TEST SCHEDULE AND TEST PROCEDURE

FOR

18 GHz HIGH PERFORMANCE ANTENNA NO:TEC/TSTP/GR/PI/ANT-009/04/MAR-11

(SUPERSEDES TSTP/ANT-09/03.MAY 2004)

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TELECOMMUNICATION ENGINEERING CENTRE
KHURSHID LAL BHAVAN, JANPATH
NEW DELHI-110001
INDIA

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General

The following points may be recorded before starting the testing of the equipment/ product :

1.

a) **Name of the original manufacturer of the equipment/product :**
b) **Name of the vendor :**
c) **Commercial/Brand name of the equipment/product :**
d) **Model No. :**
e) **Serial No. :**

2. The list of the instruments / jigs., etc. used for testing along with their calibration certificate/details.

S.No.	Instrument	Manufacturer	Model	S.No.	Calibration Date

3. Measure the loss of the cables used for testing the equipment/product.

S.No.	Type of cables used	Loss in dB

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1. Introduction and scope:

The objective of this Test Schedule & Test Procedure is to evaluate the design and performance of the antenna against the TEC specifications for type approval.

2. Test instruments / equipment required:

i) Sweep Signal Generator
ii) Scalar Network Analyzer
iii) Modulator
iv) Dual Directional Coupler
v) Detector
vi) Signal Source
vii) Source Antenna
viii) Theodolite
ix) Dynamometer
x) Pattern recorder
xi) Standard Gain Horn Antenna
xii) Frequency Counter
xiii) Wave guide Short
xiv) Connecting Cables
xv) Receiver e.g. Model S A 1742 or S A1780
xvi) Walkie-Talkie Set

3. Test set up: Schematic diagram with instruments for measurement of various parameters:

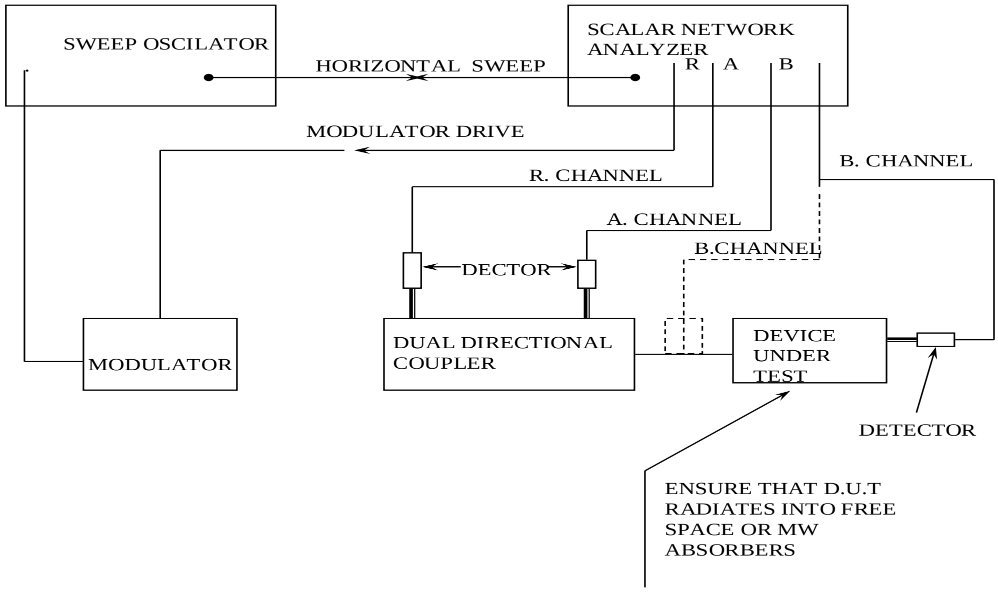


Figure 1: Measurement of Return Loss & Isolation of Microwave Antennas

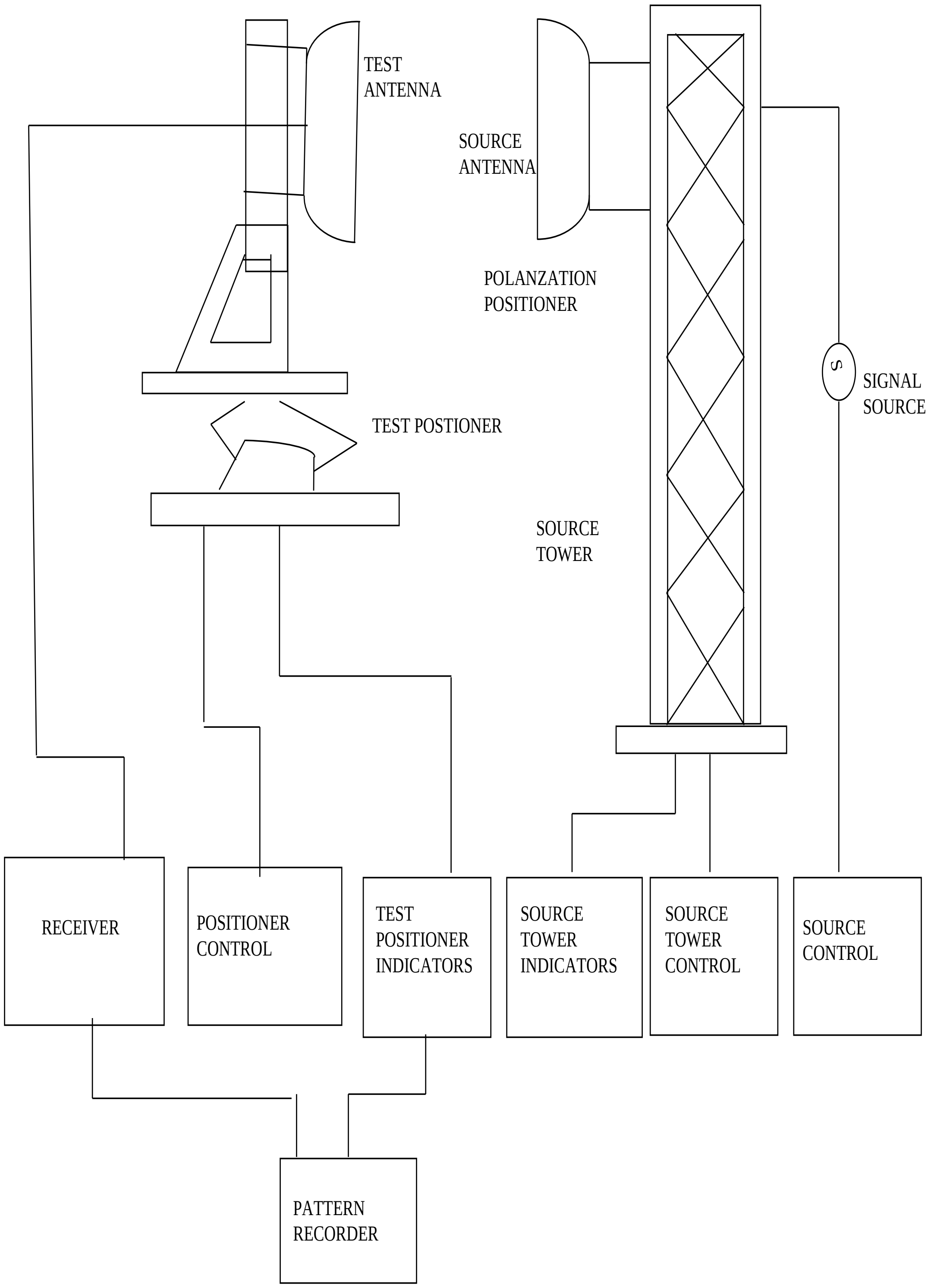


Figure 2 : Set up Radiation Pattern Measurements of Microwave LOS Antennas

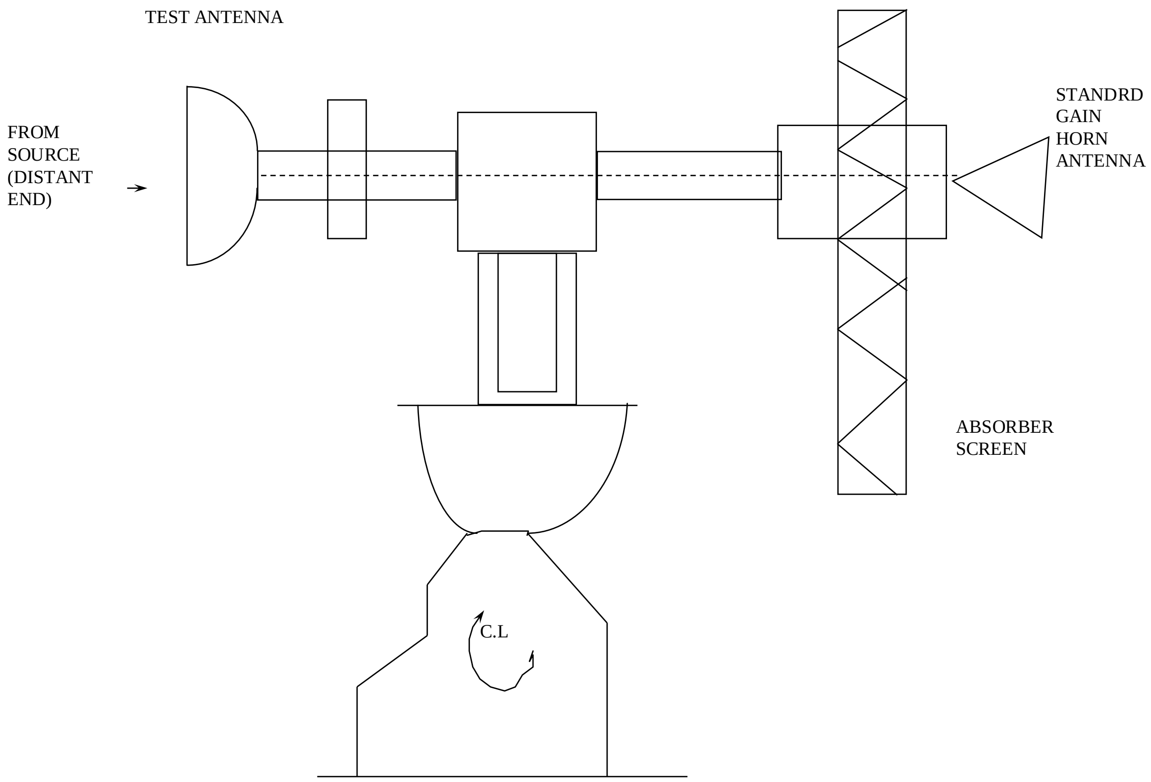


Figure 3: Gain Measurement of Antennas

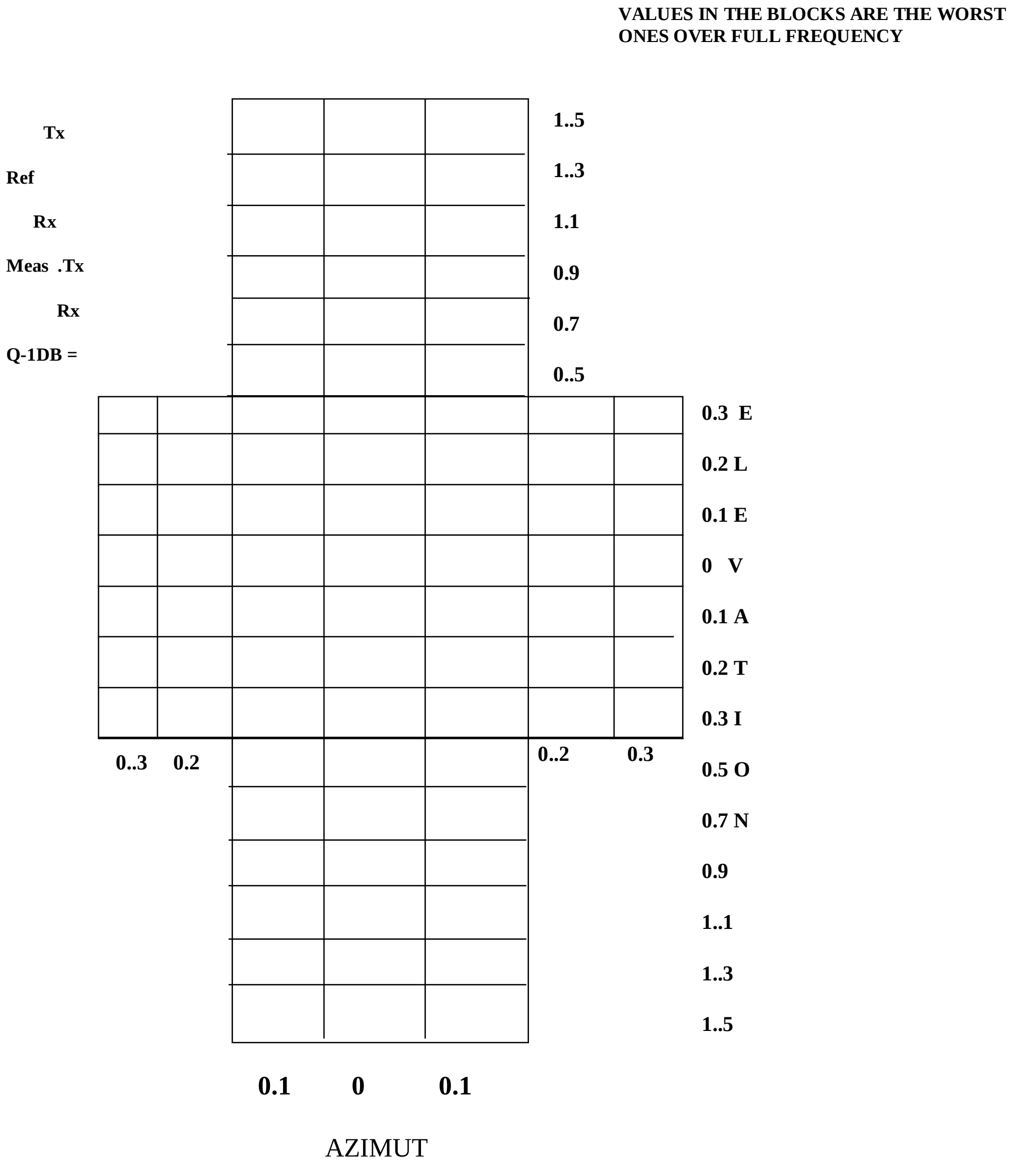


Figure 4: XPD Contour Plot HPH XPD Antennas

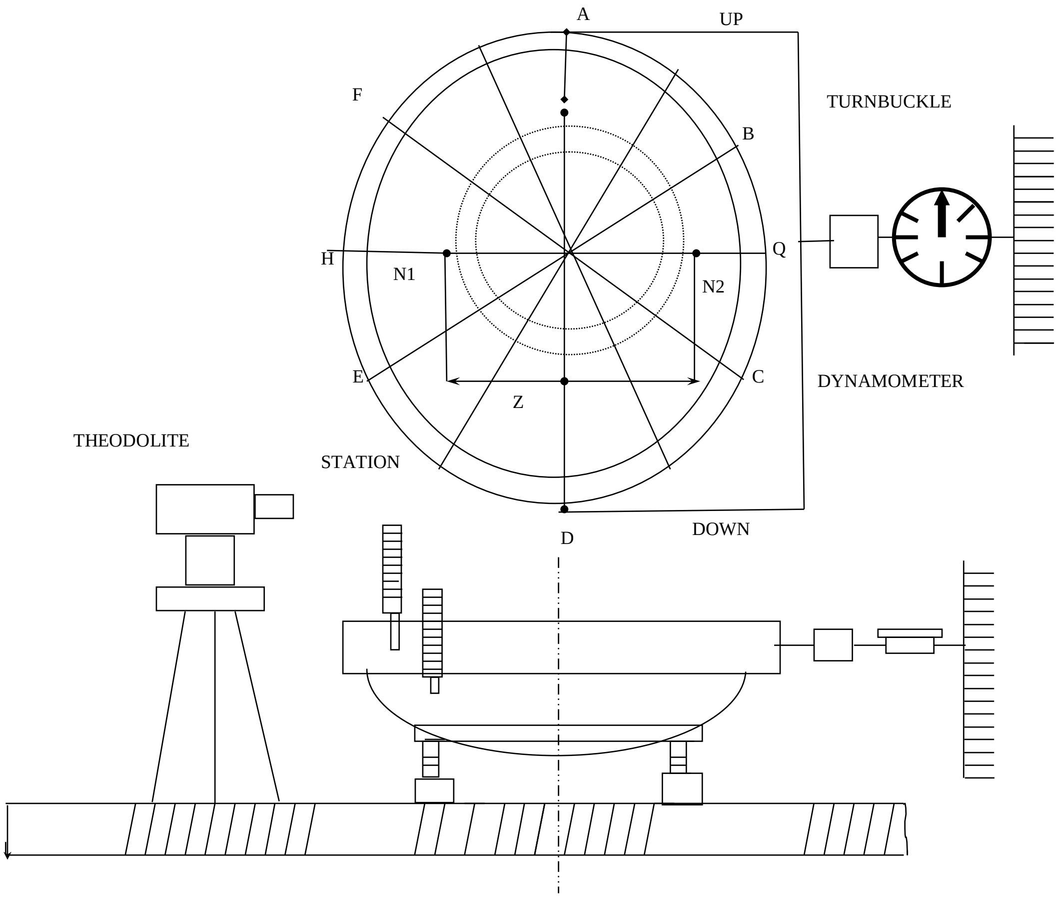


Figure 5: Wind Load Test on Parabolic Reflector

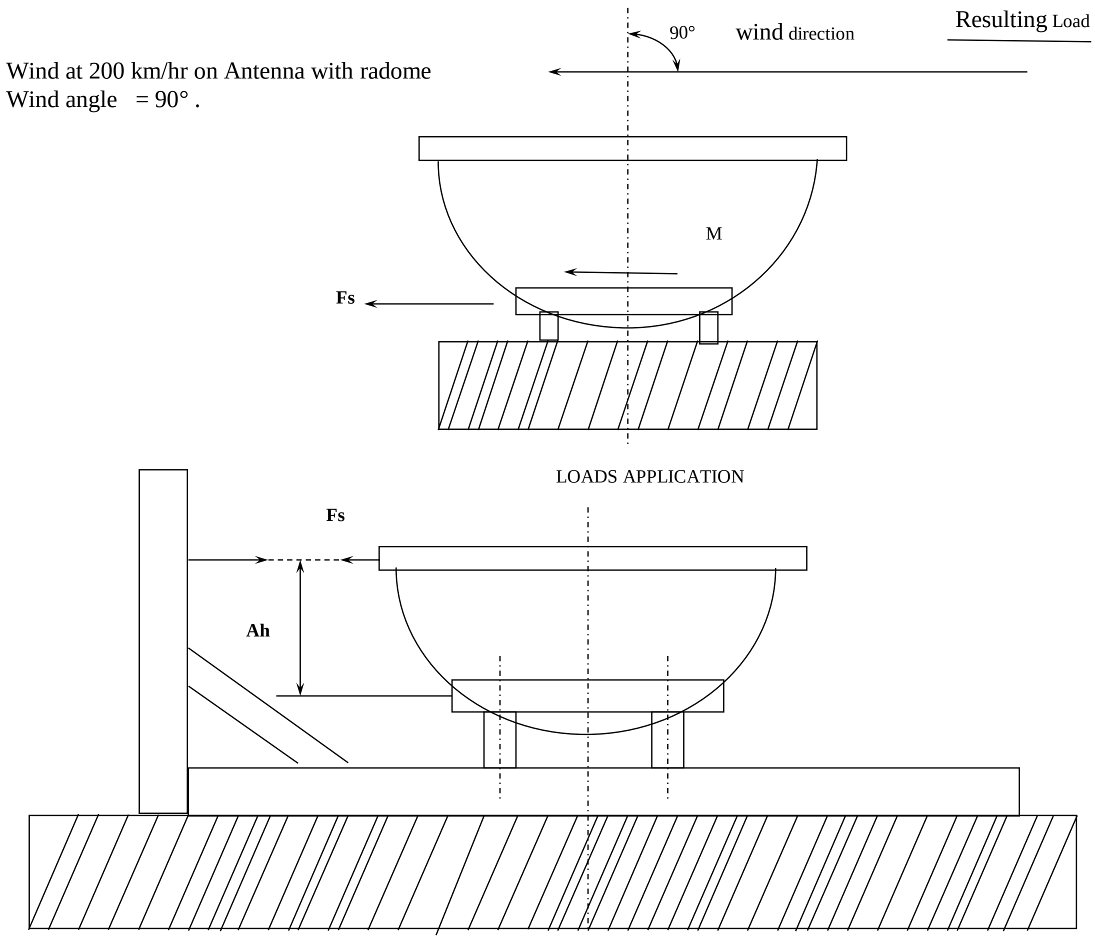


Figure 6 : Wind Load Test on Parabolic Reflector

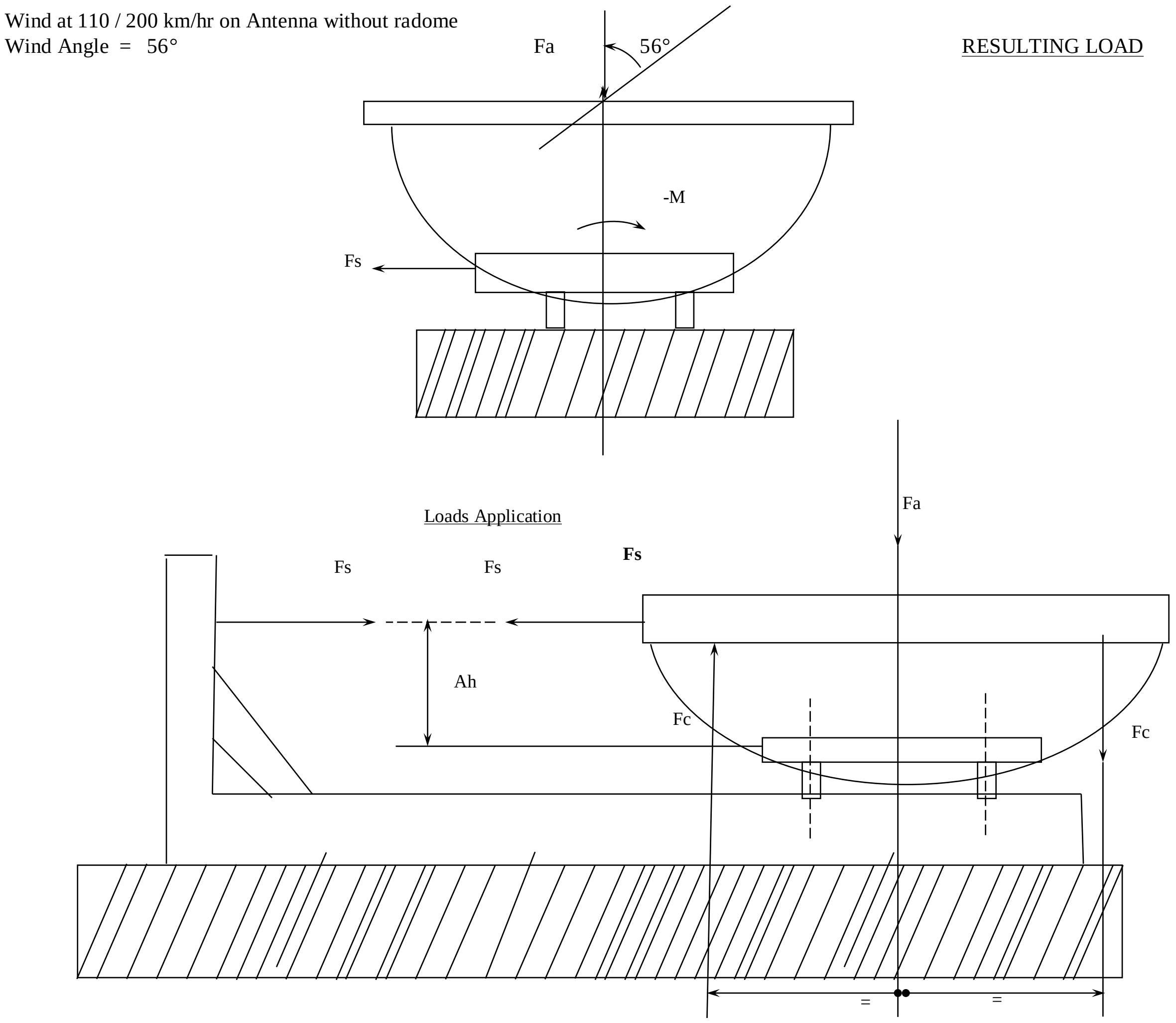


Figure 7 : Wind Load Test on Parabolic Reflector

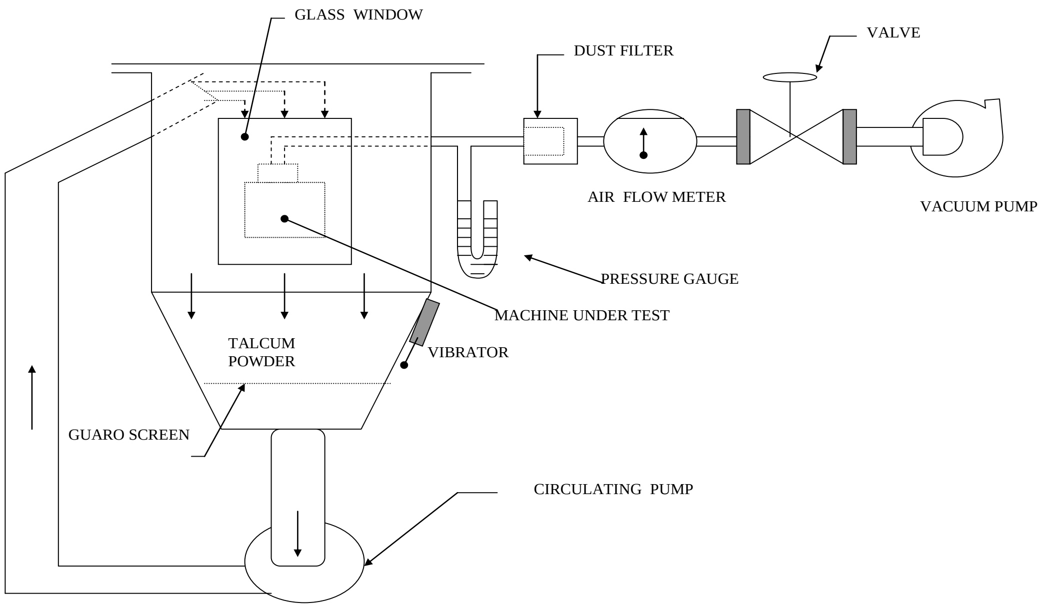
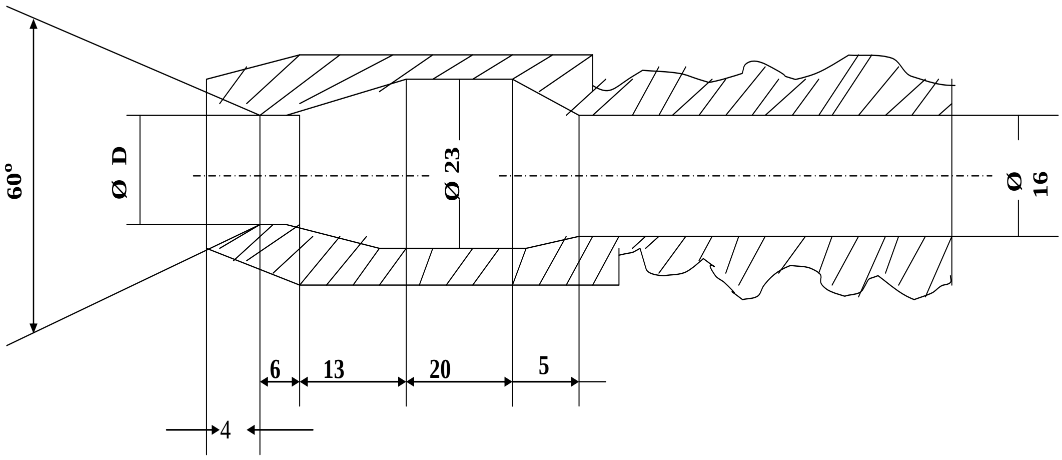


Fig 8: Equipment To Prove Protection Against Dust



D = 6.3 mm

Fig 9 :NOZZLE FOR PROTCTION TEST: NUMERAL 5 of IP-65

4. Test procedures for measuring various parameters:

SL. No.	Cl. No.	Parameters	Test procedures / Remarks
1	**1.0**	**Introduction**	
2	**1.1**	This part of the document contains the generic requirements of 18 GHz High Performance antennas of nominal diameters 0.3 m, 0.6 m, 1.2 m, and 1.8 m /2.0m.	Check and note that the antenna offered is of the diameter by actual measurements.
3	**1.2**	The 18 GHz High Performance antennas would be used in conjunction with 18 GHz Digital Microwave Systems. The use would be for junction working and therefore nodal and multi system operation is envisaged in close proximity. Thus front to back ratio and Cross-polar Discrimination has to be of high order.	Check and note that the antenna submitted is for use of 18 GHz Digital Microwave Systems.
4	**2.0**	**Functional and Technical Requirements**	
5	**2.1**	**Material:** Type of Antenna: Parabolic Reflector: Aluminium or FRP Shroud : Aluminium lined with suitable absorbing material Radome : UV resistant plastic Radome. The minimum thickness of the Radome material shall be 0.44mm. **Note :** All the material used shall be resistant to corrosion. For reflector, Aluminium shall be as per IS : 737. Thickness of the reflector and radome shall be furnished by the vendor. The technical specification of radome material and FRP along with test results, grade of material etc. shall also be furnished by the vendor. The life time for Radome's material shall be ten years or more.	Check and note the type of the antenna is Parabolic. Take a certificate regarding type of material used for reflector,shroud and radome and note that the material used for Reflector should be Aluminium or FRP, shroud may be Aluminium lined with suitable absorbing material and Radome to be UV resistant plastic.For reflector, Aluminum shall be as per IS:737. Thickness of the reflector and radome shall be furnished by the vendor. The detailed technical specification of radome material and FRP along with test results, grade of material etc. shall be furnished by the vendor. The life time for Radome's material shall be ten years or more. The thickness of the Radome material shall be checked and noted.

6	**2.2**	**Frequency of operation:** 17.7 - 19.7 GHz	Check and note the frequency of the antenna.
7	**2.3**	**Nominal diameter:** 0.3 m, 0.6 m, 1.2 m, 1.8 m / 2.0m	Check and confirm the diameter offered by measuring the diameter along three axes with a tape and taking average of the readings.
8	**2.4**	**Gain (minimum) with Radome:** **Frequency :** Bottom {17.7 GHz}, Mid {18.7 GHz}, Top {19.7 GHz} **For 0.3 m :** 32.0 dBi, 32.5 dBi , 33.0 dBi **For 0.6 m** : 38.0 dBi , 38.6 dBi, 39.0 dBi **For 1.2 m :** 44.0 dBi, 44.5 dBi , 44.9 dBi **For 1.8 m :** 47.4 dBi, 47.9 dBi , 48.3 dBi **For 2 m** : 47.5 dBi , 48.4 dBi, 49.0 dBi	**Equipment Set Up:** The general measurement set up is as shown in Fig. 2. Generally for range measurements a distance over 2 * D * D/lambda should be maintained where D is the aperture of the antenna so that measurements are not affected by phase error effects. A standard gain horn antenna for the measurement freq. range is mounted at the back of the test antenna on the same positioner. A screen of absorbing material is also fixed behind the standard gain horn antenna. It should be ensured that the centre lines of the two antennas coincide as shown in Fig 3. The gain should be measured at the mid band, bottom and the top band frequencies. **Step by step Procedure:** (a) Set frequency of the transmitter to the desired frequency in the operating frequency range. Transmit it at suitable power level. (b) Align the antenna under test with the help of antenna positioner controls (in both azimuth and elevation axes) to get maximum received power on the selected polarization, horizontal or vertical. An indication of this power will be available on the amplitude display meter of the receiver as well as the pattern recorder. (c) Orient the transmit antenna also to see if the power increases. Communication with operator at transmit end can be maintained over a telephone line or walkie-talkie set.

			(d) Realign at receive end, if necessary, for maximum power. (e) Insert some IF attenuators in the microwave receiver. The inserted attenuators should be greater than the estimated difference between the gain of the antenna under measurement and that of the standard gain horn. (f) Adjust the amplitude display meter pointer to the null reference point. (g) At this point check the linearity of the receiver at the selected operating point. Vary the IF attenuator by 1 dB step. The amplifier gain tell the correspondence is achieved. (h) Rotate the antenna positioner by 180 deg in azimuth so that the standard gain horn faces the transmitter. (i) Align for max. receive power. (j) Now remove the IF attenuator inserted in the receiver to bring the amplitude display meter pointer to the same null reference point. Let the attenuation removed is L dB. (k) The gain of the test antenna is then G (dB) = Gain of the standard horn + L curve of the horn at the desired frequency. (l) Repeat the above measurements for the other polarisation. (m) Record the measured gain values in the data sheet. **Note :** When using the receiver S A Model 1780 (B E L' Test Range)the following steps may be performed. (a) to (d) as above

			(e) Record the received signal on the recorder on an expanded scale for bottom, top and centre frequencies of the prescribed frequency range. (f) Remove the cable from the antenna and connect it to the standard gain horn. (g) Rotate the positioner by 180 deg in azimuth so that the standard gain horn faces the transmitter. (h) Align for max. power as at steps 2 & 3. (i) Record the standard gain horn signal below the corresponding test antenna signal at the three frequencies. (j) The antenna gain is given by G (dB) = Gain of the standard horn + The level difference between antenna and standard horn signal. (k) Repeat the above measurements for other polarisations. (l) Gain values at the frequencies in both the polarisations may be entered in the data sheet.
9	**2.5**	**HPBW (nominal mid band):** **For 0.3 m:** 3.6^0 **For 0.6 m** : 1.9^0 **For 1.2 m :** 0.9^0 **For 1.8 m :** 0.7^0 **For 2 m** : 0.6^0	First follow the test procedure as par clause No : 2.14 Radiation Pattern. After the radiation pattern at the three frequencies is plotted, the travel of the pattern recorder is changed to 9 deg so that the main beam plotting gets expanded. After plotting, it is possible to read at the measured polarization. Similar plotting may be done for other polarization at the same frequencies. Worst value should meet the specifications.
10	**2.6**	**Front to back ratio {180° ± 80°} (Production margin better than ± 2 dB):**	First follow the test procedure as par clause No. : 2.14 Radiation Pattern. Front to back ratio can be read from

		For 0.3 m: 52 dB **For 0.6 m** : 60 dB **For 1.2 m :** 65 dB **For 1.8 m :** 65 dB **For 2 m** : 75 dB	the patterns recorded. It should be read in the angular zone as specified. It is not necessary to record both the left and right readings (meaning left half and right half of the pattern). Only the worst of the two should be recorded for the three frequencies in both the polarisations in the data sheet which should meet the specified value.
11	**2.7**	**Polarisation :** Single (Horizontal or Vertical)	Check and note that the feed is single polarized (Horizontal or vertical).
12	**2.8**	**XPD:** Better than 30 dB	**Step by Step Procedure :** (a) Equipment set up is same as the set up for radiation pattern.(Fig. 2) (b) Transmit the required frequency at a suitable power level. (c) Match receive and transmit antenna polarisations. Adjust the transmit and receive antenna orientations in azimuth and elevation axes so as to get the maximum received signal. This co-polor signal is recorded on the pattern recorder. (d) Keeping the receive antenna polarization unchanged, the Transmit antenna polarization is changed slowly so that a minimum is obtained. The cross polarization discrimination in main beam is given by the difference in levels of signals obtained in co- polar and cross polar received signals on an axis. (e) Test antenna is then rotated through 360 deg in azimuth to obtain the X P D pattern over 360 deg for one combination of transmitter (H or V) and receiver (V or H).

			(f) Similar steps are repeated for other combinations of transmitter (V or H) and receiver (H or V). (g) The worst value of X P D of the two combinations may be recorded for each of the three frequencies where patterns are taken in the data sheet and they should meet the specifications.
13	**2.9**	**Return Loss** : 17 dB (Minimum)	**Step by step description of the testing procedure:** (a) Arrange the test set up as shown in fig. 1. (b) Adjust the sweep signal generator to sweep over the desired band of frequencies. Verify with frequency counter. Sweep should be off when checking the end frequencies. Disconnect the freq. (c) Press the position knob of channel 'A' and set the trace to some convenient reference level. (d) Connect a short at the test port of the dual directional coupler. Press A/R push button. Set offset Cal. switch to ON. Adjust offset cal control to place the CRT trace on the 'reference'. i.e. for different dB/division levels. This channel is used to measure return loss. (e) Remove the short and connect channel B of the analyzer to Dual Directional Coupler test port through a W G to coaxial adaptor. Press B/R push button and adjust channel B offset calibration to bring the trace to reference level. This channel is used to measure the isolation between ports. (f) Remove the adaptor from the directional coupler and connect a

			new port of the feed under test to the directional coupler and other port to channel B. The R.L. may be read in dB directly (by pressing A/R) by noting how much the trace is down the reference line and isolation may be read in channel B (B/R pressed) similarly. (g) Same procedure may be repeated for the other port. (h) Return Loss & Isolation curves may be plotted over the whole band with a plotter or a printer interfaced to the analyzer. (i) V S W R can be calculated as follows. $$V S W R = \frac{1 + p}{1 - p}$$ Where p = 1/ (antilog (R L/20)) (j) Record the worst values of V S W R and Isolation value in the data sheet Precaution: The antenna must radiate into space free from reflecting objects or alternatively towards microwave absorbers.
14	**2.10**	**Feed horn** : It should be provided with guy wire kit, if required and provided with satisfactory vibration damping mechanism. The feed shall be terminated with UBR-220 flange for connection to the wave-guide in case pressurization is not used. In case pressurization is used, it should be pressure tight to 10 psi (70 kPa) and provided with guy wire kit, if required,and provided with satisfactory vibration damping mechanism.The feed shall be terminated with PBR-220 flange for	To be checked.

		connection to the waveguide. **Note: The type of feed horn termination i.e. UBR220 or PBR220 shall be clearly mentioned by the purchaser at the time of tendering.**	
15	**2.11**	**Antenna Mount:** The antenna mount shall permit fine adjustment of at least ± 5° in elevation and continuous adjustment in azimuth of at least ± 45° with fine adjustment of ± 5°. The antenna shall be suitable for mounting on a GI pipe of 114.3 mm outer diameter and 4.5 mm thickness. All clamps and accessories including antenna mount, necessary for fitting of antenna to the pipe to be supplied by the manufacturer, shall be with non-corrosive finish.	Mount of the antenna may be checked physically as per the drawings The antenna mount should be checked separately and one with antenna mounted on it. Normally the azimuth adjustment will be through loosening of U-clamps to the pipe mount and it should be possible to do this adjustment over +/- 45 deg without any hindrance from other parts of the supporting structure. The +/- 45 deg directions can be marked as vertical lines on the pipe mount about a reference point. The fine adjustment of +/- 5 deg should likewise be checked. As for the elevation adjustment of +/- 5 deg, this can be measured by the movement of the top bracket hinges of the triangular mounting from where the elevation adjustment bolt is adjusted.
16	**2.12**	**Wind Load :** The antenna shall be able to withstand a wind speed of 200 kmph. Maximum beam centre deflection shall not exceed 0.1 degree at wind speed of 110 kmph. The antenna shall come back to normal after the wind is subsided.	The wind load test is conducted to verify the profile deformations of the parabolic reflector under the loads corresponding to the operational wind velocity of 110 km/hr and survival wind velocity of 200 km/hr. The test is conducted by placing static load to simulate the worst wind velocity conditions at 56 deg wind angle. Design calculations for the Grid paraboloid antenna for 200 km/hr wind speed to be provided by the manufacturer. It should indicate that the stress at the clamp due to structure is with in the safe limits of the Ultimate Tensile Strength of the alloy used.

			(I) CALCULATION OF LOADS : In each loading configuration the worst condition is simulated taking into account wind direction and the antenna configuration as per EIA standards. Load coefficients for paraboloid antennas for calculating the wind loading values are given at Annexure 1. The following three loading cases are to be taken for every reflector to be tested for wind load. (a) Operational wind (without radome) V = 110 km/hr Wind angle = 56 deg Dia of the reflector = D meter Area = PI *D *D/4 sq. m Fa = Ca. *A *V *V = .0045* 18.47* A* 200* 200/9.81 kg Fs = Cs. *A *V *V = .0045* 18.47* A* 200* 200/9.81 kg M = Cm. D. A. V* V = -.00024* 18.47* D* A* 200* 200/9.81 kg (b) Survival wind (without radome) V = 200 km/hr Wind angle = 56 deg Fa = Ca* A* V* V = .0045* 18.47* A *200* 200/9.81 kg Fs = Cs* A* V* V = .0005* 18.47* A* 200* 200/9.81 kg M = Cm* D* A* V* V = -.00024* 18.47* D* A* 200* 200/9.81 kg M (c) Survival Wind (With radome)

			V = 200 km/hr Wind angle = 90 deg Fa = Ca* A *V *V = 0* 18.47 *A * 200 *200/9.81 = 0 Fs = Cs* A* V * V = .0015* 18.47* A* 200* 200/9.81 kg M = Cm* D* A* V* V = -.0028 *D* A* 200* 200/9.81 kg M Since Load coefficients Ca, Cs, M are in FPS system, a conversion factor 18.47 is taken for metric system. **(II) LOADING PATTERN :** After calculating the loads (Fa, Fs ,M) for a particular wind speed at 56 deg wind angle, the loading pattern is decided so reflector surface is divided into six sectors as shown in Fig 5. Both halves of the reflector have 3 such sectors. Frontal loads generated by displacing loads from one half to the other half. A sample procedure for developing pattern for placement of loads and radii of the rings where loads are to be placed is given in Annexure II. This pattern is for 3 meter dia reflector. Similar patterns can be made for reflectors of other diameters. **(III) DESCRIPTION OF THE LOADING TEST :** (a) The reflector under test is fixed to a supporting structure of extreme rigidity in the shape of a cross, by means of the same pole mount frame used to fix the antenna to the supporting tower. The reflector is placed with its aperture upwards as showing fig 5. and its aperture plane is leveled, checking the horizontality with a stadia, spirit level and a theodolite.

			(b) The frontal load is uniformly distributed into the reflector by means of steel blocks of 10 kg each, sub dividing the reflector surface into 6 sections in order to allow the possibility to move and maneuver the stdia and make the readings. (c) The lateral load is applied by means of a turnbuckle, a rod and a metallic strap placed around the reflector rim. The load is regulated by a dynamometer placed after the turnbuckle. It must be noted that the lateral load generates an additional torque caused by the fact that the lateral load for practical reasons is applied in correspondence to the reflector rim instead of that in correspondence to the vertex with an arm equivalent to antenna height Ah from the vertex. (d) The torque M is applied by displacing uniformly a part of the load Fc of the frontal load from one to the other half of the reflector in such a way that the loads are uniformly distributed in both the halves, the detailed loading pattern for distributing the loads uniformly in both halves is given at sub clause (II). In case of the lateral wind (sub clause (I) (c)) this operation is not required because the load Fs applied with an arm of Ah generates already a torque slightly larger than that value indicated at sub clause (I) (c). **(IV) TEST SEQUENCE AND DATA COLLECTION :** (a) Preloading of 1000 Kg uniformly distributed on the reflector surface. (b) Return to no-load condition. (c) Reading of the reference position points corresponding to no load

			condition. Take 8 points A,B,C,D,E,F,G,H on the reflector rim and take predetermined no. of points (say 36 for 3m antenna on the six radii OA,OB,OC,OD,OE&OF. Calculate the root mean square (RMS) value of the deviation of the reflector profile (Theoretical). Method of calculation at Annexure III. (d) Load the antenna corresponding to the operational wind velocity of 110km/hr wind load (Fa,Fs,M) for 8 hours. (sub clause (I) (a)) (e) Reading of the displacements of the same points after 8 hr. operational wind velocity of 110 km/hr at wind angle 56 deg on antenna without radome. Calculate the RMS value of the profile deviation from the theoretical. (f) Unloading. (g) Reading in no-load condition of the same points and calculation of the profile RMS. (h) Load the antenna corresponding to the survival wind velocity of 200 km/hr for 30 min. { sub clause (I) (b)} (i) Unloading. (j) Reading of the displacement of reference points in loads and calculate the profile RMS. (k) Reading of the displacement of reference points after 18 hr. of removal of load and calculate of profile RMS. (l) Reading of the displacement of reference points after 72 hr. of removal of load and calculate the profile RMS. (m) To check the effect of

			displacement of fixing points (where the antenna is mounted) dial gauges are placed at two points N1&N2. along the axis GH. (n) Load the antenna corresponding to a wind velocity of 200 km/hr with wind angle 90 deg on antenna with plans radome (Fs,M) for 30 minutes. (sub clause (I) (c)) (o) Reading of the displacement of the reference points and calculate the profile RMS. (p) Note down the displacement of fixing points N1 & N2. (q) Calculate the beam centre deflection corresponding to operational wind velocity (Annexure IV) **(V) TEST RESULTS :** **S. No. Loading case : RMS value** (i) No load after preloading (ii) With load : 110km/hr at 56 (iii) After removal of load as above (iv) After removal of load as above : 200 km/hr (v) After 18 hours of recovery (vi) After 72 hr. of recovery (vii) Beam Centre Deflection : 110 km/hr
17	**2.13**	**Environmental condition:** The antenna is intended for installation and operation under fully exposed weather conditions. It shall also be capable of withstanding the effects of industrial pollution, salinity of atmosphere in coastal areas, storms etc. The performance shall not deteriorate beyond values specified in this GR for testing as per	Test the antenna for all the applicable tests as per category "E" of TEC Standard SD: QM-333, Issue March 2010 {Latest Issue}"Standard for Environmental Testing of Telecommunication Equipment" including corrosion (salt mist) tests. The following tests are carried out to check the capability of the antenna material to work under the environment conditions specified

		category "E" of TEC Standard SD: QM-333, Issue March 2010 {Latest Issue}"Standard for Environmental Testing of Telecommunication Equipment" including corrosion (salt mist) tests.	without any degradation of performance. **1) Salt Spray Test :** This test is carried out to simulate the effect of coastal weather conditions on ferrous and nonferrous materials used in antenna feeds and supporting structures adopted. Samples of materials of all these parts including nuts and bolts are subjected to salt spray test as per Q M- 333. No corrosion should be observed. **2) Protection test :** **2.1) <u>Test for First Numeral 6 :</u>** (a) Dust test at 40^0 The test is made using equipment incorporating the basic principles shown in Fig. 8 in which talcum powder is maintainer in suspension in a suitable closed test chamber The talcum powder used shall be able to pass through a square– meshed sieve whose nominal wire diameter is 50 µn the nominal width between wires is 75 µn. The amount of talcum powder to be used is 2 kg per cubic meter of the test chamber volume. It shall not have been used for more than 20 tests. Enclosure are of necessity in one of two categories: 1) Enclosure where the normal working cycle of the equipment cause reductions in air pressure within the enclosure below the surrounding atmospheric pressure, e. g. thermal cycling effects. 2) Enclosure where reductions in pressure below the surrounding atmospheric pressure are not present. **Note : The antenna is to be tested under category –2**

			Foe enclosure under category (2) the equipment under test is supported in its normally operating position inside the test chamber, but is not connected to a vacuum pump. Any drain hole normally open shall be left open for the duration of the test. The test shall be continued for a period of 8 hours. If it is impracticable to test the complete equipment in the test chamber, one of the following procedures shall be applied : - testing of individually enclosed sections of the equipment : - testing of representative parts of the equipment, comprising components such as doors ventilating openings, joints shaft seals, etc., with the vulnerable parts of the equipment, such as terminals, slip rings, etc., in position at the time of testing ; and - testing of smaller equipment have the same full scale design details. In the last two cases, the volume of air to be drawn through the equipment under test is as specified for the whole equipment in full scale. **2.2) <u>Test for Second Numeral 5 :</u>** The test is made by spraying the antenna from all practicable directions with a stream of water from a standard test nozzle as shown in figure 9. The conditions to be observed are as follows : - nozzle internal diameter : 6.3 mm - delivery rate : 12.5 liters/ minute ± 5% - water pressure * at the nozzle : approximately 30 kN/m2 (0.3 bar) * The pressure should be adjusted to achieve the specified delivery rate. At kN/ m2, the water should rise freely for a vertical distance of approximately 2.5 meter above the

			nozzle. - test duration per meter square of surface area of enclosure : 1 minute - minimum test duration : 3 minute - distance from nozzle to enclosure surface : approximately 3 meters. After the test is over, VSWR and Isolation measurements are repeated. There should be no deterioration in the values. **3)Feed horn VSWR measurement under environmental conditions :** This test is conducted to check the performance of the antenna under the Category 'E' for environment specified in TEC Standard SD: QM-333, Issue March 2010 {Latest Issue}"Standard for Environmental Testing of Telecommunication Equipment" **Procedure :** The feed horn is placed in the climatic chamber with arms of the feed partially out of the chamber for measurements. Follow the QM333 environmental cycle. VSWR and Isolation measurements are carried out. The set up and procedure is same as clause 2.9. The horn should be protected with Microwave absorbers to avoid reflections from the metallic chamber. The performance of the antenna should not deteriorate under these conditions.
18	**2.14**	**Radiation pattern:** The guaranteed radiation pattern envelope (RPE) for both polarisations over the entire 360-degree range shall be furnished. Actual radiation patterns for production antennas, under still, dry conditions, will not have any peak	**Equipment Set Up:** Generally for range measurements a distance over 2 * D * D/lambda should be maintained where D is the aperture of the antenna so that measurements are not affected by phase error effects. Equipment set up is as shown in Fig. 2. The positioner permits the complete

		exceeding the current RPE by more than 3dB. An angular accuracy of ± 1° is maintained throughout.	rotation of the antenna (360 deg) in the horizontal plane and elevation movement from -60 to +80 degree. Both positioner axes are synchronized to a rectangular X Y recorder. The X axis of the recorder gives the actual azimuth position of the antenna. All the maneuvers and operations (antenna pointing and pattern recordings) are made and controlled from within the control room located at the same vicinity where test antenna is mounted. The transmit antenna radiates a C R W F signal at the prescribed frequency. The antenna under test is connected to the measuring channel of the receiver while a standard gain horn is connected to the reference channel. The output signal from the receiver is fed into the X Y recorder whose amplitude axis is calibrated over the range of 80 dB and is recorded on the paper roll whose movement is synchronized to the positioner rotation in such a way that a direct correspondence is established between the angular position read on the paper and the actual position of the antenna. **Step by step Procedure:** (a) The transmit R F generator is set to the prescribed frequency and the transmit antenna to the desired polarization, vertical or horizontal. Select same polarization at the receive end. (b) With the receiver set in the A P C (automatic phase control),track the TX frequency and lock the receiver. (c) Align the antenna under test maximizing the R x signal level. (d) Adjust the signal level on both R x channels in order to avoid the receiver saturation by inserting the receiver IF attenuators.

			(e) Adjust the recorder pen on the 0 deg mark on the X axis and on the 0 dB mark (on the top of the calibrated scale) on the Y (amplitude) axis. (f) Calibrate the Y scale of the recorder with the IF attenuators of the receiver. Remove attenuators after calibration. (g) Start the antenna rotation. (h) Complete the 360 deg rotation and record the desired polarisation pattern. (i) Bring back the antenna to the 0 deg. (j) The above patterns may be taken at the mid band, top & bottom band frequencies in the prescribed frequency band in both polarisations.
19	**2.15**	**Colour** The colour of reflector, feed, shroud assembly and radome shall be olive green or white or off white or gray or sky blue. The paint used for reflector, feed and shroud assembly shall be as per BIS standard IS-168:1993 (Reaffirmed in 2007) "Ready mixed paint, air drying for general purpose-specification" and it is to be tested as per BIS standard IS-101 "Method of sampling and test for paints, varnishes and related products". Mount assemblies need not be painted.	Check and conform from manufacturer for copies of test certification for the paint used by the manufacturer. Ask for report of one sample piece got tested as per IS-101. Check and note that the colour of reflector, feed, shroud assembly and radome shall be olive green or white or off white or grey or sky blue. The paint used for reflector, feed and shroud assembly shall be as per BIS standard IS-168:1993 (Reaffirmed in 2007) "Ready mixed paint, air drying for general purpose-specification" and it is to be tested as per BIS standard IS-101 "Method of sampling and test for paints, varnishes and related products ". Mount assemblies need not be painted.
20	**3.0**	**Quality requirements**	
21	**3.1**	a) The antenna shall be manufactured in accordance with international quality management system ISO 9001:2000 for which the manufacturer should be duly	Obtain certificate for ISO 9001:2000 and quality plan describing the quality assurance followed by the manufacturer

		accredited. A quality plan describing the quality assurance system followed by the manufacturer would be required to be submitted. and b) The antenna shall meet the latest BSNL QA Guidelines including instructions indicated in Quality Manual QM 312 "Quality Manual on Antenna".	Obtain certificate from manufacturer
22	**3.2**	RF connector used shall be reliable and of standard type to ensure failure free operation for over 500 matings.	Check and take tests for 500 mating for reliability of the connectors used in the antenna in normal and under environmental conditions as specified in GR.
23	**3.3**	The joints in the antenna assembly, if any, shall have protection as per BIS standard IS/IEC60529:2001 "Degrees of protection provided by enclosures (IP Code)" (equivalent to IEC–60529) to meet at least the protection level of IP-65.	Obtain test certificate from manufacturer
24	**3.4**	The antenna shall conform to requirements for environment specified in TEC Standard SD: QM-333, Issue March 2010 {Latest Issue} "Standard for Environmental Testing of Telecommunication Equipment" for operation, transportation and storage. The applicable tests shall be for environmental category "E" including vibration and corrosion (salt mist)tests. **Notes :** i) Antenna along with all the accessories including antenna mounts, radome etc., shall be subjected to environmental tests as per Category "E" of the SD: QM –333, Issue March 2010{Latest Issue}. ii) In order to ensure that the	Test the antenna for environment category "E" including vibration and corrosion (salt mist) as specified in TEC Standard SD: QM-333, Issue March 2010 {Latest Issue} "Standard for Environmental Testing of Telecommunication Equipment" for operation, transportation and storage. Note: Test report & results from accredited lab should be submitted along with test certifications from the vendor that the offered antenna conforms to the standard mentioned in this clause

		materials of the antenna mount, Radome etc., are UV protected, a copy of the certificate mentioning that the materials used for the Mounts and Radome are UV protected as per G53 ASTM or any other national / international standard (title of standard & its brief details to be furnished by the vendor) must be obtained from the manufacturer / supplier of the material. This is applicable only for non-metallic materials.	
25	**4.0**	**Desirable Requirements:** **Documentation :** Documentation shall include one hard copy and one soft copy of technical literature in Hindi or English with detailed assembly and installation procedure and shall be provided along with the antenna.	To be checked

5. Observations/ records:

Sl. No.	**Clause No. of spec.**	**parameters**	**Measured values/ Observations**	**Compliance with specification**	**Remarks**
1	**1.0 Introduction**				
2	**1.1**	This part of the document contains the generic requirements of 18 GHz High Performance antennas of nominal diameters 0.3 m, 0.6 m, 1.2 m, and 1.8 m /2.0m.			
3	**1.2**	The 18 GHz High Performance antennas would be used in conjunction with 18 GHz Digital Microwave Systems. The use would be for junction working and therefore nodal and multi system operation is envisaged in close proximity.			

		Thus front to back ratio and Cross-polar Discrimination has to be of high order.			
4	**2.0: Functional and Technical requirements**				
5	**2.1: Material**	Type of Antenna: Parabolic Reflector: Aluminium or FRP Shroud : Aluminium lined with suitable absorbing material Radome : UV resistant plastic Radome. The minimum thickness of the Radome material shall be 0.44mm. **Note :** All the material used shall be resistant to corrosion. For reflector, Aluminium shall be as per IS : 737. Thickness of the reflector and radome shall be furnished by the vendor. The technical specification of radome material and FRP along with test results, grade of material etc. shall also be furnished by the vendor. The life time for Radome's material shall be ten years or more.			
6	**2.2: Frequency of operation**	17.7 - 19.7 GHz			
7	**2.3: Nominal diameter**	0.3 m, 0.6 m, 1.2 m, 1.8 m / 2.0m			
8	**2.4: Gain (minimum) with radome**	**Frequency :** Bottom {17.7 GHz}, Mid {18.7 GHz}, Top {19.7 GHz}			

		For 0.3 m : 32.0 dBi, 32.5 dBi , 33.0 dBi **For 0.6 m** : 38.0 dBi , 38.6 dBi, 39.0 dBi **For 1.2 m :** 44.0 dBi, 44.5 dBi , 44.9 dBi **For 1.8 m :** 47.4 dBi, 47.9 dBi , 48.3 dBi **For 2 m** : 47.5 dBi , 48.4 dBi, 49.0 dBi			
9	**2.5: HPBW (nominal mid band)**	**For 0.3 m:** 3.6^0 **For 0.6 m** : 1.9^0 **For 1.2 m :** 0.9^0 **For 1.8 m :** 0.7^0 **For 2 m** : 0.6^0			
10	**2.6: Front to back ratio {180° ± 80°} (Production margin better than ± 2 dB): (Minimum)**	**For 0.3 m:** 52 dB **For 0.6 m** : 60 dB **For 1.2 m :** 65 dB **For 1.8 m :** 65 dB **For 2 m** : 75 dB			
11	**2.7 : Polarisation**	Single (Horizontal or Vertical)			
12	**2.8: XPD (minimum)**	Better than 30 dB			
13	**2.9: Return Loss**	17 dB (Minimum)			
14	**2.10: Feed horn**	It should be provided with guy wire kit, if required and provided with satisfactory vibration damping mechanism. The feed shall be terminated with UBR-220 flange for connection to the wave-guide in case pressurization is not used. In case pressurization is			

		used, it should be pressure tight to 10 psi (70 kPa) and provided with guy wire kit, if required, and provided with satisfactory vibration damping mechanism. The feed shall be terminated with PBR-220 flange for connection to the waveguide. **Note: The type of feed horn termination i.e. UBR220 or PBR220 shall be clearly mentioned by the purchaser at the time of tendering.**			
15	**2.11: Antenna Mount:**	The antenna mount shall permit fine adjustment of at least ± 5° in elevation and continuous adjustment in azimuth of at least ± 45° with fine adjustment of ± 5°. The antenna shall be suitable for mounting on a GI pipe of 114.3 mm outer diameter and 4.5 mm thickness. All clamps and accessories including antenna mount, necessary for fitting of antenna to the pipe to be supplied by the manufacturer, shall be with non- corrosive finish.			
16	**2.12: Wind**	The antenna shall be able to withstand a wind speed of 200 kmph. Maximum beam centre deflection shall not exceed 0.1 degree at wind speed of 110 kmph. The antenna shall come back to normal after the wind is subsided.			
17	**2.13: Environmental condition:**	The antenna is intended for installation and operation under fully exposed weather			

		conditions. It shall also be capable of withstanding the effects of industrial pollution, salinity of atmosphere in coastal areas, storms etc. The performance shall not deteriorate beyond values specified in this GR for testing as per category "E" of TEC Standard SD: QM-333, Issue March 2010 {Latest Issue}"Standard for Environmental Testing of Telecommunication Equipment" including vibration and corrosion (salt mist) tests.			
18	**2.14: Radiation pattern**	The guaranteed radiation pattern envelope (RPE) for both polarisations over the entire 360-degree range shall be furnished. Actual radiation patterns for production antennas, under still, dry conditions, will not have any peak exceeding the current RPE by more than 3dB. An angular accuracy of ± 1° is maintained throughout.			
19	**2.15: Colour**	The colour of reflector, feed, shroud assembly and radome shall be olive green or white or off white or gray or sky blue. The paint used for reflector, feed and shroud assembly shall be as per BIS standard IS-168:1993 (Reaffirmed in 2007) "Ready mixed paint, air drying for general purpose-specification" and it is to be tested as per BIS standard IS-101 "Method of sampling and test for paints, varnishes			

		and related products". Mount assemblies need not be painted.			
20	**3.0: Quality requirements**				
21	**3.1**	a) The antenna shall be manufactured in accordance with international quality management system ISO 9001:2000 for which the manufacturer should be duly accredited. A quality plan describing the quality assurance system followed by the manufacturer would be required to be submitted. and b) The antenna shall meet the latest BSNL QA Guidelines including instructions indicated in Quality Manual QM 312 "Quality Manual on Antenna".			
22	**3.2**	RF connector used shall be reliable and of standard type to ensure failure free operation for over 500 matings.			
23	**3.3**	The joints in the antenna assembly, if any, shall have protection as per BIS standard IS/IEC 60529:2001 "Degrees of protection provided by enclosures (IP Code)" (equivalent to IEC–60529) to meet at least the protection level of IP-65.			
24	**3.4**	The antenna shall conform to requirements for environment specified in TEC Standard SD: QM-333, Issue March 2010 {Latest Issue} "Standard for Environmental Testing of Telecommunication Equipment" for operation,			

		transportation and storage. The applicable tests shall be for environmental category "E" including vibration and corrosion (salt mist) tests. Notes : i) Antenna along with all the accessories including antenna mounts, radome etc., shall be subjected to environmental tests as per Category "E" of the SD: QM –333, Issue March 2010{Latest Issue}. ii) In order to ensure that the materials of the antenna mount, Radome etc., are UV protected, a copy of the certificate mentioning that the materials used for the Mounts and Radome are UV protected as per G53 ASTM or any other national / international standard (title of standard & its brief details to be furnished by the vendor) must be obtained from the manufacturer / supplier of the material. This is applicable only for non-metallic materials.			
25	**4.0: Desirable requirements: Documentation**	Documentation shall include one hard copy and one soft copy of technical literature in Hindi or English with detailed assembly and installation procedure and shall be provided along with the antenna.			

6. Lab Test Reports

7. **Conclusion:**

ANNEXURE I

EIA –195
Revision C

APPENDIX I: Antenna Wind Load Data – Introduction

This Appendix contains information on the forces produced by typical microwave antennas on towers or other support structures.

NOTE: Wind loading values have been complied from a wide variety of sources. Some data are based on wind tunnel tests, and some are based on theoretical calculations from many sources. Precise antenna geometry may vary from manufacturer to manufacturer.

The values shown are intended as guides; it is the responsibility of the tower designer to determine the actual wind loading performance of a specific antenna

Wind force data presented in this Appendix are described in the antenna axis system* having the origin at the vertex of the reflector. The antenna axis system has three orthogonal axes with one of the axes coincident with the antenna axis. Rigorously, wind effects are resolved into three forces acting along the axes and three moments rotating about the axes. However, the forces system under consideration is simplified by considering only the forces in the horizontal plane which are illustrated by the inset of figure 1.

The axial force, F_A, acts along the axis of the antenna; the side force F_S, as perpendicular to the axis of the antenna with its line of action passing through the vertex of the parabolic. The twisting moment, M is a couple which acts in the horizontal plane (the plane of the wind).

The magnitude of F_A, F_S and M depends on the dynamic pressure of the wind, the projected frontal area of the antenna, and aerodynamic characteristics of the antenna body. The aerodynamic characteristics vary with wind angle. It is therefore convenient to express the variation of F_A, F_S and M in terms of the following coefficients:

$$C_A = F_A/AV^2 \qquad C_S = F_S/AV^2 \qquad C_M = M/DAV^2$$

Where
C is the coefficient,
A is the frontal area in square feet,
V is the wind velocity in mph and
D is the antenna diameter in feet.

The most important wind angles and the corresponding load coefficients are listed in Table 2. Variations of these coefficients for typical antenna and passive reflector configurations with wind angle are given in Figures 1 through 5.

* The wind axis system is another system which is frequently employed. The wind axis system is defined as having axes parallel to wind direction (drag), in the vertical direction (life) and the horizontal normal to the wind (side force).

TABLE - 2

Load Coefficients for Typical Paraboloidal Antennas

WIND ANGLE	AXIAL FORCE F_A/AV^2	SIDE FORCE F_S/AV^2	TWISTING MOMENT M/DAV^2
0º	+ 0.0040	0.0	0.0
45º	+ 0.0425	+ 0.0002	- 0.00015
56º	+ 0.0044	+ 0.0005	- 0.00022
90º	- 0.00025	+ 0.00085	+ 0.000345
125º	- 0.00125	+ 0.0012	+ 0.000375
180º	- 0.00270	0.0	0.0

For a 12 ft diameter antenna in 125 mph wind the calculations are as follows:

$$A = 113 \text{ sq ft}$$
$$V^2 = 15{,}600$$
$$D = 12 \text{ ft}$$
$$AV^2 = 1.765 \times 10^6$$
$$DAV^2 = 2.12 \times 10^7$$

The force on the antenna when the wind makes an angle of 56º with the antenna axis are:

$$F_A = 0.0044\ (1.765 \times 10^6) = +7770 \text{ 1b}$$
$$F_S = 0.0005\ (1.765 \times 10^6) = +882 \text{ 1b}$$
$$H = 0.00022\ (2.12 \times 10^7) = -4660 \text{ 1b ft}$$

The coefficients shown in the following graphs apply to F in pounds, M in foot-pounds; D in feet, A in square feet and V in mph. For metric use, multiply by 18.47 for F in newtons, M in N-m, A in sq m, and V in km per hr.

ANNEXURE -II

LOADING PATTERN FOR 3.0m ANT AT PRE LOAD OF 1000 Kg.

ANT. SIZE	3.00 m				
ANT. RAD	1500.00 mm		F =	860.00 mm	
LOAD (Fa)	1000.00 Kg		ARM LENGTH OF Fs	0.65	m
LOAD (Fs)	0.00 Kg		MOMENT DUE TO Fs	0.00	Kgm
MOMENT M	0.00 Kgm		TOTAL MOMENT (Mt)	0.00	Kgm

CENTROIDE OF SEMI – CIRCLE "L(cg)" = (4*R/3*PI) 636.62 mm

LOAD TO BE SHIFTED FROM LEFT (Mt/L(cg) 0.00 0.00

NO OF Wts TO BE SHIFTED FROM LEFT 0.00

LOAD ON LEFT HALF 500.00 LOAD ON RIGHT HALF 300.00

LOADING PATTERN LEFT HALF			LOADING PATTERN RIGHT HALF		
1st RING	30.00	Kg	1st RING	30.00	Kg
2nd RING	60.00	Kg	2nd RING	60.00	Kg
3rd RING	90.00	Kg	3rd RING	90.00	Kg
4th RING	120.00	Kg	4th RING	120.00	Kg
5th RING	200.00	Kg	5th RING	200.00	Kg
6th RING		Kg	6th RING		Kg
TOTAL	500.00	Kg	TOTAL	500.00	Kg

RADIUS (IN THE PROJECTED CIRLE) AT WHICH LOADS AS ABOVE SHALL PRODUCE UNIFORM LOADING.

LEFT			RIGHT		
LOAD/UNIT AREA		0.14			0.14
1st RING	367.42		1st RING	367.42	
2nd RING	636.40		2nd RING	636.40	
3rd RING	900.00		3rd RING	900.00	
4th RING	1161.90		4th RING	1161.90	
5th RING	1500.00		5th RING	1500.00	
6th RING			6th RING		

(CONTD)

LOADING PATTERN FOR 3.0m ANT AT PRE LOAD OF 1000 Kg. (Contd.)

RADIUS (PROJECTED) OF THE CENTRES OF LOADS FOR UNIFORM LOADING

1st LOAD	223.71	1st LOAD	223.71
2nd LOAD	501.91	2nd LOAD	501.91
3rd LOAD	768.20	3rd LOAD	768.20
4th LOAD	1030.95	4th LOAD	1030.95
5th LOAD	1330.95	5th LOAD	1330.95
6th LOAD		6th LOAD	

DISTANCES OF CENTRES OF LOADS FROM THE APEX OF PARABOLA ALONG THE PARABOLA CURVE (LENGTHS ALONG THE CURVE).

RADIAL LENGTH ALONG THE CURVE (FOR F = 1500) = 1672.80

1st LOAD	224.34	1st LOAD	224.34
2nd LOAD	508.94	2nd LOAD	508.94
3rd LOAD	793.02	3rd LOAD	793.02
4th LOAD	1089.72	4th LOAD	1089.72
5th LOAD	1433.84	5th LOAD	1433.84
6th LOAD		6th LOAD	

LOADING PATTERN FOR 3.0m ANT AT 110 Km/h AT 56 DEGREE (CONTD.)

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RADIUS (PROJECTED) OF THE CENTRE OF LOADS FOR UNIFORM LOADING.

1st LOAD	305.17	1st LOAD	216.78
2nd LOAD	724.44	2nd LOAD	482.96
3rd LOAD	1052.21	3rd LOAD	773.89
4th LOAD	1342.93	4th LOAD	1080.08
5th LOAD		5th LOAD	1362.37
6th LOAD		6th LOAD	

DISTANCES OF CENTRES OF LOADS FROM THE APEX OF PARABOLA ALONG THE PARABOLA CURVE (LENGTHS ALONG THE CURVE).

RADIAL LENGTH ALONG THE CURVE (FOR F = 1500) = 1672.80

1st LOAD	306.76	1st LOAD	217.35
2nd LOAD	745.33	2nd LOAD	489.24
3rd LOAD	1114.57	3rd LOAD	799.26
4th LOAD	1469.01	4th LOAD	1147.36
5th LOAD	0.00	5th LOAD	1493.75
6th LOAD	0.00	6th LOAD	0.00

(CONTD)

LOADING PATTERN FOR 3.0m ANT AT 110 Km/h AT 56 DEGREE

ANT. SIZE	3.00	m		
ANT. RAD	1500.00	mm	860.00 mm	

LOAD (Fa)	780.00 Kg	ARM LENGTH OF Fs	0.65	m
LOAD (Fs)	90.00 Kg	MOMENT DUE TO Fs	58.50	Kgm
MOMENT M	-140.00 Kgm	TOTAL MOMENT (Mt)	-198.50	Kgm

CENTROIDE OF SEMI – CIRCLE "L(cg)" = (4*R/3*PI) 636.62 mm

LOAD TO BE SHIFTED FROM LEFT (Mt/L(cg) -155.90 -160.00

NO OF Wts TO BE SHIFTED FROM LEFT 16.00

LOAD ON LEFT HALF 230.00 LOAD ON RIGHT HALF 550.00

LOADING PATTERN LEFT HALF			LOADING PATTERN RIGHT HALF		
1st RING	30.00	Kg	1st RING	30.00	Kg
2nd RING	60.00	Kg	2nd RING	60.00	Kg
3rd RING	60.00	Kg	3rd RING	120.00	Kg
4th RING	90.00	Kg	4th RING	150.00	Kg
5th RING		Kg	5th RING	180.00	Kg
6th RING		Kg	6th RING		Kg
TOTAL	240.00	Kg	TOTAL	540.00	Kg

RADIUS (IN THE PROJECTED CIRLE) AT WHICH LOADS AS ABOVE SHALL PRODUCE UNIFORM LOADING.

LEFT		RIGHT	
LOAD/UNIT AREA	0.07		0.15
1st RING	530.33	1st RING	353.55
2nd RING	918.56	2nd RING	612.37
3rd RING	1185.00	3rd RING	935.41
4th RING	1500.00	4th RING	1224.74
5th RING		5th RING	1500.00
6th RING		6th RING	

(CONTD)

LOADING PATTERN FOR 3.0m ANT AT 200 Km/h AT 56 DEGREE

ANT. SIZE	3.00	m	
ANT. RAD	1500.00	mm	860.00 mm

LOAD (Fa)	2570.00 Kg	ARM LENGTH OF Fs	0.65	m
LOAD (Fs)	300.00 Kg	MOMENT DUE TO Fs	195.00	Kgm
MOMENT M	-470.00 Kgm	TOTAL MOMENT (Mt)	-665.00	Kgm

CENTROIDE OF SEMI – CIRCLE “L(cg)” = (4*R/3*PI) 636.62 mm

LOAD TO BE SHIFTED FROM LEFT (Mt/L(cg) -522.29 -520.00

NO OF Wts TO BE SHIFTED FROM LEFT 52.00

LOAD ON LEFT HALF 765.00 LOAD ON RIGHT HALF 1805.00

LOADING PATTERN LEFT HALF			LOADING PATTERN RIGHT HALF		
1st RING	30.00	Kg	1st RING	60.00	Kg
2nd RING	60.00	Kg	2nd RING	120.00	Kg
3rd RING	120.00	Kg	3rd RING	240.00	Kg
4th RING	180.00	Kg	4th RING	360.00	Kg
5th RING	180.00	Kg	5th RING	450.00	Kg
6th RING	200.00	Kg	6th RING	570.00	Kg
TOTAL	770.00	Kg	TOTAL	1800.00	Kg

RADIUS (IN THE PROJECTED CIRLE) AT WHICH LOADS AS ABOVE SHALL PROCEDURE UNIFORM LOADING.

LEFT		RIGHT	
LOAD/UNIT AREA	0.22		0.51
1st RING	296.08	1st RING	273.86
2nd RING	512.82	2nd RING	474.34
3rd RING	783.35	3rd RING	724.57
4th RING	1067.53	4th RING	987.42
5th RING	1290.58	5th RING	1239.96
6th RING	1500.00	6th RING	1500.00

LOADING PATTERN FOR 3.0m ANT AT 200 Km/h AT 56 DEGREE (CONTD.)

RADIUS (PROJECTED) OF THE CENTRE OF LOADS FOR UNIFORM LOADING.

1st LOAD	188.04	1st LOAD	176.93
2nd LOAD	404.45	2nd LOAD	374.10
3rd LOAD	648.09	3rd LOAD	599.46
4th LOAD	925.44	4th LOAD	855.99
5th LOAD	1179.05	5th LOAD	1113.69
6th LOAD	1395.29	6th LOAD	1369.98

DISTANCES OF CENTRES OF LOADS FROM THE APEX OF PARABOLA ALONG THE PARABOLA CURVE (LENGTHS ALONG THE CURVE).

RADIAL LENGTH ALONG THE CURVE (FOR F = 1500) = 1672.80

1st LOAD	188.41	1st LOAD	177.24
2nd LOAD	408.15	2nd LOAD	377.03
3rd LOAD	663.11	3rd LOAD	611.38
4th LOAD	968.33	4th LOAD	890.12
5th LOAD	1265.78	5th LOAD	1187.23
6th LOAD	1535.95	6th LOAD	1503.46

LOADING PATTERN FOR 3.0m ANT AT 200 Km/h AT 90º

ANT. SIZE	3.00	m	
ANT. RAD	1500.00	mm	860.00 mm

LOAD (Fa)	0.00 Kg	ARM LENGTH OF Fs	0.65	m
LOAD (Fs)	850.00 Kg	MOMENT DUE TO Fs	0.00	Kgm
MOMENT M	504.00 Kgm	TOTAL MOMENT (Mt)	0.00	Kgm

CENTROIDE OF SEMI – CIRCLE "L(cg)" = (4*R/3*PI) 636.62 mm

LOAD TO BE SHIFTED FROM LEFT (Mt/L(cg) - 9.82 - 10.00

NO OF Wts TO BE SHIFTED FROM LEFT 1.00

LOAD ON LEFT HALF -10.00 LOAD ON RIGHT HALF

LOADING PATTERN LEFT HALF LOADING PATTERN RIGHT HALF

1st RING	0.00	Kg	1st RING	0.00	Kg
2nd RING	0.00	Kg	2nd RING	0.00	Kg
3rd RING	0.00	Kg	3rd RING	0.00	Kg
4th RING	0.00	Kg	4th RING	0.00	Kg
5th RING	0.00	Kg	5th RING	0.00	Kg
6th RING	0.00	Kg	6th RING	0.00	Kg
TOTAL	0.00	Kg	TOTAL	0.00	Kg

RADIUS (IN THE PROJECTED CIRLE) AT WHICH LOADS AS ABOVE SHALL PROCEDURE UNIFORM LOADING.

LEFT		RIGHT	
LOAD/UNIT AREA	0.00		0.00

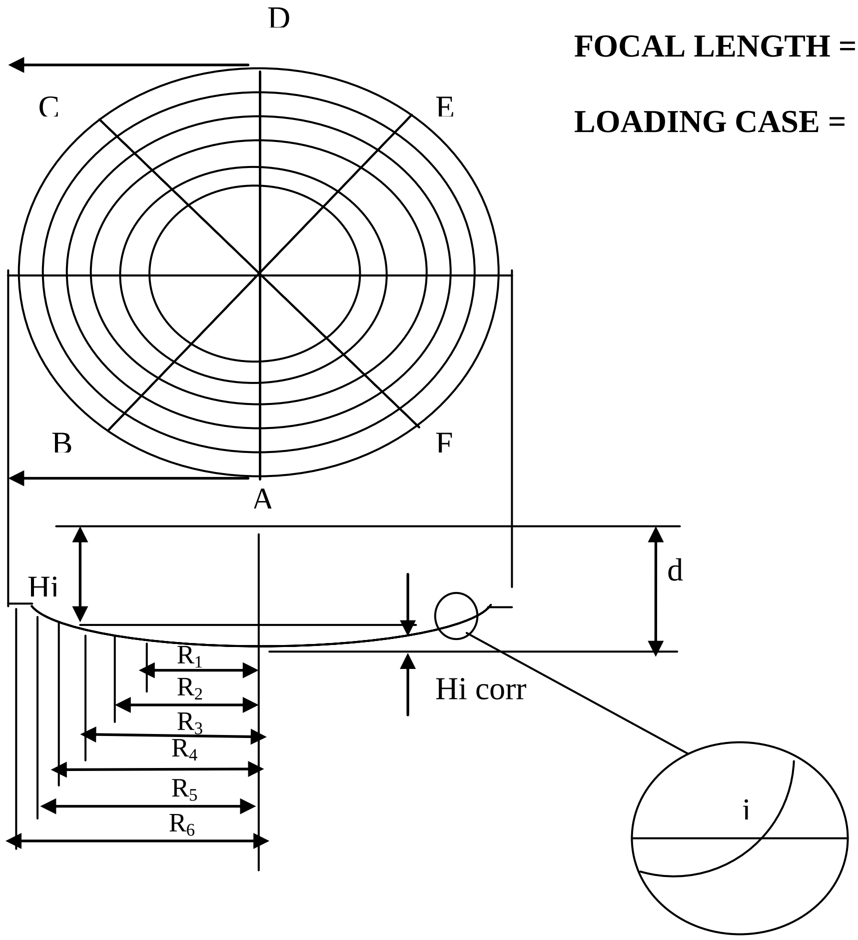
1st RING	ERR	1st RING	ERR
2nd RING	ERR	2nd RING	ERR
3rd RING	ERR	3rd RING	ERR
4th RING	ERR	4th RING	ERR
5th RING	ERR	5th RING	ERR
6th RING	ERR	6th RING	ERR

WIND LOAD TEST ON PARABOLIC REFLECTOR

DIA =

FOCAL LENGTH =

LOADING CASE =



Recorded values of the reference points [Hi] mm

Radius R	R_1	R_2	R_3	R_4	R_5	R_6	Rim
0 – A							
0 – B							
0 – C							
0 – D							
0 – E							
0 – F							

Mean value of readings on circle of Radius R_1 [mm]

$$\overline{H} = \sum_{n=1}^{6} \frac{H_i , R_1}{n}$$

Theoretical depth of circle of radius R_1

$$H_{t\,,} R_1 = \frac{R_1^{\,2}}{4 \text{ x } f}$$

Height of theodolite reference line with respect to reflector aperture

$$d = [\,\overline{H} + H_{t\,,} R_1\,]$$

Actual height from apex of paraboloid

$$\text{Hi corr} = d - H_i$$

Radius R	R_1	R_2	R_3	R_4	R_5	R_6
0 – A						
0 – B						
0 – C						
0 – D						
0 – E						
0 – F						

H_t						

Difference between theoretical and corrected value

$$\triangle i = \text{Hi corr} - H_t$$

Radius R	R_1	R_2	R_3	R_4	R_5	R_6
0 – A						
0 – B						

0 – C						
0 – D						
0 – E						
0 – F						

α						
Cos α						

After application of Correction Factor

$$\triangle_{n_i} = \triangle_i \cdot \cos \alpha$$

Radius R	R_1	R_2	R_3	R_4	R_5	R_6
0 – A						
0 – B						
0 – C						
0 – D						
0 – E						
0 – F						

ANNEXURE-IV

CALCULATION OF BEAM CENTRE DEFLECTION

Dia. of the reflector =D meter

Test conducted at simulated wind load corresponding to wind angle 90 deg.

Reading at points of rim (mm)

Point	Before Load	With load	Diff.
A			
B			
C			
D			
E			
F			
G			
H			

Displacement of the diagonally apposite points.

AD =
BE =
CF =
GH =

Worst value of displacement on the rim = X mm (say)

Angular deflection for this displacement of fixing points N1 & N2

Point	Before Load	After load	Diff.
N1			
N2			

Total deflection N1-N2 = Y mm (say)

Distance between N1 and N2 = Z mm (say)

Angular deflection for this displacement = tan (Y/Z) _ _ _ _ _ (II)

Net Beam centre deflection art 200 Km/hr = (I) – (II) = _ _ _ _ _ (III)

Net Beam centre deflection Corresponding to 110 Km/hr = (III) * 110*110 / (200*200) deg