

This is a preview - click here to buy the full publication



**IEC 60533**

Edition 3.0 2015-08

# INTERNATIONAL STANDARD

---

**Electrical and electronic installations in ships – Electromagnetic compatibility (EMC) – Ships with a metallic hull**

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

---

ICS 33.100; 33.100.10; 47.020

ISBN 978-2-8322-2849-4

**Warning! Make sure that you obtained this publication from an authorized distributor.**

## CONTENTS

FOREWORD.....	5
INTRODUCTION.....	7
1 Scope.....	8
2 Normative references.....	8
3 Terms and definitions .....	9
4 General .....	14
5 EMC test plan .....	15
5.1 Objective.....	15
5.2 Configuration of equipment under test (EUT) .....	15
5.2.1 General .....	15
5.2.2 Assembly of EUT .....	15
5.2.3 EUT interconnecting cables.....	15
5.2.4 Auxiliary equipment.....	15
5.2.5 Cabling and grounding .....	15
5.3 Test pre-conditioning.....	16
5.3.1 Operational conditions .....	16
5.3.2 Environmental conditions .....	16
5.3.3 Test software.....	16
5.4 Acceptance criteria.....	16
5.5 Scope of EMC testing.....	16
6 Emission requirements.....	17
6.1 Conditions during the emission tests .....	17
6.2 Emission limits .....	19
6.2.1 General .....	19
6.2.2 Emission limits for equipment installed in the deck and bridge zone.....	21
6.2.3 Emission limits for equipment installed in the general power distribution zone .....	21
6.2.4 Emission limits for equipment installed in the special power distribution zone .....	22
7 Immunity requirements.....	22
7.1 Conditions during the immunity tests .....	22
7.2 Minimum immunity requirements .....	22
7.3 System aspects.....	24
8 Test results and test report .....	24
Annex A (informative) General EMC planning procedures .....	25
A.1 Overview.....	25
A.2 General procedures.....	25
A.3 EMC management.....	25
A.3.1 General .....	25
A.3.2 EMC advisory group.....	25
A.3.3 EMC management tasks .....	26
A.3.4 Rough analysis .....	26
A.3.5 EMC requirements for equipment.....	27
A.3.6 EMC interface agreements.....	27
A.3.7 Installation recommendations.....	27
A.3.8 Assessment of conformity with EMC regulations.....	27

A.3.9	Additional measures .....	28
A.4	Full EMC analysis.....	28
A.4.1	General .....	28
A.4.2	Electromagnetic interference matrix (EMI matrix) .....	28
A.4.3	Collection of data .....	28
A.4.4	Data processing.....	29
A.4.5	Completing the matrix .....	33
A.4.6	Calculations .....	34
A.4.7	Conclusions to be drawn from the matrix .....	34
A.5	Additional EMC measures .....	34
A.5.1	General .....	34
A.5.2	Limitation of electromagnetic emission .....	34
A.5.3	Limitation of electromagnetic influences .....	35
A.6	EMC testing .....	35
A.6.1	Equipment testing .....	35
A.6.2	System testing .....	35
Annex B (informative)	Mitigation guidelines .....	37
B.1	Applicability.....	37
B.2	General technical measures .....	37
B.2.1	General .....	37
B.2.2	Equipment and installation groups.....	38
B.2.3	Shielding.....	38
B.2.4	Grounding.....	38
B.2.5	Cable routing .....	40
B.2.6	Filtering and overvoltage protection.....	42
B.3	Special measures for equipment groups A to G .....	44
B.3.1	General .....	44
B.3.2	Measures for group A.....	44
B.3.3	Measures for group B.....	45
B.3.4	Measures for group C .....	46
B.3.5	Measures for group D .....	47
B.3.6	Measures for group E.....	47
B.3.7	Measures for group F.....	49
B.3.8	Measures for group G .....	50
B.4	Organizational measures.....	51
B.4.1	On-board operation .....	51
B.4.2	Maintenance and repair.....	51
Annex C (informative)	EMC test report .....	53
Bibliography	.....	54
Figure 1	– Examples for ports .....	13
Figure 2	– Schematic diagram of zones (example).....	20
Figure A.1	– EMC analysis, flow chart .....	31
Figure A.2	– EMC analysis, EMI matrix.....	32
Figure A.3	– EMC analysis, frequency survey .....	33
Figure A.4	– EMC analysis, level survey .....	33
Table 1	– Equipment test matrix .....	18

Table 2 – Emission limits (deck and bridge zone) .....	21
Table 3 – Emission limits (general power distribution zone) .....	22
Table 4 – Minimum immunity requirements for equipment.....	23
Table A.1 – EMC-matrix, explanation of symbols .....	34
Table B.1 – Signal types and cable categories.....	41

## INTERNATIONAL ELECTROTECHNICAL COMMISSION

### **ELECTRICAL AND ELECTRONIC INSTALLATIONS IN SHIPS – ELECTROMAGNETIC COMPATIBILITY (EMC) – SHIPS WITH A METALLIC HULL**

#### FOREWORD

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

International Standard IEC 60533 has been prepared by IEC technical committee 18: Electrical installations of ships and of mobile and fixed offshore units.

This third edition cancels and replaces the second edition, published in 1999. This edition constitutes a technical revision.

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

- Introduction has been supplemented;
- scope and title have been modified to limit the application of the standard to installations in ships with metallic hulls only;
- the normative references have been updated;
- further explanation for *in-situ* testing has been given in 5.1;
- numbering of CISPR-Standards in Tables 1, 2 and 3 has been updated;

- title of Annex B has been changed;
- requirements on cable routing in Annex B have been amended;
- new Annex C EMC test report has been added.

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

FDIS	Report on voting
18/1460/FDIS	18/1471/RVD

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

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

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

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

A bilingual version of this standard may be issued at a later date.

## INTRODUCTION

Electrical installations of ships with electric and/or electronic systems need to operate under a wide range of environmental conditions.

The control of undesired electromagnetic emission ensures that no other device on board will be unduly influenced by the equipment under consideration. Suitable limits are specified.

On the other hand, the equipment needs to function without degradation in the normal electromagnetic environment. The limit values for immunity, specified in this International Standard, have been chosen under this assumption. Equipment which is tested and installed in accordance with this International Standard meets the relevant IMO requirements. Special risks, for instance lightning strikes, transients from the operation of circuit breakers and electromagnetic radiation from radio transmitters are also covered.

Complex electric and/or electronic systems require EMC planning in all phases of design and installation, considering the electromagnetic environment, any special requirements and the equipment performance.

This third edition of IEC 60533 is applicable to electromagnetic compatibility of all electrical and electronic installations in ships with metallic hull.

It is based on the assumption that the ship is constructed in such a way that metallic hull and structure parts will significantly attenuate electromagnetic disturbance from the outer deck environment to the inner deck environment and vice versa.

# **ELECTRICAL AND ELECTRONIC INSTALLATIONS IN SHIPS – ELECTROMAGNETIC COMPATIBILITY (EMC) – SHIPS WITH A METALLIC HULL**

## **1 Scope**

This International Standard specifies minimum requirements for emission, immunity and performance criteria regarding electromagnetic compatibility (EMC) of electrical and electronic equipment for ships with metallic hull. Additional or divergent requirements for ships with non-metallic hull will be given in a future International Standard (IEC 62742).

This International Standard assists in meeting the relevant EMC requirements as stated in SOLAS 74, Chapter IV, Regulation 6 and Chapter V, Regulation 17. Reference to this International Standard is made in IMO Resolution A.813(19).

The normative part of this International Standard has been prepared as a product family EMC standard.

This International Standard further gives guidelines and recommendations on the measures to achieve EMC in the electrical and electronic installations of the following equipment groups:

- a) group A: maritime navigation and radio communication equipment and systems;
- b) group B: power generation and conversion equipment;
- c) group C: equipment operating with pulsed power;
- d) group D: switchgear and controlgear;
- e) group E: intercommunication and signal processing equipment and control systems;
- f) group F: non-electrical items and equipment;
- g) group G: integrated systems.

The basic EMC standard for groups A and C is IEC 60945. The EMC requirements according to IEC 60945 apply additionally for

- bridge mounted equipment;
- equipment in close proximity to receiving antennas;
- equipment capable of interfering with the safe navigation of the ship and with radio communication.

Effects on humans, like exposure to electromagnetic fields, and basic safety requirements such as protection against electric shock and dielectric strength tests for equipment are not within the scope of this International Standard.

## **2 Normative references**

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

IEC 60050 (all parts), *International Electrotechnical Vocabulary* (available at: [www.electropedia.org](http://www.electropedia.org))



IEC 60945, *Maritime navigation and radiocommunication equipment and systems – General requirements – Methods of testing and required test results*

IEC 61000-4-2, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test*

IEC 61000-4-3, *Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test*

IEC 61000-4-4, *Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques – Electrical fast transient/burst immunity test*

IEC 61000-4-5, *Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test*

IEC 61000-4-6, *Electromagnetic compatibility (EMC) – Part 4-6: Testing and measurement techniques – Immunity to conducted disturbances, induced by radio-frequency fields*

IEC 61000-4-11, *Electromagnetic compatibility (EMC) – Part 4-11: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations immunity tests*

IEC 61000-4-16, *Electromagnetic compatibility (EMC) – Part 4-16: Testing and measurement techniques – Test for immunity to conducted common mode disturbances in the frequency range 0 Hz to 150 kHz*

IEC 61000-6-1, *Electromagnetic compatibility (EMC) – Part 6-1: Generic standards – Immunity for residential, commercial and light-industrial environments*

IEC 61000-6-3, *Electromagnetic compatibility (EMC) – Part 6-3: Generic standards – Emission standard for residential, commercial and light-industrial environments*

CISPR 16-1-2, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-2: Radio disturbance and immunity measuring apparatus – Coupling devices for conducted disturbance measurements*

CISPR 16-1-4, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-4: Radio disturbance and immunity measuring apparatus – Antennas and test sites for radiated disturbance measurements*

CISPR 16-2-1, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 2-1: Methods of measurement of disturbances and immunity – Conducted disturbance measurements*

CISPR 16-2-3, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 2-3: Methods of measurement of disturbances and immunity – Radiated disturbance measurements*

IACS E10, *Test specification for type approval*