

SLOVENSKI STANDARD

SIST EN 55016-1-5:2015

01-april-2015

Nadomešča:

SIST EN 55016-1-5:2005

SIST EN 55016-1-5:2005/A1:2013

Specifikacija za merilne naprave in metode za merjenje radijskih motenj in odpornosti - 1-5. del: Merilne naprave za merjenje radijskih motenj in odpornosti - Preskuševališča za kalibriranje anten in referenčna preskuševališča za 5 Mhz do 18 Mhz

Specification for radio disturbance and immunity measuring apparatus and methods - Part 1-5: Radio disturbance and immunity measuring apparatus - Antenna calibration sites and reference test sites for 5 MHz to 18 GHz

Anforderungen an Geräte und Einrichtungen sowie Festlegung der Verfahren zur Messung der hochfrequenten Störaussendung (Funkstörungen) und Störfestigkeit - Teil 1-5: Geräte und Einrichtungen zur Messung der hochfrequenten Störaussendung (Funkstörungen) und Störfestigkeit - Messplätze für die Antennenkalibrierung und Referenz-Messplätze für den Frequenzbereich von 5 MHz bis 18 GHz

Ta slovenski standard je istoveten z: EN 55016-1-5:2015

ICS:

17.220.20	Merjenje električnih in magnetnih veličin	Measurement of electrical and magnetic quantities
33.100.20	Imunost	Immunity

SIST EN 55016-1-5:2015

en

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[SIST EN 55016-1-5:2015](#)

<https://standards.iteh.ai/catalog/standards/sist/87801f9a-0030-47e2-a137-54b0d6934989/sist-en-55016-1-5-2015>

EUROPEAN STANDARD

EN 55016-1-5

NORME EUROPÉENNE

EUROPÄISCHE NORM

February 2015

ICS 33.100.10; 33.100.20

Supersedes EN 55016-1-5:2004

English Version

Specification for radio disturbance and immunity measuring
apparatus and methods -
Part 1-5: Radio disturbance and immunity measuring apparatus -
Antenna calibration sites and reference
test sites for 5 MHz to 18 GHz
(CISPR 16-1-5:2014)

Spécification des méthodes et des appareils de mesure des
perturbations radioélectriques et de l'immunité aux
perturbations radioélectriques -

Partie 1-5: Appareils de mesure des perturbations
radioélectriques et de l'immunité aux perturbations
radioélectriques - Emplacements d'étalonnage d'antenne et
emplacements d'essai de référence pour la plage comprise
entre 5 MHz et 18 GHz
(CISPR 16-1-5:2014)

Anforderungen an Geräte und Einrichtungen sowie
Festlegung der Verfahren zur Messung der hochfrequenten
Störaussendung (Funkstörungen) und Störfestigkeit -
Teil 1-5: Geräte und Einrichtungen zur Messung der
hochfrequenten Störaussendung (Funkstörungen) und
Störfestigkeit - Messplätze für die Antennenkalibrierung und
Referenz-Messplätze für den Frequenzbereich
von 5 MHz bis 18 GHz
(CISPR 16-1-5:2014)

(standards.iteh.ai)

This European Standard was approved by CENELEC on 2015-01-21. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.



European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

Foreword

The text of document CISPR/A/1086A/FDIS, future edition 2 of CISPR 16-1-5, prepared by CISPR SC A "Radio-interference measurements and statistical methods" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 55016-1-5:2015.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2015-10-21
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2018-01-21

This document supersedes EN 55016-1-5:2004.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC [and/or CEN] shall not be held responsible for identifying any or all such patent rights.

Endorsement notice

The text of the International Standard CISPR 16-1-5:2014 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

CISPR 16-1-1:2010	NOTE	Harmonized as EN 55016-1-1:2010 (not modified).
CISPR 16-1-1:2010/A1:2010	NOTE	Harmonized as EN 55016-1-1:2010/A1:2010 (not modified).
CISPR 16-2-3:2010	NOTE	Harmonized as EN 55016-2-3:2010 (not modified).
CISPR 16-2-3:2010/A1:2010	NOTE	Harmonized as EN 55016-2-3:2010/A1:2010 (not modified).
CISPR 16-4 Series	NOTE	Only Part 4-2 harmonized as EN 55016-4-2.

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE 1 When an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
CISPR 16-1-4	2010	Specification for radio disturbance and immunity measuring apparatus and methods -	EN 55016-1-4	2010
+A1	2012	Part 1-4: Radio disturbance and immunity measuring apparatus - Antennas and test sites for radiated disturbance measurements	+A1	2012
CISPR 16-1-6	2014	Specification for radio disturbance and immunity measuring apparatus and methods -	EN 55016-1-6	2015
		Part 1-6: Radio disturbance and immunity measuring apparatus - EMC-antenna calibration		
IEC 60050	Series	International Electrotechnical Vocabulary	-	-

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[SIST EN 55016-1-5:2015](#)

<https://standards.iteh.ai/catalog/standards/sist/87801f9a-0030-47e2-a137-54b0d6934989/sist-en-55016-1-5-2015>



CISPR 16-1-5

Edition 2.0 2014-12

INTERNATIONAL STANDARD

NORME INTERNATIONALE



INTERNATIONAL SPECIAL COMMITTEE ON RADIO INTERFERENCE
COMITÉ INTERNATIONAL SPÉCIAL DES PERTURBATIONS RADIOÉLECTRIQUES

BASIC EMC PUBLICATION
PUBLICATION FONDAMENTALE EN CEM

iTeh STANDARD PREVIEW
(standards.iteh.ai)

**Specification for radio disturbance and immunity measuring apparatus and methods –
Part 1-5: Radio disturbance and immunity measuring apparatus – Antenna calibration
sites and reference test sites for 5 MHz to 18 GHz**

**Spécification des méthodes et des appareils de mesure des perturbations
radioélectriques et de l'immunité aux perturbations radioélectriques –
Partie 1-5: Appareils de mesure des perturbations radioélectriques et de l'immunité aux
perturbations radioélectriques – Emplacements d'étalonnage d'antenne et
emplacements d'essai de référence pour la plage comprise entre 5 MHz et 18 GHz**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

PRICE CODE **XD**
CODE PRIX

ICS 33.100.10; 33.100.20

ISBN 978-2-8322-1932-4

**Warning! Make sure that you obtained this publication from an authorized distributor.
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.**

CONTENTS

FOREWORD.....	6
INTRODUCTION.....	8
1 Scope.....	10
2 Normative references	10
3 Terms, definitions and abbreviations	10
3.1 Terms and definitions.....	10
3.1.1 Antenna terms	11
3.1.2 Measurement site terms	13
3.1.3 Other terms	14
3.2 Abbreviations.....	15
4 Specifications and validation procedures for CALTS and REFTS from 5 MHz to 1 000 MHz.....	16
4.1 General.....	16
4.2 Antenna calibration test site (CALTS) specification	16
4.2.1 General	16
4.2.2 Normative specification.....	17
4.3 Test antenna specification	17
4.3.1 General	17
4.3.2 Details of the required characteristics of the test antenna	18
4.4 Antenna calibration test site validation procedure	20
4.4.1 General	20
4.4.2 Test set-up.....	20
4.4.3 Test frequencies and receive antenna heights.....	22
4.4.4 SIL measurements.....	22
4.4.5 Swept frequency SIL measurements.....	25
4.4.6 Identifying and reducing reflections from antenna supports.....	28
4.5 Antenna calibration test site acceptance criteria	28
4.5.1 General	28
4.5.2 Measurement uncertainties.....	28
4.5.3 Acceptance criteria	29
4.6 Calibration site with a metal ground plane for biconical antennas and tuned dipole antennas over the frequency range 30 MHz to 300 MHz	30
4.7 Validation of a REFTS	31
4.7.1 General	31
4.7.2 Validation for horizontal polarization	31
4.7.3 Validation for vertical polarization	31
4.8 Validation report for CALTS and REFTS	33
4.8.1 General	33
4.8.2 Validation report requirements.....	33
4.9 Site validation for the calibration of biconical and dipole antennas, and the biconical part of hybrid antennas in vertical polarization.....	34
4.10 Validation of a CALTS using vertical polarization from 5 MHz to 30 MHz for the calibration of monopole antennas.....	35
4.10.1 General	35
4.10.2 Uncertainty evaluation	36
5 Validation methods for a FAR from 30 MHz to 18 GHz.....	36
5.1 General.....	36

5.2	Validation procedure 1 GHz to 18 GHz.....	37
5.2.1	Power transfer between two antennas	37
5.2.2	Measurement procedure for validation from 1 GHz to 18 GHz.....	37
5.2.3	Analysis of results	39
5.2.4	Acceptance criterion	40
5.2.5	Chamber performance versus polarization	41
5.2.6	Uncertainty	41
5.3	Validation of a FAR for the calibration of antennas by alternative methods.....	42
5.3.1	General	42
5.3.2	Validation of a FAR from 30 MHz to 1 GHz	42
5.3.3	Alternative validation of a FAR for the calibration of LPDA antennas above 1 GHz.....	42
5.3.4	Alternative validation of a FAR applying time-domain measurements above 500 MHz.....	43
6	Validation methods for sites used for the calibration of directive antennas	43
6.1	Validation of the calibration site minimizing ground reflection by a height ≥ 4 m	43
6.1.1	Measurement procedure	43
6.1.2	Uncertainties	45
6.2	Validation of the calibration site minimizing ground reflection by use of absorber	46
7	Site validation by comparison of antenna factors, and application of RSM to evaluate the uncertainty contribution of a SAC site	47
7.1	Use of SAM for site validation by comparison of antenna factors	47
7.2	Application of RSM to evaluate the measurement uncertainty contribution of a calibration site comprising a SAC	48
Annex A (informative)	CALTS characteristics and validation	50
A.1	General.....	50
A.2	The reflecting plane	50
A.2.1	Reflecting plane construction.....	50
A.2.2	Plane-edge effects and plane surroundings	51
A.3	Ancillary equipment	51
A.4	Additional stringent CALTS validation testing	52
A.4.1	General	52
A.4.2	Antenna-height scan measurements	52
A.4.3	Frequency scan measurements	53
Annex B (informative)	Test antenna considerations.....	56
B.1	General.....	56
B.2	Example and verification of a test antenna	56
B.3	Determination of balun properties	58
B.3.1	The ideal lossless balun	58
B.3.2	Relations between balun properties and <i>S</i> -parameters	59
B.3.3	Insertion loss measurements	60
Annex C (informative)	Antenna and SIL theory.....	63
C.1	Analytical relations.....	63
C.1.1	General	63
C.1.2	Total length of the test antenna	64
C.1.3	Theoretical SIL	65
C.1.4	Calculation example	69

C.2	Computations by the MoM.....	72
C.2.1	General	72
C.2.2	Antenna input impedance	73
C.2.3	Total length of the test antenna	73
C.2.4	SIL computations	73
C.2.5	Antenna factor (AF) computations.....	80
Annex D (informative)	Pascal Program used in C.1.4	84
Annex E (informative)	Validation procedure checklist.....	88
Annex F (informative)	Evidence that field taper of VP site validation method has negligible effect on measured antenna factor	90
F.1	Investigation of vertical field taper.....	90
F.2	Calibration of biconical antennas using vertical polarization.....	90
Bibliography	92
Figure 1	– Schematic diagram of the test antenna	18
Figure 2	– Adjustment of a telescopic wire element to the length L_{we}	19
Figure 3	– Determination of $V_{r1}(f)$ or $V_{r2}(f)$	23
Figure 4	– Determination of $V_S(f)$ with the wire antennas in their specified positions	23
Figure 5	– Example NSIL: horizontal polarization, antenna height 2 m, separation 10 m	26
Figure 6	– NSIL of the four pairs of calculable dipoles at 10 m separation and using the alternative heights for the 600 MHz to 1 000 MHz pair according to Table 5.....	27
Figure 7	– Relation between the quantities used in the SIL acceptance criterion	29
Figure 8	– Set-up of site validation for EMC antenna calibrations above 1 GHz in a FAR, also showing distance between antenna phase centres	38
Figure 9	– Example plots of $[A_{im}(d) - A_{im}(d_3 m)]$ in dB against distance in m at 1 GHz to 18 GHz in 1 GHz steps, corrected for LPDA and horn phase centres	40
Figure 10	– Example of antenna set-up for an LPDA antenna calibration in the frequency range above 200 MHz.....	44
Figure 11	– Example of SIL versus antenna height measured at 200 MHz with two LPDA antennas in vertical polarization at 2,5 m distance between their midpoints above the reflecting ground plane of an OATS	45
Figure 12	– Illustration of distances of transmit horn to omni-directional receive antenna and reflective building, and transmitted signal paths A and B	45
Figure B.1	– Example of a test antenna	58
Figure B.2	– Diagram of the measurement of S_{11} and S_{12} , and of S_{22} and S_{21} , when generator and load are interchanged	59
Figure B.3	– Schematic diagram for determination of the insertion loss $A_1(f)$	61
Figure B.4	– Schematic diagram for determination of the insertion loss $A_2(f)$	61
Figure C.1	– Network model for A_{ic} calculations	66
Figure C.2	– Equivalent circuit to the network in Figure C.1	66
Figure C.3	– Definition of the mutual couplings, feed-terminal voltages and antenna currents of the antennas above the reflecting plane and their images	67
Figure C.4	– Cascade combination of the baluns and the site two-port network	74
Figure C.5	– Flow chart showing how SIL is obtained by combining the measured balun S -parameters and the NEC calculated S -parameters of the site two-port network	75
Figure F.1	– Field uniformity with height step 1 m to 2,6 m, normalized to field at 1,8 m height; monocone at 15 m range.....	90

Figure F.2 – Averaging of height steps, SAM, B.4.2 in CISPR 16-1-6:2014	91
Table 1 – Summary of site validation methods by subclause number	9
Table 2 – Maximum tolerances for $d = 10$ m	18
Table 3 – Frequency and fixed receive antenna height data for SIL measurements at 24 frequencies, with $h_t = 2$ m and $d = 10$ m [specified in 4.4.2.3 and 4.4.2.4]	22
Table 4 – RSM frequency steps	25
Table 5 (informative) – Antenna heights for SIL measurements	26
Table 6 – Antenna set-up for the SIL measurement of the calibration site using horizontally polarized resonant dipole antennas (see also 4.4.4 for SIL at 250 MHz and 300 MHz)	31
Table 7 – Antenna heights	32
Table 8 – Example measurement uncertainty budget for SIL between two monopole antennas	36
Table 9 – Example measurement uncertainty budget for FAR validation method at and above 1 GHz	41
Table 10 – Example measurement uncertainty budget for the site validation method in 6.1.1	46
Table 11 – Maximum tolerances for validation set-up at $d = 10$ m	49
Table A.1 – Example of fixed-length calculable dipole antennas and their subdivision of the frequency range 30 MHz to 1 000 MHz	51
Table A.2 – Receive antenna heights and centre frequencies	54
Table C.1 – Example numerical (analytical) calculation of L_a , A_{iC} (see C.1.4.2)	69
Table C.2 – Example numerical (analytical) calculation of ΔA_t (see C.1.4.3)	71
Table C.3 – Example numerical (analytical) calculation of h_{rC} and Δh_{rt}	72
Table C.4 – Example numerical (analytical) calculation of f_C and Δf_t	72
Table C.5 – MoM example calculation of A_{iC} for vertical polarization, $h_t = 2$ m, except $h_t = 2,75$ m at 30 MHz, 35 MHz and 40 MHz	78

INTERNATIONAL ELECTROTECHNICAL COMMISSION
INTERNATIONAL SPECIAL COMMITTEE ON RADIO INTERFERENCE

**SPECIFICATION FOR RADIO DISTURBANCE AND IMMUNITY
MEASURING APPARATUS AND METHODS –**

**Part 1-5: Radio disturbance and immunity measuring apparatus –
Antenna calibration sites and reference test sites for 5 MHz to 18 GHz**

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard CISPR 16-1-5 has been prepared by CISPR subcommittee A: Radio-interference measurements and statistical methods.

This second edition cancels and replaces the first edition published in 2003, and its Amendment 1 (2012). It constitutes a technical revision.

It has the status of a basic EMC publication in accordance with IEC Guide 107, *Electromagnetic compatibility – Guide to the drafting of electromagnetic compatibility publications*.

This edition includes the following significant technical changes with respect to the previous edition:

- site validation methods for other sites covered in CISPR 16-1-6 are added;
- smaller step sizes are specified for swept-frequency measurements;
- the minimum ground plane size is increased;
- other miscellaneous technical and editorial refinements are included.

The text of this standard is based on the following documents:

FDIS	Report on voting
CISPR/A/1086A/FDIS	CISPR/A/1097/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

A list of all parts of the CISPR 16 series can be found, under the general title *Specification for radio disturbance and immunity measuring apparatus and methods*, on the IEC website.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this amendment and the base publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

iTeh STANDARD PREVIEW
(standards.iteh.ai)

- reconfirmed,
 - withdrawn,
 - replaced by a revised edition, or
 - amended.
- [SIST EN 55016-1-5:2015
https://standards.iteh.ai/catalog/standards/sist/87801f9a-0030-47e2-a137-54b0d6934989/sist-en-55016-1-5-2015](https://standards.iteh.ai/catalog/standards/sist/87801f9a-0030-47e2-a137-54b0d6934989/sist-en-55016-1-5-2015)

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

This standard describes validation procedures for Calibration Test Sites (CALTS) that are used to calibrate antennas in the frequency range 5 MHz to 18 GHz. The associated antenna calibration procedures are described in CISPR 16-1-6.

Due to problems with suppressing ground reflections in the frequency range 30 MHz to 200 MHz, the main function of a reflecting ground plane is for the calibration of dipole, biconical, and hybrid antennas over the frequency range for which their H-plane patterns are uniform. The free-space antenna factor, F_a , for dipole antennas may be measured in a free-space environment above 200 MHz. Because of the difficulty of reducing reflections from objects that surround an antenna, and in particular the ground surface, a flat metal ground plane is used to ensure reproducibility of results and to enable the ground reflected signal to be precisely removed mathematically.

Requirements for the construction of a CALTS are given in Annex A. The specifications and validation procedures for a CALTS are given in Clause 4. The most precise way of validating a CALTS is to use calculable dipole antennas, which are the basis of the validation procedure in this standard. The design principles of calculable antennas are given in Annex B, and the theory and methods for calculating site insertion loss (SIL) are given in Annex C and Annex D.

Validation procedures for other antenna calibration sites are given in Clause 5 through Clause 7. Where an antenna calibration method utilizes the ground reflection, a CALTS is required. The validation methods are summarized in Table 1 with reference to the associated antenna calibration methods in CISPR 16-1-6.

All site validation methods involve the measurement of SIL between two antennas. It is critical that the validation of the site itself not be unduly compromised by reflections from antenna supports; see A.3 for associated guidance.

<https://standards.iteh.ai/catalog/standards/sist/87801f9a-0030-47e2-a137-54b0d6934989/sist-en-55016-1-5-2015>

Table 1 – Summary of site validation methods by subclause number

Calibration site(s)	CISPR 16-1-5 validation method(s) Subclause	CISPR 16-1-6:2014 calibration method(s) Subclause	Frequency range MHz	Antenna type(s)	Polarization	Notes
1 CALTS for monopoles	4.10	G.1	5 to 30	Monopole	VP	With tolerance of ± 1 dB
2 CALTS or SAC ^a	4, 7.2	8.4	30 to 1000	Biconical, LPDA, hybrid	HP	SSM
3 CALTS or SAC	4	9.2.2	30 to 300	Biconical, hybrid, dipole	HP or VP	At large height or with absorber on ground
4 FAR	5.3.2	9.2.2	30 to 300 60 to 1000	Biconical, hybrid, dipole Biconical, dipole	HP	
5 REFTS CALTS	4.7 4.9	9.3	30 to 300	Biconical, hybrid	VP	
6 Free space	6.1	9.4.2 9.4.3	200 to 18000	LPDA, hybrid, horn	VP	HP with greater height
7 Free space	6.2	9.4.4	200 to 18000	LPDA, hybrid, horn	VP (or HP)	With absorber on ground
8 FAR	5.3.3	9.5	1000 to 18000	Horn, LPDA	HP or VP	
9 FAR	5.3.2	9.2 and 9.4	140 to 1000	LPDA, hybrid	HP or VP	
10 CALTS	4.6	B.4, B.5	30 to 300	Biconical, dipole	HP	
11 Transfer of properties of a validated site to a site not validated by methods in other clauses	7.1 (excluding 5.3 FAR)	A.9.4	30 and above	Any, but not monopole or loop	HP or VP	Use primarily for SAM and FAR, for particular antenna types and frequencies, except 5.3

^a A CALTS is well specified as being free of reflecting obstacles, and if the antenna supports have negligible reflections the ground plane itself is likely to provide results that agree with the theoretical performance to better than 0,5 dB. However for a Semi Anechoic Chamber (SAC), it is important that the entire allowed acceptance criterion of 1 dB is not taken up by wall reflections, leaving no latitude for other uncertainty components such as reducing reflections from masts and cables.