



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



Tender No.: EmA&ID/EMAS/MAH/2022/ 24823

Date: 19.01.2022

Sub: Fabrication, assembly, qualification and supply of multipole magnet sprocket assembly as per Technical specification sheet TSP/2022/011

Dear Sir/Madam,

1. Quotations are invited for the *execution of subject work*.
2. Taxes and Excise Duties shall be quoted separately. Form AF / H whichever is applicable shall be provided, if required.
3. The suppliers shall submit the cost for Fabrication, Assembly, Testing **and** Supply. All necessary tools, instruments have to be arranged by the supplier.
4. The quotation must reach the undersigned on or before 31<sup>st</sup> **January, 2022** and must be sent in a sealed envelope super-scribed with the **reference number & the due date** given above.
5. The quotations must reach us on or before the aforesaid date by India post (by speed post or ordinary post) only.
6. The address on the envelop should read:  
**The Head,**  
**Electromagnetic Applications & Instrumentation Division**  
**RCnD Bldg., North Site,**  
**B.A.R.C, Trombay,**  
**Mumbai - 400 085.**  
**(Attn: Kum. Mahima)**
7. The Purchaser representative shall approve the design of the assembly sequence, and fabrication procedure, testing scheme.
8. The testing of the sputtering target shall be conducted in the presence of the Purchaser representatives only, further details are laid down in the enclosed specification sheet.
9. The bidder is expected to deliver the finished components after the approval by our engineer within 03 months from the date of receipt of firm Work Order.
10. All the raw materials used shall have the manufacturer's QC/QA certificates for ensuring the authenticity of the components. Further details are mentioned in the enclosed specification sheet.
11. The finished components with the test certificates as mentioned in the enclosures shall be delivered by the manufacturer after the award of the contract at Electromagnetic Applications & Instrumentation Division ( EmA&ID ), BARC, Trombay, Mumbai - 400 085.
12. Head, EmA&ID reserves the right to accept / reject any or all quotations without assigning any reason.
13. Delivery, packing & forwarding charges, if any, must be clearly mentioned in the offer.
14. Drawings / Sketches (if any) must be returned along with the offer
15. Quotation must indicate the VAT no / PAN no of the vendor & validity of offer. Minimum validity of 60 days is preferred.
16. The quotation has to be duly signed by *authorized person with company seal*. *Unsigned offers shall be treated as invalid*.
17. For any technical clarifications, please contact us vide email: [mahima@barc.gov.in](mailto:mahima@barc.gov.in), Tel: +912225591492/6437.

Encl.: TSP/2022/011

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Mahima  
Scientific Officer (C), B.A.R.C  
For & on Behalf of the President of India  
(The Purchaser)

## Technical Specifications

Specification no.	Revision no.	Date of Issue
TSP/2022/011	0	17/01/2021

### Fabrication, assembly, qualification and supply of multipole magnet sprocket assembly

#### 1) Scope:

The quotations are invited for the "Fabrication, assembly, qualification and supply of multipole magnet sprocket assembly" as per the following technical specification.

- Para 2 gives Statement of purpose.
- Para 3 scope of supply and deliverables.
- Para 4 gives technical requirements of the Magnet assembly. Supplier has to offer their product equivalent to this specification along with complete product sheet for technical evaluation.
- Para 5 gives acceptance criteria and test and inspection plan.
- Para 6 gives Clauses for performance of contract. Supplier shall confirm the acceptance of the same.
- Para 7 list down the reference drawings and documents.
- Par 8 gives general instructions.

#### 2) Statement of purpose:

Permanent magnet dipoles are often used for various applications as an economical way to make fixed-field magnets. A prototype magnet assembly employing permanent-magnet bars has been designed using finite element method to produce a multipole field. By carefully designing the pole pieces, it has been ensured that it produces a highly uniform axial field in the required Good field region (GFR). The magnet being discussed in this technical specification is equipped with high energy density NdFeB permanent magnets. The magnet assembly shall behave in all respects as rigid units so that relative movements between parts due to the action of magnetic forces are excluded. Aluminium sockets need to be fabricated to insert and arrest the permanent magnets in place and ease out the assembly. It is mandatory to respect dimensional accuracy during part fabrication so as to ensure accurate assembly of the parts.

#### 3) Scope of supply and deliverables:

- Preparation of manufacturing documents
- Procurement of all materials (magnet, magnetic steel, aluminium, screws, bolts, tools etc.) except free issue material as mentioned in section 3.1.
- Design and fabrication of suitable assembly jigs & fixtures using lead-screw/vice arrangement for sprocket assembly with baseplate against push force of approximately 100N.
- Machining of parts as listed in table 4.
- Dimensional inspection of parts and inspection reports\*
- Surface treatment (nickel coating or painting)
- Magnet assembly \*
- Packing in rigid aluminium cases or molded plastic cases.
- Assembly of magnets at Purchaser's site. Technical manpower involved in assembly shall have PVC.
- Delivery of components to Purchaser' site

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**Table 1. List of Deliverables**

S. No.	Description of items	Quantity
1)	PM based solenoid magnet assembly	1No.s
2)	Assembly jigs and fixture	1 No.s
3)	Inspection reports and Raw material test certificates	1 set

\*To be carried out in presence of purchaser's representative

**Free Issue Material** -No free issue material is involved

**4) Technical requirements:**

Slots for housing permanent magnets needs to be precisely machined from EDM wire cut method as specified in the Drawing. All the parts of the magnet assembly shall be fabricated within the dimensional tolerance as specified in the drawing (20 microns). All the screws and fasteners used shall be of non-magnetic stainless steel material.

**4.1 Raw Materials**

**4.1.1 Aluminium**

Sprocket shall be made by Aluminium (Grade T6 6061).

**Grade of Aluminium: Aluminium Alloy 6061**, with UNS no. A96061.

- Chemical composition as per ASTM B221.
- All specifications and test methods and ASTM B221.

**Chemical composition:** As specified in ASTM B221-13

Material test certificate to be provided along with the all the raw materials.

**4.1.2 Magnetic steel**

Magnetic steel conforming to the below mentioned technical specifications shall be used -

**Chemical composition**

C	Si	Mn	S	P	Fe
0.06	0.15	0.35	0.02	0.02	Balance
max		max	max	max	

**Physical Properties**

- Specific Gravity 7.85 g/cm<sup>3</sup>
- Specific Heat 0.11 cal/g
- Resistivity 11 μΩ-cm

**4.1.3 Permanent Magnet**

High energy density rare earth magnets (NdFeB) of following technical specifications are used in the current application:

**Table 2. Magnetic Characteristics**

S.No.	Particulars	Value
1.	Residual Induction Br	13.6 ± 0.2 kgauss
2.	Coercive Force H <sub>cB</sub>	12.8 ± 0.2 kOe
3.	Energy (BH) max	≥ 47 MGOe
4.	Intrinsic Coercive Force H <sub>cj</sub>	≥ 17 kOe
5.	Temperature coefficients of reversible changes in Br	≤ -0.11 %/°C

**Table 3. Geometrical Characteristics (All dimensions in mm)**

Particulars	Dimensions			Quantity
	Length	Breadth	Height	
Magnet	50	17	25	40

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Note:

1. Magnetization Direction is along length in all magnets,
2. Tolerances on all dimensions +0.00/-0.050 mm

## **4.2 Manufacturing**

### **4.2.1 Manufacturing steps for aluminium sprocket**

- Turning/Milling
- EDM machining (wire-cut method) for magnet slots
- Jig boring and tapping of mounting holes

### **4.2.2 Manufacturing steps for Pole flanges**

- Turning/Milling
- Spot facing
- Grinding of flat face
- Wire cutting into two halves

### **4.2.3 Protection and painting**

All the soft iron pole pieces need to be prevented from rust and corrosion. Prior to the application of a protection coating, each piece shall be thoroughly cleaned and any burrs and chips removed. The parts of the soft iron pole piece including connection joints shall be nickel coated for rust protection (4-5  $\mu\text{m}$ ). The coated surfaces shall not show any sign of degradation, such as fissures, blisters, etc.

### **4.2.4 Workability of the soft iron pole pieces**

Recommended machining process for soft iron shall be followed.

Turning/milling: The recommended rake angle is  $6-8^\circ$  with all cutting tools while relief angle is  $35^\circ$  with tool steel and  $25^\circ$  with carbide tipped tools.

Cutting: The recommended rake angle and relief angle are  $6^\circ$  and  $35^\circ$  respectively.

Drilling: Drills which are used with aluminium are recommended.

Point angle	$120^\circ$
Clearance	$6-8^\circ$
Feed	0.03-0.08 mm
Cutting speed	25-35 mm/min.

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In all respects, it must be ensured that the machining is done using copious amount of coolant so that temperature of the parts while machining is controlled.

## **4.3 Magnet assembly**

Supplier shall design and fabricate suitable jigs and vises to slide the magnet and the pole pieces in place as huge forces will be encountered while assembly of the magnet. Care shall be taken while assembly of magnets. Magnets shall not be subjected to any mechanical abuse (hitting or throwing), since it will degrade the magnetic properties. Experienced personnel shall be used for magnet assembly.

## **4.4 Identification of the Magnet assembly**

An engraved plate shall be fixed on the side yoke of magnet assembly which will list down the major specifications of the magnet in a position readable after a complete assembly of the magnet.

Details will be provided by purchaser after magnet assembly and tests. Laser engraving on the parts and assembly shall also be considered as an option.

## **5.0 Acceptance criteria**

### ***5.1 Visual inspection and geometrical control***

The part itself may be subject to appropriate quality requirements. For convenience, these may be grouped as follows:

- Dimension and dimensional stability. Fabricated parts shall comply with the dimensional tolerances as per drawings.
- CMM inspection shall be carried out for all parts and an inspection report shall be generated.
- Appearance. All the parts should be without splay, burn marks, flash, sinks, voids, contamination, un-melted particles and visible weld lines. The surface of the impregnated coil shall be free of cracks, voids or dry spots.

### ***5.2 Quality Control Records***

The QCR shall contain:

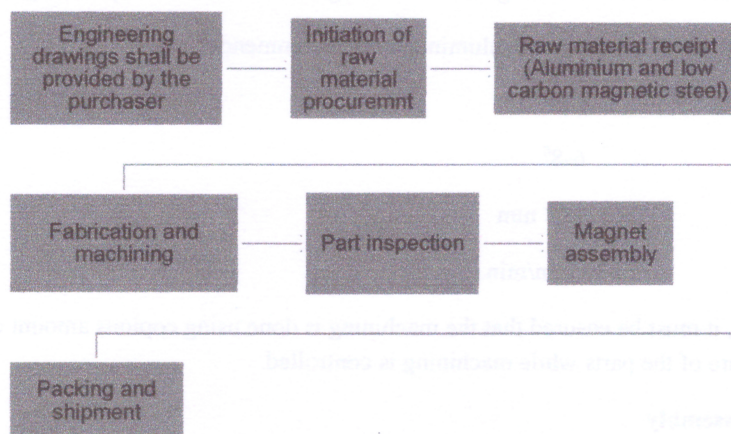
- the progress reports;
- the material certificates, in particular of the aluminium, magnets and magnetic steel;
- Inspection test plan such as dimensional checks.

## **6.0 Performance of the Contract**

### ***6.1 Fabrication and Delivery Schedule***

The bidder shall complete the job within 6 months starting from the date of firm purchase order is issued to bidder.

### ***6.2 Flow sheet for execution of the job***



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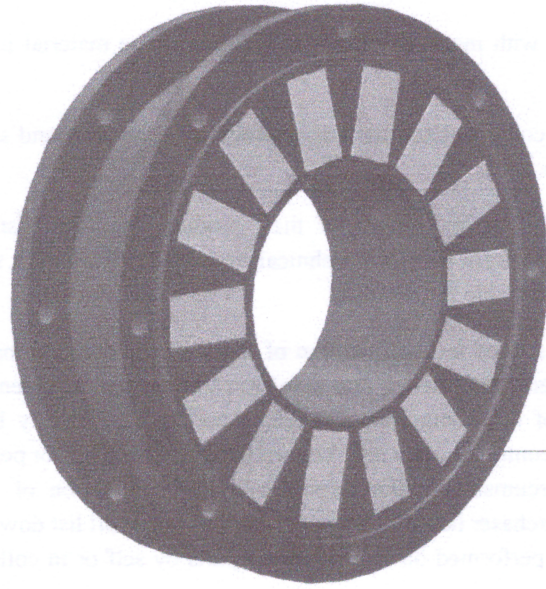
## **7.0 Drawings and reference document**

The specification drawings listed in Table 4 are an integral part of this document. Any conflicts noted by the contractor shall be immediately brought to the attention of BARC and clarified before proceeding with the work. Drawings enclosed with these technical specifications are not manufacturing drawings and shall be used only for tendering purpose. Machine readable engineering drawings are in the scope of supplier.

**8.0 General Instructions:**

- 8.1 Supplier shall quote with material; except for the free issue material involved in this tender.
- 8.2 Overall cost will be compared and include packaging, forwarding and safe delivery to BARC at RCZ stores.
- 8.3 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.
- 8.4 Vendors with test facilities for qualification of magnet assembly like basic metrology equipment's for dimensional checks, non-magnetic Vernier will be given preference. In case vendor plans of sub-contracting the job, same shall be clearly brought out in quotations. The sub-contracting can only be carried out only after prior permission of the purchaser. In all circumstances the responsibility of completion of job up to the satisfaction of the purchaser lies with the supplier. Vendors shall list down the details of qualification checks performed on the fabricated parts by self or in collaboration with other laboratories.

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Permanent magnet

**Figure: Magnet 3D model**

O.D - 160 mm, ID - 80 mm, Flange O.D - 190 mm

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