

**Transmission and Multiplexing (TM);  
Digital Radio Relay Systems (DRRS);  
Part 1: Antennas for Point-to-Point (P-P) radio links  
in the 1 GHz to 3 GHz band**

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*European Telecommunications Standards Institute*

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## Foreword

This European Standard (Telecommunications series) has been produced by ETSI Technical Committee Transmission and Multiplexing (TM), and is now submitted for the ETSI standards Vote Procedure.

It was decided by TM to split the original document (ETS 300 631, processed through Public Enquiry 88) into two parts. This part 1 deals with Point-to-Point (P-P) antennas while part 2 deals with Point-to-Multipoint (P-M) antennas.

The purpose of the present document is to define the antenna performance standards necessary to ensure optimum frequency co-ordination between services in the re-planned 1 GHz to 3 GHz band. The 3 GHz upper limit has been introduced making reference to the WRC-95 Final Acts [3] and the frequency plans as given in CEPT Recommendation T/R 13-01 [1].

Additional parameters appropriate to system implementation may be subject to agreement between the equipment purchaser and supplier. Further guidance is provided in annex A.

Proposed transposition dates	
Date of latest announcement of this EN (doa):	3 months after ETSI publication
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	6 months after doa
Date of withdrawal of any conflicting National Standard (dow):	6 months after doa

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# 1 Scope

The present document addresses the requirements for directional fixed beam antennas to be utilized with new Point-to-Point (P-P) systems operating in the frequency band 1 GHz to 3 GHz. Electronically steerable antennas, and circularly polarized antennas will not be considered under the present document.

The application of these Digital Radio Relay Systems (DRRS) is anticipated to be for P-P links in local, regional and national networks, mobile base station connections, customer access links, telemetering and telecontrol (including transportable and offshore use).

Only in exceptional circumstances, after a consultation period with operators and manufactures, a Regulatory Authority may impose tighter requirements than the minimum values given in the present document, in order to maximize the use of the scarce spectrum resources.

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# 2 Normative references

References may be made to:

- a) specific versions of publications (identified by date of publication, edition number, version number, etc.), in which case, subsequent revisions to the referenced document do not apply; or
- b) all versions up to and including the identified version (identified by "up to and including" before the version identity); or
- c) all versions subsequent to and including the identified version (identified by "onwards" following the version identity); or
- d) publications without mention of a specific version, in which case the latest version applies.

A non-specific reference to an ETS shall also be taken to refer to later versions published as an EN with the same number.

- [1] CEPT Recommendation T/R 13-01: "Preferred Channel Arrangement for Fixed Services in the range 1-3 GHz".
- [2] ITU-R Recommendation F.746: "Radio-Frequency channel arrangements for radio-relay systems", version Geneva 1994.
- [3] Final Acts of the World Radiocommunications Conference (WRC-95), Geneva 1995.
- [4] DEN/TM-04026-01: "Transmission and Multiplexing (TM); Digital Radio Relay Systems (DRRS); Conformance testing for DRRS; Part 1: Point-to-point equipment parameters".

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# 3 Definitions, symbols and abbreviations

## 3.1 Definitions

For the purposes of the present document, the following definitions apply:

**antenna:** That part of the transmitting or receiving system that is designed to radiate or receive electromagnetic waves.

**co-polar pattern:** A diagram representing the radiation pattern of a test antenna when the reference antenna is similarly polarized, scaled in dBi or dB relative to the measured antenna gain.

**Cross-Polar Discrimination (XPD):** The difference between the peak of the co-polarized main beam and the maximum cross-polarized signal over an angle twice the half power beamwidth of the co-polarized main beam.

**cross-polar pattern:** A diagram representing the radiation pattern of a test antenna when the reference antenna is orthogonally polarized, scaled in dBi, or dB relative to the measured antenna gain.

**gain:** The ratio of the radiation intensity, in a given direction, to the radiation intensity that would be obtained if the power accepted by the antenna was radiated isotropically.

**half power beamwidth:** The angle between the two directions at which the measured co-polar pattern is 3 dB below the value on the main beam axis.

**isotropic radiator:** A hypothetical, lossless antenna having equal radiation intensity in all directions.

**main beam:** The radiation lobe containing the direction of maximum radiation.

**main beam axis:** The direction for which the radiation intensity is maximum.

**radiation pattern:** A diagram relating power flux density at a constant distance from the antenna to the direction relative to the antenna main beam axis.

**Radiation Pattern Envelope (RPE):** An envelope below which the radiation pattern shall fit.

**radome:** A cover of dielectric material, intended to protect an antenna from the effects of its physical environment.

## 3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

DRRS	Digital Radio Relay Systems
P-P	Point-to-Point
RPE	Radiation Pattern Envelope
XPD	Cross-Polar Discrimination
UV	Ultra Violet
VSWR	Voltage Standing Wave Ratio

## 3.3 Symbols

For the purposes of the present document, the following symbols apply:

dB	decibel
dBi	decibels relative to an isotropic radiator
MHz	MegaHertz
GHz	GigaHertz

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## 4 Frequency bands

The present document applies to the frequency bands given in CEPT Recommendation T/R 13-01 [1] and ITU-R Recommendation F.746 [2].

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## 5 Classification of antennas

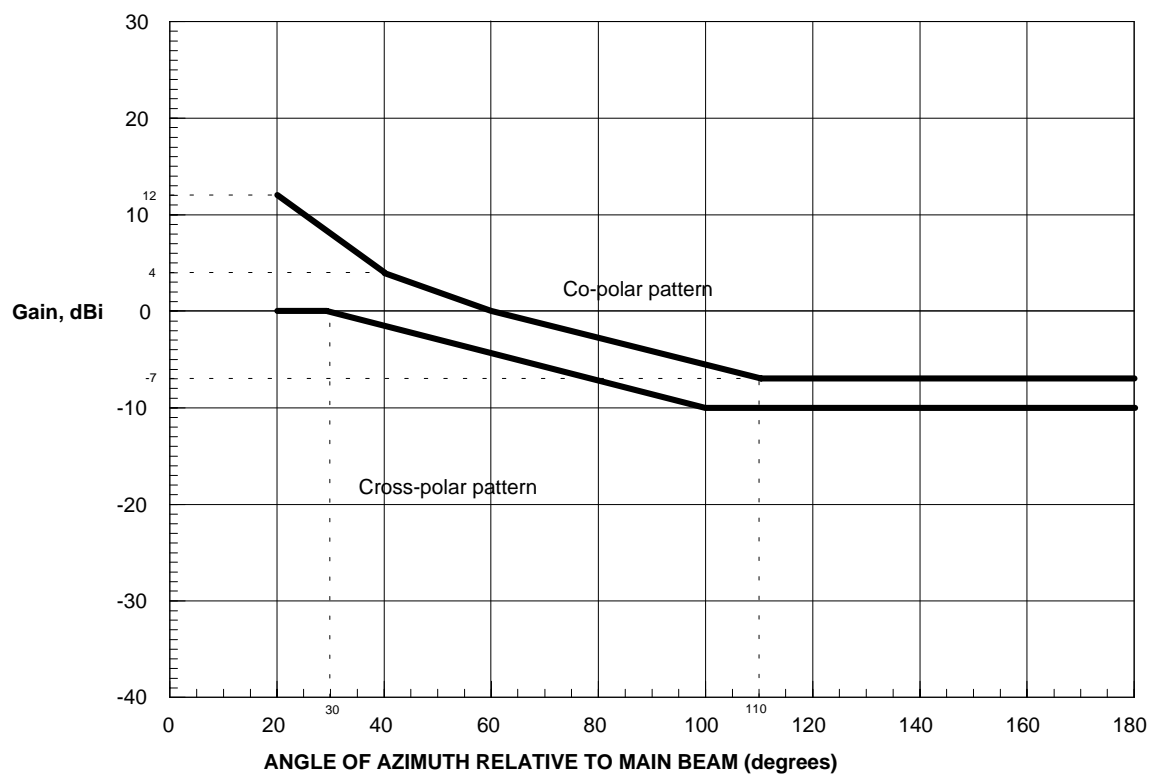
With respect to Radiation Pattern Envelopes (RPEs), three classes of antennas have been identified:

- Class 1: Those antennas required for environments where interference is unlikely.
- Class 2: Those antennas required for use in networks where there is a low interference potential.
- Class 3: Those antennas required for use in networks where there is a high interference potential.

## 6 Electrical characteristics

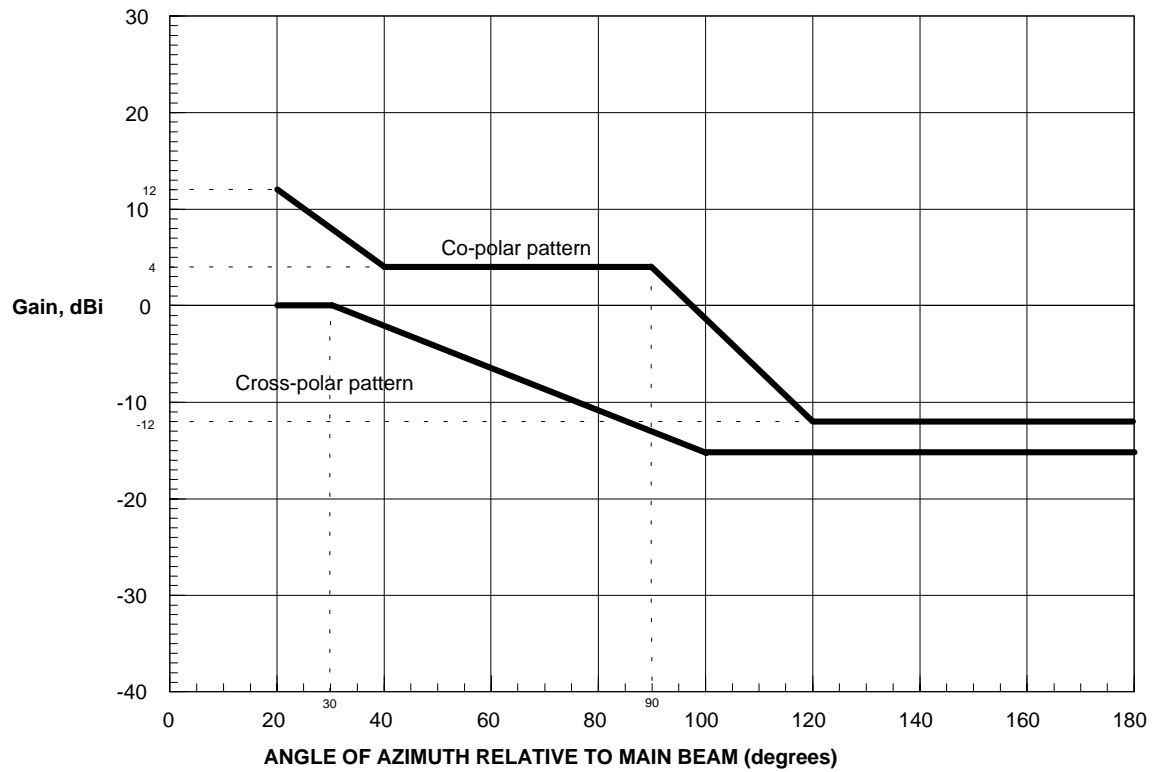
### 6.1 RPE

The choice of antenna depends on the application planned for this band, requirements of the operators and the responsible administration. Figures 1 to 5 give the RPEs for antenna classes 1 to 3.



Angle (degree)	Co-polar (dBi)	Angle (degree)	Cross-polar (dBi)
20	12	20	0
40	4	30	0
110	-7	100	-10
180	-7	180	-10

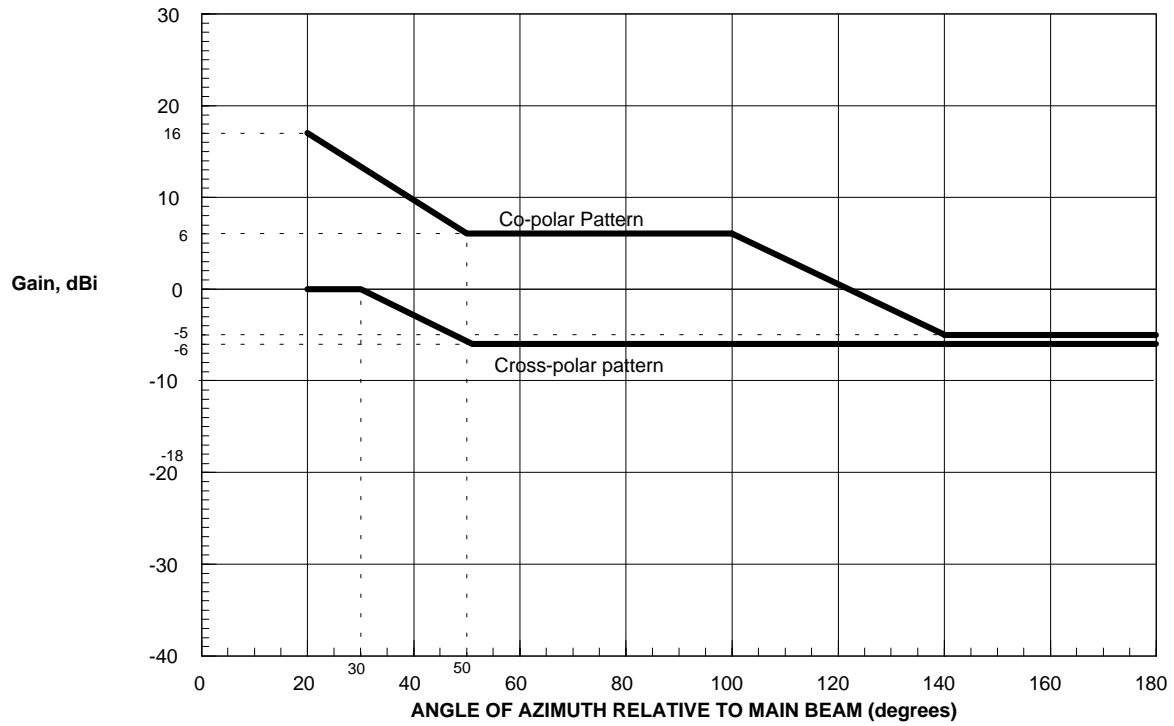
Figure 1: Class 1 antenna



Angle (degree)	Co-polar (dBi)	Angle (degree)	Cross-polar (dBi)
20	12	20	0
40	4	30	0
90	4	100	-15
120	-12	180	-15
180	-12		

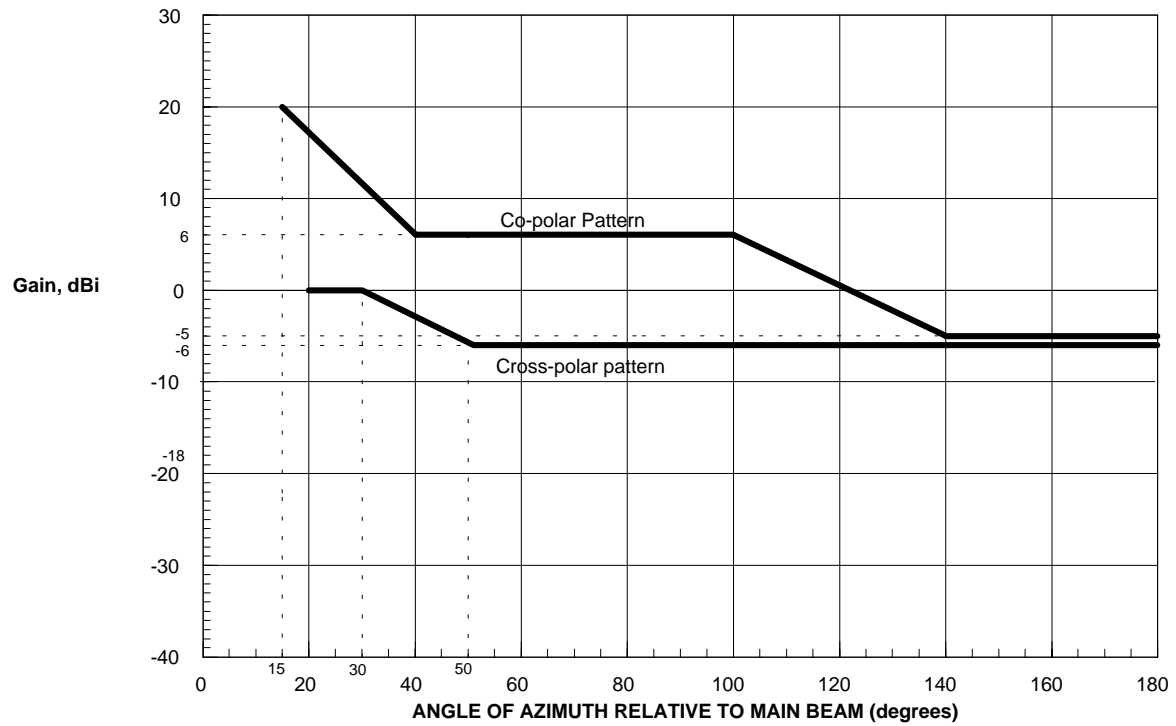
Figure 2: Class 2 antenna





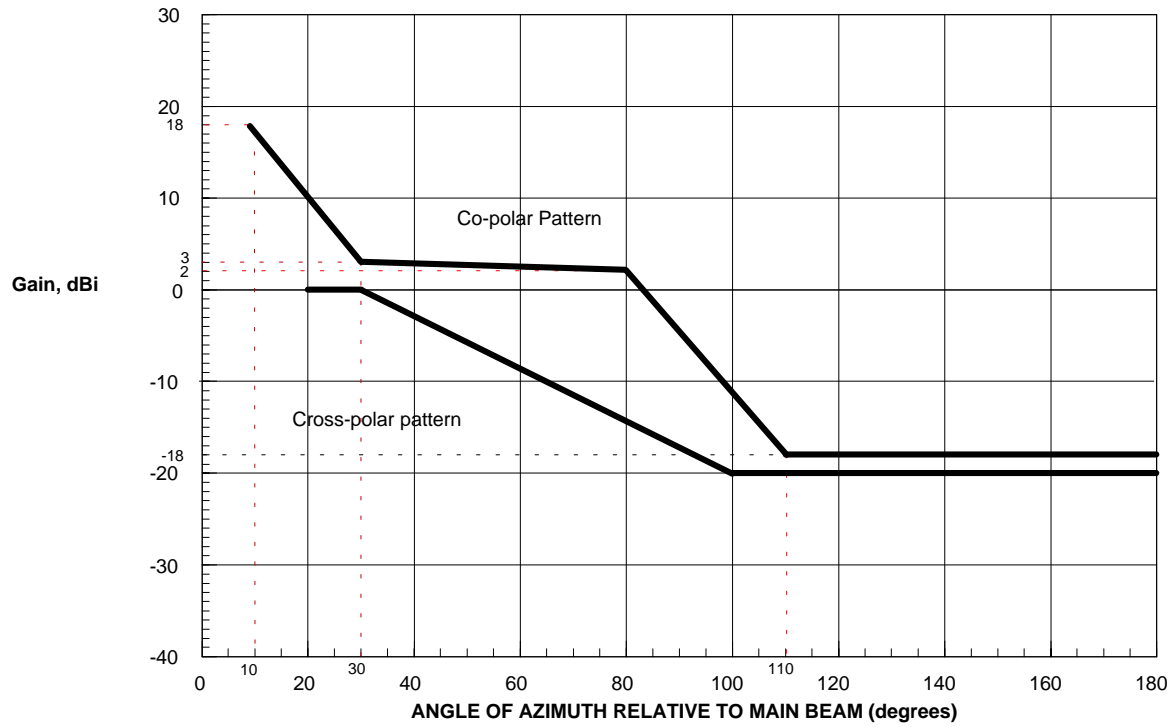
Angle (degree)	Co-polar (dBi)	Angle (degree)	Cross-polar (dBi)
20	16	20	0
50	6	30	0
100	6	50	-6
140	-5	180	-6
180	-5		

Figure 3: Class 2 antenna



Angle (degree)	Co-polar (dBi)	Angle (degree)	Cross-polar (dBi)
15	20	20	0
40	6	30	0
100	6	50	-6
140	-5	180	-6
180	-5		

Figure 4: Class 2 antenna



Angle (degree)	Co-polar (dBi)	Angle (degree)	Cross-polar (dBi)
10	18	20	0
30	3	30	0
80	2	100	-20
110	-18	180	-20
180	-18		

Figure 5: Class 3 antenna

## 6.2 Cross-Polar Discrimination (XPD)

The XPDs corresponding with the RPEs referenced in subclause 6.1 shall be equal to or higher than those values defined in table 1.

**Table 1: Minimum XPD for each antenna class**

Class	Figure	XPD (dB)
1	1	20
2	2, 3 and 4	25
3	5	25

## 6.3 Antenna gain

The gain of the antenna shall be expressed relative to an isotropic radiator as detailed in table 2.

**Table 2: Minimum antenna gain for each antenna class**

Class	Figure	Minimum Gain (dBi)
1	1	13
2	2	16
2	3	16
2	4	20
3	5	20

## 6.4 Radomes

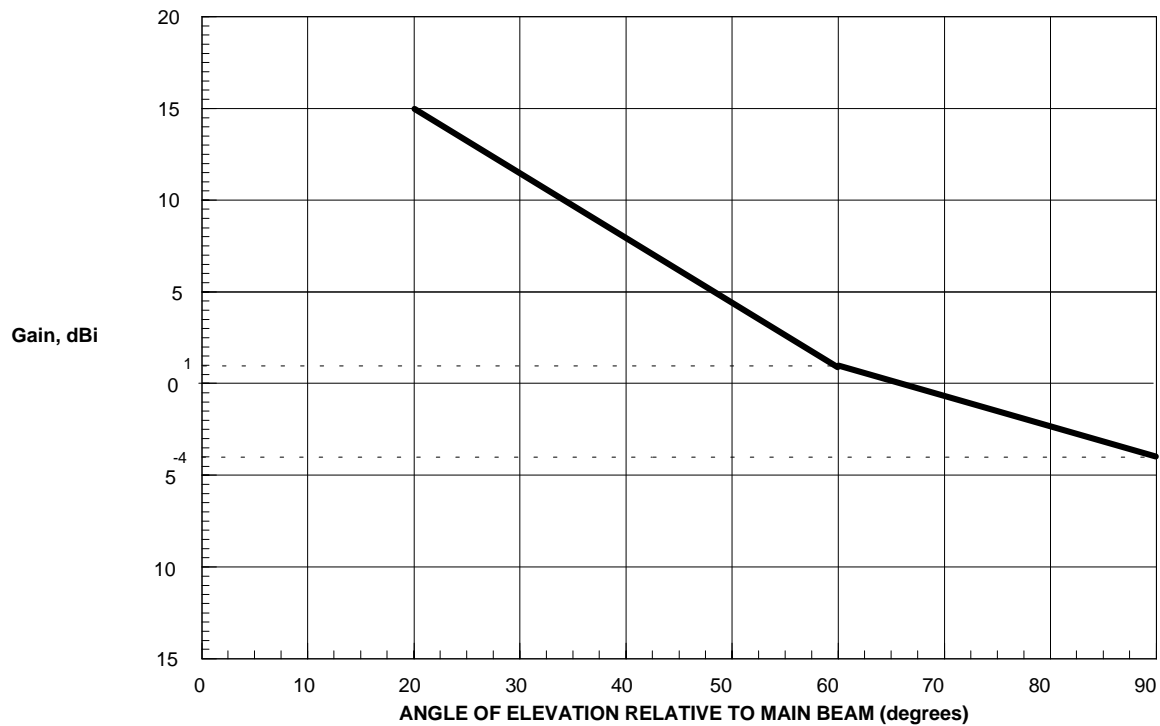
Antenna systems using radomes shall conform to the maximum RPE and minimum XPD values described in subclauses 6.1 and 6.2 with the radome in place.

## 6.5 Antenna polarization

The antenna system shall radiate a linearly (single or dual) polarized wave.

## 6.6 Elevation RPE for class 1 antennas

For class 1 the antenna shall conform to the elevation RPE as provided in figure 6.



Angle (degree)	dBi
20	15
60	1
90	-4

Figure 6: Elevation RPE for class 1 antennas

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## 7 Conformance tests

DEN/TM-04026-01 [4] shall apply.

## Annex A (informative): Antenna characteristics

### A.1 Mechanical characteristics

#### A.1.1 Environmental characteristics

The antenna should be designed to operate within a temperature range of  $-45^{\circ}\text{C}$  to  $+45^{\circ}\text{C}$  with a relative humidity up to 100 % with salt mist, industrial atmosphere, Ultra Violet (UV)-irradiation etc.

The temperature range could be divided in two parts where at least one of the following ranges should be covered:

- 1)  $-33^{\circ}\text{C}$  to  $+40^{\circ}\text{C}$ ;
- 2)  $-45^{\circ}\text{C}$  to  $+45^{\circ}\text{C}$ .

The antenna should be designed to meet wind survival ratings specified in table A.1.

**Table A.1: Wind survival ratings**

Antenna type	Wind velocity m/s (km/h)	Ice load (density 7 kN/m <sup>3</sup> )
Normal duty	55 (200)	25 mm radial ice
Heavy duty	70 (252)	25 mm radial ice

#### A.1.2 Antenna stability

The antenna equipment should be stable under the most severe operational conditions at the site of intended application.

For installation on trellis or towers, the deviation of the antenna main beam axis should not be more than 0,3 times the -3 dB beamwidth under the conditions specified in table A.2.

**Table A.2: Antenna stability**

Antenna type	Wind velocity m/s (km/h)	Ice load (density 7 kN/m <sup>3</sup> )
Normal duty	30 (110)	25 mm radial ice
Heavy duty	45 (164)	25 mm radial ice

### A.2 Antenna input connectors

The input connector on the antenna should be mechanically compatible with the radio equipment, this should be agreed between the antenna supplier and the purchaser. Attention is drawn to a range of coaxial connectors referred to in IEC 339, Parts 1 and 2, IEC 169-1, and CENELEC CECC 22.150 and 22.151 (see annex B). However, it should be noted that these standards are not exhaustive. The impedance of the input ports shall be nominally 50  $\Omega$  coaxial.

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## A.3 Voltage Standing Wave Ratio (VSWR) at the input ports

An input port is defined as the connection point through which access to the antenna system is given.

The maximum VSWR should be agreed between the equipment supplier and purchaser in line with the overall system design requirements.

For guidance antennas with a VSWR in a range of 1:6 to 1:1 are typical.

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## A.4 Inter-port isolation

Concerning dual polarized antennas, the isolation between the two inputs should be agreed between the equipment supplier and purchaser in line with the overall system design requirements.

For guidance the isolation between ports may be between 25 dB and 35 dB.

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## A.5 Antenna labelling

Antennas should be clearly identified with a weather-proof and permanent label showing the manufacturers name, antenna type, serial number and type approval reference number which identifies the country of origin.

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## Annex B (informative): Bibliography

The following references are given for information:

- IEC 339, Parts 1 and 2: "General purpose rigid coaxial transmission lines and their associated flange connectors".
- IEC 169: "Radio-frequency connectors. Part 1: General requirements and measuring methods", and applicable sub-parts.
- CENELEC CECC 22.150: "Radio frequency coaxial connectors - Series EIA flange".
- CENELEC CECC 22.151: "Radio frequency coaxial connectors - Series EIA flange".
- ANSI/EIA Standard 195-C: "Electrical and Mechanical Characteristics for Terrestrial Microwave Relay System Antennas and Passive Reflector".



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## History

Document history				
	July 1995	Public Enquiry	PE88:	1995-07-24 to 1995-11-17
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