

Vehicles, boats and internal combustion engine driven devices — Radio disturbance characteristics — Limits and methods of measurement for the protection of receivers except those installed in the vehicle/boat/device itself or in adjacent vehicles/boats/devices

The European Standard EN 55012:2002, with the incorporation of amendment A1:2005, has the status of a British Standard

ICS 27.020; 33.100.10

National foreword

This British Standard is the official English language version of EN 55012:2002, including Amendment No. 1. It is identical with CISPR 12:2001. It supersedes BS CISPR 12:1997 which is withdrawn.

The start and finish of text introduced or altered by CENELEC amendment is indicated in the text by tags **A1** **A1**. Tags indicating changes to CENELEC text carry the number of the amendment. For example, text altered by CENELEC amendment A11 is indicated by **A11** **A11**.

The UK participation in its preparation was entrusted by Technical Committee GEL/210, EMC policy committee, to Subcommittee GEL/210/12, EMC product standards, which has the responsibility to:

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Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 53 and a back cover.

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This British Standard was published under the authority of the Standards Policy and Strategy Committee on 21 May 2002

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Amendments issued since publication

Amd. No.	Date	Comments
15692 Amendment No. 1	28 April 2006	See national foreword

**Vehicles, boats and internal combustion engine driven devices -
Radio disturbance characteristics -
Limits and methods of measurement for the protection of receivers
except those installed in the vehicle/boat/device itself
or in adjacent vehicles/boats/devices**
(includes amendment A1:2005)
(CISPR 12:2001)

Véhicules, bateaux et engins entraînés
par des moteurs à combustion interne -
Caractéristiques de perturbation
radioélectrique -
Limites et méthodes de mesure
pour la protection des récepteurs
à l'exception de ceux installés dans
les véhicules/bateaux/engins eux-mêmes
ou dans des véhicules/bateaux/engins
proches
(inclut l'amendement A1:2005)
(CISPR 12:2001)

Fahrzeuge, Boote und von Verbrennungs-
motoren angetriebene Geräte -
Funkstöreigenschaften -
Grenzwerte und Messverfahren
zum Schutz von Empfängern
mit Ausnahme derer,
die in den Fahrzeugen, Booten, Geräten
selbst oder in benachbarten Fahrzeugen,
Booten, Geräten installiert sind
(enthält Änderung A1:2005)
(CISPR 12:2001)

This European Standard was approved by CENELEC on 2002-02-01; amendment A1:2005 was approved by CENELEC on 2005-03-01. 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 Central Secretariat 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 Central Secretariat has the same status as the official versions.

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CENELEC

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

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

Foreword

The text of document CISPR/D/255/FDIS, future edition 5 of CISPR 12, prepared by CISPR SC D, Electromagnetic disturbances related to electric/electronic equipment on vehicles and internal combustion engine powered devices, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 55012 on 2002-02-01.

The following dates were fixed:

- latest date by which the EN has to be implemented
at national level by publication of an identical
national standard or by endorsement (dop) 2002-11-01
- latest date by which the national standards conflicting
with the EN have to be withdrawn (dow) 2005-02-01

The standard is applicable to vehicles, boats and other devices equipped with combustion engines, as well as their electrical means.

In the European Union, the EMC requirements for this kind of "vehicles" are regulated in the following directives:

- 95/54/EC on motor vehicles;
- 97/24/EC on two- or three-wheel motor vehicles;
- 2000/2/EC on agricultural or forestry tractors.

Vehicles and other combustion engine powered devices not covered by these directives (e.g. pleasure motor boats) have to fulfil the requirements of the directive 89/336/EC on EMC. The r.f. emission requirements are specified in this standard.

Annexes designated "normative" are part of the body of the standard.

Annexes designated "informative" are given for information only.

In this standard, annexes A, H and ZA are normative and annexes B to G are informative.

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard CISPR 12:2001 was approved by CENELEC as a European Standard without any modification.

Foreword to amendment A1

The text of document CISPR/D/302/FDIS, future amendment 1 to CISPR 12:2001, prepared by CISPR SC D, Electromagnetic disturbances related to electric/electronic equipment on vehicles and internal combustion engine powered devices, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as amendment A1 to EN 55012:2002 on 2005-03-01.

The following dates were fixed:

- latest date by which the amendment has to be implemented
at national level by publication of an identical
national standard or by endorsement (dop) 2005-12-01
- latest date by which the national standards conflicting
with the amendment have to be withdrawn (dow) 2008-03-01

Endorsement notice

The text of amendment 1:2005 to the International Standard CISPR 12:2001 was approved by CENELEC as an amendment to the European Standard without any modification.

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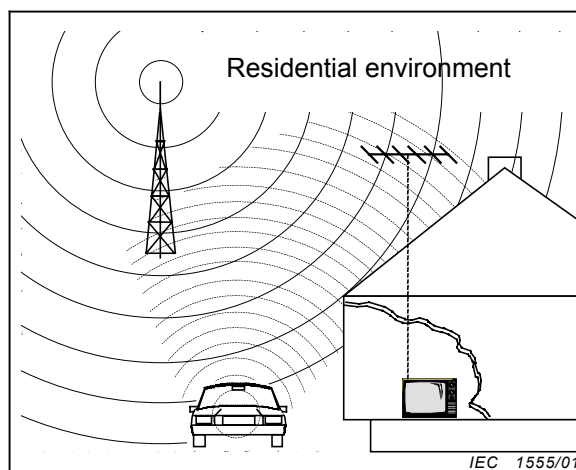
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**VEHICLES, BOATS, AND INTERNAL COMBUSTION
ENGINE DRIVEN DEVICES –
RADIO DISTURBANCE CHARACTERISTICS –
LIMITS AND METHODS OF MEASUREMENT FOR THE PROTECTION OF
RECEIVERS EXCEPT THOSE INSTALLED IN THE VEHICLE/BOAT/DEVICE
ITSELF OR IN ADJACENT VEHICLES/BOATS/DEVICES**

1 Scope

The limits in this International Standard are designed to provide protection for broadcast receivers in the frequency range of 30 MHz to 1 000 MHz when used in the residential environment. Compliance with this standard may not provide adequate protection for new types of radio transmissions or receivers used in the residential environment nearer than 10 m to the vehicle or device.



NOTE 1 Experience has shown that compliance with this standard may provide satisfactory protection for receivers of other types of transmissions when used in the residential environment, including radio transmissions in frequency ranges other than that specified.

This standard applies to the emission of broadband and narrowband electromagnetic energy which may cause interference to radio reception and which is emitted from

- a) vehicles propelled by an internal combustion engine, electrical means or both (see 3.1);
- b) boats propelled by an internal combustion engine, electrical means or both (see 3.2). Boats are to be tested in the same manner as vehicles except where they have unique characteristics as explicitly stated in this standard;
- c) devices equipped with internal combustion engines (see 3.3).

This standard includes limits and test methods for both broadband and narrowband emissions.

This standard does not apply to aircraft, traction systems (railway, tramway and trolley bus), or to incomplete vehicles.

NOTE 2 Protection of receivers used on board the same vehicle as the disturbance source(s) are covered by CISPR 25.

The measurement of electromagnetic disturbances while the vehicle is connected to power mains for charging is not covered in this standard. The user is referred to appropriate IEC and CISPR standards which define measurement techniques and limits for this condition.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 60050(161), *International Electrotechnical Vocabulary (IEV) – Chapter 161: Electromagnetic compatibility*

CISPR 16-1, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1: Radio disturbance and immunity measuring apparatus*

CISPR 25, *Limits and methods of measurement of radio disturbance characteristics for the protection of receivers used on board vehicles*

3 Definitions

For the purpose of this International Standard, the definitions contained in IEC 60050(161) are applicable.

The following definitions are specific to this standard.

3.1

vehicle

machine operating on land which is intended to carry persons or goods. Vehicles include, but are not limited to, cars, trucks, buses, mopeds, agricultural machinery, earth-moving machinery, material-handling equipment, mining equipment and snowmobiles

3.2

boat

vessel intended to be used on the surface of water, its length being no greater than 15 m

3.3

device

machine driven by an internal combustion engine which is not primarily intended to carry persons or goods. Devices include, but are not limited to, chainsaws, irrigation pumps, snow blowers, air compressors, and landscaping equipment

3.4

impulsive ignition noise

unwanted emission of electromagnetic energy, predominantly impulsive in content, arising from the ignition system within a vehicle or device

3.5

ignition noise suppressor

that portion of a high-voltage ignition circuit intended to limit the emission of impulsive ignition noise

3.6

resistive distributor brush

resistive pick-up brush in an ignition distributor cap

3.7

frequency sub-band

segment of the frequency spectrum (30 MHz to 1 000 MHz) defined to enable statistical evaluation of the test data acquired by swept frequency testing

3.8

representative frequency

assigned frequency of a frequency sub-band to be used for comparison of the data to the limit. To be used only in 6.4 and 6.5 and annex A

3.9

characteristic level

controlling (or dominant) emission level experienced in each frequency sub-band. The characteristic level is the maximum measurement obtained for both antenna polarizations and for all the specified measurement positions of the vehicle or device. Known ambient signals shall not be considered part of the characteristic level

3.10

tracking generator

test signal oscillator (continuous wave, cw) that is frequency locked to the receive frequency of a measuring instrument

3.11

RF disturbance power

RF power measured with a current transformer of an absorbing clamp and an RF measuring instrument. It may be measured – as the RF disturbance voltage – in a peak or quasi-peak mode

3.12

spark discharge

spark discharge in this document is the discharge of energy stored in the ignition coil, in an arc across the electrodes of a measuring spark plug

3.13

resistive high-tension (HT) ignition cable

ignition cable whose conductor has a high resistance (attenuation)

3.14

residential environment

residential environment has a 10 m protection distance between the source and the point of radio reception and where the source uses the public low-voltage power system or battery power. For example, rooming houses, private dwellings, entertainment halls, theatres, schools, public streets, etc.

4 Limits of disturbance

4.1 Determination of the appropriate limit level

If the type of disturbance is unknown, the flow chart shown in figure 1 may be used to determine which limit shall be applied.

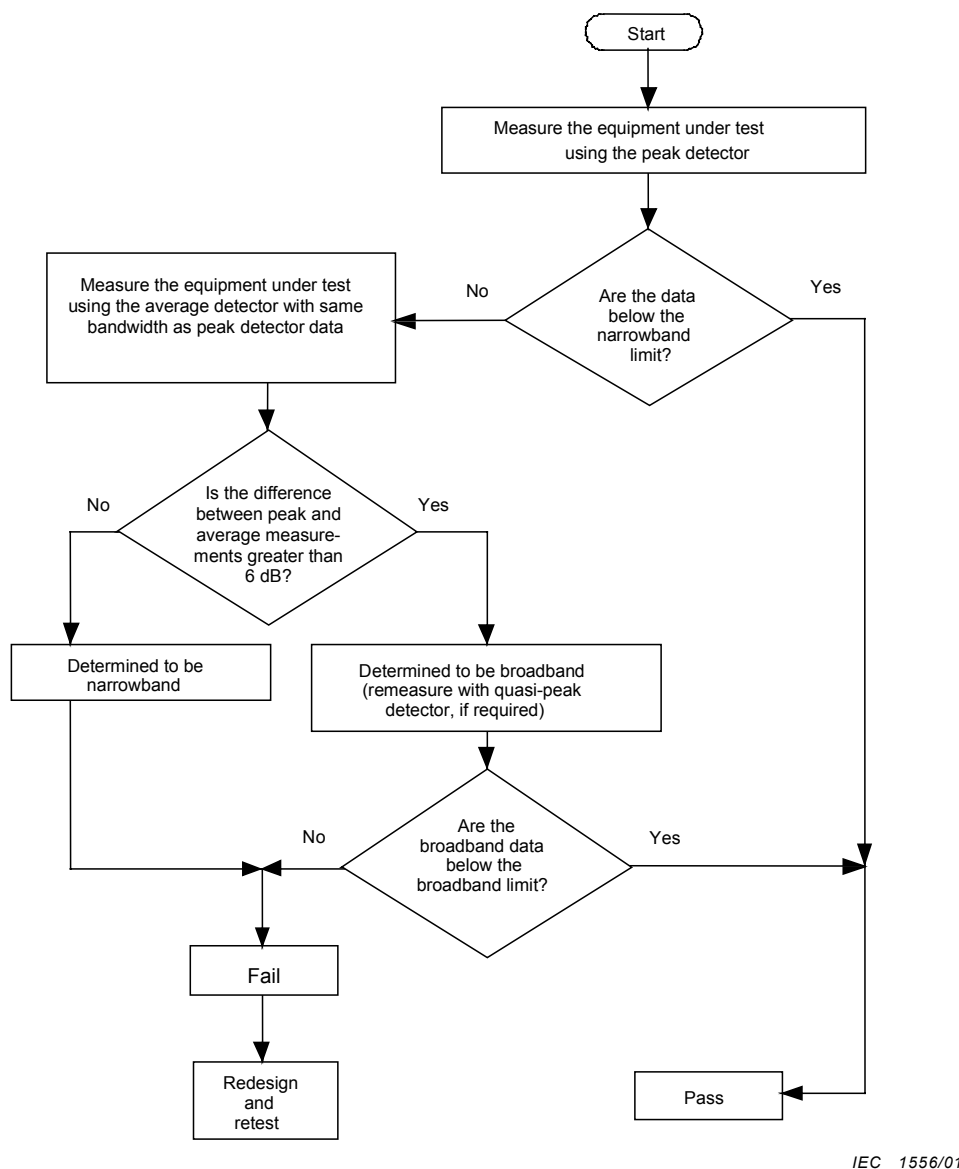
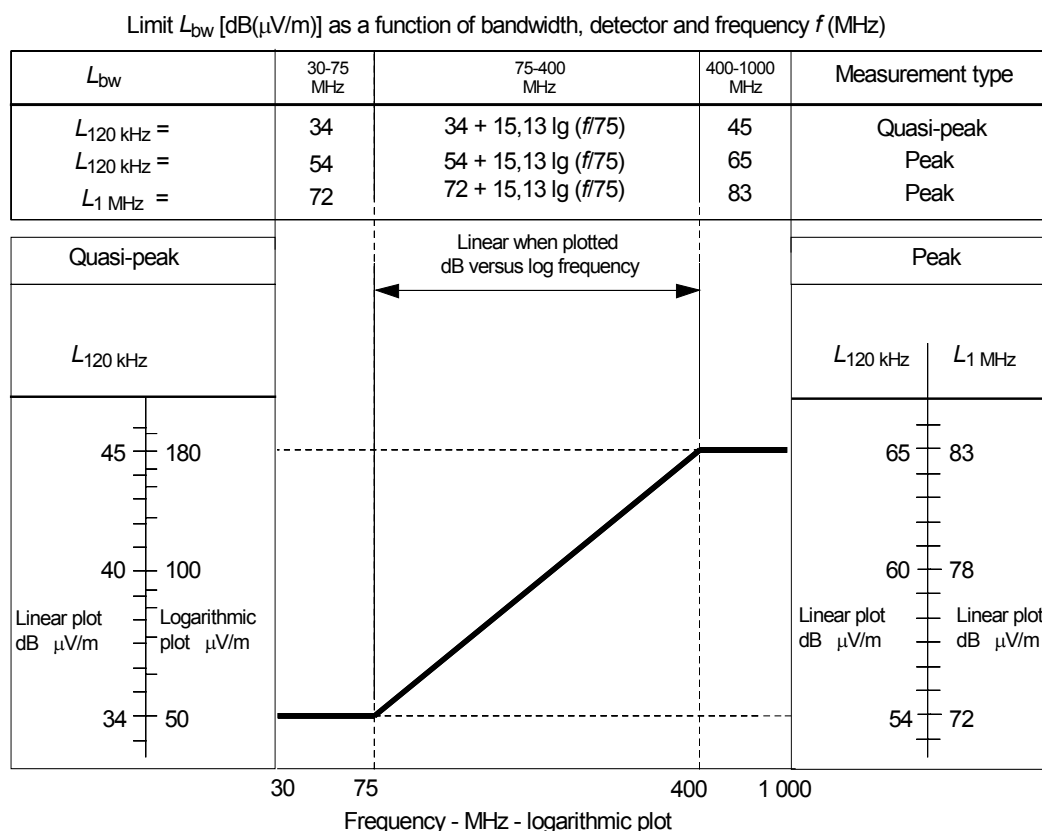


Figure 1 – Example method of determination of conformance of radiated disturbance

4.2 Broadband emissions

The limit for broadband emissions measured at 10 m antenna distance is given in the table of figure 2 and is shown graphically in figure 2. Only one of the bandwidths listed needs to be chosen for testing. For more accurate determination, the equations given in Figure 2 shall be used. For measurements at 3 m antenna distance, 10 dB shall be added to the limit.



IEC 1557/01

NOTE 1 For vehicles equipped with electric propulsion motors, see 5.3.2.

NOTE 2 For peak measurements, see 5.5.

NOTE 3 The correlation factor between quasi-peak and peak measurements is +20 dB at 120 kHz bandwidth, based on experimental data accumulated in several countries.

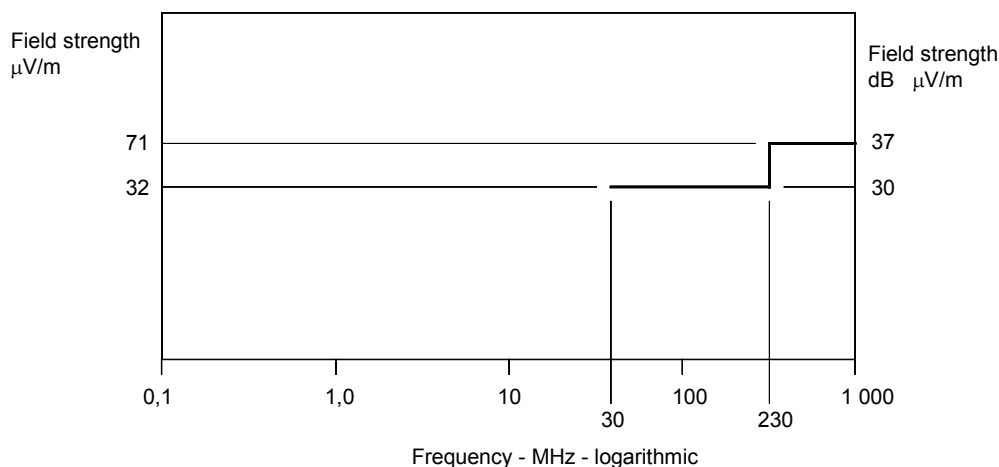
NOTE 4 Limits from 1 GHz to 18 GHz are under consideration.

Figure 2 – Limits of disturbance (broadband) at 10 m antenna distance

4.3 Narrowband emissions

The limit for narrowband emissions measured at 10 m antenna distance is shown in figure 3. The limit applies to peak or quasi-peak detector measurements. Vehicles/boats/devices not including electronic oscillators with an operating frequency greater than 9 kHz shall be deemed to be in compliance with the narrowband requirements of this clause without performing tests for narrowband emissions. Vehicles/boats/devices which meet the narrowband emissions requirements of CISPR 25 Section 2 shall also be deemed to be in compliance with the narrowband requirements of this subclause and no further testing is necessary.

For measurements at 3 m antenna distance, 10 dB shall be added to the limit.



IEC 1558/01

NOTE Limits between 150 kHz and 30 MHz are under consideration.

Figure 3 – Limits of disturbance (narrowband) at 10 m antenna distance

5 Methods of measurement

NOTE Methods of measurement from 1 GHz to 18 GHz are under development.

5.1 Measuring apparatus requirements

5.1.1 Measuring instrument

5.1.1.1 Type

The measuring instrument shall comply with the requirements of CISPR 16-1. Either manual or automatic frequency scanning may be used.

NOTE Spectrum analysers and scanning receivers are particularly useful for disturbance measurements. The peak detection mode of spectrum analysers and scanning receivers provides a display indication which is never less than the quasi-peak indication for the same bandwidth. It may be convenient to measure emissions using peak detection because of the faster scan possible than with quasi-peak detection.

When quasi-peak limits are being used and a peak detector is being used for time efficiency, any peak measurements at or above the single sample type test limit shall be remeasured using the quasi-peak detector.

5.1.1.2 Minimum scan time

The scan rate of a spectrum analyser or scanning receiver shall be adjusted for the CISPR frequency band and detection mode used. The minimum sweep time/frequency (i.e. the most rapid scan rate) is listed in table 1.

Table 1 – Minimum scan time

Band		Peak detection	Quasi-peak detection
A	9 kHz to 150 kHz	Does not apply	Does not apply
B	0,15 MHz to 30 MHz	100 ms/MHz	200 s/MHz
C, D	30 MHz to 1 000 MHz	1 ms/MHz	20 s/MHz
Band definition from CISPR 16-1. Bands A and B are not used in the 5th edition of this standard.			
NOTE Certain signals (for example low repetition rate signals) may require slower scan rates or multiple scans to ensure that the maximum amplitude has been measured.			

5.1.1.3 Measuring instrument bandwidth

The bandwidth of the measuring instrument shall be chosen such that the noise floor is at least 6 dB lower than the limit curve. The bandwidths in table 2 are recommended.

NOTE When the bandwidth of the measuring instrument exceeds the bandwidth of a narrowband signal, the measured signal amplitude will not be affected. The indicated value of impulsive broadband noise will be lower when the measuring instrument bandwidth is reduced.

Table 2 – Recommended measuring instrument bandwidth (6 dB)

Frequency band MHz	Instrument bandwidth kHz
0,15 to 30 (not used in this fifth edition)	9
30 to 1 000	120

If a spectrum analyser is used for peak measurements, the video bandwidth shall be at least three times the resolution bandwidth.

5.1.2 Antenna types

5.1.2.1 Reference antenna for the frequency range of 150 kHz to 30 MHz

The antenna shall be the 1 m rod antenna of CISPR 16-1, vertically polarized, having its terminal voltage referenced to a counterpoise of the size and shape appropriate to the design of the antenna. (The size and shape of the counterpoise shall be determined by the antenna manufacturer.)

The rod antenna should be connected to the measuring instrument through a coupling unit (or "coupler"), which may be active or passive, to provide high-impedance to low-impedance transformation. The coupling unit may be mounted either below (preferred) or above the counterpoise. The coupler shall be designed to work into a 50 Ω coaxial transmission line to transfer the antenna output to the measuring instrument input.

5.1.2.2 Reference antenna for the frequency range of 30 MHz to 1 000 MHz

The antenna shall be a balanced dipole (see CISPR 16-1). Free-space antenna factors are to be used. For frequencies of 80 MHz or above, the antenna shall be resonant in length, and for frequencies below 80 MHz it shall be the length equal to the 80 MHz resonant length. It shall be matched to the feeder by a suitable symmetric-asymmetric transformer device.

5.1.2.3 Broadband antennas for the frequency range of 30 MHz to 1 000 MHz

Any linearly polarized receiving antenna is permitted, provided that it can be normalized to the reference antenna.

A broadband antenna is required when making measurements with an automated receiving system using a scanning measuring instrument. Such a broadband antenna is usable for measuring emission levels (over the frequency spectrum covered by this standard), provided that its output can be normalized to the output of the reference antenna in the actual test environment at the actual test site.

When broadband antennas are used, they shall meet the requirements for complex antennas given in CISPR 16-1. Examples of factors to be considered include

- a) the effective aperture area of the antenna, including its polar response (horizontal and vertical planes);
- b) the effect of a phase centre which moves with frequency;
- c) the effect of ground reflection characteristics (including multiple-ray reflections which may arise at specific frequencies at about 500 MHz vertical polarization and 900 MHz horizontal polarization).

5.1.3 Antenna characteristics

5.1.3.1 Frequency range 150 kHz to 30 MHz

See annex B for rod antenna (monopole) performance equations and characterization of the rod antenna matching amplifier.

5.1.3.2 Frequency range 30 MHz to 1 000 MHz

See annex C for alternate antenna characterization.

5.1.4 Accuracy

The measurement system consisting of the antenna, transmission line and the measuring instrument, but excluding the source and the measuring site, shall measure electric field strength over the frequency range of 30 MHz to 1 000 MHz with an accuracy of ± 3 dB. See 5.5 of CISPR 16-1. The frequency accuracy shall be better than ± 1 %.

NOTE To ensure that the measurements defined in this standard are within the stated tolerances, consideration should be given to all pertinent characteristics of measuring equipment (for example, frequency and amplitude stability, image rejection, cross-modulation, overload levels, selectivity, time constants, and signal/noise ratio), as well as those affecting the antenna and transmission line.

5.1.5 Repeatability

The repeatability of the measurement system shall be established and periodically checked to detect variability; the input/output characteristics of the measuring instrument shall be checked at shorter intervals of time.

NOTE It is reasonable to expect variations of as much as ± 3 dB in measurements made of an electric field (see clause C.12) within the range of 30 MHz to 1 000 MHz. These are caused by variations in ground conductivity and other factors influencing repeatability.

5.2 Measuring location requirements

5.2.1 Open Area Test Site (OATS) requirements

5.2.1.1 OATS for vehicles and devices

The test site shall be a clear area, free from electromagnetic reflecting surfaces within a circle of minimum radius 30 m measured from a point midway between the vehicle or device and the antenna. As an exception, the measuring equipment, and the test hut or vehicle in which the measuring equipment is located (when used) may be within the test site, but only in the permitted region indicated by the cross-hatched area of figure 4.

NOTE The site requirements defined in 5.2.1.1 and Figure 4 are the application of CISPR 16-1 to large automotive objects.

Vehicles and devices smaller than 2 m in length and width may be tested on a OATS with dimensions corresponding to CISPR 16-1, figures 14 or 15.

5.2.1.2 OATS for boats

The test site shall be a clear area free from electromagnetic reflecting surfaces within a circle of minimum radius 30 m measured from a point midway between the engine under test and the antenna. Exceptions for the measuring equipment are specified in 5.2.1.2.1 and also in 5.2.1.2.2.

Boats or engines/motors for boats tested separately shall be tested in salt or fresh water at a measuring site as shown in figure 5.

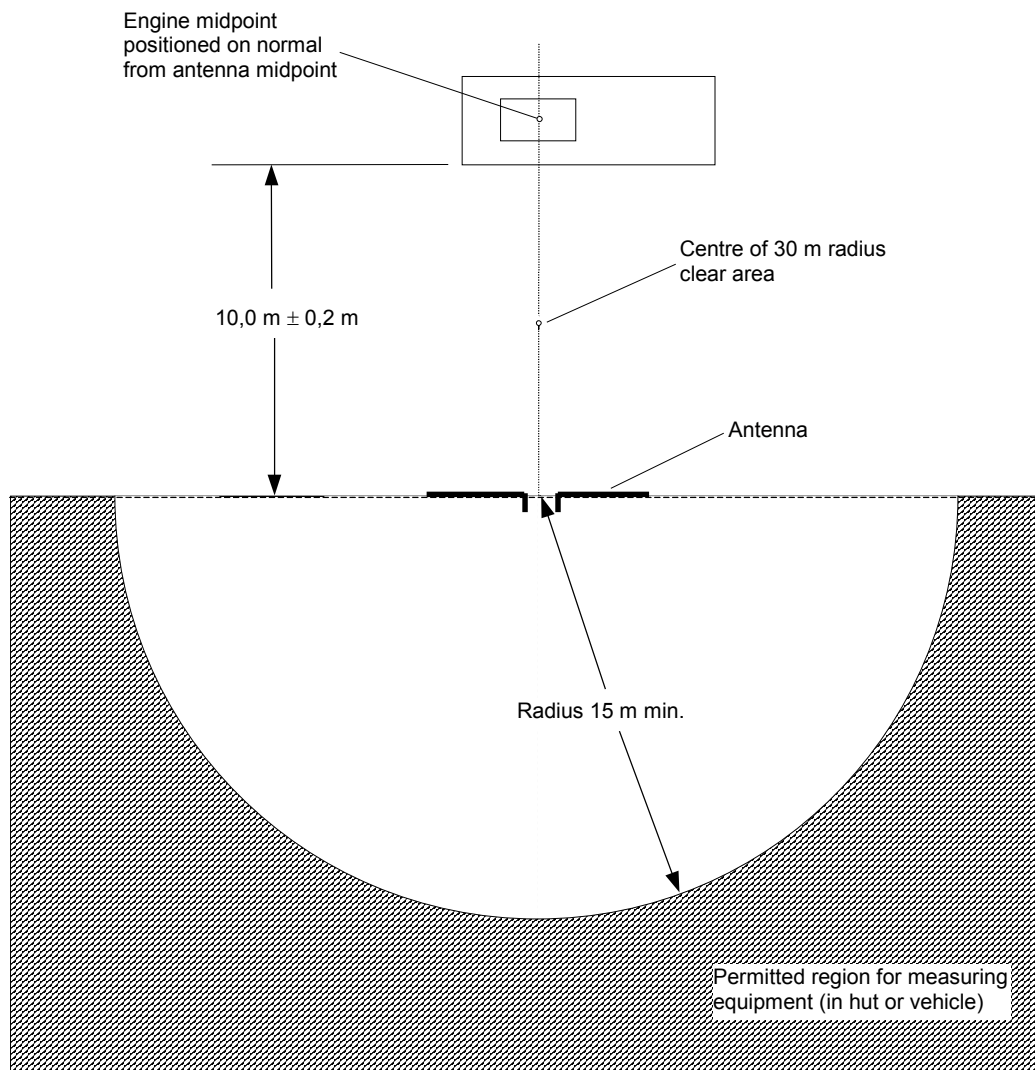
5.2.1.2.1 Land-based measuring equipment

When the measuring equipment is on land, the test hut or vehicle in which the measuring equipment is located may be within the test site, but only in the permitted region indicated by the cross-hatched area of figure 5. If the measuring equipment is not in a hut or vehicle, it may be located within the test site in either the shaded or cross-hatched area of figure 5.

5.2.1.2.2 Water-based measuring equipment

The measuring equipment shall be installed in a non-metallic boat or non-metallic test fixture which may be within the test site, but only within the permitted region indicated by the shaded or cross-hatched areas of figure 5.

NOTE Allowing measuring equipment in the shaded area (as opposed to figure 4 for the vehicle test site) is a compromise for the special problems of boat testing.



IEC 1559/01

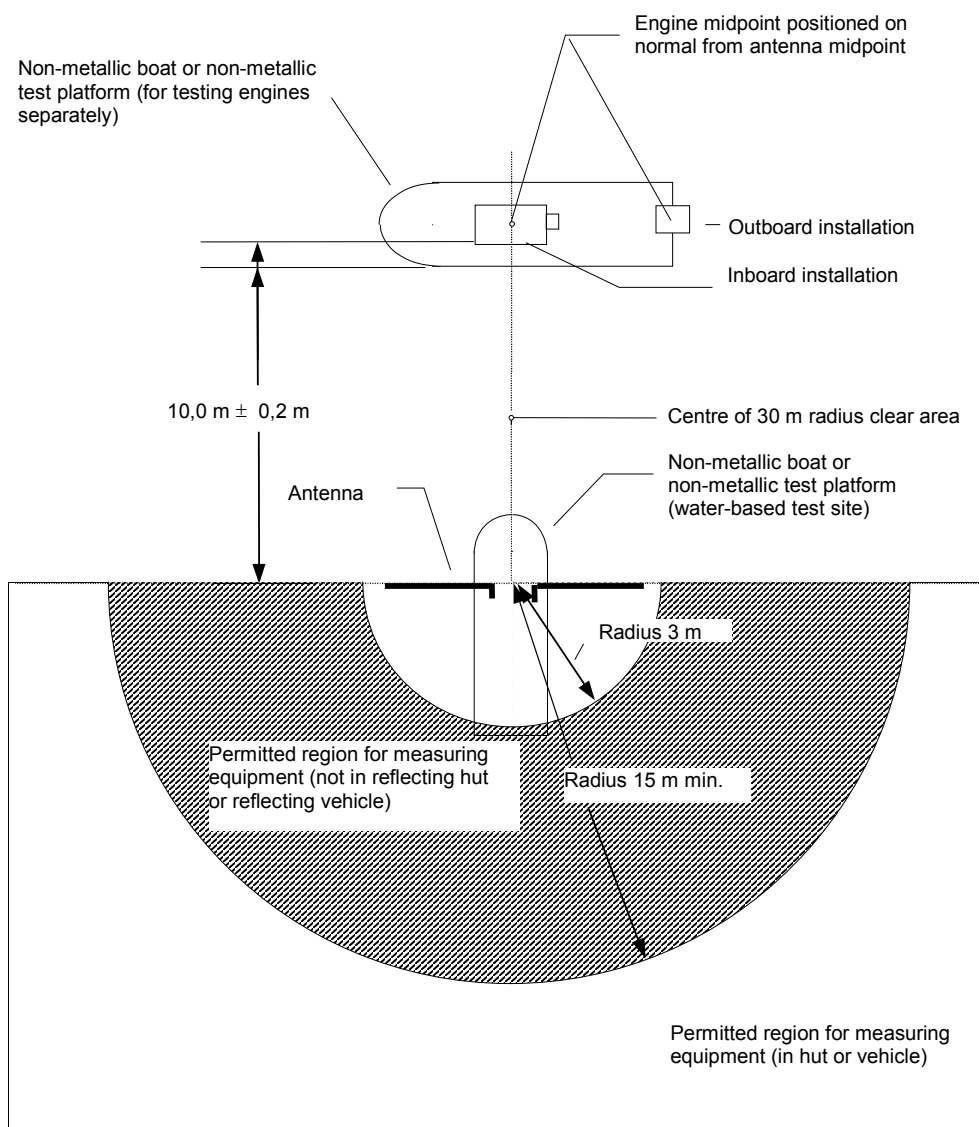
NOTE The 10,0 m $\pm$ 0,2 m dimension may be changed to 3,00 m $\pm$ 0,05 m in accordance with 5.2.3.2 and 5.2.3.4.

Figure 4 – Measuring site (OATS) for vehicles and devices

5.2.1.3 Ambient requirements

To ensure that there is no extraneous noise or signals of sufficient magnitude or density to affect materially the vehicle measurement, ambient measurements shall be taken before and after the main test, but without the vehicle/boat/device under test running. In both of these measurements, the ambient noise shall be at least 6 dB below the limits of disturbance given in clause 4, excluding intentional radiators. When assessing compliance in accordance with clause 6 any emission exceeding the limits shall require investigation to ensure that they are not attributable to the vehicle/boat/device in order to be excluded.

NOTE For further guidance, see 5.6 of CISPR 16-1.



IEC 1560/01

Figure 5 – Measuring site (OATS) for boats

5.2.2 Absorber lined shielded enclosure (ALSE) requirements

5.2.2.1 Correlation

Absorber lined shielded enclosures may be used provided that the results obtained can be correlated with those obtained using the OATS described in 5.2.1.

NOTE Such chambers have the advantages of all weather testing, controlled environment and improved repeatability because of stable chamber electrical characteristics.

5.2.2.2 Ambient requirements

The ambient noise level shall be at least 6 dB below the limits of disturbance given in clause 4. The ambient level shall be verified periodically or when test results indicate the possibility of non-compliance.