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AMENDMENT 1
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INTERNATIONAL SPECIAL COMMITTEE ON RADIO INTERFERENCE

Amendment 1

Specification for radio disturbance and immunity measuring apparatus and methods –

Part 1-4: Radio disturbance and immunity measuring apparatus – Ancillary equipment – Radiated disturbances

*This **English-language** version is derived from the original **bilingual** publication by leaving out all French-language pages. Missing page numbers correspond to the French-language pages.*

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FOREWORD

This amendment has been prepared by CISPR subcommittee A: Radio interference measurements and statistical methods.

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

FDIS	Report on voting
CISPR/A/499/FDIS	CISPR/A/514/RVD

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

The committee has decided that the contents of the base publication and its amendments will remain unchanged until 2005. At this date, the publication will be

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

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3 Definitions

Add, after definition 3.10 on page 17, the following new definitions:

3.11
fully anechoic room
FAR
shielded enclosure, the internal surfaces of which are lined with radio-frequency absorbing material (i.e. RF absorber), which absorbs electromagnetic energy in the frequency range of interest

3.12
quasi-free space test-site
test-site for which the site attenuation measured with vertically polarized tuned dipoles deviates by no more than ± 1 dB from the calculated free-space attenuation at any frequency

3.13
test volume
volume in the FAR in which the EUT is positioned

NOTE In this volume the quasi-free space condition is met and this volume is typically 0,5 m or more from the absorbing material of the FAR.

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5.7 Alternative test site suitability

Replace the title of this subclause by the following new title:

5.7 Test site suitability with ground-plane

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Add, after Table 2, the following new subclause:

5.8 Test site suitability without ground-plane

The procedure for test sites without ground-plane in the frequency range 30 MHz to 1 000 MHz is as follows.

5.8.1 Measurement considerations for free space test sites, as realized by fully absorber-lined shielded enclosures

A fully absorber lined shielded enclosure, also known as a fully anechoic chamber (FAC), or a fully anechoic room (FAR), may be used for radiated emission measurements. When the FAR method is used, appropriate radiated emission limits shall be defined in relevant standards (generic, product or product family standards). Compliance with the radio services protection requirements (limits) shall be established for FARs in a similar way as for tests on an OATS.

A FAR is intended to simulate a free space environment such that only the direct ray from the transmitting antenna or EUT reaches the receiving antenna. All indirect and reflected waves shall be minimized with the use of appropriate absorbing material on all walls, the ceiling and the floor of the FAR.

5.8.2 Site performance

Site performance may be validated by two methods which are described below – the site reference method and the *NSA* method.

5.8.2.1 Theoretical normalized site attenuation

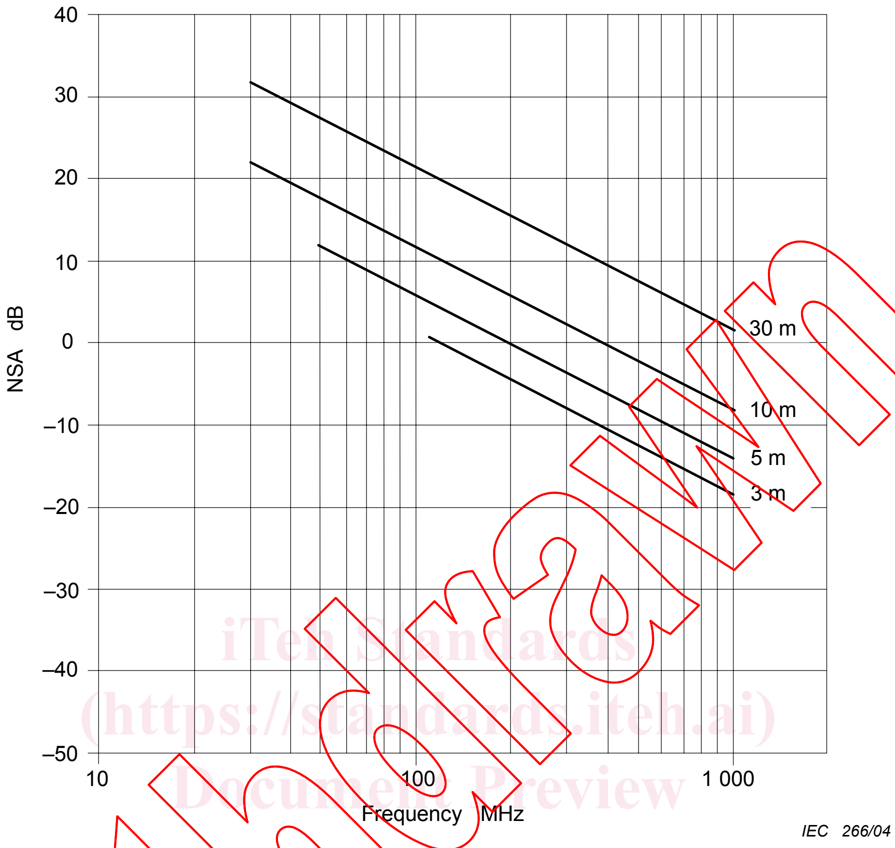

Figure 9 – Graph of theoretical free-space *NSA* as a function of the frequency for different measurement distances (see equation 4)

NOTE Frequencies below 110 MHz for 3 m measurement and below 60 MHz for 5 m measurement distances include near field effects. These must be calculated for each individual test site.

The following describes the *NSA* theory for infinitely small antennas.

Site attenuation (*SA*) is the transmission loss measured between the connectors of two antennas on a particular site. For a free space environment, *SA* (in dB) can be approximated by Equation (2)[1)]

$$SA = 20\log_{10}\left[\left(\frac{5Z_0}{2\pi}\right)\left(\frac{d}{\sqrt{1-\frac{1}{(\beta d)^2}+\frac{1}{(\beta d)^4}}}\right)\right] - 20\log_{10} f_m + AF_R + AF_T \qquad (2)$$

1) Reference: GARBE, H. New EMC Test Facilities for Radiation Measurements. *Review of Radio Science 1999-2002*. John Wiley & Sons, New York, 2002

where

AF_R, AF_T	are the antenna factors of the receive and transmit antennas in dB/m;
d	is the distance between the phase centres of both antennas in metres;
Z_0	is the reference impedance (i.e. 50 Ω);
$ß$	is defined as $2\pi/\lambda$; and
f_m	is the frequency in MHz.

The theoretical normalized site attenuation (*NSA*) in dB is defined as site attenuation with respective antenna factors subtracted, thus:

$$NSA_{calc} = 20\log_{10}\left[\left(\frac{5Z_0}{2\pi}\right)\left(\frac{d}{\sqrt{1-\frac{1}{(\beta d)^2}+\frac{1}{(\beta d)^4}}}\right)\right] - 20\log_{10} f_m \qquad (3)$$

Below 60 MHz at a 5 m distance or 110 MHz at a 3 m distance, it is necessary to apply near field correction factors for each of the required test positions of Table 3 for comparison with the theoretical *NSA* of Figure 9 and Equation (2). Near field correction factors are specific to the antennas, test distance, and test volume used, and therefore must be obtained by using a numerical modelling code such as NEC. Alternatively the site reference method of 5.8.2.2.1 provides cancellation of near field terms if the same antennas and frequencies are used for both the site reference measurement and FAR validation.

For measurement distances of 10 m and 30 m, the near-field terms in Equation (3) may be omitted, and the equation simplifies as follows:

$$NSA_{calc} = 20\log_{10}\left[\frac{5Z_0 d}{2\pi}\right] - 20\log_{10} f_m \qquad (4)$$

If simplified Equation (4), is used instead of Equation (2) the error introduced is less than 0,1dB at frequencies above 60 MHz for 5 m distance and above 110 MHz for 3 m distance. The error will be >0,1 dB below these frequencies due to near-field effects. For a 3 m distance the maximum error is 1 dB at 30 MHz. To reduce this error Equation (2) should be used.

5.8.2.2 Site validation procedure

The *NSA* shall satisfy the requirement of 5.8.3 over a cylindrical test volume generated by the rotation of the EUT on the turntable. In this context “the EUT“ includes all components of a multi-unit EUT and the interconnecting cables. Table 3 defines the maximum height and diameter ($h_{max} = d_{max}$) of the test volume as a function of test distance. This ratio between diameter and test distance ensures an acceptable uncertainty in EUT emissions testing.

Table 3 – Maximum dimensions of test volume versus test distance

Maximum diameter d_{max} and height h_{max} of the test volume m	Test distance $D_{nominal}$ m
1,5	3,0
2,5	5,0
5,0	10,0

A single position *SA* (site attenuation) measurement may not be sufficient to pick up possible reflections from the room construction and/or absorbing material lining the walls, floor, ceiling and turntable of the FAR.

The fully anechoic room *SA* measurements and validation shall therefore be performed at 15 measurement positions for both horizontal and vertical antenna polarizations of the transmit antenna in the test volume (see Figure 10):

– at three heights of the test volume: bottom, middle and top;
– at 5 positions in all 3 horizontal planes: centre, left, right, front and rear positions in each horizontal plane. The rear position may be omitted if the distance between rear position and absorbers is more than 0,5 m. During EUT testing, the rear position on the turntable is also turned to the front, and the contribution of the back reflection will then not affect the maximum signal.

For *SA* measurements two broadband antennas shall be used: one transmit antenna with its reference point at the measurement positions of the test volume and one receive antenna outside this test volume at a prescribed orientation and position. The transmit antenna shall have an approximately omni-directional *H*-plane pattern. (The maximum dimension shall not exceed 40 cm for a 3 m test distance, at larger distances, the size of the antenna can be scaled accordingly).

Typical receive antennas are hybrid (biconical/LPD combination) antennas for 30 MHz to 1 000 MHz, or separate [biconical antennas (for 30 MHz to 200 MHz) and LPD antennas (for 200 MHz to 1 000 MHz)].

NOTE Use of a hybrid (biconical/LPD combination) antenna is not recommended for either emission testing or chamber validation at 3 m distance, due to the large physical size of such antennas.

The same antennas, cables, ferrites, attenuators, amplifier, signal generator and receiver used to measure the *SA* of the FAR, shall be used to measure the reference *SA* on the quasi-free space test site (5.8.2.2.2). The receive antenna used during the room validation shall be of the same type as used during radiated emission testing of the EUT.

For test volume validation both in horizontal and vertical polarization, and for all transmitting antenna positions in the test volume, the position in height of the receiving antenna in the FAR shall be set and remain at the fixed middle level of the test volume, as shown in Figures 10 and 11. Tilting the antennas shall be necessary to align the bore sight axis of both antennas in one measurement axis. The distance between the antenna reference point (defined in antenna calibration) and the front position of the test volume is $d_{nominal}$. When the transmit antenna is moved to other positions in the test volume, the receive antenna shall be translated along the measurement axis to maintain $d_{nominal}$. The measurement axis is