

Fabrication, supply, assembly and vacuum testing of UHV Antenna Feeder system as per detailed specifications and drawings

Contents:

- 1.0 Introduction.**
- 2.0 Subsystem, Items to be procured**
- 3.0 Scope of Work**
- 4.0 Work Procedure / guidelines**
- 5.0 Infrastructure and Equipment Available at Site**
- 6.0 Material to be provided by IPR as FIM**
- 7.0 Performance Guarantee**
- 8.0 Delivery and Installation schedule**
- 9.0 Eligibility criteria**

1.0 INTRODUCTION: A antenna feeder system consists of two conductors (coaxial) for RF transmission. The RF electrical current flows on the outside surface of the inner conductor (IC) and inside surface of the outer conductor (OC), hence these surfaces require to be smooth, without any discontinuity or sharp edges or transitions in diameter. Sharp edges in these surfaces increases RF electric field and makes it vulnerable to voltage breakdown. The coaxial line should be UHV compatible and care should be taken during fabrication and testing. Some of the components like bellow, ceramic disks, and supports are available at the IPR and will be provided during site assembly and acceptance test (SAT).

The detailed design of the system layout, detailed engineering drawing of all the components are provided here as built to print. The vendors are requested to study it in detail and offer best of their quotations. Any modification in this built to print design if suggested by the vendor MUST be discussed with the IPR and get it approved, since the present system is designed for high power RF application and any unwarranted modification / alteration may inhibit RF power transmission at high power. The vendor is supposed to be competent enough to deal in UHV component fabrication, handling and testing and does not necessarily required to have an expertise in high power RF transmission technology.

2.0 SUB-SYSTEM, ITEMS TO BE PROCURED IN THIS CONTRACT

Sr.	Description of Items	Quantity
1	Fabrication, supply, and testing of UHV antenna feeder system along with support structure as per detailed specifications and drawings mentioned in our enquiry	2

3.0 SCOPE OF WORK**3.1. Fabrication [Following is for each of the unit of system]**

1	Material	SS304L non-magnetic, UHV compatible , without defects, porosity, impurities etc.
2	Pipe	Seamless
3	Dimensions	as per drawing attached
4	Surface smoothness	better than $\nabla\nabla\nabla$ ($R_a < 0.8 \mu$) for inside surface of outer RF conductor and outside surface of inner RF conductor, Standard IS:3073-1967/March 2006 or better to be followed
5	End flanges	Standard and non-standard CF type with metal gasket as per drawing.
6	Welding	All flange joints shall be argon arc welding (TIG) welded from inside. They shall be machined and polished for the required smoothness. Trapped volume should be avoided. Full penetration welds shall be employed.
7	Circlip for Inner Conductor Joints	The component (Drawing no IPR/VTL/A1/16/4026, sheet 9/12, VTL_IC, Part no# 3 & 4, 5 & 6) should be tight fit by hand. Required SS304L circlip to be provided for ensuring good RF contact between them
8	Smooth transition	No sharp edges and abrupt transitions are acceptable. All sharp edges in RF path to be rounded off. The step reducers (Drawing nos # IPR/VTL/A1/16/4026, sheet 9/12, VTL_IC, Part 2/3 and 6) and (Drawing nos # IPR/VTL/A1/16/4026, sheet 8/12, 9VTL_IC, Part 2) to be smoothen out on the RF conducting surface by suitable method. Vendor shall propose and get it approved during drawing approval stage.
9	Perspex Acrylic	Perspex ring and disk (Drawing no # IPR/VTL/A1/16/4026, sheet 4/12-part 2, sheet 6/12- part 3, sheet 2/12-part 4) shall be fabricated and used for leak test and UHV test during factory acceptance test. They will be replaced by original ceramic disks (to be provided by IPR) during the site acceptance test.
10	Support structure	A suitable support structure made of T slot aluminum extrusion channels for supporting VTL to be made as per the dimension in the drawing. T-slot channels are NOT shown instead simple C

		channels are shown.
11	CF gaskets	Four sets of matching standard/non-standard copper, Aluminum and Viton gaskets (one set for each type) for all the CF joints to be provided during shipment. One set shall be used at site acceptance test. Required sets (at least 2) of copper gaskets to be prepared extra for factory acceptance test by the vendor. All the gaskets should be prepared as per the respective knife edge as detailed in drawings.
12	Viton O-rings	Four sets of matching Viton O-rings to be provided during shipment. One set shall be used at site acceptance test. Required sets (at least 2) to be prepared extra for factory acceptance test by the vendor. Viton O-rings should be of UHV standard and bakeable up to 150 deg C.
13	Matching nuts, bolts and washers	Matching Nuts, bolts, washers (spring + Flat) two sets to be supplied during shipment. The fasteners shall be made of SS 304 L/ 316. Vendor may prepare extra set for factory acceptance test,
14	Nylon Bushing assembly	Two sets of Nylon bushing for electrical isolation for component (Drawing no # IPR/VTL/A1/16/4026, sheet 4/12 part 4,5) to be shipped.
15	Heat treatment	All the components should be baked in an inert atmosphere (Nitrogen gas purging), to a temperature of 400 deg.C for 4 to 8 hours after welding for stress removal and for gas desorption from the surfaces. After baking, components are required to be checked for any deformation/distortion if any, before going for final machining.
16	Electro-polish and Ultrasonic cleaning	Standard procedure to be followed

3.2. Factory acceptance test

1. Individual components shall be tested for
 - a. Dimensional check as per drawing
 - b. CF gasket matching test
 - c. Viton O-ring check
 - d. Surface roughness test by surface profile meter (provided by vendor or should be requested to IPR)
 - e. Relative Magnetic permeability test $< 1.03 (\mu/\mu_0)$, if not available to be done at SAT
2. Each component having CF joints shall individually tested for
 - a. Leak rate test by Helium (He) leak detector (provided by vendor) .
 - b. Less than 1×10^{-9} mbar.l/s for all CF joints, weld joints and body.
 - c. Oversized plastic bags to completely enclose the component for global leak rate test to be provided by the vendor

3. Dummy assembly of all the components shall be carried out to rule out finer compatibility issue.
4. Vacuum sections shall be tested for UHV test for an ultimate pressure $< 1 \times 10^{-8}$ mbar.
5. The system shall be baked up to 150 deg C with the help of baking tapes, wrapped by fiber clothes and temperature sensors. All the required instruments including Vacuum Gauge, TMP, Rotary and all accessories for the test to be provided by the vendor.

3.3. Site acceptance test

1. The components shall be shipped with adequate packaging safely to IPR and shall be tested.
2. Individual components shall be tested for
 - a. Dimensional check
 - b. CF gasket matching test
 - c. Viton O-ring check
 - d. Relative Magnetic permeability test $< 1.03 (\mu/\mu_0)$
3. Each component having CF joints shall individually tested for
 - a. Leak rate test by He leak detector (provided by IPR) .
 - b. Less than 1×10^{-9} mbar.l/s for all CF joints, weld joints and body.
4. Assembly of all the components with actual ceramic rings, disks, supports etc. shall be carried out.
5. Vacuum section shall be tested for UHV test for an ultimate pressure $< 1 \times 10^{-8}$ mbar. Vacuum Gauge, TMP, Rotary and all accessories for the test to be provided by the IPR.
6. The complete installation and testing shall be supervised by the IPR representatives and all the required assembly and tests shall be carried out by vendor.
7. The complete system shall be checked for electrical continuity ($< 0.1 \Omega$) separately for outer conductor and inner conductor.
8. The complete system should be electrically isolated from its support structures by G10 composite laminate sheet with Teflon/ Nylon bush at the support location to be supplied by the vendor. The DC electrical isolation across the DC break and w.r.t. support shall be tested for 10kV by megger (provided by IPR).

4.0 WORKS PROCEDURE /GUIDELINES

4.1. Drawing and verification

1. The vendor should study the detailed drawings provided and generate fabrication / shop floor drawings. Any suggested modification in drawings and detailed fabrication procedure MUST be discussed with IPR and final approval MUST be taken before fabrication. Soft copy (CATIA) of drawing submitted herewith may be provided to successful bidder upon request at the sole discretion of IPR.
2. All the final drawings should be submitted to IPR both in soft copy and hard copy.
3. Material test certificate from Govt. Approved laboratory must be submitted before fabrication. Relative Magnetic permeability test $< 1.03 (\mu/\mu_0)$ for sample from same batch should also be sent to IPR.
4. IPR representatives reserves the right to visit with prior intimation and inspect the progress of the job.
5. A final Factory acceptance test (FAT) at factory shall be carried out before shipping.
6. All the components should be properly packed and transported to IPR's premises and special care should be taken to avoid contamination of vacuum surfaces or damage to CF knife edges.
7. All the knife edges should be protected by gaskets and end flanges should be covered with plastic cap.

4.2. Fabrication

1. The vendor shall procure all the raw materials and obtain material test certificate from Govt. approved laboratory.
2. All raw materials should be surface cleaned for removing oil / grease before fabrication process to avoid contamination.
3. All the inner conductor pipe should go tight fit with the IC joint for very good electrical contacts.
4. All the sharp edges on RF current surface should be adequately rounded off.
5. All the vacuum components shall be adequately cleaned with Acetone / Isopropyl alcohol to remove any dust, finger spots, oil, adhesives etc. This is required to obtain UHV during testing.
6. The individual components (Sr# 1 to 5 of Table 1) should be super scribed with a component name tag (Metal tag, size approx. 1cm x 6cm) as per the drawing table submitted. The vendor may put only one sticker of his company name in the VTL system / Support with a size not exceeding 3cm x 10 cm.
7. Where ever blind tapping are made, corresponding bolts should have slot to pump out trapped gases. Slot should be of 1 mm wide by 1 mm deep along the length of the bolt.
8. Interruption during welding should be reduced to minimum possible extent.
9. All welds should be ground smooth and flush with adjoining surfaces with convex curvature with adjoining wall everywhere.
10. For two matched flanges of adjacent components, holes should be drilled together in order to avoid error in PCD making.
11. Tolerance should be strictly followed as given in the drawings.
12. Uniform gap within ± 0.1 mm is required between three concentric parts i.e. inner conductor, outer conductor and outermost conductor.
13. Fixtures should be used during welding, machining and heat treatment to avoid ovality to the conductors.
14. Radiography test shall be carried out on all weld joints.

4.3. Post-fabrication Cleaning for UHV compatibility

All the SS304L components shall be cleaned and treated for UHV compatibility as per the following procedure.

1. All the tapes, adhesives, inks should be removed with acetone
2. Electro polishing should be done for every component for surface finish
3. Ultrasonic cleaning in trichloroethylene.
4. Drying with hot air shall be done.
5. Pack with aluminum foil or plastic bag.

5. INFRASTRUCTURE AND EQUIPMENTS AVAILABLE AT SITE

1. Vendor may use some of the facility at IPR's site without any cost subject to availability and as per rules.
2. Crane with 5T load capacity to move, position VTL sections and components.
3. Equipment to test electrical continuity and isolation.
4. Upright drill machine 20mm for minor job which require in situ modification.
5. He leak detector, TMP, Rotary, vacuum gauge, He cylinder and spray pistol, hose pipes and connectors.

6. MATERIAL TO BE PROVIDED BY IPR

1. IPR will provide following components (of 99.5% Al₂O₃ ceramic) at IPR during the site acceptance test. However, the vendor shall fabricate those components made of Nylon/ Perspex as per given drawing for Factory acceptance test.
 - a. Ceramic for DC break (Drawing no# IPR/VTL/A1/16/4026, Sheet 4 of 12, part 2 , Component name # VTL_03_DC_CER)
 - b. Ceramic disk for vacuum window (Drawing no# IPR/VTL/A1/16/4026, Sheet 6 of 12, part 3, Component name # VTL_05_VW_CER)
 - c. Ceramic coaxial support (Drawing no# IPR/VTL/A1/16/4026, Sheet 2 of 12, part 4, Component name # VTL_01_OUT_CER)
 - d. Edge welded bellow assembly with end flanges (Drawing no# IPR/VTL/A1/16/4026, Sheet 3 of 12, complete component, Component name # VTL_02_BL)
 - e. Brass I/C finger joint (Drawing no# IPR/VTL/A1/16/4026, Sheet 9 of 12, part 7, Component name VTL_IC_01_ICJ3)

7. PERFORMANCE GUARANTY

1. The vendor shall guarantee for a period of **ONE year from the date of acceptance**,
 - a. the quality of material provided and certified copy of material test certificate from Govt. approved test laboratory.
 - b. Mechanical integrity of the assembled system
 - c. Weld joints for all the flanges for leak tightness
 - d. Leaks from metal body due to material defect or porosity.

8. DELIVERY AND INSTALLATION SCHEDULE

1. The FAT, Delivery at IPR and SAT shall positively be finished **within SIX months** from the date of drawing approval from IPR after the PO.
2. SAT can be started within one week after the delivery at IPR.
3. The vendor **MUST** bring all the equipment and accessories/tools required for assembly and test except that have been mentioned in sr. 5& 6. All other specialized tools and accessories shall be brought by vendor. This list must be finalized before coming to SAT to avoid any delay.