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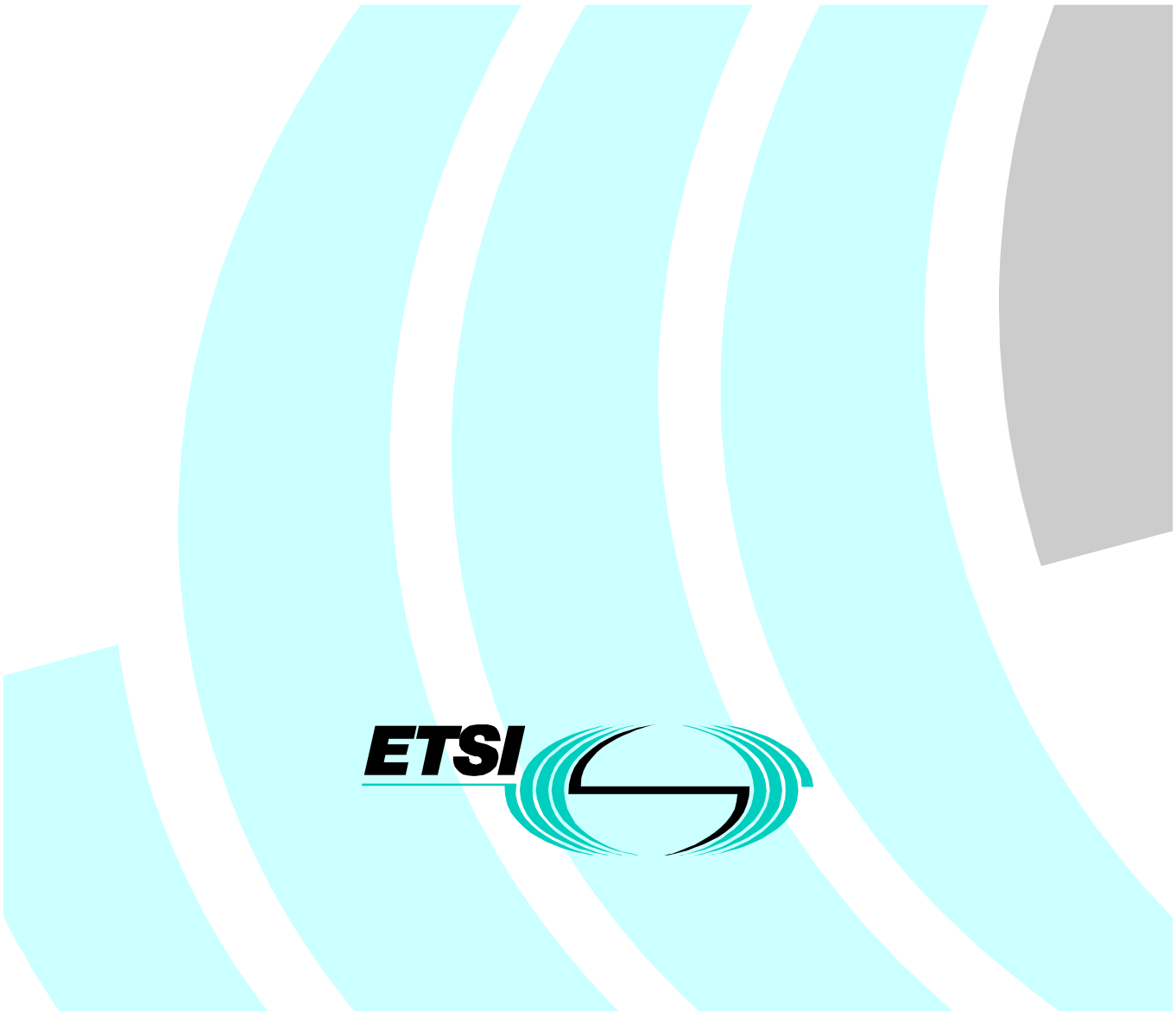
ETSI Guide

Electromagnetic Compatibility and Radio Spectrum Matters (ERM); Guidance on the incorporation of ElectroMagnetic Compatibility (EMC) requirements for radio equipment into ETSI standards intended to be referenced under Council Directive 96/98/EC on Marine Equipment



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Contents

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Foreword

This ETSI Guide (EG) has been produced by ETSI Technical Committee Electromagnetic compatibility and Radio spectrum Matters (ERM).

This Guide for the preparation of EMC requirements for ETSI Standards in the scope of Council Directive 96/98/EC [1] (Marine Equipment Directive) has been produced by the ETSI Technical Committee Electromagnetic compatibility and Radio spectrum Matters (ERM), and is now submitted for the Member Vote phase of the ETSI Approval Procedure.

The present document has been produced by ETSI to provide the competent Technical Body within ETSI with a suitable tool for the effective development of ETSI Standards for marine radio equipment in the scope of the Marine Equipment Directive, which include the essential requirements regarding to the maritime environment, related EMC conditions, and the effective use of the Radio Frequency (RF) spectrum.

Introduction

Requirements for the various types of maritime radio equipment have in the past been prepared in two different standards for each type of equipment:

- requirements related to the radio technical parameters (functional requirements);
- requirements related to electromagnetic compatibility (EMC requirements);

As the EMC environment is generally the same for all maritime radio equipment installations, the standards detailing the EMC requirements are quite similar.

The Marine Equipment Directive (Council Directive 96/98/EC [1] and Commission Directive 98/85/EC [2]), exclude all other directives, including the EMC Directive (Council Directive 89/336/EEC [3]), in respect of radio equipment intended to meet mandatory carriage requirements onboard ships subject to the International Convention on the "Safety Of Life At Sea" (SOLAS Convention) [5]. It is therefore sensible that all requirements relevant to a type of equipment intended to fulfil the requirements of the Marine Equipment Directive should be included in a single integrated standard for that type of equipment.

The text in the present document has been generalized as far as possible, but when preparing integrated standards, its applicability in any particular case may be considered.

1 Scope

The present document provides information and guidelines related to electromagnetic compatibility requirements for maritime radio equipment covered within the scope of the Marine Equipment Directive [1], in order to be of assistance in the preparation of ETSI Standards (ES), Technical Specifications (TS), or European Norms (EN) for such equipment.

A single standard for an item of marine radio equipment which covers all the applicable requirements, i.e. one which includes electromagnetic compatibility requirements as well as operational, environmental and radio technical requirements, is referred to in the present document as an integrated standard.

The guidelines set out in the present document are based upon established parameters, methods and techniques of test and measurement.

The present document sets out a proposed general structure for integrated standards which contain operational, environmental, radio functional and EMC parameters within the scope of the Marine Equipment Directive [1]. The Guide deals only with EMC requirements for maritime radio equipment and is only intended for standards that are intended to be set by ETSI as testing standards in accordance with the relevant requirements of the Marine Equipment Directive [1].

The EMC requirements have been selected to ensure an adequate level of compatibility for apparatus intended to be used in maritime environments.

Annex A of the document contains a library of standardized text modules for EMC measurements and requirements. These text modules may be used when preparing integrated standards.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, subsequent revisions do apply.
- 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] Council Directive 96/98/EC of 20 December 1996 on marine equipment.

[2] Commission Directive 98/85/EC of 11 November 1998 amending Council Directive 96/98/EC on marine equipment (Text with EEA relevance).

[3] Council Directive 89/336/EEC of 3 May 1989 on the approximation of the laws of the Member States relating to electromagnetic compatibility.

[4] International Telecommunication Union: "Radio Regulations".

[5] International Maritime Organization (IMO): "International Convention for Safety of Life at Sea (SOLAS Convention 1974) as amended (GMDSS)".

[6] CISPR 16-1: "Specification for radio disturbance and immunity measuring apparatus and methods - Part 1: Radio disturbance and immunity measuring apparatus".

[7] EN 60945: "Maritime navigation and radiocommunication equipment and systems - General requirements - Methods of testing and required test results".

[8] EN 61000-4-2: "Electromagnetic compatibility (EMC) - Part 4-2: Testing and measuring techniques - Electrostatic discharge immunity test".

[9] EN 61000-4-3: "Electromagnetic compatibility (EMC) - Part 4-3: Testing and measuring techniques - Radiated, radio-frequency, electromagnetic field immunity test".

[10] EN 61000-4-4: "Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques - Section 4: Electrical fast transient/burst immunity test - Basic EMC Publication".

[11] EN 61000-4-5: "Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques - Section 5: Surgeimmunity test".

[12] EN 61000-4-6: "Electromagnetic compatibility (EMC) - Part 4: Testing and measurement - Section 6: Immunity to conducted disturbances, induced by radio-frequency fields".

3 Definitions and abbreviations

3.1 Definitions

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

ancillary equipment: equipment (apparatus), used in connection with a receiver or transmitter, is considered as an ancillary equipment (apparatus) if:

- the equipment is intended for use in conjunction with a receiver or transmitter to provide additional operational and/or control features to the radio equipment, (e.g. to extend control to another position or location); and
- the equipment cannot be used on a stand alone basis to provide user functions independently of a receiver or transmitter; and
- the receiver or transmitter to which it is connected, is capable of providing some intended operation such as transmitting and/or receiving without the ancillary equipment (i.e. it is not a sub-unit of the main equipment essential to the main equipment basic functions).

integrated standard: single standard for a category of marine radio equipment which covers all relevant requirements, including electromagnetic compatibility requirements as well as operational, environmental and radio technical requirements.

radio communications equipment: apparatus which includes one or more radio transmitters and/or receivers and/or parts thereof.

integral antenna: antenna designed to be connected directly to the equipment with or without the use of an external connector and considered to be part of the equipment. An integral antenna may be fitted internally or externally to the equipment.

port: particular interface of the specified equipment under test with the external electromagnetic environment.

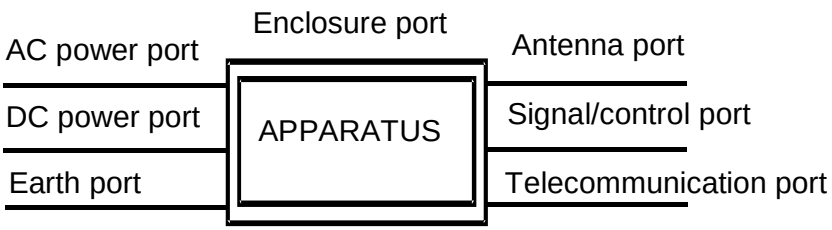

Figure 1: Examples of ports

enclosure port: physical boundary of the apparatus through which electromagnetic field may radiate or impinge.

effective radiated power: product of the power supplied to the antenna and its gain relative to a half-wave dipole.

necessary bandwidth: for a given class of emission, the width of the frequency band which is just sufficient to ensure the transmission of information at the rate and with the quality required under specified conditions (ITU Radio Regulations [4], clause S1.152). For application to multi-channel or multi-carier transmitters/transponders, where several carriers may be transmitted simultaneously from a final output amplifier or an active antenna, the necessary bandwidth is taken to be the transmitter or transponder bandwidth.

occupied bandwidth: width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to a specified percentage $\beta/2$ of the total mean power of a given emission. Unless otherwise specified for the appropriate class of emission, the value of $\beta/2$ should be taken as 0,5 %.

operating frequency range: range(s) of continuous radio frequencies covered by the equipment under test without any change of units.

3.2 Abbreviations

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

AC	Alternating Current
AM	Amplitude Modulation
DC	Direct Current
EM	ElectroMagnetic
EMC	ElectroMagnetic Compatibility
EUT	Equipment Under Test
IF	Intermediate Frequency
RF	Radio Frequency
rms	root mean square

4 Applicable EMC requirements

Technical specifications related to the antenna port of radio equipment are not included in the EMC part of the Guide. Such technical specifications for the effective use of the radio spectrum are exclusively found in the radio technical part of the integrated standard.

Within an integrated standard the EMC requirements should be concentrated into clauses entitled 'Emissions' and 'Immunity'.

The applicability overview tables below give a comprehensive overview about all relevant EMC tests specified for maritime radio equipment which normally should be considered for inclusion in an integrated standard.

The applicability of EMC tests specified in this Guide depends on the actual type of radio and/or associated ancillary equipment under test. All tests are port-related EMC tests. For certain types of equipment not having a particular type of port or for operation/technical reasons, the related EMC tests do not apply.

4.1 EMC emission

Table 1: Overview of EMC emission measurements for maritime radio and associated ancillary equipment

		Portable equipment	Mobile equipment	Frequency range
Radiated emissions	Enclosure of ancillary equipment, stand alone basis	applicable	applicable	30 MHz - 2 GHz
Radiated emissions	Enclosure of radio equipment or combination of radio and ancillary equipment	not applicable	not applicable	---
Conducted emissions	DC power input/ output port	not applicable	applicable	10 kHz - 30 MHz
Conducted emissions	AC mains power input/output port	not applicable	applicable	10 kHz - 30 MHz
NOTE: Frequency ranges given are for information only, and requirements current at the time of drafting the integrated standard should be established.				

4.2 EMC immunity

Table 2: Overview of EMC immunity tests for maritime radio and associated ancillary equipment

		Portable equipment	Mobile equipment	Frequency range
RF electromagnetic field	Enclosure	applicable	applicable	80 MHz - 1 GHz
Electrostatic discharge	Enclosure	applicable	applicable	-
Fast transients, common mode	Signal and control ports, DC and AC power ports	not applicable	applicable	-
RF common mode	Signal and control ports, DC and AC power ports	not applicable	applicable	150 kHz - 80 MHz
Short term power supply variations	AC power input ports	not applicable	applicable	-
Power supply failure	AC power input ports	not applicable	applicable	-
Surges	AC power input ports	not applicable	applicable	-
NOTE: Frequency ranges given are for information only, and requirements current at the time of drafting the integrated standard should be established.				

5 Structure of integrated standards

5.1 Typical clause structure for an integrated standard

A typical integrated standard for marine radio equipment might include the clauses listed below, in the listed order. Specific types of equipment might not require all these clauses, for instance receiver equipment would not require the transmitter tests clause. Similarly certain types of equipment might require additional clauses, e.g. equipment intended for duplex operation would require a clause including additional duplex tests.

- Foreword;
- Scope;
- References;
- Definitions, symbols and abbreviations;
- General requirements, technical and operational requirements;
- Test conditions, power sources and ambient temperatures;
- General conditions of measurement;
- Sequence of testing;
- Environmental tests;
- EMC tests:
  - Measurement conditions;
  - EMC emission tests;
  - EMC immunity tests.
- Radio parameter tests:
  - Measurement conditions;
  - Transmitter parameter tests;
  - Receiver parameter tests.
- Annexes.

The above list of clauses provides the model on which the further discussion in the present document is based.

The text related to EMC requirements may be additional to or combined with the text related to the radio technical requirements, when an integrated standard is prepared.

The proposed clause on general requirements as distinct from technical requirements is intended to allow for differentiation between those requirements which are objectively verifiable under the terms of accreditation of an independent test house (technical requirements) and those requirements which a manufacturer may declare compliance against and which are subject to the approval of a relevant institution (general requirements).

6 Scope of integrated standards

Generally, the scope should define without ambiguity the subject of the integrated standard and the aspect(s) covered, thereby indicating the limits of applicability of the integrated standard or particular parts of it. The scope may not contain requirements.

The scope should state that the integrated standard covers both radio technical parameters and EMC requirements. The following sentences related to the EMC requirements for an equipment, should always be included:

- the EMC requirements specified in the present document have been selected to ensure an adequate level of compatibility for apparatus used in maritime environments;
- compliance to the EMC requirements of the present document does not signify compliance to any safety requirements. However, it is the responsibility of the assessor of the equipment to record in the test report any observations regarding the test sample becoming dangerous or unsafe as a result of the application of the EMC tests called for in the present document.

The scope should also inform that the integrated standard is intended to be set by ETSI as a testing standard in accordance with the relevant requirements of the Council Directives on marine equipment.

The scope should be succinct so that it can be used as a summary for bibliographic purposes.

7 References in an integrated standards

This element should be provided for the references that are made to other documents. References should normally be given to Standards and Recommendations issued by recognized standardization bodies.

The list of references should include documents concerning both the EMC and the radio technical parameters.

The list should not include documents which are not explicitly cited in the provisions of the integrated standard.

8 Definitions, symbols and abbreviations in integrated standards

These elements give definitions necessary for the understanding of certain terms used in the integrated standard.

The definitions, symbols and abbreviations should be listed in alphabetic order.

The subclause should contain all definitions, symbols and abbreviations in the whole integrated standard.

9 General, technical and operational requirements in integrated standards

This clause should contain general requirements to the equipment. Such requirements may relate to construction, operating frequencies, controls and labelling of the equipment.

The general requirements may not be measurable and are therefore not included with the radio technical parameters or the EMC requirements.

10 Test conditions, power sources and ambient temperatures in integrated standards

This clause should specify the temperature and humidity conditions for test at normal and extreme conditions, and the voltage and frequency of the test power source for measurements these test conditions, as well as procedures for tests at extreme temperatures.

Further, the clause may include necessary technical requirements to the test power source.

The clause should only contain elements that are common to test for both the radio technical parameters and the EMC requirements.

11 General conditions of measurement

This clause may contain:

- specification of arrangements for test signal to be applied to the equipment;
- definitions of normal test modulation and of artificial antenna;
- requirements to test connections and test channels.

The clause should also contain specifications for measurement uncertainty and interpretation of the measuring results.

The clause should only include elements that are common to test for both radio technical parameters and EMC requirements.

12 Sequence of tests in integrated standards

If tests are required to be carried out in any specific order, then this shall be as required in the Standard. It is generally the case that environmental tests are required to be carried out before electrical tests, upon the same test sample.

It has been the practice with conformance testing of marine radio equipment to require that compliance with all requirements of a product standard be verified upon a single test sample. It is suggested that, at the manufacturers' discretion, conformance testing may be carried out on two test samples in order to allow for parallel testing paths for radio technical requirements and EMC requirements.

However it is recommended that all equipment samples used should be required to be subjected to the influence of the environmental test cycle before other tests are carried out. This would mean that if a separate EMC test sample were to be used, it would have to go through the same environmental conditions – hot and cold cycles, vibration (including any endurance tests), immersion, drop, etc. – as the sample being subjected to the environmental tests, but without the requirement to be subjected to detailed performance checks during each step of the process; in such a case the EMC test sample would have to survive the environmental test cycle in order to pass successfully through the EMC tests.

Compliance testing may be carried out on either one or two samples of the product, at the manufacturers discretion.

Where one sample is used, environmental tests shall be carried out first, followed by emissions and immunity tests, before tests are performed with respect to the other requirements of the standard.

Where two samples are used, environmental test shall be carried out on sample 1, while Sample 2 shall undergo the same pre-conditioning as Sample 1, but without the requirement to be subjected to performance checks during the pre-conditioning.

Following environmental tests/pre-conditioning, both samples shall be subject to performance checks.

Emissions and immunity tests shall be carried out on Sample 2 after environmental pre-conditioning.

Tests with respect to the other requirements of this standard shall be carried out on Sample 1 after environmental tests are completed.

Single equipment sample:

sample #1	Environmental tests	EMC tests	Radio tests

Two equipment samples:

sample #1	Environmental tests	Radio tests

sample #2	Environmental cycle	EMC tests

13 EMC tests in integrated standards

13.1 General

The clause with EMC tests of an integrated standard should comprise all necessary information to allow for an accurate assessment of the EMC characteristics of the EUT.

The structure of the EMC testing as indicated in Annex A should remain unaltered when integrated standards are being prepared. If any further structuring is necessary, the added new information should form lower order subclauses to the existing ones.

When preparing the integrated standards, the following factors should be considered:

- where an equipment includes a radio transmitter, it will normally be necessary to verify compliance of the equipment both in transmit mode and in standby mode. Where such an equipment is a transceiver, the receive mode may be equivalent to the standby mode;
- tests should be performed on a representative configuration of the radio equipment or a representative configuration of the combination of radio and ancillary equipment;
- ancillary equipment may be tested in conjunction with the radio equipment with which it is associated;
- at the manufacturers' discretion an ancillary equipment may be declared compliant to the appropriate harmonized EMC standard separately from the radio equipment with which it is associated.

The manufacturer will need to supply the following information, to be recorded in the test report if appropriate, or otherwise documented in the certification of the product:

- details of any ancillary equipment to be combined with the radio equipment for testing (where applicable);
- an exhaustive list of ports, with associated maximum recommended cable lengths, classified as either power ports, signal or control ports; power ports shall be further classified as AC or DC power ports.

The equipment shall be tested under normal test conditions according to the relevant product and basic standards or to the information accompanying the equipment, which are within the manufacturers declared range of humidity, temperature and supply voltage. The test conditions shall be recorded in the test report.

For emission and immunity tests, the test modulation, test conditions and tests arrangements, etc., are found in the part dealing with the appropriate radio equipment.

The test shall be carried out at a point within the specified normal operating environmental range of temperature and humidity with the equipment connected to the normal power supply voltage as defined in clause

The measurements shall be performed in both receive and transmit modes of operation unless indicated otherwise.

Measurement shall be made in the operation mode producing the largest emission in the frequency band being investigated consistent with normal applications and an attempt shall be made to maximize the detected radiated emissions for example by moving the cables of the equipment.

The test configuration shall be as close as possible to normal intended use.

If the equipment is part of a system, or can be connected to ancillary equipment, then it shall be acceptable to test the equipment while connected to the minimum representative configuration of ancillary equipment necessary to exercise the ports.

Ports which in normal operation are connected shall be connected to an ancillary equipment or to a representative piece of cable correctly terminated to simulate the input/output characteristics of the ancillary equipment. RF input/output ports shall be correctly terminated.

If the equipment has a large number of ports, then a sufficient number shall be selected to simulate actual operation conditions and to ensure that all the different types of termination are tested.

Ports which are not connected to cables during normal intended operation, e.g. service connectors, programming connectors, temporary connectors etc. shall not be connected to any cables for the purpose of electromagnetic compatibility testing. Where cables have to be connected to these ports, or interconnecting cables have to be extended in length in order to exercise the equipment under test (EUT), precautions shall be taken to ensure that the evaluation of the EUT is not affected by the addition or extension of these cables.

The test conditions, test configuration and mode of operation shall be recorded in the test report.

13.2 Test conditions

During the EMC tests, the measuring equipment should generally be located outside the test environment and may require additional measures for its protection from any immunity test signal applied within the test environment.

Test arrangement for EMC may be product dependent. Therefore, when preparing a dedicated integrated standard based on this Guide, information may be supplemented or amended by more appropriate information.

During immunity tests of radio receivers, it is generally necessary to set the level of the wanted RF input signal to approximately 40 dB above the minimum level necessary to achieve a receiver performance which meets the relevant specified performance criteria, measured while the power amplifiers generating the electromagnetic (EM) disturbance are switched on, but without excitation. This increased level of the wanted RF input signal is expected to represent a normal operation signal level and should be sufficient to avoid the broad band noise from the power amplifiers generating the EM disturbance from influencing the measurement.

13.3 Exclusion bands

For the purpose of EMC tests, the radio communications equipment is subject to an exclusion band. This exclusion band is always product dependent.

All real radio receivers will exhibit spurious responses at certain frequencies related to the receiver architecture, and will be susceptible to very high level interfering signals within their operational frequency range: these spurious responses are properly dealt with in receiver spurious response and blocking tests, and allowance should be made for this when conducting immunity tests on equipment which includes a radio receiver.

This is generally dealt with by inclusion of two separate subclauses entitled "receiver exclusion bands for immunity testing" and "assessment of receiver responses, wideband and narrowband".

In this approach an "exclusion band" is defined which is basically the operational frequency range of the receiver: frequencies in the exclusion band for the receiver are excluded from the immunity tests for conducted and radiated interference.

13.3.1 Transmitter exclusion band

The concept of transmitter exclusion band is introduced to allow the assessment of unwanted emissions separate from the legitimate wanted emissions.

For the purposes of radiated emissions from the enclosure port the transmitter exclusion band will normally be defined implicitly in the measurement method: the proposed method excludes only the nominal transmitting channel and its adjacent channels (this approach has been found to be satisfactory in practice over a long period of time).

For the purposes of conducted emissions from the power port, which will normally only be measured up to 30 MHz, the transmitter exclusion band may usefully be defined as 200 kHz centred at the fundamental and harmonics of the carrier frequency.

The value stated above is valid for a particular class of maritime radio equipment and should be replaced by other values specific to the bandwidth of the wanted RF emission for the given type of EUT being considered.

13.3.2 Receiver exclusion band

It is suggested that the exclusion band for receivers is defined as the operating frequency band of the receiver, as declared by the manufacturer, extended at each end by 5 % of the end-of-band frequency. This definition allows for the fact that the operating band of some marine radio receivers can cover several octaves, and the end result is not materially different from that of other definitions used elsewhere.

The value stated above is valid for a particular class of maritime radio equipment and should be replaced by other values specific to the bandwidth of the wanted RF emission for the given type of EUT being considered.

13.4 Narrow band responses of receivers

Receiver spurious responses can be divided into two categories:

- narrow band phenomena which are a receiver spurious response dealt with in the equipment product standard and therefore is not regarded as part of EMC immunity tests; and
- wideband phenomena which are regarded as part of EMC immunity tests.

Responses on receivers or the receiver part of (duplex) transceivers occurring during the immunity tests at discrete frequencies which are narrow band responses (spurious responses), may be identified by the following method:

The unwanted signal frequency is increased by an amount equal to twice the bandwidth of the receiver intermediate frequency (IF) filter immediately preceding the demodulator, as declared by the manufacturer. The test is repeated with the frequency of the unwanted signal decreased by the same amount.

If the degradation disappears, then the response is considered as a narrow band response.

If the degradation remains, this may be due to the fact that the offset has made the frequency of the unwanted signal correspond to the frequency of another narrow band response. Under these circumstances the procedure is repeated with the increase and decrease of the frequency of the unwanted signal adjusted two and one half times the bandwidth previously referred to. If the degradation remains, the phenomena is considered wide band and therefore an EMC problem.

Narrow band responses should be disregarded during immunity tests since they are considered in detail during the radio receiver tests.

13.5 Performance criteria

The performance criteria are used to take a decision on whether a radio equipment passes or fails immunity tests.

For the purpose of this standard four categories of performance criteria may apply:

- performance criteria for continuous phenomena applied to transmitters;
- performance criteria for transient phenomena applied to transmitters;
- performance criteria for continuous phenomena applied to receivers;
- performance criteria for transient phenomena applied to receivers.

Normally, the performance criteria depend on the type of radio equipment. Thus, this Guide only contains general performance criteria commonly used for the assessment of radio equipment. More specific and product-related performance criteria for a dedicated type of radio equipment may be established for each type of the radio equipment.

Annex A (informative): EMC tests; Library of text modules for the development of EMC related requirements

This annex indicates how the EMC part of an integrated standard may be. The annex may serve as a practical example as well as being a library of text modules for the different individual EMC related requirements.

The Foreword, Scope, References, Definitions/Symbols/Abbreviations as well as General Requirement and Test Conditions are common for both the radio technical and the EMC part of an integrated standard. These clauses should therefore cover all necessary information related to both parts of the integrated standard. No text modules for these clauses are therefore included in this Annex as the information may vary widely with the equipment category.

A.1 Measurement conditions

A.1.1 General

The equipment shall be tested under normal test conditions.

The test configuration and mode of operation shall represent the intended use and shall be recorded in the test report.

A.1.2 Arrangements for test signals

Equipment for the generation and measurement of test signals shall as far as possible be located outside the test environment. Adequate measures shall be taken to avoid the effect of the unwanted signal on the measuring equipment and to ensure that any effect on the test is minimized.

Adequate measures shall be taken to avoid the effect of immunity test signals on both the measuring equipment and the signal sources for the wanted signals located outside the test environment.

A.1.2.1 Arrangements for test signals at the input of transmitters

The signal source providing the transmitter under test with the modulation signal shall be located outside the test environment, unless the transmitter is modulated by its own internal source.

A.1.2.2 Arrangements for test signals at the output of transmitters

For transmitters without an antenna connector (i.e. in case of integral antenna equipment), the wanted RF output signal to establish a communication link shall be delivered from the EUT to an antenna located within the test environment. This antenna shall be connected to the external measuring equipment by a coaxial cable.

For transmitters with an antenna connector (i.e. in case of non integral antenna equipment), the wanted RF output signal to establish a communication link shall be delivered from that antenna connector to the external measuring equipment by a shielded transmission line, such as a coaxial cable. Adequate measures shall be taken to minimize the effect of unwanted common mode currents on the external conductor of the transmission line at the point of entry to the transmitter.

A.1.2.3 Arrangements for test signals at the input of receivers

For receivers without an antenna connector (i.e. in case of integral antenna equipment), the wanted RF input signal to establish a communication link shall be presented to the EUT from an antenna located within the test environment. This antenna shall be connected to the external RF signal source by a coaxial cable.

For receivers with an antenna connector, the wanted RF input signal to establish a communication link shall be presented to the antenna connector of the EUT by a shielded transmission line, such as a coaxial cable. The coaxial cable shall be connected to the external RF signal source. Adequate measures shall be taken to minimize the effect of unwanted common mode currents on the external conductor of the shielded transmission line at the point of entry to the receiver.

The signal source shall be modulated with normal test modulation.

Unless otherwise specified, the level of the wanted RF input signal shall be set to be approximately 40 dB above the maximum usable sensitivity of the receiver.

A.1.2.4 Arrangements for test signals at the output of receivers

For receivers with an acoustic analogue speech output the audio frequency output signal should be coupled via an electrically non-conductive acoustic tube to an external audio distortion meter or other appropriate measuring equipment outside of the test environment. Where it is not practical to use an electrically non-conductive acoustic tube, then other means of connecting the receiver output signal to the external audio distortion meter or other measuring equipment shall be provided and recorded in the test report.

For receivers with a non-speech output the output signal shall be coupled via an electrically non-conductive means to the external measuring equipment outside the test environment (e.g. camera to read a display). If the receiver has an output connector or port providing the wanted output signal, then this port shall be used via a cable, consistent with the standard cable used in normal operation, connected to the external measuring equipment outside the test environment. The measuring equipment may be supplied by the manufacturer.

Precautions shall be taken to ensure that any effect on the test due to the coupling means is minimized.

A.1.2.5 Arrangements for testing transmitter and receiver together (as a system)

Transmitter and receivers may be tested for immunity as a system when combined as a transceiver or the combined equipment is of a size which allows simultaneously testing. In this case the transceiver or transmitter and receiver shall be located inside the test environment and shall be exposed simultaneously to the immunity test signals.

For transceivers or transmitters and receivers operating at the same frequency, the wanted output signal of the transmitter may be used via a suitable attenuator and applied to the input of the receiver as the wanted RF input signal. Alternatively, two transceivers may be used where the wanted signal from one transmitter may be applied through a suitable attenuator to the receiver input of the other equipment.

A.1.3 Exclusion bands of the radio equipment

For the purpose of EMC tests set up in this document, the radio equipment is subject to an exclusion band.

A.1.3.1 Exclusion band for transmitters for emission measurements

For measurement of conducted emissions from the power port, the transmitter exclusion band is defined as 200 kHz centred at the fundamental and harmonics of the RF carrier frequency.

For measurement of radiated emissions from the enclosure port of the transmitter, the exclusion band comprises the nominal transmitting frequency and the adjacent channels.

A.1.3.2 Exclusion band for transmitters for immunity tests

For immunity measurement, the transmitter exclusion band is defined as ±50 kHz from the nominal operating frequency of the transmitter.

A.1.3.3 Exclusion band for receiver for immunity tests

The exclusion band for receivers is defined as the operating frequency band of the receiver, as declared by the manufacturer, extended at each end by 5% of the end-of-band frequency.

A.1.4 Narrow band responses of receivers

Responses on receivers or the receiver part of (duplex) transceivers occurring during the immunity tests at discrete frequencies which are narrow band responses (spurious responses), may be identified by the following method:

The frequency of the unwanted signal frequency is increased by an amount equal to twice the bandwidth of the receiver IF filter immediately preceding the demodulator, as declared by the manufacturer. The test is repeated with the frequency of the unwanted signal decreased by the same amount.

If the degradation disappears and the receiver is in compliance with specified performance criteria, then the response is considered as a narrow band response.

If the degradation remains and the receiver does not comply with the specified performance criteria, this may be due to the fact that the offset has made the frequency of the unwanted signal correspond to the frequency of another narrow band response. Under these circumstances the procedure is repeated with the increase and decrease of the frequency of the unwanted signal adjusted two and one half times the bandwidth referred to above. If the degradation remains and the receiver still does not comply with the specified performance criteria, the phenomena is considered wide band and therefore an EMC problem.

For immunity tests, narrow band responses shall be disregarded.

A.1.5 Performance assessment

A.1.5.1 General

The manufacturer shall at the time of submission of the equipment for test, supply the following information to be recorded in the test report:

- the primary functions of the radio equipment to be assessed during and after the EMC exposure;
- the intended functions of the radio equipment which shall be in accordance with the documentation accompanying the equipment;
- the user control functions and stored data that are required for normal operation and the method to be used to assess whether these have been lost after the EMC exposure;
- the type of modulation, the characteristics of the transmission used for testing (random bit stream, message format, etc.) and the necessary test equipment delivered to enable the assessment of the EUT;
- the ancillary equipment to be combined with the radio equipment for testing (where applicable);
- an exhaustive list of ports, with the maximum cable lengths allowed, classified as either power or telecommunication/signal/control. Power ports shall further be classified as AC or DC power;
- the bandwidth of the IF filter immediately preceding the demodulator;
- the method to be used to verify that a communication link is established and maintained (if appropriate);
- the operating frequency bands over which the equipment is intended to operate.

A.1.5.2 Equipment which can provide a continuous communication link

For radio equipment of non-specialized nature or for radio equipment tested in combination with ancillary equipment, the normal test modulation, test arrangements, etc., shall apply.

A.1.5.3 Equipment which does not provide a continuous communication link

For radio equipment of a specialized nature and/or ancillary equipment intended to be tested on a stand alone basis, the manufacturer shall specify the permissible minimum level of performance or degradation of performance during and/or after the EMC exposure.

Further, the manufacturer shall define the test method(s) for the assessment of the actual level of performance or degradation of performance during and/or after the EMC exposure. Under these circumstances the manufacturer shall additionally provide the following information also for inclusion in the test report:

- the primary functions of the relevant type of the EUT during and after EMC stress;
- the intended functions of the relevant type of the EUT which shall be in accordance with the documentation accompanying the equipment;
- suitable pass/fail criteria for the relevant type of the EUT;
- the method of monitoring the actual level of performance and/or the actual degradation of performance of the EUT.

The assessment of the actual performance or its degradation which is carried out during and/or after the EMC exposure, shall be simple, but at the same time give adequate proof that the primary functions of the equipment are operational.

For immunity tests of ancillary equipment without separate pass/fail criteria, the receiver, transmitter or transceiver coupled to the ancillary equipment shall be used to judge whether the ancillary equipment passes or fails the test.

A.1.5.4 Ancillary equipment

At the manufacturer's discretion ancillary equipment may be tested and assessed applying the provisions of the present document:

- separately to the ancillary equipment; or
- to the combination of ancillary and radio equipment.

In each case, compliance enables the ancillary equipment to be used with different receivers, transmitters or transceivers.

For immunity tests of ancillary equipment intended to be tested on a stand alone basis, the manufacturer shall specify the permissible level of performance or the permissible degradation of performance during and/or after the EMC tests.

For immunity tests of ancillary equipment without separate pass/fail criteria, the receiver, transmitter or transceiver coupled to the ancillary equipment shall be used to judge whether the ancillary equipment passes or fails the test.

A.1.6 Performance criteria

The performance criteria are used to take a decision on whether a radio equipment passes or fails immunity tests.

For the purpose of the EMC tests, the following categories of performance criteria apply:

- performance criteria A for continuous phenomena;
- performance criteria B for transient phenomena;
- performance criteria C for power supply failure.

A.1.6.1 Performance criteria A

During and after the test, the equipment shall continue to operate as intended. No degradation of performance or loss of function below a level as defined by the performance check or as specified by the manufacturer is allowed.

During the test, the equipment shall not unintentionally transmit or change actual operating state and stored data.

A.1.6.2 Performance criteria B

During the test, degradation or loss of function or performance which is self recoverable is allowed, but the equipment shall not unintentionally transmit or change actual operating state and stored data.

The equipment shall continue to operate as intended after the test. No degradation of performance or loss of function below the level as defined by the performance check or as specified by the manufacturer is allowed.

A.1.6.3 Performance criteria C

During the test sequence the equipment shall not unintentionally transmit or change stored data.

Temporary degradation or loss of function or performance is allowed during the test sequence, provided the function, as defined in the Standard and in the technical specification published by the manufacturer, is self recoverable or can be restored after the test by operation of user controls.

A.1.7 Equipment classification

For the purpose of EMC performance assessment, the maritime radio equipment and/or associated ancillary equipment shall be classified as mobile equipment or portable equipment.

A.2 EMC emission tests

A.2.1 Test configuration

This subclause defines the requirements for test configurations:

- measurements shall be made in the operational mode producing the largest emission in the frequency band being investigated consistent with normal applications;
- the equipment shall be configured in a manner which is representative for normal/typical operation, where practical;
- an attempt shall be made to maximize the detected radiated emission, e.g. by moving the cables of the equipment;
- where radio equipment is provided with a detachable integral antenna, it shall be tested with the antenna fitted in a manner typical of normal intended use, unless specified otherwise;
- if the equipment is part of a system, or can be connected to ancillary equipment, then it shall be acceptable to test the equipment while connected to the minimum representative configuration of ancillary equipment necessary to exercise the ports;
- if the equipment has a large number of ports, then a sufficient number shall be selected to simulate actual operational conditions and to ensure that all the different types of termination are covered;
- ports which in normal operation are connected shall be connected to an ancillary equipment or to a representative piece of cable terminated to simulate the impedance of the ancillary equipment. RF input/output ports shall be correctly terminated;
- the configuration and mode of operation during the measurements shall be precisely noted in the test report.

Control settings and the operational mode and physical configuration of the EUT should be selected so as to produce the maximum emission levels in the frequency band being investigated, consistent with normal applications of the equipment.

Taking into account the above consideration the integrated standard should define the modulation conditions to be applied to the EUT for emission tests.

A.2.2 Radiated EMC emissions, enclosure of ancillary equipment measured on a stand alone basis

This test is only applicable to ancillary equipment not incorporated in the radio equipment and intended to be measured on a stand alone basis, as declared by the manufacturer. This test shall be performed on a representative configuration of the ancillary equipment.

This test is not applicable to ancillary equipment incorporated in the radio equipment or for ancillary equipment intended to be measured in combination with the radio equipment.

A.2.2.1 Definition

This test assesses the ability of ancillary equipment to limit unwanted emissions from the enclosure.

A.2.2.2 Test method

The test method shall be in accordance with EN 60945 [7].

The ancillary equipment shall be tested under operational conditions typical for its normal use.

The EUT shall be placed on a non-conductive support with a height of 1,5 m. The measuring distance between the centre of the test antenna and the EUT shall be 3 m or 10 m as indicated in table A.2. A test site in accordance with EN 60945 [7] and CISPR 16-1 [6] shall be used.

The measuring bandwidth shall be in accordance with table A.1.

Table A.1: Measuring bandwidth - radiated emissions

Frequency range	Measuring bandwidth
150 kHz to 30 MHz	9 kHz to 10 kHz
> 30 MHz to 1 GHz	100 kHz to 120 kHz
156 MHz to 165 MHz	9 kHz to 10 kHz

The setting of controls which may affect the level of radiated interference shall be varied in order to ascertain the maximum emission level.

When the EUT consists of more than one unit the interconnecting cables shall have the maximum length and type as indicated by the manufacturer. Available input and output ports of the ancillary equipment under test shall be connected to the maximum length of cable as indicated by the manufacturer and terminated to simulate the impedance of the radio equipment. These cables shall be bundled at the approximate centre of the cable with the bundles of 30 cm to 40 cm in length running in the horizontal plane from the port to which it is connected. If it is impractical to do so because of cable bulk or stiffness, the disposition of the excess cable shall be precisely noted in the test report.

The emissions shall be measured in the frequency range of 150 kHz to 1 GHz in accordance with CISPR 16-1 [6] using the measuring receiver or a comparable spectrum analyser. During the measurements the quasi-peak detector shall be used.

A.2.2.3 Limit

The levels of field strength of any radiated emission from the enclosure of the EUT in the frequency range 150 kHz to 1 GHz shall not exceed the values given in table A.2 (for the frequency range 150 kHz to 30 MHz, see also figure A.1.

Table A.2: EMC emission limits

Frequency range	Limit (Quasi Peak)	Measuring distance
150 kHz to 300 kHz	80 dBµV/m to 50 dBµV/m (see note)	3 m
300 kHz to 30 MHz	50 dBµV/m to 34 dBµV/m (see note)	3 m
> 30 MHz to 230 MHz	30 dBµV/m	10 m
> 230 MHz to 1 GHz	37 dBµV/m	10 m
156 MHz to 165 MHz	24 dBµV/m	3 m
NOTE FOR EDITORS: The limit decreases linearly with the logarithm of frequency.		

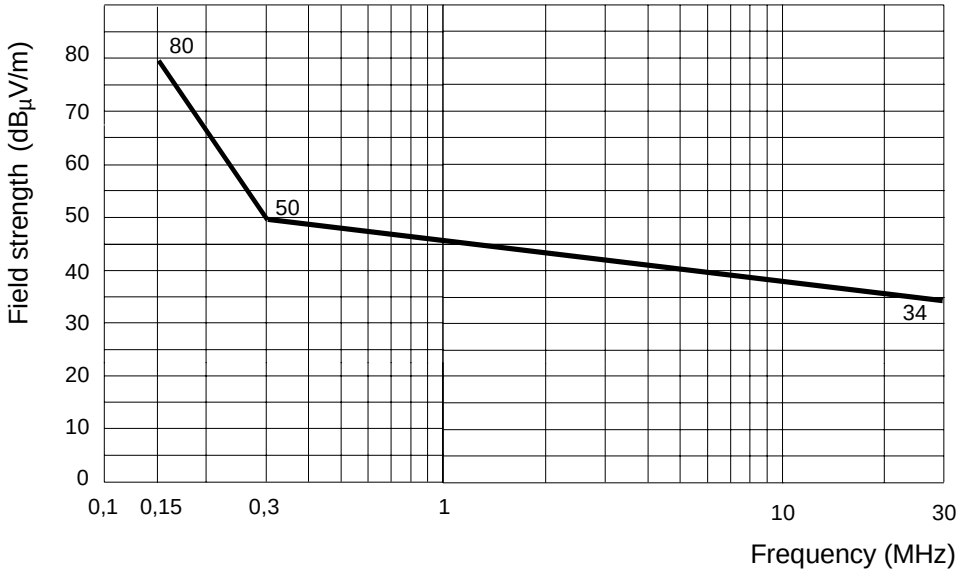

Figure A.1: Maximum permissible level of radiated EMC emissions for ancillary equipment measured on a stand alone basis (within the range 150 kHz to 30 MHz)

A.2.3 Conducted emissions - DC power ports

This test is applicable for radio equipment and ancillary equipment for fixed use that may have DC cables longer than 3 m.

If the DC power cable of the radio and/or the ancillary equipment is less than 3 m in length, and intended for direct connection to a dedicated AC/DC power supply, then the measurement shall be performed on the AC power input port of that power supply as specified in subclause 8.4. If the DC power cable may be longer than 3 m, then the measurement shall additionally be performed on the DC power port of the radio and/or ancillary equipment.

A.2.3.1 Definition

This test assesses the ability of the EUT to limit its internal noise from the DC power ports.

A.2.3.2 Test method

The power input cable(s) between DC input ports of the EUT and the artificial mains network shall be screened and not exceed 0,8 m in length.

If the EUT consists of more than one unit with individual DC power input ports, power input ports of the same nominal supply voltages shall be connected in parallel to the artificial mains network.

This test shall be performed in both receive and transmit modes of operation.

The setting of controls which may affect the level of conducted interference shall be varied in order to ascertain the maximum emission level.

The measuring bandwidth shall be:

- 200 Hz in the frequency range 10 kHz to 150 kHz;
- 9 kHz to 10 kHz in the frequency range 150 kHz to 30 MHz.

The emissions shall be measured in the frequency range of 10 kHz to 30 MHz, applying the transmitter exclusion band to measurements in the transmit mode of operation, by means of a measuring receiver using a quasi-peak detector and an artificial mains V-network (50 Ω/50 µH).

Measurements shall be made with all measuring equipment and the EUT mounted on, and bonded to, an earth plane. Where provisions of an earth plane is not practicable, equivalent arrangements shall be made using the metallic frame or mass of the EUT as the earth reference.

A.2.3.3 Limits

The level of any conducted spurious signal shall not exceed the values given in figure A.2.

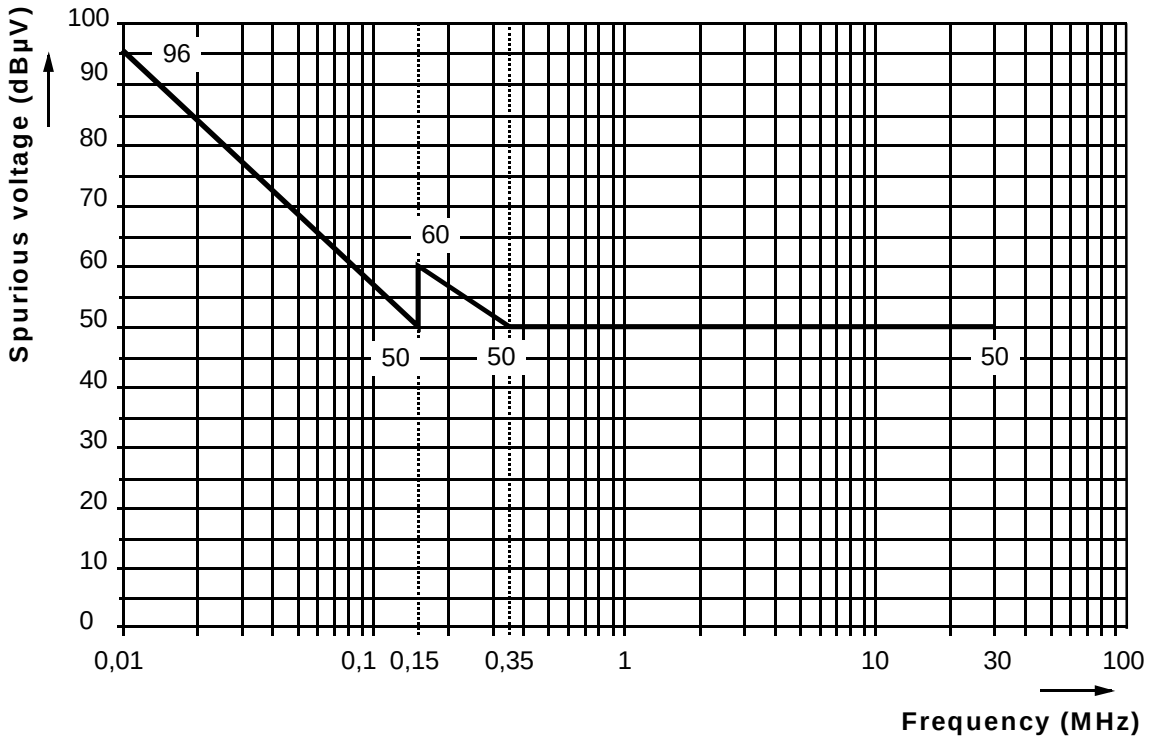

Figure A.2: Maximum permissible level of conducted EMV emissions

A.2.4 Conducted emissions - AC power ports

This test is applicable for radio equipment and/or ancillary equipment for fixed use powered by the AC mains.

This test is not applicable to AC output ports which are connected directly (or via a switch or circuit breaker) to the AC input port.

This test shall be performed on a representative configuration of the radio equipment or a representative configuration of the combination of radio and ancillary equipment.

A.2.4.1 Definition

This test assesses the ability of the EUT to limit its internal noise from the AC mains power ports.

A.2.4.2 Test method

The power input cable(s) between AC input ports of the EUT and the artificial mains network shall be screened and not exceed 0,8 m in length.

If the EUT consists of more than one unit with individual AC power input ports, power input ports of the same nominal supply voltages shall be connected in parallel to the artificial mains network.

This test shall be performed in both receive and transmit modes of operation.

The setting of controls which may affect the level of conducted interference shall be varied in order to ascertain the maximum emission level.

The measuring bandwidth shall be:

- 200 Hz in the frequency range 10 kHz to 150 kHz;
- 9 kHz to 10 kHz in the frequency range 150 kHz to 30 MHz.

The emissions shall be measured in the frequency range of 10 kHz to 30 MHz, applying the transmitter exclusion band to measurements in the transmit mode of operation, by means of a measuring receiver using a quasi-peak detector and an artificial mains V-network (50 Ω/50 µH).

Measurements shall be made with all measuring equipment and the EUT mounted on, and bonded to, an earth plane. Where provisions of an earth plane is not practicable, equivalent arrangements shall be made using the metallic frame or mass of the EUT as the earth reference.

A.2.4.3 Limits

The level of any conducted spurious signal shall not exceed the values given in figure A.2.

A.3 EMC immunity tests

A.3.1 Test configuration

For the immunity tests of ancillary equipment without separate pass/fail criteria, the performance of the radio equipment coupled to the ancillary equipment may be used to judge whether the ancillary equipment passes or fails.

For immunity tests of transmitters, the transmitter should be operated at its maximum output power setting and with the normal test signal.

For immunity tests of receivers, the radio frequency input signal to the receiver should be the normal test signal.

This subclause defines the requirements for test configurations:

- the tests shall be carried out at a point within the specified normal operating environmental range and at the rated supply voltage for the equipment;
- if the equipment is part of a system, or can be connected to ancillary equipment, then it shall be acceptable to test the equipment connected to the minimum representative configuration of ancillary equipment necessary to exercise the ports;
- where radio equipment is provided with a detachable integral antenna, it shall be tested with the antenna fitted in a manner typical of intended use, unless specified otherwise;

- for the immunity tests of ancillary equipment, without a separate pass/fail criteria, the receiver or transmitter coupled to the ancillary equipment, shall be used to judge whether the ancillary equipment passes or fails;
- if the equipment has a large number of ports, then a sufficient number shall be selected to simulate actual operational conditions and to ensure that all the different types of termination are covered;
- ports which in normal operation are connected, shall be connected to an ancillary equipment or to a representative piece of cable terminated to simulate the impedance of the ancillary equipment. RF input/output ports shall be correctly terminated;
- ports which are not connected to cables during normal intended operation, e.g. service connectors, programming connectors, temporary connectors etc. shall not be connected to any cables for the purpose of EMC testing. Where cables have to be connected to these ports, or interconnecting cables have to be extended in length in order to exercise the EUT, precautions shall be taken to ensure that the evaluation of the EUT is not affected by the addition or extension of these cables;
- the configuration and mode of operation during the tests shall be precisely noted in the test report.

The tests shall be performed in both receive and transmit mode of operation unless otherwise indicated.

Receive and transmit modes of operation, are both subject to frequency exclusion bands when testing for RF immunity.

For immunity tests on receivers a test signal shall be connected to the RF input of the receiver, with a carrier frequency equal to the nominal frequency of the receiver, and modulated with normal test modulation. The level of this test signal shall be 40 dBμV emf unless indicated otherwise.

For the immunity tests of ancillary equipment without separate pass/fail criteria, the receiver, transmitter or transceiver coupled to the ancillary equipment shall be used to judge whether the ancillary equipment passes or fails.

The normal test modulation will typically be defined in the set of clauses dealing with radio technical general conditions of measurement. The same set of clauses will normally define requirements for the connection of test signals to the RF input of receivers and for the termination of RF outputs of transmitters.

A.3.2 RF electromagnetic field

This test is applicable for radio equipment and associated ancillary equipment.

A.3.2.1 Definition

This test assesses the ability of the EUT to operate as intended in the presence of a radio frequency electromagnetic field disturbance impinging upon the enclosure.

A.3.2.2 Test method

The test methodology to be applied and the parameters of the measuring apparatus to be employed are detailed in EN 61000-4-3 [9].

In addition, the following testing conditions shall apply:

- the RF test level shall be 10 V/m (measured unmodulated). The test signal shall be amplitude modulated (AM) to a depth of 80 % by a sinusoidal audio signal of 1 000 Hz. If the wanted signal is modulated with 1000 Hz, then an audio signal of 400 Hz shall be used;
- the test shall be performed over the frequency range 80 MHz to 1 000 MHz with the exception of the exclusion band for transmitters or with the exception of the exclusion band for receivers, as appropriate;
- for receivers and transmitters the stepped frequency increments shall be 1 % frequency increment of the momentary used frequency;
- responses on receivers occurring at discrete frequencies which are narrow band responses, shall be disregarded from the test;

- the frequencies selected and used during the test shall be recorded in the test report.

A.3.2.3 Performance criteria

Performance criteria A shall apply.

For ancillary equipment the pass/failure criteria supplied by the manufacturer shall apply, unless the ancillary equipment is tested in connection with a receiver or transmitter in which case the corresponding performance criteria above shall apply.

A.3.3 Electrostatic discharge

This test is applicable for radio equipment and associated ancillary equipment.

A.3.3.1 Definition

This test assesses the ability of the EUT to operate as intended in the event of an electrostatic discharge.

A.3.3.2 Test method

The test generator, test set-up and test procedure shall be in accordance with EN 61000-4-2 [8]. The test levels shall be 6 kV contact discharge and 8 kV air discharge.

The test shall be performed with ten single discharges applied to each test point. Ten test points shall be chosen on exposed surfaces on any unit of the EUT including where appropriate, knobs and other protrusions or projecting parts accessible to the user in normal operation.

Care should be taken not to apply these discharges to conductive pins of connectors.

A.3.3.3 Performance criteria

Performance criteria B shall apply.

For ancillary equipment the pass/failure criteria supplied by the manufacturer shall apply, unless the ancillary equipment is tested in connection with a receiver or transmitter in which case the corresponding performance criteria above shall apply.

A.3.4 Fast transient

This test is applicable for radio equipment with AC mains power port and for associated ancillary equipment.

This test shall additionally be performed on signal and control ports and DC power ports of radio equipment and associated ancillary equipment, if the cables they are connected to may be longer than 3 m.

Where this test is not carried out on any port because the manufacturer declares that it is not intended to be used with cables longer than 3 m, a list of ports which were not tested for this reason shall be included in the test report.

A.3.4.1 Definition

This test assesses the ability of the EUT to operate as intended in the event of fast transients on the power, signal and control ports.

A.3.4.2 Test method

The test methodology to be applied and the parameters of the measuring apparatus to be employed are detailed in EN 61000-4-4 [10].

The induction of the interference shall be:

- to AC/DC power ports by a coupling/decoupling network complying with subclause 6.2 of EN 61000-4-4 [10];
- to signal and control ports by a capacitive coupling clamp complying with subclause 6.6.3 of EN 61000-4-4 [10].

The test level shall be 2 kV. The test voltage shall be applied as a 15 ms burst every 300 ms for the duration of 3 minutes for each positive and negative polarity of the test voltage.

A.3.4.3 Performance criteria

Performance criteria B shall apply.

For ancillary equipment the pass/failure criteria supplied by the manufacturer shall apply, unless the ancillary equipment is tested in connection with a receiver or transmitter in which case the corresponding performance criteria shall apply.

A.3.5 Conducted disturbances on power ports

This test is applicable for radio equipment with AC mains power port and for associated ancillary equipment.

This test shall additionally be performed on signal and control ports and DC power ports of radio equipment and associated ancillary equipment, if the cables may be longer than 3 m.

Where this test is not carried out on any port because the manufacturer declares that it is not intended to be used with cables longer than 3 m, a list of ports which were not tested for this reason shall be included in the test report.

A.3.5.1 Definition

This test assesses the ability of the EUT to operate as intended in the presence of a radio frequency electromagnetic disturbance on the input/output ports.

A.3.5.2 Test method

The test methodology to be applied and the parameters of the measuring apparatus to be employed are detailed in EN 61000-4-6 [12]. The frequency step size shall be either 1 % of the present frequency or 50 kHz if the frequency is below 5 MHz.

A test generator complying with subclause 6.1 of EN 61000-4-6 [12] shall be used. The induction of the disturbances shall be:

- to power supply lines by a coupling/decoupling network complying with subclause 6.2.2.1 of EN 61000-4-6 [12];
- to input/output and control lines by direct injection as described in subclause 6.2.1 of EN 61000-4-6 [12].

The test level shall be 3 V rms swept over the frequency range of 150 kHz to 80 MHz., applying the Rx exclusion band (subclause 6.3.2) to measurements in the receiver mode of operation. The modulation shall be amplitude modulation (AM) at a frequency of 400 Hz to a depth of 80 %.

For receivers and transmitters only, the stepped frequency increments shall be 50 kHz in the frequency range 150 kHz - 5 MHz and 1 % frequency increment of the momentary frequency in the frequency range 5 MHz - 80 MHz.

Additionally a test shall be performed with a test level of 10 V rms at the following frequencies:

2 MHz; 3MHz; 4 MHz; 6,2MHz 8,2 MHz; 12,2 MHz; 16,5 MHz; 18,8 MHz; 22 MHz; and 25MHz.

A.3.5.3 Performance criteria

Performance criteria A shall apply.

For ancillary equipment the pass/failure criteria supplied by the manufacturer shall apply, unless the ancillary equipment is tested in connection with receivers or transmitters in which case the corresponding performance criteria above shall apply.

A.3.6 Power supply short term variations

This test is applicable for radio equipment with AC mains power port and for associated ancillary equipment. The test is not applicable for DC powered equipment.

A.3.6.1 Definition

This test assesses the ability of the EUT to operate as intended in the event of power supply short term variations on the AC power input ports.

A.3.6.2 Test method

The test methodology to be applied is detailed in EN 60945 [7].

The EUT shall be subject to the following power supply variations relative to the nominal value once per minute for the duration of 10 minutes each:

a) test voltage = nominal voltage + (20 V ± 1 %) deviation, duration 1,5 s ± 0,2 s;

   test frequency = nominal frequency + (10 Hz ± 0,5 %) deviation, duration 5 s ± 0,5 s, superimposed;

b) test voltage = nominal voltage - (20 V ± 1 %) deviation, duration 1,5 s ± 0,2 s;

   test frequency = nominal frequency - (10 Hz ± 0,5 %) deviation, duration 5 s ± 0,5 s, superimposed.

Voltage and frequency variation rise and decay times are 0,2 s ± 0,1 s (at 10 % and 90 %).

A.3.6.3 Performance criteria

Performance criteria B shall apply.

A.3.7 Power supply failure

This test covers the break in supply which may occur during changeover between ships main and emergency power supplies.

The test is not applicable to EUT intended for operation from battery power sources only or fitted with or connected to back-up batteries.

The power supply break in this test is defined in accordance with the break allowed by the IMO SOLAS Convention [] for changeover between ships main and emergency power supplies.

A.3.7.1 Definition

This test assesses the ability of the EUT to operate as intended after being subjected to short breaks in the power supply due to power supply changeover and breaker dropout.

A.3.7.2 Test method

The EUT shall be subjected to three breaks in the power supply of a duration of 60 s each.

A.3.7.3 Performance criteria

Performance criteria C shall apply.

A.3.8 Surges

This test is applicable for radio equipment with AC mains power input port and for associated ancillary equipment.

A.3.8.1 Definition

These tests assess the ability of the EUT to operate as intended in the event of surges present on the AC mains power ports and telecommunication ports.

A.3.8.2 Test method

The test methodology to be applied and the parameters of the measuring apparatus to be employed are detailed in EN 61000-4-5 [11].

A combination wave (hybrid) generator complying with subclause 6.1 of EN 61000-4-5 [11] in combination with any coupling/decoupling network complying with subclause 6.3 of EN 61000-4-5 [11] shall be used.

The test voltage shall be 0,5 kV line-to-line and 1 kV line-to-ground. The test voltage shall be applied with a repetition rate of 6 pulses/minute for a duration of 3 minutes for each of the positive and negative polarity of the test voltage.

A.3.8.3 Performance criteria

Performance criteria B shall apply.

For ancillary equipment the pass/failure criteria supplied by the manufacturer (subclause 7.4) shall apply, unless the ancillary equipment is tested in connection with a receiver or transmitter in which case the corresponding performance criteria above shall apply.

History

Document history			
V1.1.1	March 2000	Membership Approval Procedure	MV 20000519: 2000-03-21 to 2000-05-19
V1.1.1	July 2000	Publication	