

INTERNATIONAL STANDARD

IEC 60945

Fourth edition
2002-08

Maritime navigation and radiocommunication equipment and systems – General requirements – Methods of testing and required test results

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



Reference number
IEC 60945:2002(E)

INTERNATIONAL STANDARD

IEC 60945

Fourth edition
2002-08

Maritime navigation and radiocommunication equipment and systems – General requirements – Methods of testing and required test results

© IEC 2002 Copyright - all rights reserved

No part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from the publisher.

International Electrotechnical Commission, 3, rue de Varembe, PO Box 131, CH-1211 Geneva 20, Switzerland
Telephone: +41 22 919 02 11 Telefax: +41 22 919 03 00 E-mail: inmail@iec.ch Web: www.iec.ch



Commission Electrotechnique Internationale
International Electrotechnical Commission
Международная Электротехническая Комиссия

CONTENTS

FOREWORD	9
INTRODUCTION	13
1 Scope	15
2 Normative references.....	17
3 Definitions and abbreviations	21
3.1 Definitions	21
3.2 Abbreviations used in this standard	23
3.3 IMO performance standards.....	23
4 Minimum performance requirements	27
4.1 General	27
4.2 Design and operation.....	29
4.3 Power supply.....	39
4.4 Durability and resistance to environmental conditions	39
4.5 Interference	41
4.6 Safety precautions	41
4.7 Maintenance	43
4.8 Equipment manuals	43
4.9 Marking and identification	45
5 Methods of testing and required test results.....	45
5.1 General	45
5.2 Test conditions	47
5.3 Test results.....	51
6 Operational checks (all equipment categories).....	51
6.1 Ergonomics and HMI	51
6.2 Hardware.....	59
6.3 Software	61
6.4 Inter-unit connection	63
7 Power supply – Methods of testing and required test results	63
7.1 Extreme power supply	63
7.2 Excessive conditions	63
7.3 Power supply short-term variation.....	65
7.4 Power supply failure	65
8 Durability and resistance to environmental conditions – Methods of testing and required test results	65
8.1 General	65
8.2 Dry heat.....	67
8.3 Damp heat.....	69
8.4 Low temperature.....	71
8.5 Thermal shock (portable equipment).....	73
8.6 Drop (portable equipment)	75
8.7 Vibration (all equipment categories).....	77
8.8 Rain and spray (exposed equipment).....	79
8.9 Immersion.....	79
8.10 Solar radiation (portable equipment).....	83
8.11 Oil resistance (portable equipment)	85
8.12 Corrosion (salt mist) (all equipment categories).....	85

9	Electromagnetic emission – Methods of testing and required test results	87
9.1	General	87
9.2	Conducted emissions (all equipment categories except portable).....	89
9.3	Radiated emissions from enclosure port (all equipment categories except submerged)	91
10	Immunity to electromagnetic environment – Methods of testing and required test results	93
10.1	General	93
10.2	Radio receiver equipment	95
10.3	Immunity to conducted radio frequency disturbance.....	97
10.4	Immunity to radiated radiofrequencies (all equipment categories except submerged)	97
10.5	Immunity to fast transients on a.c. power, signal and control lines (all equipment categories except portable)	99
10.6	Immunity to surges on a.c. power lines (all equipment categories except portable).....	101
10.7	Immunity to power supply short-term variation (all equipment categories except portable).....	101
10.8	Immunity to power supply failure (all equipment categories except portable).....	103
10.9	Immunity to electrostatic discharge (all equipment categories except submerged)	103
11	Special purpose tests – Methods of testing and required test results	105
11.1	Acoustic noise and signals (all equipment intended for installation in wheelhouses and bridge wings)	105
11.2	Compass safe distance (all equipment categories except submerged).....	107
12	Safety precautions – Methods of testing and required test results (all equipment categories).....	109
12.1	Protection against accidental access to dangerous voltages	109
12.2	Electromagnetic radio frequency radiation	109
12.3	Emission from visual display unit (VDU).....	111
12.4	X-radiation	113
13	Maintenance (all equipment categories).....	115
14	Equipment manuals (all equipment categories).....	115
15	Marking and identification (all equipment categories).....	115
	Annex A (normative) IMO Resolution A.694(17) <i>Adopted on 6 November 1991</i>	141
	Annex B (informative) Environmental conditions for ships	151
	Annex C (informative) EMC requirements for ships	157
	Annex D (informative) Examples of equipment by environmental class	167
	Annex E (informative) Test Report	169
	Annex F (informative) Cross-references between the requirements of IMO Resolution A.694 and the tests/checks in this standard.....	171
	Annex G (informative) Summary of significant changes to test requirements from Edition 3 of IEC 60945	173
	Bibliography	175

Figure 1 – Examples of ports referred to in electromagnetic emission and immunity tests ...	117
Figure 2 – Radio frequency terminal voltage limits for conducted emissions.....	117
Figure 3 – Artificial mains networks for tests for conducted emissions.....	119
Figure 4 – Limiting values for radiated emissions from enclosure ports	121
Figure 5 – Schematic set-up for immunity test to conducted radio-frequency disturbance....	123
Figure 6 – Example of a simplified diagram for CDN used with unscreened supply (mains) lines, in tests for conducted radio frequency disturbance.....	125
Figure 7 – Example of suitable test facility for immunity to radiated radiofrequencies	127
Figure 8 – General test set-up for immunity to fast transient/burst.....	129
Figure 9 – Test set-up for immunity to surges on power lines	131
Figure 10 – Power supply variations for tests of immunity to power supply short-term transients.....	133
Figure 11 – Example of test set-up for floor-standing equipment, for tests of immunity to electrostatic discharge (ESD) showing typical positions of the ESD generator.....	135
Figure 12 – Example of test set-up for table-top equipment, for tests of immunity to electrostatic discharge (ESD) showing typical positions of the ESD generator.....	137
Figure 13 – Arrangements for all-round alternating field measurements	139
Table 1 – Extreme power supply variation	49
Table 2 – Schedule of performance tests and checks.....	63
Table 3 – Durability and resistance to environmental conditions.....	67
Table 4 – Spectral energy distribution and permitted tolerances.....	85
Table 5 – Electromagnetic emission	89
Table 6 – Electromagnetic immunity.....	95
Table C.1 – Characteristics of radio equipment	159
Table C.2 – Field strengths experienced on ships generated by the ships transmitters.....	163

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**MARITIME NAVIGATION AND RADIOCOMMUNICATION
EQUIPMENT AND SYSTEMS –**

**General requirements –
Methods of testing and required test results**

FOREWORD

- 1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the 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, the IEC publishes International Standards. 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. The 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 the 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 National Committees.
- 3) The documents produced have the form of recommendations for international use and are published in the form of standards, technical specifications, technical reports or guides and they are accepted by the National Committees in that sense.
- 4) In order to promote international unification, IEC National Committees undertake to apply IEC International Standards transparently to the maximum extent possible in their national and regional standards. Any divergence between the IEC Standard and the corresponding national or regional standard shall be clearly indicated in the latter.
- 5) The IEC provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with one of its standards.
- 6) Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. The IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 60945 has been prepared by IEC technical committee 80: Maritime navigation and radiocommunication equipment and systems.

This fourth edition cancels and replaces the third edition published in 1996 and constitutes a technical revision.

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

FDIS	Report on voting
80/345/FDIS	80/349/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 3.

Annex A forms an integral part of this standard.

Annexes B, C, D, E, F, and G are for information only.

The committee has decided that the contents of this publication will remain unchanged until 2007. At this date, the publication will be

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

INTRODUCTION

IEC 945 was originally produced to give test methods and, where appropriate, limit values to the IMO Resolution A.574(14) which was a recommendation on general requirements for electronic navigational aids. (It has subsequently been replaced, see below.) The tests dealing with electromagnetic immunity could not be produced in time for the publication of the original standard, and these were added later in 1992 as amendment 1.

In 1991 the IMO, when discussing the changes that would arise with the introduction of the global maritime distress and safety system (GMDSS), noted that in future, radio equipment would be installed on the bridge of a vessel alongside the navigation equipment instead of in a special radio room as hitherto. The IMO consequently withdrew Resolution A.574(14), and a corresponding Resolution A.569(14) dealing with the general requirements of radio equipment, and replaced them with IMO Resolution A.694(17). A second edition of IEC 945 was rapidly prepared to reflect this change.

The third edition of IEC 945 in 1996 was a complete revision which aligned the test methods with appropriate other IEC standards and introduced, wherever possible, the requirements of the classification societies. The scope was extended to make the standard applicable additionally to other equipment installed on and around the bridge of a ship with regard to EMC. A new class of equipment – “portable” – was added, together with better definitions of operational tests which involve subjective judgement and descriptions of operational and durability aspects of software.

This fourth edition (now IEC 60945) extends the detail of operational tests particularly for equipment which is operated through software menus. This has been derived from an exhaustive investigation of appropriate references as described in the Bibliography. The layout of clause 4 (Minimum performance requirements) has been changed to give a better grouping of ergonomics, hardware and software requirements.

The EMC tests have been revised with the frequency range having been extended from 1 GHz to 2 GHz.

Clarifications to the text of the third edition have been added where experience has shown a need and the references have been updated.

A comparison of the test requirements in the third and fourth editions is given in annex G to assist manufacturers and test houses in the use of the new edition.

MARITIME NAVIGATION AND RADIOCOMMUNICATION EQUIPMENT AND SYSTEMS –

General requirements – Methods of testing and required test results

1 Scope

This International Standard assists in meeting a requirement of the International Convention for Safety of Life at Sea (SOLAS), adopted by the International Maritime Organization (IMO), that the radio equipment defined in chapters III and IV, and the navigation equipment defined in chapter V of the Convention, be type-approved by administrations to conform with performance standards not inferior to those adopted by the IMO. (Administrations are defined by the IMO as governments of the states whose flags the ships are entitled to fly.)

The performance standard for general requirements for shipborne radio equipment and electronic navigation aids that has been adopted by the IMO is given in IMO Resolution A.694 and is reproduced in this standard as annex A, which forms the basis for this standard. Reference is made, where appropriate, to IMO Resolutions A.694 and A.813 and all subclauses whose wording is identical to that in the resolutions are printed in italics.

This standard specifies minimum performance requirements, methods of testing and required test results for general requirements which can be applied to those characteristics common to all equipment described hereunder:

- a) shipborne radio equipment forming part of the global maritime distress and safety system required by the International Convention for Safety of Life at Sea (SOLAS) as amended, and by the Torremolinos International Convention for the Safety of Fishing Vessels as amended;
- b) shipborne navigational equipment required by the International Convention for Safety of Life at Sea (SOLAS) as amended, and by the Torremolinos International Convention for the Safety of Fishing Vessels as amended, and to other navigational aids, where appropriate; and
- c) for EMC only, all other bridge-mounted equipment, equipment in close proximity to receiving antennas, and equipment capable of interfering with safe navigation of the ship and with radio-communications (see IMO Resolution A.813).

NOTE For EMC, this standard is in the IEC category “product family”.

The requirements of this standard are not intended to prevent the use of new techniques in equipment and systems, provided the facilities offered are not inferior to those stated.

2 Normative references

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

IEC 60050-161:1990, *International Electrotechnical Vocabulary (IEV) – Chapter 161: Electromagnetic compatibility*
Amendment 1 (1997)
Amendment 2 (1998)

IEC 60068-2-1:1990, *Environmental testing – Part 2: Tests – Tests A: Cold*
Amendment 1 (1993)
Amendment 2 (1994)

IEC 60068-2-2:1974, *Environmental testing – Part 2: Tests – Tests B: Dry heat*
Amendment 1 (1993)
Amendment 2 (1994)

IEC 60068-2-5:1975, *Environmental testing – Part 2: Test Sa: Simulated solar radiation at ground level*

IEC 60068-2-6:1995, *Environmental testing – Part 2: Test Fc: Vibration (sinusoidal)*
Corrigendum 1 (1995)

IEC 60068-2-9:1975, *Environmental testing – Part 2: Guidance for solar radiation testing*
Amendment 1 (1984) Corrigendum 1 (1989)

IEC 60068-2-30:1980, *Environmental testing – Part 2: Test Db and guidance: Damp heat, cyclic (12 + 12-hour cycle)*
Amendment 1 (1985)

IEC 60068-2-48:1982, *Environmental testing – Part 2: Guidance on the application of the tests of IEC 60068 to simulate the effects of storage*

IEC 60068-2-52:1996, *Environmental testing – Part 2: Test Kb: Salt mist, cyclic (sodium chloride solution)*
Corrigendum 1 (1996)

IEC 60071-2:1996, *Insulation co-ordination – Part 2: Application guide*

IEC 60092-101:1994, *Electrical installations in ships – Part 101: Definitions and general requirements*
Amendment 1 (1995)
Corrigendum 1 (1996)

IEC 60417(all parts), *Graphical symbols for use on equipment*

IEC 60529:1989, *Degrees of protection provided by enclosures (IP code)*
Amendment 1 (1999)

IEC 60533:1999, *Electrical and electronic installations in ships – Electromagnetic compatibility*

IEC 60651:1979, *Sound level meters*
Amendment 1 (1993)

IEC 61000-4-2:1995, *Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques – Section 2: Electrostatic discharge immunity test* – Basic EMC publication

IEC 61000-4-3:1995, *Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques – Section 3: Radiated, radio frequency, electromagnetic field immunity test*

IEC 61000-4-4:1995, *Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques – Section 4: Electrical fast transient/burst immunity test* – Basic EMC publication

IEC 61000-4-5:1995, *Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques – Section 5: Surge immunity test*

IEC 61000-4-6:1996, *Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques – Section 6: Immunity to conducted disturbances, induced by radio-frequency fields*

IEC 61000-4-8:1993, *Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques – Section 8: Power frequency magnetic field immunity test* – Basic EMC publication

IEC 61000-4-11:1994, *Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques – Section 11: Voltage dips, short interruptions and voltage variations immunity tests*

CISPR 16-1:1999, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1: Radio disturbance and immunity measuring apparatus*

ISO 694:2000, *Ships and marine technology – Positioning of magnetic compasses in ships*

ISO 3791:1976, *Office machines and data processing equipment – Keyboard layouts for numeric applications*

IMO Convention for Safety of Life at Sea (SOLAS):1997

IMO Torremolinos Convention for the Safety of Fishing Vessels, 1977, as modified by the Torremolinos Protocol of 1993

IMO MSC/Circ.794 IMO Standard Marine Communication Phrases (SMCPs):1997

IMO Resolution A.694:1991, *General requirements for shipborne radio equipment forming part of the global maritime distress and safety system and for electronic navigational aids*

IMO Resolution A.803:1995, *Performance standards for shipborne VHF radio installations capable of voice communication and digital selective calling*

IMO Resolution A.813:1995, *General requirements for electromagnetic compatibility (EMC) for all electrical and electronic ship's equipment*

ITU-T Recommendation E.161:1993, *Arrangement of digits, letters and symbols on telephones and other devices that can be used for gaining access to a telephone network*

NOTE A bibliography of informative references is given at the end of this standard.