No.s

5.	Thermally Qualified gold plated OFHC copper spacer 70 mm dia 2 mm thick	5 No.s

2.2 Free Issue material

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

3.0 TECHNICAL REQUIRMENTS

3.1 Technical specification

Fabrication and Supply

(a) Fabrication, testing, supply of copper links flags as per attached Drg. and safe delivery to Purchaser's site.

(b) Geometrical inspection and qualification.

(c) Thermal inspection report and electrical inspection report

(d) Transportation and safe delivery to purchaser's site including protection for all machined and sealing surfaces to mitigate any damage during transportation.

4.0 RAW MATERIALS

4.1 OFHC copper

Chemical Composition: (as specified in ASTM B170 for copper UNS no. C10100)

Sr. No	Element	Composition %
1.	Copper (inclusive of silver) min %	Min 99.995#
2.	Oxygen (max %)	Max 0.0010

Copper will determined by the difference of total impurities from 100. Other elements as EN13604 and ASTMB170max%:Ag0.0025,As0.0005,Bi0.0001,Cd0.0001,Fe0.001,Mn0.00005,Ni0.001,O0.0005,P0.0003,Pb0.0005,S0.0015,Sb 0.0004,Se0.0002,Sn0.0002,Te0.0002,Zn0.0001

Physical Properties:

S. No	Parameter	Value
1.	Density (nominal)	8.94 g/cm^3
2.	Specific heat [J/(kg.K)]	385
3.	Melting temperature	1083

Electrical and thermal Properties

S.No.	Particulars	Value
1.	Electrical Conductivity @20^{0}C %IACS	≥ 101%
2.	Thermal Conductivity @20^{0}C %IACS	391 W/m-K

Mechanical properties

S.No.	Particulars	Hard-Temper
1.	Hardness HV	85-11 HV

2.	Tensile strength	260-400N/mm2
3.	0.2% yield strength	220-380 N/mm2
4.	Elongation	Min. 5%

5.0 PERFORMANCE OF THE CONTRACT

5.1 Fabrication and Delivery Schedule

Delivery of all five Helium vessels is expected in **about ten (10) weeks after the contract is awarded.**

Container and packaging design is subject to review and approval by Purchaser, but approval shall not relieve Manufacturer of any responsibility for damage to the assemblies during transit due to improper packaging or handling.

5.2 Manufacturing Plan

The Subcontractor shall submit a manufacturing plan to the purchaser for approval. The plan shall identify and describe all aspects of work to be executed from the point of design work through delivery of the Solenoid Lenses. The Manufacturing Plan shall include and document the following stages:

- Manufacturing drawings
- Parts Procurement
- Welding procedures
- Thermal and electrical testing

In cases where the Subcontractor modifies the design and/or develops its own tooling, an approval of the purchaser would be necessary to proceed to the next step of the manufacturing phase.

The Purchaser must accept the Manufacturing Plan prior to use. Sections of the Manufacturing Plan may be submitted earlier for acceptance. This will allow the Subcontractor to commence some fabrication tasks earlier.

6.0 INSPECTION BY THE PURCHASER

6.1 Hold points

In addition to any hold points identified by the Subcontractor in the normal course of QC, Test, or Fabrication operations, the Purchaser may specify in the subcontract hold points in the processing and fabrication of the finished product covered by this Specification. The purpose of all hold points shall be to determine conformance of products to the requirements of this Specification before continuation of further processing and/or fabrication. The Purchaser may elect to witness and sign off any mandatory hold points.

In the event of a Non-Conforming condition further processing of the Non-Conforming item shall be put on hold until the corrective action has been accepted by the Purchaser.

The purchaser reserves rights to put the third lens assembly on hold until the first of two solenoid lens assembly is delivered and tested at the Purchaser's facility.

6.2 Purchaser right to inspection

- The Purchaser reserves the right to have its designated representative witness, at the place of manufacture, processing/fabrication operations agreed upon by the Purchaser and Subcontractor and specified in the Subcontract.

- The Purchaser reserves the right to have its designated representative witness, at the place of manufacture, the inspections, analyses, and tests established under the Subcontractor's QA Program to demonstrate compliance with the Specification.
- The intent of the Purchaser in witnessing inspections, tests, and/or processing/fabrication operations is to gain confidence that developed helium vessel meet all the requirements.

6.3 Corrective action

In the event that any lens assembly or a portion thereof is rejected by the Purchaser as a result of poor workmanship or nonconformance to this Scope of Work, the Subcontractor shall take corrective action on the material or process, or both as necessary, on all items or portions thereof which were similarly manufactured which are subject to the same cause for rejection. Acceptance shall be withheld until inspections and tests have shown that the corrective action was successfully implemented and the solenoid or any portion thereof conforms to the requirements of this Specification.

7.0 CONFORMANCE TESTS

7***.1 Responsibility for testing and inspection***

The Subcontractor 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 communicate to the supplier of any modification required in series vessel assembly. The conformance tests required to be performed are as stated below:

Factory acceptance tests			
Sr. no	**Qualification**	**Acceptance criteria**	**Scope**
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.	Electrical Qualification	Supplier/ fabricator shall demonstrate voltage drop across the strap to ensure	Purchaser Representative shall inspect the vessel assembly at suppliers premises
3.	Thermal	Supplier/ fabricator shall demonstrate temperature gradient across the links to	Purchaser Representative shall

	qualification	ensure thermal conductance at room temperature as well as at liquid nitrogen temperature	inspect the vessel assembly at suppliers premises
4.	Geometrical inspection	Parts and final assemblies shall be measured by coordinate measuring machine (CMM) to check the geometrical properties of the objects and their adherence to released drawings	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.

7.2 ***Test Certificates***

Supplier shall carry out and arrange for the following test certificates for the raw materials:

Sr. No	Test Certificate
1.	Mill test certificate - Mill test certificate containing heat no., batch no., chemical composition, size etc.
2.	Mechanical test certificate - Mechanical and other physical properties of the plates & sheets shall conform to the requirements of ASTM standards
3.	***Chemical test certificate : Mandatory with the offer***
4.	Dimensional inspection report - Dimensional inspection report containing drawing dimension, measured dimension, deviation if any, within tolerance limit or not, rectification needed etc

8.0 GENERAL DESCRIPTION

- 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, winding machine details, list of users and compliance certificates form users for technical evaluation. Quotations submitted with incomplete details are viable for rejection. A technical committee will visit the facilities

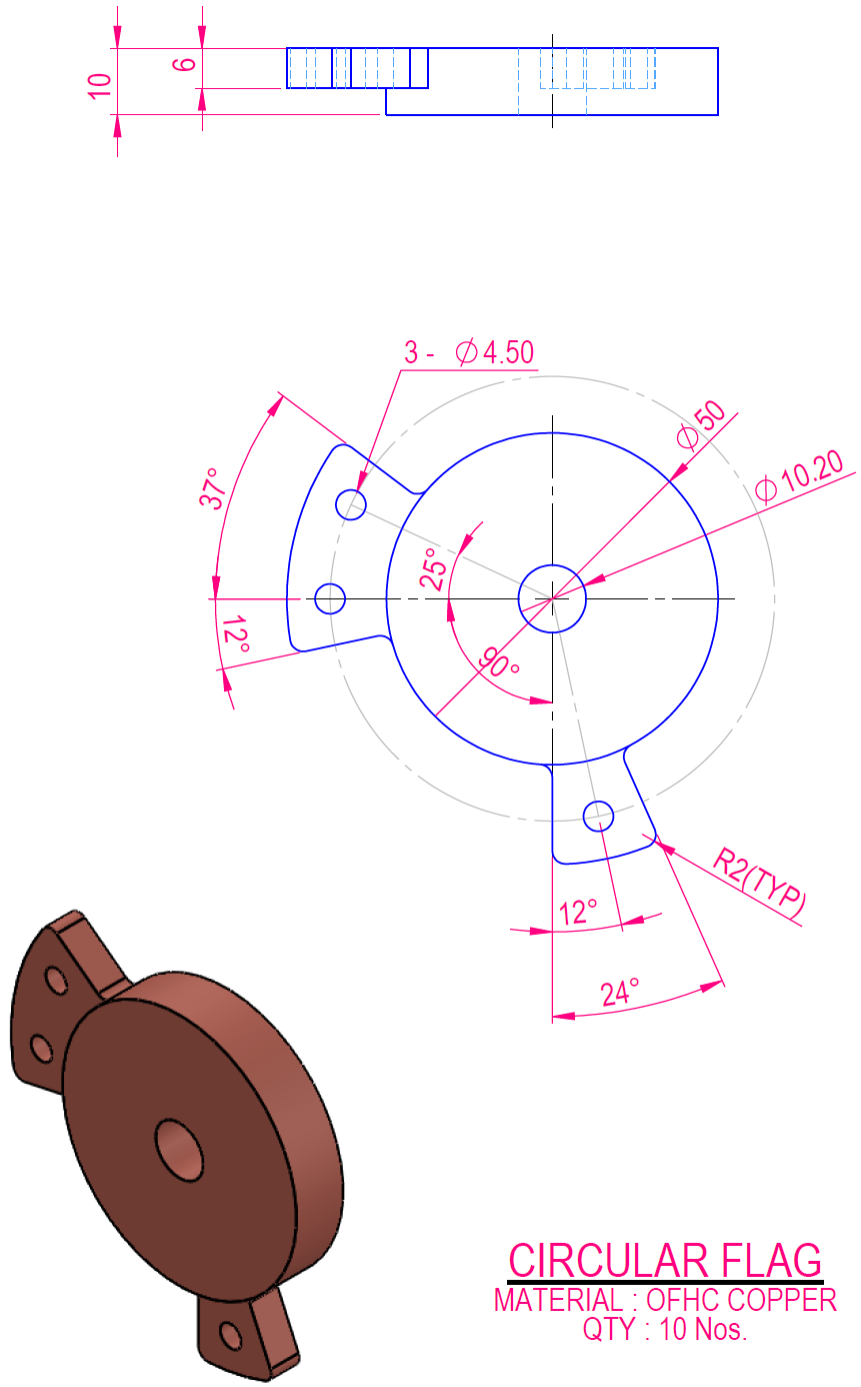

Fig 1. 50mm dia circular flag (Same drawing applicable for 70 mm dia flag with diameter changed)

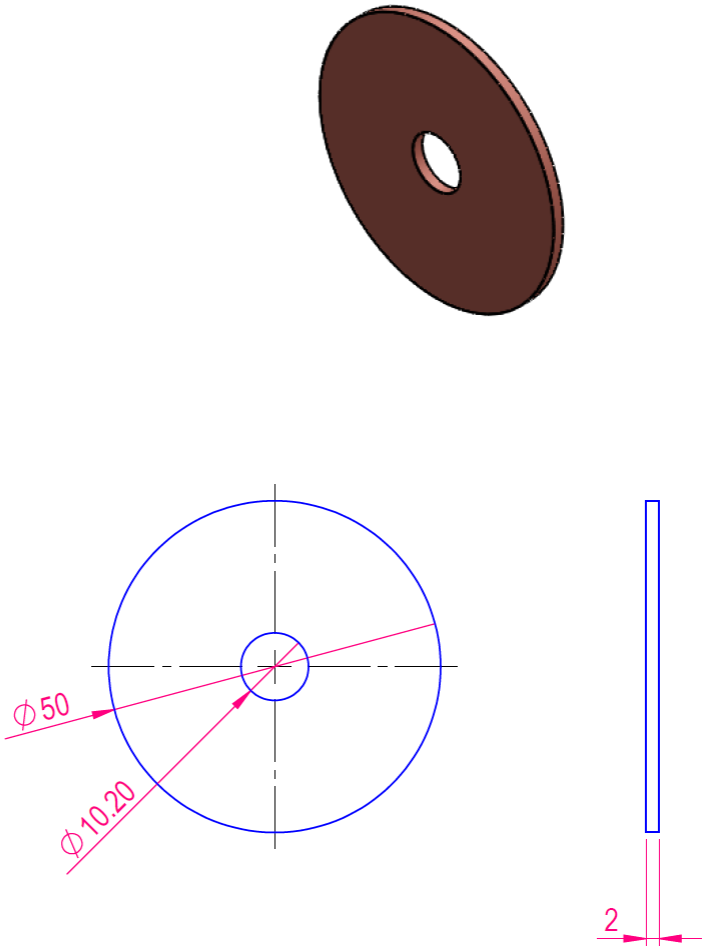

Fig 1. 50mm dia circular spacer (Same drawing applicable for 70 mm dia spacer with diameter changed)