
Maritime navigation and radiocommunication equipment and systems - Radar - Part 1: Shipborne radar - Performance requirements - Methods of testing and required test results - Amendment A1 (IEC 60936-1:1999/A1:2002)

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**Maritime navigation and radiocommunication equipment and systems -
Radar**

**Part 1: Shipborne radar -
Performance requirements -
Methods of testing and required test results
(IEC 60936-1:1999/A1:2002)**

Matériels et systèmes de navigation
et de radiocommunication maritimes -
Radar

Partie 1: Radars de navire -

Exigences de fonctionnement -

Méthodes d'essai et résultats

d'essai exigés

(CEI 60936-1:1999/A1:2002)

Navigations- und

Funkkommunikationsgeräte und -systeme

für die Seeschifffahrt -

Radar

Teil 1: Radar für die Seeschifffahrt -

Leistungsanforderungen -

Prüfverfahren und geforderte

Prüfergebnisse

(IEC 60936-1:1999/A1:2002)

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This amendment A1 modifies the European Standard EN 60936-1:2000; it was approved by CENELEC on 2002-09-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this amendment 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 amendment 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.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland and United Kingdom.

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 80/341/FDIS, future amendment 1 to IEC 60936-1:1999, prepared by IEC TC 80, Maritime navigation and radiocommunication equipment and systems, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as amendment A1 to EN 60936-1:2000 on 2002-09-01.

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) 2003-06-01
- latest date by which the national standards conflicting with the amendment have to be withdrawn (dow) 2005-09-01

Annexes designated "normative" are part of the body of the standard.
In this standard, annex D normative.

Endorsement notice

The text of amendment 1:2002 to the International Standard IEC 60936-1:1999 was approved by CENELEC as an amendment to the European Standard without any modification.

SIST EN 60936-1:2004/A1:2004

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INTERNATIONAL STANDARD

IEC
60936-1

1999

AMENDMENT 1
2002-06

Amendment 1

**Maritime navigation and radiocommunication
equipment and systems – Radar –**

**Part 1:
Shipborne radar – Performance requirements –
Methods of testing and required test results**

[SIST EN 60936-1:2004/A1:2004](https://standards.iso.org/standards/sist/7c583c96-bfe1-40be-96ae-b3013cd18e7/sist-en-60936-1-2004-a1-2004)

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*Matériels et systèmes de navigation et
de radiocommunication maritimes – Radar –*

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Commission Electrotechnique Internationale
International Electrotechnical Commission
Международная Электротехническая Комиссия

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FOREWORD

This amendment has been prepared by IEC technical committee 80: Maritime navigation and radiocommunication equipment and systems.

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

FDIS	Report on voting
80/341/FDIS	80/346/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 2003. At this date, the publication will be

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

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Annex D, replace by new title: [SIST EN 60936-1:2004/A1:2004](http://standards.iteh.ai/standards/sist/7c683e96-1011-410ba96e-b301f3cd18e7/sist-en-60936-1-2004-a1-2004)

Annex D (normative) [Unwanted emissions of radar systems – Methods of measurement and required results](http://standards.iteh.ai/standards/sist/7c683e96-1011-410ba96e-b301f3cd18e7/sist-en-60936-1-2004-a1-2004)

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Annex D – Measurement methods for spurious emissions

Replace the existing annex D by the following new annex D:

Annex D (normative)

Unwanted emissions of radar systems – Methods of measurement and required results

D.1 Introduction

ITU-R has now developed a new recommendation for out-of-band (OOB) emission limits (D.6.d)). This recommendation is associated with the following recommendations:

- a) OOB emissions falling into an adjacent allocated band (D.6.f));
- b) boundary between OOB and spurious emissions (D.6.e));
- c) spurious emissions – SM.329 (D.6.c)).

Spurious emission limits for radar systems have been incorporated into section II of appendix 3 of the Radio Regulations, in terms of level, but not in terms of frequency range. There is no intention at present of a similar treatment for either the OOB or adjacent allocated band limits.

It has been agreed that within the ITU WRC – 2003 Agenda item 1.8.1, the boundary between OOB and spurious emissions will be defined for all radio services and incorporated into Appendix 3 of the Radio Regulations. As this will not occur until after the date of 1 January 2003 (the date at which the new spurious limits apply for new radar installations), there is a need for this standard to define the boundary conditions based upon the text contained in the ITU-R Recommendation SM.1539 (D.6.e)).

The purpose of this annex is to define how the requirements of Appendix 3 of the Radio Regulations and these new ITU Recommendations concerned with unwanted emissions are to be implemented with regard to marine radars. This includes the requirements, method of measurement, the results to be obtained and the interpretation of the measurement results.

D.2 Requirements

The requirements are defined in Appendix 3 of the Radio Regulations and the recommendations listed above in D.1.

The boundary between the OOB and spurious domains and the OOB mask are defined in the OOB recommendation – Annex 8 in the following manner –

- a) (Boundary and mask) – “the mask rolls off at 20 dB per decade from the 40 dB bandwidth to the spurious level specified in Appendix 3 of the Radio Regulations. The B_{-40} dB bandwidth can be offset from the frequency of maximum emission level, but the necessary bandwidth (1.152 of the Radio Regulations) should be contained completely within the allocated band”.
- b) (Exclusions) – “the OOB limits are not applicable inside exclusive Radiodetermination and or Earth Exploration Satellite (EES) and Space research service bands, but do apply at the band edges.”

These requirements are illustrated in Figures D.1 and D.2.

The OOB masks shown in Figures D.1 and D.2 are calculated using the transmitted pulse width and rise time.

The necessary bandwidth and the –40 dB bandwidth are generally centred about the operating frequency but may be offset to take account of spectrum asymmetry.

The OOB mask commences at a level of –40 dB and falls off at the rate of –20 dB per decade until it meets the spurious emission limit at the OOB boundary.

When the calculated –40 dB bandwidth falls within the allocated band the OOB mask commences at the edge of the allocated band.

When the –40 dB bandwidth falls outside the allocated band the OOB mask commences at that point in the adjacent band.

The OOB mask can be offset further into the adjacent band to allow for spectrum asymmetries, but the necessary bandwidth associated with this mask shall be contained completely within the allocated band.

The OOB mask emission limits only apply outside the adjacent bands i.e. below 2,7 GHz and above 3,3 GHz in the case of radars operating in the 2,9 GHz to 3,1 GHz band, and below 8,5 GHz and above 9,8 GHz in the case of radars operating in the 9,3 GHz to 9,5 GHz band.

Emissions in the spurious domain (Figures D.1 and D.2) shall be at least $43 + 10 \log \text{PEP}$ or 60 dB, whichever is the least stringent, below the carrier power, as measured in the far field of the radar. For most current marine radars the limit will be 60 dB and this means that the spurious domain starts at $5 \times B_{-40}$ from the operating frequency of the radar.

D.3 Methods of measurement

The basic methods of measurement for unwanted emissions are contained in ITU-R Recommendation M.1177 (D.6.a)). This describes two methods, referred to as the “direct” and “indirect” methods. Either method is admissible.

Measurements are to be made for all frequencies in the measurement frequency bands specified in the table D.1 below.

Table D.1 – Measurement frequency ranges

Allocated band	Measurement band	
	Lower limit	Upper limit
2,9 GHz – 3,1 GHz	2 GHz	5 th harmonic
9,3 GHz – 9,5 GHz	0,7 of the waveguide cut-off	26 GHz

D.4 Guidelines for the use and interpretation of ITU-R Recommendation M.1177

The recommendation provides some specific techniques for the measurement of the unwanted emissions of radar systems, that in principle can be used for any type of radar system. In practice, the recommendation makes no attempt to provide detailed test methods for each type of system.

This standard provides the additional detail required for the minimum test requirements for the measurement of marine radars as a basis for certification, that the particular marine radar system under test, meets the requirements of the Radio Regulations and ITU-R Recommendations as appropriate.

D.4.1 Selection of pulse widths

The ITU-R Recommendation on OOB (D.6.d)) applies to complex and simple radars with user-selectable pulse waveforms. For a particular radar, the pulse length and rise time for a number of representative pulses (including the shortest and longest pulses) shall be measured and the corresponding

B_{40} bandwidths calculated. The widest calculated B_{40} bandwidth shall then be used to create the OOB mask to be applied to that radar. Emission measurements only need to be carried out for the pulse length setting producing the widest calculated B_{40} bandwidth.

D.4.2 Measurement in azimuth and elevation – antennas

For marine radars that are essentially surface search radars, there is no requirement to make measurements in the vertical plane.

For measurements in the azimuth plane, the antenna may be either rotating or the measurement system may be aligned to the antenna bore sight and measurements in azimuth taken at appropriate antenna angles where the directions of unwanted emissions are known. Both techniques are admissible and the particular choice shall be made by agreement between the manufacturer and the test authority.

In both cases the maximum value of the emission occurring in the azimuth plane shall be recorded over the frequency range defined in table D.1.

Provided that all of the antennas to be used with the equipment under test are of the same type, then only the smallest (i.e. that with the largest azimuth beamwidth) need to be used to verify compliance with the unwanted emission requirements.

D.5 Results required

D.5.1 Necessary bandwidth

The necessary bandwidth as calculated from the measured pulse width and rise time shall be within the allocated frequency band.

D.5.2 B_{40} bandwidth

The B_{40} bandwidth shall be calculated using the methods defined in D.4.1 and in Annex 8 of reference D.6.d). This bandwidth together with the declared frequency of the pulse transmission are used to determine which of the masks illustrated in Figure D.1 or Figure D.2 shall be used for the purposes of conformity.

D.5.3 Emission spectrum

The emission spectrum shall be below the calculated mask, as determined by D.5.2 above, in both the OOB and spurious domains, for all appropriate frequencies over the ranges specified in table D.1. As previously indicated in D.2, the OOB emission masks limits do not apply within the allocated band or the adjacent RD/ESS bands.

The spurious emission limit applies in the spurious domain, regardless of frequency band.

Systems shall be compliant if the OOB mask of Figure D.2 is offset further into the adjacent band to allow for spectrum asymmetries, provided that the necessary bandwidth associated with this mask is completely contained within the allocated band.