Technical Specifications for Fabrication and supply of 9 inch Aluminum and 4 inch copper pipes with end flanges as per the specification and drawings.

Contents:

1.0 INTRODUCTION: Coaxial transmission lines are used to transmit high power radio frequency (RF) waves in the MHz range from source to antenna. These lines consists of two hollow conductors placed one inside the other. 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. To connect a source and antenna at different locations, these coaxial transmission lines needs to be laid out consisting straight sections, 90 degree elbows and T-junctions. These different sections are joined with the help of end flanges. The hollow space between the IC and OC are generally kept in atmospheric pressure but sometimes pressurized with < 0.5 bar above atmosphere with dry air/ nitrogen. Hence the coaxial lines and end flanges should not have holes, cracks or mismatched joints. End flanges are provided with Neoprene gaskets to leak tight it. There are Teflon (PTFE) insulator supports at every joints to fix IC and OC. Thus the entire IC and OC are electrically isolated from each other and at the same time offer electrical continuity along their lengths individually.

The detailed design of transmission line layout, detailed engineering drawing of all the components are provided here. The vendors are requested to study it in detail and offer best of their quotations. Any modification in this 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**

mechanical fabrication of the pipes of large sizes, welding, machining etc. and does not necessarily required to have any expertise in high power RF transmission technology.

Please note that the indented item is not a commercial item and is intended solely for scientific and research purpose. Vendor should discuss with IPR representatives if they face any difficulties in fabrication or have some suggestions. Please read this document and drawings carefully and offer your best and competitive quotation.

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

Table-1

Sr.	Description of Items	Length (L) [mm]	Quantity
1	9 3/16" Coaxial Transmission lines of various lengths consisting of a. One Aluminum outer conductor (O/C) b. Two Aluminum end flanges (One fixed, other swivel) welded to the O/C c. One Inner copper conductor (I/C) d. One Brass I/C Joint e. One Teflon support	344	1
		507	1
		657	1
		823	1
		957	2
		974	1
		1000	5
		1291	1
		1642	1
		1676	1
		1755	2
		2059	1
		2376	1
		2656	1
		3100	6
2	9 3/16" Coaxial 90 degree elbow with end flange, outer and inner conductor		**10 nos**
3	Spare brass I/C Joint		**20 nos**
4	Spare Teflon Support		**20 nos**

IMPORTANT NOTE:

1. Depending on the fabrication constraint, if the vendor propose to use shorter straight sections, it should not be any less than 1.5m in length. However, such proposal MUST be clearly written in the quotation.
2. In such a scenario, length of some straight sections and their quantity may change as given in table-1.

3. Vendors are requested to study the supplied drawing in detail and in case any question / request of site visit should be directed to IPR. All requests of more information or site visit should be made well in advance from the due date.

3.0 Technical Specifications

3.1. Material specifications for Aluminum outer conductor with aluminum end flanges [As mentioned in Table-1, Sr. 1 (a,b) of this document]

Material	6061-T6 or equivalent grade Aluminum alloy as per BIS standard or equivalent
Pipe type	Seamless / roll-joint with smooth inner surface
Dimensions	$9\ ^{3/16}$ " standard coaxial as per drawing
Surface smoothness	better than ∇∇ (R_a < 3.2 μ) for inside surface of outer pipe and outside surface of inner pipe,
End flanges	Aluminum flanges to be welded to both end of the straight section. One flange being fixed, the other being swivel as per drawing.
Flange facing	The two end flange faces of straight conductor should be parallel to each other and perpendicular to the straight conductor within ±0.5 degree

3.2. Copper Inner conductor [As mentioned in Table-1, Sr. 1 (c) of this document]

Material	ETP grade copper as per BIS standard or equivalent
Pipe type	Seamless
Dimensions	as per drawing
Surface smoothness	better than ∇∇ (Ra < 3.2 μ) for outside surface

3.3. Brass inner conductor finger joint [As mentioned in Table-1, Sr. 1 (d) of this document]

Joint Material	Forged Brass with Copper≥60% and Zinc ≤40%, BIS standard or equivalent
Finger Slits and cuts	As per drawing, all the sharp corners are to be rounded off
Fitting	Should be tight fit to the inner conductor by hand.
Circlip	one set matching SS304 circlip to be provided for each side of the joint to be provided

3.4. Teflon support [As mentioned in Table-1, Sr. 1 (e) of this document]

Teflon (PTFE) support	As per drawing
Dielectric constant of Teflon	2.1
Dielectric strength of	~ 32 kV/mm

Teflon

3.5. 9 3/16" Coaxial 90 degree elbow with end flange, outer and inner conductor [As mentioned in Table-1, Sr. 2 of this document]

O/c material	Aluminum 6068-T6
I/C material	ETP copper
End flanges	Aluminum 6068-T6, one side fix and other side swivel
Welding	End flanges to be welded to outer conductor
Construction	Miter bend type as given in the drawing OR standard right angle type. Both types are acceptable with drawing approval from IPR

3.9. Supplies and accessories

1. The vendor shall supply all the required nuts, bolts, washers made of SS.
2. Viton O-rings at all flange joints : 20 % extra supply as spares
3. Circlip: 20% extra

4.0 WORKS PROCEDURE /GUIDELINES

4.1. Drawing and verification

1. Drawings and layout are **available in soft copy (CATIA) with purchase section** along with the pdf version. Any **vendor can request to purchase section for soft copy** of drawings.
2. 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.
3. Depending on the fabrication constraint, the vendor may propose to use shorter straight section not less than 1.5m in place of 3 m sections. However, such proposal MUST be discussed and approved by IPR beforehand. In such a scenario, length of some straight sections and their quantity may change as given in table-1.
4. All the final drawings should be submitted to IPR both in soft copy and hard copy.
5. IPR reserves the right to visit with prior intimation and inspect the progress of the job.

4.2. Fabrication

1. The vendor shall procure all the raw materials and obtain material (composition) test certificates from Govt. approved laboratory. All the certificates should be supplied to IPR for confirmation before commencement of the fabrication. The IPR reserves the right to test the material separately and in that case the vendor must supply test sample of the material procured from same batch.
2. All raw materials should be surface cleaned for removing oil / grease before fabrication process to avoid contamination.
3. Aluminum outer conductor may be made out of rolling and joining by welding oversized sheet. Materials from the inner surface should be machined out to provide a smooth finish. The vendor may use of Aluminum extruded pipes manufactured as standard. Such pipes should be checked for inner surface smoothness.

4. The two end flanges of any straight conductor should be parallel to each other and perpendicular to the straight conductor within ±0.5 degree.
5. All the inner conductor joints should go tight fit with the copper inner conductor for very good electrical contacts as defined in 4.4(3).
6. All the sharp edges on RF current surface should be rounded off at R1.
7. Hooks or nuts at both ends of a straight section should be welded so that they can be used to lift up by crane.

4.3. Inspection at Vendor site and supply

1. A final pre-dispatch inspection (PDI) at factory shall be carried out by the IPR representatives before shipping.
2. Before PDI, vendor shall submit a report with measured dimensions of all the types of components and all the pieces, radiography test reports.
3. IPR representatives shall carry out the PDI and followings shall be checked:
    a. Dimensional checks
    b. Surface roughness measurement by mechanical / laser profilometer. The vendor should make necessary arrangements measuring surface roughness of the inside surface of OC and outside surface of IC at discrete locations.
    c. Planarity of flange mating surfaces
    d. Inner conductor joints connection
    e. Braze joints and their strength by tightening two Tx line flanges by standard M12 bolts so as to come face-to-face.
    f. Ovality of outer and inner conductors. Maximum allowed ovality is 0.45% over the nominal diameter. This is same as general dimensional tolerances given in the drawing blocks.
    g. Material defects like cracks as seen visually.
4. All the components should be properly packed and transported to IPR's premises and special care should be taken to avoid any ovality issue of the straight conductors.

4.4. Post Delivery checking at IPR

1. All the tests done at factory stated in section 4.3.3 shall be tested at IPR by IPR personnel at no cost to vendor.

5. PERFORMANCE GUARANTY

1. The vendor shall guarantee
    a. the quality of material provided or certified copy of material test certificate from Govt. approved test laboratory. The certificate should be submitted before start of fabrication.
    b. weld joints for all the flanges and pipe should not yield / crack.
    c. mechanical integrity of the assembled system for a period of ONE year from the date of acceptance.

6. DELIVERY SCHEDULE:

1. Time t0 =0 : Placing of order
2. Time t1 = 4 weeks from time t0 : Drawing submission to IPR for approval
3. Time t2 = 2 weeks from t1 : Drawing approval by IPR
4. Time t3 = 26 weeks from t2 : Delivery at IPR
5. Time t4 = 2 weeks from t3 : Acceptance by IPR