

DIN EN 62252

ICS 47.020.70

**Navigations- und Funkkommunikationsgeräte und -systeme für die Seeschifffahrt –
Radar für Schiffe, die nicht IMO SOLAS Kapitel V entsprechen –
Leistungsanforderungen, Prüfverfahren und geforderte Prüfergebnisse (IEC 62252:2004);
Deutsche Fassung EN 62252:2004, Text Englisch**

Maritime navigation and radiocommunication equipment and systems –
Radar for craft not in compliance with IMO SOLAS Chapter V –
Performance requirements, methods of test and required test results (IEC 62252:2004);
German version EN 62252:2004, text English

Matériels et systèmes de navigation et de radiocommunication maritimes –
Radars pour navires non conformes au Chapitre V de l'OMI-SOLAS –
Exigences d'exploitation et de fonctionnement, méthodes d'essai et résultats d'essai
exigés (CEI 62252:2004);
Version allemande EN 62252:2004, texte anglaise

Gesamtumfang 151 Seiten

DKE Deutsche Kommission Elektrotechnik Elektronik Informationstechnik im DIN und VDE
Normenstelle Schiffs- und Meerestechnik (NSMT) im DIN

Beginn der Gültigkeit

Die von CENELEC am 2004-10-01 angenommene EN 62252 gilt als DIN-Norm ab 2005-06-01.

Nationales Vorwort

Vorausgegangener Norm-Entwurf: E DIN EN 62252:2003-09.

Für die vorliegende Norm ist das nationale Arbeitsgremium K 738 „Elektronische Navigationsinstrumente“ der DKE Deutsche Kommission Elektrotechnik Elektronik Informationstechnik im DIN und VDE zuständig.

Die enthaltene IEC-Publikation wurde vom TC 80 „Maritime navigation and radiocommunication equipment and systems“ erarbeitet.

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méthodes d'essai et résultats d'essai exigés
(CEI 62252:2004)

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European Committee for Electrotechnical Standardization
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Zentralsekretariat: Rue de Stassart 35, B-1050 Brüssel

Vorwort

Der Text des Schriftstücks 80/393/FDIS, 1. Ausgabe von IEC 62252, ausgearbeitet von dem IEC/TC 80 „Maritime navigation and radiocommunication equipment and systems“, wurde der IEC-CENELEC Parallelen Abstimmung unterworfen und von CENELEC am 2004-10-01 als EN 62252 angenommen.

Nachstehende Daten wurden festgelegt:

- spätestes Datum, zu dem die EN auf nationaler Ebene durch Veröffentlichung einer identischen nationalen Norm oder durch Anerkennung übernommen werden muss (dop): 2005-07-01
- spätestes Datum, zu dem nationale Normen, die der EN entgegenstehen, zurückgezogen werden müssen (dow): 2007-10-01

Der Anhang ZA wurde von CENELEC hinzugefügt.

Anerkennungsnotiz

Der Text der Internationalen Norm IEC 62252:2004 wurde von CENELEC ohne irgendeine Abänderung als Europäische Norm angenommen.

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

MARITIME NAVIGATION AND RADIOCOMMUNICATION EQUIPMENT AND SYSTEMS – RADAR FOR CRAFT NOT IN COMPLIANCE WITH IMO SOLAS CHAPTER V – PERFORMANCE REQUIREMENTS, METHODS OF TEST AND REQUIRED TEST RESULTS

FOREWORD

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International Standard IEC 62252 has been prepared by IEC technical committee 80: "Maritime navigation and radiocommunication equipment and systems".

This standard is based on the standards for radar and radar plotting used on SOLAS vessels, IEC 60872 series, IEC 60936 series and IEC 60945.

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

FDIS	Report on voting
80/393/FDIS	80/397/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 maintenance result 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 publication may be issued at a later date.

INTRODUCTION

This IEC radar standard is produced specifically for radar not fully compliant with the IMO Performance Standard for radar/radar plotting and applies to the following:

- radar (class A) intended for commercial craft under 150 gross tonnage, where no SOLAS radar carriage requirement currently exists, where the antenna beam width is not more than $4,0^\circ$ and the display minimum effective diameter is limited to not less than 150 mm.
- radar (class B) intended for recreational craft or other maritime use and where the antenna beam width is not more than $5,5^\circ$ and the display minimum effective diameter is limited to not less than 85 mm.
- radar (class C) intended for small recreational craft where the antenna beam width is not more than $7,5^\circ$ and the display minimum effective diameter is limited to not less than 75 mm.

The requirements for commercial craft radar are covered in the main body of this specification. The requirements, where different, for radar (class B and C) are shown in parenthesis where applicable.

NOTE 1 The IMO performance standard for radar/radar plotting is in Resolution MSC.64(67) which is implemented in the IEC 60872 series and the IEC 60936 series of standards.

NOTE 2 For the purposes of this IEC standard, the words 'craft' and 'ship' are interchangeable and have the same meaning.

MARITIME NAVIGATION AND RADIOCOMMUNICATION EQUIPMENT AND SYSTEMS – RADAR FOR CRAFT NOT IN COMPLIANCE WITH IMO SOLAS CHAPTER V – PERFORMANCE REQUIREMENTS, METHODS OF TEST AND REQUIRED TEST RESULTS

1 Scope

This International Standard specifies the minimum performance requirements for testing and required test results for conformance of radar not fully compliant with the IMO Performance Standard for radar/radar plotting (RP) (MSC.64(67)). In addition, it takes into account IEC 60945. When a requirement of this standard is different from that of IEC 60945 the requirement in this standard shall take precedence.

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 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, *Electrical installations in ships – Part 101: Definitions and general requirements*

IEC 60417:1998, *Graphical symbols for use on equipment – Part 1: Overview and application*

IEC 60529:1989, *Degrees of protection provided by enclosures (IP Code)*

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

IEC 60872-2:1999, *Maritime navigation and radiocommunication equipment and systems – Radar plotting – Part 2: Automatic tracking aids (ATA) – Methods of testing and required test results*

IEC 60872-3:1999, *Maritime navigation and radiocommunication equipment and systems – Radar plotting – Part 3: Electronic plotting aid (EPA)*

IEC 60936-1:1999, *Maritime navigation and radiocommunication equipment and systems – Radar – Part 1: Shipborne radar – Methods of testing and required test results*

IEC 60936-2:2000, *Maritime navigation and radiocommunication equipment and systems – Radar – Part 2: Shipborne radar for high-speed craft (HSC) – Methods of testing and required test results*

IEC 60936-3:2000, *Maritime navigation and radiocommunication equipment and systems – Radar – Part 3: Shipborne radar with chart facilities – Methods of testing and required test results*

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

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 61108 (all parts), *Maritime navigation and radiocommunication equipment and systems GNSS/DGNSS*

IEC 61162 (all parts), *Maritime navigation and radiocommunication equipment and systems – Digital interfaces*

IEC 61672, *Electroacoustics – Sound level meters*

IEC/PAS 60936-5, *Guidelines for the use and display of AIS information on Radar*

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*

ITU Radio Regulations 2001

ITU-R Recommendation M.1177-3, *Techniques for measurement of unwanted emissions of radar systems*

ITU-R Recommendation M.1313, *Technical characteristics of maritime radionavigation radars*

ITU-R Recommendation SM.328, *Spectra and bandwidth of emissions*

ITU-R Recommendation SM.329, *Unwanted emissions in the spurious domain*

ITU-R Recommendation SM.1539, *Variation of the boundary between the out-of-band and spurious domains required for the application of Recommendations ITU-R SM.1541 and ITU-R SM.329*

ITU-R Recommendation SM.1540, *Unwanted emissions in the out-of-band domain falling into adjacent allocated bands*

ITU-R Recommendation SM.1541, *Unwanted emissions in the out-of-band domain*

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

IHO S.52, *Specifications for chart content and display aspects of ECDIS*

3 Terms, definitions and abbreviations

3.1 Definitions

For the purposes of this document, the following definitions apply.

3.1.1

accuracy

measure of the error between the point desired and the point achieved, or between the position indicated by measurement and the true position

3.1.2

by inspection

visual check of the EUT or its documentation

3.1.3**hazards**

objects, potentially leading to grounding or collision

3.1.4**maintenance**

repair or replacement of defective parts or corresponding corrections to software. Minor changes and improvements to existing functionality are considered to be maintenance but not the addition of new functionality

3.1.5**manufacturer**

organization responsible for the production of the radar

3.1.6**mode – functional**

applicable to functions where the system can be used to display alternative modes such as chart mode, speed log mode, i.e. multi-function mode or composite mode (when the system can simultaneously display a combination of two or more modes)

3.1.7**mode – radar stabilized**

true motion – heading and speed input required

course up – heading input required

north up – heading input required

3.1.8**mode – radar unstabilized**

relative motion head up – no heading input required

3.1.9**mode – standard operating**

display modes selectable by the operator (for example, relative motion head-up, true motion north up, etc.)

3.1.10**navigational aid**

shipborne item, for example, instrument, device or chart, intended to assist in the navigation of a ship

NOTE Aids to navigation (AtoN) are different from navigational aid.

3.1.11**operational check**

check by a suitably qualified person to confirm that the equipment complies with the operational requirements in this standard

3.1.12**performance check**

short functional test carried out during or after a technical test to confirm that the equipment operates

3.1.13**performance check (EMC)**

short functional test carried out during or after an EMC test to confirm that the equipment complies with the required immunity performance criteria

3.1.14

performance check (operational)

short functional test carried out by reconfiguration of the EUT and checking by non-quantitative visual means that the system is still operative for the purposes of Annex E. Operation of the gain, tune, clutter, EBL, VRM and plotting facilities to confirm normal operation during or after environmental and EMC tests

3.1.15

performance test (operational)

for radar EUT, shall be identical to the performance check for the purposes of Annex E, with the addition of the display test specified in 4.7

3.1.16

performance test

measurement or a group of measurements carried out during or after a technical test to confirm that the EUT complies with selected parameters as defined in the equipment standard

3.1.17

pre-conditioning

treatment of a specimen with the object of removing or partly counteracting the effects of its previous history

NOTE 1 Where pre-conditioning is called for, it is the first process in the test procedure

NOTE 2 Pre-conditioning may be effected by subjecting the specimen to climatic, electrical, or any other conditions required by the relevant specification in order that the properties of the specimen may be stabilized before measurements and test

3.1.18

product family EMC standard

definition of specific EMC requirements and test procedures dedicated to particular product families. It applies the IEC basic standards, is co-ordinated with IEC generic standards, and has precedence over IEC generic standards

3.1.19

radar echo

signal detected by a radar receiver that is processed and capable of being clearly displayed at the correct range and bearing on a radar display

3.1.20

radar effective area

area where radar echoes, radar plotting (RP) and other reported targets (for example AIS) may be displayed and which falls inside of the radar bearing scale

3.1.21

radar information area

area where radar menus and associated information may be shown and which falls outside of the radar bearing scale

3.1.22

radar plotting (RP)

radar plotting as implemented in ATD or EPD (see Annex F and Annex G respectively)

3.1.23

radar target

object that reflects transmitted radar signals

3.1.24**sensor**

navigational aid, with or without its own display and/or control as appropriate, providing information to the radar

3.1.25**standard operating mode**

in the operational condition defined in 4.18.7 and in the optional true motion mode described in 4.18.8, manual or simulated forward speed of 10 knots shall be applied, unless otherwise specified in the test clause

3.1.26**synthetic information**

information, in addition to radar echoes, consisting of graphical objects with or without alphanumerical information within the effective radar display. This information may consist of target identifiers, vectors and other symbols

3.1.27**technical test**

tests, for which a repeatable method of measurement is defined in this standard

3.1.28**warning**

visual indication which may be accompanied by a short audible signal, giving information about a condition of which the operator needs to be aware

3.2 Abbreviations

a.c.	Alternating current
AIS	Automatic Identification System
ATA	Automatic Tracking Aid
ATD	Automatic Tracking Device
d.c.	Direct current
EBL	Electronic Bearing Line
ECDIS	Electronic Chart Display and Information System
EMC	Electromagnetic compatibility
e.m.f.	Electromotive force
EPA	Electronic Plotting Aid
EPD	Electronic Plotting Device
EPFS	Electronic Position Fixing System
EUT	Equipment Under Test
GPS	Global Positioning System
HMI	Human Machine Interface
IEC	International Electrotechnical Commission
IMO	International Maritime Organization
ISO	International Organisation for Standardization
ITU	International Telecommunication Union
PC	Performance Check
PT	Performance Test

RCS	Radar Cross-Section
r.m.s.	Root Mean Square
RF	Radio-frequency
RP	Radar Plotting incorporating ATD and EPD
SDME	Speed and Distance Measuring Equipment
SMCPs	Standard Marine Communication Phrases
SOLAS	Safety Of Life At Sea
THD	Transmitting Heading Device
VRM	Variable Range Marker
VCP	Vertical Coupling Plane
VDU	Visual Display Unit

NOTE See also Annex B for abbreviations in relation to controls.

4 Performance requirements

4.1 Radar indication

The radar equipment shall provide an indication, in relation to own ship, of the position of other surface craft/obstructions, buoys, shorelines and navigational marks, in a manner which will assist in navigation and in avoiding collision.

4.2 Safety of options

The equipment, including facilities that are provided in addition to those required herein, shall not degrade the radar performance as specified in 4.1. The manufacturer shall provide information for all options available.

4.3 Technical information

Adequate information shall be provided and shall include a manual to enable the equipment to be properly installed, set up, routinely maintained and operated. The manufacturer shall declare that the manual contains adequate information to meet this requirement.

4.4 Quality assurance

The manufacturer shall have a quality control system in place for production, final-product inspection and testing that is audited by a competent authority to ensure continuous compliance with the certified product. Alternatively, the manufacturer may use final product verification procedures where a competent authority verifies compliance with the equipment certification before the product is installed.

4.5 Radio-frequency spectrum requirements

The operational radio-frequency of the equipment shall be within the appropriate bands allocated for radionavigation defined in the ITU Radio Regulations at all times. (see also Annex D).

4.6 Range

With the radar antenna mounted at a height of 7,5 m above sea level, the operational requirement under normal propagation conditions is that the equipment shall, in the absence of clutter, paint the radar target echoes as detailed in 4.6.1 and 4.6.2 for at least 8 out of 10 radar scans.

4.6.1 Coastlines

- At 9 nautical miles class A (5 nautical miles class B and C) when the ground rises to 60 m.
- At 5 nautical miles class A (3 nautical miles class B and C) when the ground rises to 6 m.

4.6.2 Surface objects

- At 5 nautical miles class A (3 nautical miles classes B and C) a radar reflector, having an effective echoing area of 400 m², mounted at a height of 7,5 m.
- At 2 nautical miles class A (1 nautical mile classes B and C) a radar reflector, having an effective echoing area of 10 m², mounted at a height of 3,5 m.
- At 1 nautical mile class A (classes B and C not applicable) a radar reflector, having an effective echoing area of 5 m², mounted at a height of 3,5 m.

NOTE The 7,5 m and the 3,5 m height referred to in 0 are test criteria only and not an installation requirement.

This can be achieved using triangular corner reflectors of 201 mm, 225 mm and 570 mm for the "a" dimension, calculated for X-band are equivalent to echoing areas of 5 m², 10 m² and 400 m² respectively.

4.6.3 Minimum range

A 10 m² test target, set at a height 3,5 m shall be clearly displayed from a minimum horizontal range of 50 m for class A, (60 m for class B) and (75 m for class C) from the antenna position. Without changing the setting of controls other than the range selector, the test target shall remain visible from the minimum horizontal range, up to a range of 1 nautical mile.

NOTE The minimum range is the shortest distance at which a stationary target echo ahead is still presented separately from the point representing the antenna position.

4.7 Display

4.7.1 Display size

The equipment shall provide, without external magnification, a display with a minimum effective diameter within the bearing scale of not less than 150 mm class A (85 mm class B) (75 mm class C).

Other technologies that achieve the same functional requirements are permitted.

4.7.2 Standard ranges

The equipment shall provide the following set of range scales of display; 0,75, 1,5, 3, 6 and 12 nautical miles. Intermediate range scales are not permitted for class A but may be provided for class B and class C.

An additional range of 0,25 nautical miles for class B and C shall be provided.

4.7.3 Additional range scales

Larger and smaller range scales may be provided. (see 4.7.2)

4.7.4 Additional range units

Units of measurement other than nautical miles are permitted. If other units are provided, the selection of the units shall be possible only when in the standby mode. The relationship between the

scales shall be maintained. For statute miles 0,75, 1,5, 3, 6 and 12 miles, and, for kilometres 1,5, 3, 6, 12 and 24 km.

4.7.5 Range scale in use

The range scale in use and the distance between range rings when in use shall be clearly indicated. Range UNIT consistency shall be maintained throughout.

4.7.6 Displayed information

Within the effective diameter of the display radar video area under normal operation, the display shall only contain information that pertains to the use of the radar display for navigation and collision avoidance and which has to be displayed there because of its association with a target (e.g. target identifiers, vectors) or because of some other direct relationship with the radar display.

NOTE The effective diameter of the display is the diameter of the central area into which any angular scale marking around its edge does not intrude. In the case of displays that are other than circular, the effective diameter is that of the smallest effective display dimension

Other information, not associated with the use of the radar/RP presentation for navigational and collision avoidance purposes, may be shown within the effective diameter of the display when such information is operator initiated.

The display shall automatically revert to the normal operating mode for radar/RP after 10 s following the last operator action in initiating the presentation of this other information. In the event of an alarm condition occurring, the display shall immediately revert to the normal operating mode for radar/RP.

An alarm status may be displayed in a window within the radar effective area.

4.7.7 Radar video origin

The origin of the range scale (radar video) shall start at own ship, be linear and shall not be delayed.

4.7.8 Zoom function

A zoom function may be provided and a clear indication shall be given to the user when active. The origin of own ship shall not be moved out of the radar effective area when the zoom function is activated. The scale used in the zoomed area shall be limited to a x 2-zoom of the range scale in use.

(A zoom function may be implemented using alternative methods or scaling factors for classes B and C).

4.7.9 Display colour presentation

Multiple colour displays are permitted but the following requirements shall be met:

- target echoes shall be displayed by means of the same basic colours and the echo strength shall not be displayed in different colours;
- information, in addition to target echoes, may be shown in different colours;
- different colours shall be provided for day and night presentation.

4.7.10 Display view under various light conditions

The radar picture and information shall be readable under all ambient light conditions. There shall be a means of adjusting display brilliance. If a light shield is necessary to facilitate operation of the

display in high ambient light levels, then means shall be provided for its ready attachment and removal.

4.8 Frequency band

It is permissible to use either X band or S band frequencies. Where both frequency bands are available, the frequency band in use shall be indicated to the operator.

4.9 Range markers

4.9.1 Fixed range rings

Fixed electronic range rings equally spaced from the origin shall be provided for range measurement class A (and class B) as follows:

- a) on the 0,75 nautical miles range scale and greater at least three and not more than six range rings shall be provided. At range scales of less than 0,75 nautical miles at least two range rings shall be provided;
- b) where off-centred facilities are provided (see 4.18.9), additional range rings shall be provided at the same range intervals as on the range scales indicated in 4.7.2;
- c) where a zoom function is provided and in use, a different number of range rings may be displayed.

(For class C, fixed electronic range rings are optional, where provided the range rings shall be equally spaced from the origin).

4.9.2 Range ring thickness

The thickness of the fixed range rings shall not be greater than the maximum permissible thickness of the heading line

4.9.3 Variable range marker

An electronic variable range marker (VRM) in the form of a ring shall be provided for classes A and B (optional for class C, if provided it shall meet the stated requirement), with a numeric read-out of range. This read-out shall not display any other data. Temporary overlaying of the data fields is permitted. For ranges of less than 1 nautical mile, there shall be only one 'zero' before the decimal point.

Additional variable range markers meeting the same requirements may be provided. In this case, separate identifiable read-outs shall be provided.

4.9.4 VRM thickness

The thickness of the VRM shall be not greater than the maximum permissible thickness of the heading line.

4.9.5 Time to set VRM

On all range scales, it shall be possible to set the variable range marker with the required precision within 10 s in all cases. A range that is set by the user shall not change automatically when the range scale is changed.

4.9.6 Fixed range ring and VRM accuracy when off-centred

The accuracy of fixed range rings and VRM shall be maintained when the display is off-centred class A (and class B).

4.9.7 Fixed range ring and VRM display

It shall be possible to remove the fixed range rings and the VRM independently and completely from the display.

4.10 Range measurement using range rings and VRM

The fixed range rings and the VRM shall enable the range of an object to be measured with an error not exceeding 1,5 % of the maximum range of the scale in use or 50 m, whichever is greater.

NOTE Range measurement is the determination of the distance of a target from the radar antenna.

4.11 Heading line

4.11.1 Heading line indication

The heading of the ship shall be indicated by a continuous line on the display with a maximum error of not greater than $\pm 1^\circ$.

4.11.2 Heading line thickness

The thickness of the displayed heading line shall be not greater than 1° class A (and class B) (2° class C) measured, at the edge of the radar display, in the head-up unstabilized mode with the display centred.

4.11.3 Heading line origin

The heading line shall extend from the trace origin (own ship's position) to the edge of the display.

4.11.4 Heading line bearing scale

A bearing scale shall be provided to give an indication of the heading to within $\pm 1^\circ$ for class A (and class B) ($\pm 2^\circ$ for class C if provided) (when the display is centred). A heading marker (line or mark) shall be displayed on the bearing scale in class A (classes B and C not applicable). The marker shall appear at scale zero to facilitate viewing the heading line orientation on the head-up off-centred display.

4.11.5 Heading line off facility

Provision shall be made to switch off the heading indicator (heading line) by a device which cannot be left in the "heading line off" position.

4.12 Electronic bearing line (EBL)

4.12.1 EBL indication

The EBL for class A (and class B) shall be displayed on the screen in such a way that it is clearly distinguishable from the heading line (optional for class C, when provided it shall meet the stated requirement). The EBL shall be not thicker than the heading line.

4.12.2 EBL rotation

The rotation of the EBL shall be possible in both directions continuously or in steps of not more than 2° class A (and class B) (class C not applicable).

4.12.3 EBL display

It shall be possible to remove the EBL completely from the display.

4.12.4 Time to set EBL

An EBL shall be provided with a numeric read-out to enable the bearing of any object whose echo appears on the display to be obtained within 10 s class A (and class B) (class C not applicable).

4.12.5 EBL read-out

The numeric read-out of the bearing of the EBL shall be displayed with at least a resolution of 1°. The EBL read-out shall not be used to display any other data. Temporary overlaying of the data fields is permitted. There shall be a positive identification of whether the bearing indicated is a relative bearing or a true bearing class A (and class B) (class C not applicable).

4.12.6 EBL measurement accuracy

The EBL shall enable the bearing of a target whose echo appears at the edge of the display to be measured with a maximum error of not greater than $\pm 2^\circ$ class A (and class B) (class C not applicable), excluding external sensor errors.

4.12.7 EBL origin shift

It shall be possible to move the position of the EBL origin away from the own ship to any desired point on the effective display area class A (and class B) (class C not applicable).

- By a fast simple operation it shall be possible to move the EBL origin back to own ship's position on the screen.
- On the EBL, it shall be possible to display a variable range mark.

4.12.8 Additional EBLs

Additional EBLs meeting the above requirements may be provided. In this case, separate identifiable read-outs shall be provided. These may be centred on own ship or off-centred.

4.13 Bearing scale

4.13.1 Linear or non-linear bearing scale

A bearing scale around the edge of the display shall be provided. Linear or non-linear bearing scales may be provided. The radar picture shall be within this scale for class A (and class B) (class C not applicable).

4.13.2 Minimum division marks on bearing scale

The bearing scale shall have as a minimum division marks for each 5° increment. All 30° divisions are to be clearly distinguishable from the minimum division marks.

4.13.3 Labeling of bearing scale division marks

Numbers shall be shown as a minimum at 30°, 60°, 120°, 150°, 210°, 240°, 300° and 330° points of the screen. Numbers may be omitted at the extreme top, bottom, and sides of the screen. (Optional for class B, when provided it shall meet the stated requirement) (Class C not applicable)

4.13.4 Bearing measurement using EBL

By using the EBL, it shall be possible to measure the bearing relative to the heading line. It shall also be possible to measure true bearings relative to North where stabilized modes are provided.

4.14 Discrimination

4.14.1 Range

The equipment shall be capable of displaying two small similar (10 m²) targets in the absence of clutter at a range of between 50 % and 100 % of the range scale as separate indications on a range scale of 0,75 nautical miles or less. These two targets shall have the same bearing and be separated by not more than 60 m class A (and class B) (75 m class C) in range.

4.14.2 Off-centred display

The range discrimination shall be maintained when the display is off-centred.

4.14.3 Bearing

The equipment shall be capable of displaying as separate indications, two similar small (10 m²) targets both situated at the same range, and located between 50 % and 100 % of the 0,75 nautical mile range scale. Both targets shall be individually viewable when separated by not more than: 4,5° class A (6° class B) (8° class C) in bearing.

4.15 Antenna radiation pattern

4.15.1 Antenna horizontal radiation pattern

An antenna horizontal radiation pattern shall be produced in order to ensure that picture quality is not impaired by side-lobes.

4.15.2 Antenna side-lobes

The effective side-lobes shall not adversely affect the radar system performance. The effective side-lobes are defined in Table 1.

Table 1 – Effective side-lobes

Position relative to maximum of main beam degrees	Maximum power relative to maximum of main beam dB
Within ±10 (A)	–20
Outside ±10 (A)	–23
Within ±10 (B)	–18
Outside ±10 (B)	–19
Within ±10 (C)	–18
Outside ±10 (C)	–19

4.16 Roll or pitch performance

The performance of the equipment shall be such that when the ship is rolling or pitching up to $\pm 10^\circ$, the range performance requirements of 4.6.1 and 4.6.2 shall continue to be met.

4.17 Antenna scan

4.17.1 Antenna rotation

- a) The antenna rotation shall be clockwise as viewed from above and continuous through 360° of azimuth.
- b) The antenna rotation rate shall be not less than 20 rpm.
- c) Open antenna arrays shall start and operate satisfactorily in relative wind speeds of up to 60 knots. (This requirement is not applicable to radom enclosed turning elements).

Alternative methods of scanning are permitted, provided that the performance is not inferior to that of a rotating scanner.

4.17.2 Sector blanking

To suppress unwanted indirect reflected echoes in blind arcs, sector blanking of the transmission may be used. If used, the blanked sector shall be clearly indicated on the display.

4.18 Modes

4.18.1 Head-up mode

A head-up display mode shall be provided.

4.18.2 Azimuth stabilization – optional

A stabilized mode, north-up or course-up, may be provided.

4.18.3 Automatic reversion to head-up mode

Where other display modes are provided the display shall revert to head-up mode within 1 min of the azimuth stabilization becoming inoperative. The equipment shall operate satisfactorily in the head-up unstabilized mode when the azimuth stabilization is inoperative.

An alarm shall be given within 5 s of azimuth stabilization failure.

4.18.4 Azimuth stabilization mode where no heading sensor is available

Where no heading sensor is available, selection of this mode shall not be possible.

4.18.5 Display mode indication

Where more than one mode is provided there shall be a positive indication of the display mode in use.

4.18.6 Display mode changeover

Where provided, the changeover from one display mode to the other shall be possible within 15 s and a bearing accuracy of 2° shall be achieved within this time for class A (and class B). (class C not applicable).

4.18.7 Relative motion mode

The equipment shall be capable of operating in relative motion mode.

4.18.8 True motion mode – option

The equipment may be capable of operating in true motion mode.

Where true motion mode is provided this shall be available on all range scales between 0,75 nautical miles to 12 nautical miles.

4.18.9 Origin offset

A radar origin offset may be provided, if available the origin shall not be capable of being offset from the centre to more than 75 % of the radius of the display.

4.18.10 Stabilization indication

Where provided the stabilization mode in use shall be indicated.

4.19 Tuning indication

Means shall be provided to indicate the tuning function.

4.20 Anti-clutter devices

4.20.1 Clutter suppression

Suitable means shall be provided for the suppression of unwanted echoes from sea clutter, rain or other forms of precipitation and interference from other radars.

4.20.2 Clutter controls

Where applicable, it shall be possible to adjust, manually and continuously, the anti-clutter controls in order to suppress unwanted echoes. Automatic anti-clutter functions may be provided.

Adjustment of anti-clutter controls in small discrete steps shall be regarded as continuous adjustment.

Alternatively, adjustment by controls which operate by other than circular movement are acceptable on condition that:

- they shall be inoperative in the fully left or down position; or
- if they operate by a pair of push buttons, operation of the left or lower button shall render the device inoperative;
- an indication of the operative conditions of the anti-clutter control shall be provided.

4.21 Range performance in clutter

4.21.1 Range performance using manual/automatic anti clutter

The operational requirement when the radar antenna is mounted at a height of 7,5 m above sea level, is that, the equipment shall, even in the presence of sea clutter, paint the radar target echo for at least 5 out of 10 radar scans for a target with an effective RCS at X band of 200 m² for class A. (400 m² for class B and class C) when at a distance between 100 m and 1 nautical mile.

NOTE Using a selection of RCS targets, sea states, ranges and distances determine a test scenario where a radar echo can be displayed with the sea clutter control on and adjusted and will not be detectable when the sea clutter is off.

4.21.2 Range performance using automatic anti clutter

Where automatic anti-clutter is provided the manufacturer shall provide details and limitations of this function in their documentation.

4.22 Operation

4.22.1 Language

The operation manuals and user menus in addition to being presented in English may be presented in other languages or scripts.

The user action to change the equipment to another language or script shall be within a user accessible menu function only available on switch on.

4.22.2 Availability

- a) After switching on from cold, the equipment shall be available to be operational within 4 min.
- b) A standby mode shall be provided and from which, upon switching to on, the equipment shall be operational within 15 s.

For radar displays that can be used for displaying other information and when the radar transceiver is switched to standby mode, the display of radar shall be operational within 15 s from selection of the radar mode.

4.23 Controls

Operational controls shall be identified and easy to operate (see E.4.2.1.4).

The equipment shall be capable of being switched on and off and operated from the designated master display control position.

For radars with additional synthetic information (e.g. target identifiers, vectors, navigational information), means shall be provided to remove this additional synthetic information from the screen by dedicated controls or primary access in an associated menu.

4.24 Manual speed set and drift input

4.24.1 Manual speed input

Where manual speed input is provided it shall be possible to input the ship's speed manually from 0 (zero) knots to at least 30 knots in steps of not more than 0,2 knots.

4.24.2 Manual set and drift input

If a manual input of set and drift is provided, an indication shall be given. The relevant set and drift values shall be available on demand.

4.25 Interference from external magnetic fields

After installation and adjustment on board, the bearing accuracy as prescribed in this performance standard shall be maintained without further adjustment, irrespective of the movement of the ship in

the earth's magnetic field. The effect of external magnetic fields shall be sufficiently restricted to ensure that performance is not affected.

Effective means shall be provided for the operator to degauss or to employ an equivalent technique, where applicable, to reduce the observable effect of external magnetic fields.

4.26 Radar installation

The manufacturer shall provide guidelines on installation of the radar system, including the antenna, to ensure that the equipment's performance will not be substantially impaired if these provided guidelines are followed.

4.27 Failure warnings (alarms) and status indication

4.27.1 Signal failures

An alarm shall be provided if:

- a) a failure of any of the following signals occurs:
 - 1) raw radar video,
 - 2) trigger, and
 - 3) heading line;
- b) a failure of data from the following connected/functioning sensors occurs:
 - 1) azimuth (where provided), and
 - 2) other configured sensors (where provided).

If the audible alarm sound level is less than 75 dB(A) (IEC 60945 requires a minimum of 75 dB(A) and a maximum of 85 dB(A)), specify the maximum level in the equipment manual.

4.27.2 Radar picture update failure

A fault that prevents graphic radar video update shall clear or obscure the radar display area or an appropriate alarm shall be given.

4.27.3 Input sensor failure

Functions and data that depend on a failed sensor or signal shall be indicated and inhibited within 1 min of occurrence of such failure.

4.27.4 Alarm acknowledgement

Means shall be provided to acknowledge individual alarms.

4.28 Interfacing

4.28.1 Radar input interface

Where the radar system is capable of exchanging information with other sensors, class A (and class B) shall have as minimum interfaces compliant with international standards (IEC 61162 series – see Tables 2 and 3). In addition, other suitable interfaces are permitted (class C may have any suitable interface). The manufacturer shall either provide simulators for alternative or additional proprietary interfaces or confirm that these do not degrade the performance of the radar. (see 4.2).

The source of received information shall be capable of being displayed.

Table 2 – Recommended input data sentences – IEC 61162-1/IEC 61162-2

	Class A		Class B	
	With RP	No RP	With RP	No RP
Position	GGA	GGA	GGA	GGA
	GLL	GLL	GLL	GLL
	GNS	GNS	GNS	GNS
Speed	VBW/RMC	VBW/RMC	VBW/RMC	VBW/RMC
Heading	HDT/HDG	HDT/HDG	HDT/HDG	HDT/HDG
Stabilization		VTG/RMC		VTG/RMC

Table 3 – Output data sentences – IEC 61162-1/IEC 61162-2 where available

	Class A		Class B	
	With RP	No RP	With RP	No RP
Target data	TTM		TTM	
System data	RSD	RSD	RSD	RSD

4.28.2 Input sensor failure

The radar shall provide an indication when an intended input from an external sensor is not available or is invalid. The manufacturer shall provide details of the functions that are dependent on any sensor.

4.28.3 AIS input interface

An interface for input of data for the display of AIS symbology may be provided according to IEC 61162. If provided AIS symbology shall be in accordance with IEC PAS 60936-5 and IMO SN Circ 217 Interim guidelines for the presentation and display of AIS target information or any current relevant document.

4.28.4 Radar output interface standards

If any radar serial outputs are provided, they shall be in accordance with international standards (IEC 61162 series). In addition, other suitable interfaces are permitted.

4.29 Navigational information**4.29.1 Radar mapping**

The radar display may be capable of presenting positions, navigational lines and maps in graphical form (see Annex C). Where these facilities are provided, details shall be described in the manufacturer's documentation.

4.29.2 Radar plotting

Plotting facilities Automatic Tracking Device (ATD) and/or Electronic Plotting Device (EPD) are optional but where provided, they shall comply with the "requirements, tests and required results", as in Annex F and/or Annex G respectively.

NOTE Annex F0 is based on IEC 60872-2 Automatic Tracking Aid (ATA) and Annex G is based on IEC 60872-3 Electronic Plotting Aid (EPA).

4.29.3 Connected sensors

Details of all sensors/sensor interfaces, capable of being used for the radar plotting functions to this standard, shall be detailed within the manufacturer's documentation.

4.30 Ergonomics

4.30.1 Independent controls

For the purposes of this standard the following functions shall be directly accessible by an independent control(s) or via a first level menu for class A (and not below a second level menu for class B and C) and available for immediate use:

On/off switch	Gain
Standby	Brightness
Anti-clutter sea	Variable range marker
Tuning (if manual)	Marker (cursor)
Range selection	Acknowledge alarm
Electronic bearing line	

and where provided or applicable;

Contrast	Presentation mode
Anti-clutter rain	Vector true/relative
Pulse length	Dimmer for panel illumination

NOTE EBL and VRM controls may be combined.

Inappropriate pulse lengths shall be either inhibited or clearly indicated.

These functions may be executed by alternative solutions that meet the functional requirements.

4.30.2 Functional controls

For the purpose of this standard, the following functions shall be directly accessible and immediately effective:

Range selection	Anti-clutter sea (class C optional)
Tuning (if manual) (classes B and C optional)	Variable range marker (class C optional)
Anti-clutter rain (classes B and C optional)	Marker (cursor)
Electronic bearing line (class C optional)	On /off
Standby	Gain

4.30.3 Visibility of setting

The settings of the following shall be visible in all light conditions class A (and class B) (class C optional):

Tuning (if manual)	Gain
Anti-clutter rain	Anti-clutter sea

The control of the dimmer and monitor brilliance may be located and adjusted by tactile (feel or touch) means.

4.30.4 Automatic adjustment

For the following functions, automatic adjustment may be provided:

Tuning	Gain
Anti-clutter rain	Anti-clutter sea

Where manual and automatic adjustment is available, the use of the automatic mode shall be indicated and capable of being switched off.

4.30.5 EBL and VRM controls

If discrete controls are available for the EBL and VRM, they shall be situated on the left-hand side and right hand side respectively. (classes B and C optional)

If EBL and VRM control functions are combined there shall be a clear indication of which function is selected.

4.31 Display of information

A clear and logical arrangement of data fields shall be provided. Overlaying of the data fields is permitted providing that the original data field remains available for re-display on demand.

4.32 Safety precautions

4.32.1 RF radiation

During normal operation, radiation from the antenna shall be possible only when the beam is scanning. The maximum distances from the antenna at which radio-frequency radiation levels of 100 W/m² and 10 W/m² can be expected shall be included in the equipment handbook.

NOTE An override facility to stop the antenna while radiation continues may be provided for maintenance purposes only.

4.32.2 Working at the antenna

Means shall be provided to prevent the turning of open array scanners for maintenance and other purposes.

4.33 Spurious/unwanted frequency emissions (Annex D)

The spurious/unwanted emissions shall meet the ITU requirements and be tested in accordance with Annex D.

5 Methods of test and required test result

General

This clause defines test methods and required results to ensure that the radar equipment complies with the requirements of Clause 4.

General conditions of measurement

The relevant requirements of Annex E according to the EUT's class and category, i.e. 'protected' (from the weather) or 'exposed' (to the weather) shall be carried out on the sample equipment under test (EUT) to verify whether the EUT meets these technical requirements.

NOTE Annex E is based on IEC 60945.

The manufacturer shall declare which equipment or units are 'protected', 'exposed' or 'antenna system'. The manufacturer shall declare the 'preconditioning' required before environmental checks.

Where test requirements are given in a non-quantitative manner, the results shall be the aggregate obtained over a number of observations.

All performance tests shall be carried out under normal environmental conditions unless otherwise specified.

Test sites

Performance tests shall be carried out at a test site that can present an over water test range containing the test targets and features needed for the specified tests. Operational, environmental and other checks or tests may be carried out at alternative sites. The manufacturer shall, unless otherwise agreed, set up the equipment and ensure that it is operating normally before type testing commences.

Height of radar antenna

During all appropriate tests, the radar antenna shall be mounted at a height of about 7,5 m above the surface of the water.

Test targets for range performance

For range performance tests the effective echoing area of the test target, height and distance may be adjusted in accordance with the methods given in Annex A.

Sea state

Range performance measurements shall be conducted using a test target in a calm sea (sea states 0 or 1). Measurements may be taken in other sea states, but in case of conflict, measurements taken at sea states 0 or 1 shall take precedence.

Radio-frequency

Where tests relating to the radio-frequency are specified, these shall be carried out only at the nominal operating radio-frequency of the equipment unless specified otherwise.

Power supply, cabling distances and technical information

The supply voltage applied to the equipment during the tests shall be the nominal voltage; a.c. supplies shall be at their nominal frequency unless specified otherwise.

Antenna/RF head feeder length

When equipment with separated RF head (transmitter/receiver) and antenna is tested in accordance with this standard, the RF head shall be connected to the antenna by a feeder of the length as specified by the manufacturer.

The manufacturer shall supply the appropriate cable and antenna feeder.

The manufacturer shall define the maximum and minimum distances by which units of the equipment must be separated in order to comply with the requirements of this standard. The actual distances and the lengths of cable used shall be recorded in the test report.

5.1 Radar indication

Check that the EUT paints the radar target echo of all objects in view within the allowable tolerances.

5.1.1 Method of test

Set up the EUT where several target types are present and check that these targets are detected and presented on the radar display (4.1).

5.1.2 Result required

Confirm that the requirement is met.

5.2 Safety of options

Check that manufacturer's declared options do not degrade the radar performance (4.2).

5.2.1 Method of test

Repeat the test in 5.1 with all options incorporated.

5.2.2 Result required

Confirm that the requirement is met.

5.3 Technical information**5.3.1 Method of test**

By inspection (4.3).

5.3.2 Result required

Confirm that the requirement is met.

5.4 Quality assurance**5.4.1 Method of test**

Check in accordance with the requirements. (4.4)

5.4.2 Result required

Confirm that the requirement is met.

5.5 Radio-frequency spectrum requirements

During testing for the requirements defined in Annex D, a record shall be made of the transmitted radio-frequency of the EUT. (4.5)

5.5.1 Method of test

Inspect the manufacturer's documentation.

5.5.2 Result required

Confirm that the documentation includes a result of the transmitted radio-frequency and that it complies with the limits shown in Annex D for the appropriate allocated band.

5.6 Range

Set the tune, gain and clutter controls of the radar so that the reference target echo paints 8 or more out of 10 radar scans. (4.6)

5.6.1 Detection of test-coastlines

Confirm the detection and display of coastlines. (4.6.1)

5.6.1.1 Method of test

With the EUT operating at the correct distance from a suitable coastline ensure that the target echoes are painted for coastlines as specified in 4.6.1.

5.6.1.2 Results required

The EUT paints target echoes for coastlines.

5.6.2 Detection of surface objects

Confirm the detection of surface objects (4.6.2).

5.6.2.1 Method of test

Set up one of the test target as specified in 4.6.2.

5.6.2.2 Results required

The EUT paints target echoes for the test target.

5.6.3 Minimum range

5.6.3.1 Method of test

Place a test target at 0,5 nautical miles approximately, and then reduce the distance between the radar antenna and the test target. (4.6.3)

- a) Record on the test report the distance at which the test-target echo ceases to be presented separately from the antenna position (main bang) on the display. For this measurement, only the range, sea and gain controls may be adjusted.
- b) Without any further adjustments of sea or gain controls, increase the distance between the test target and the antenna up to 1 nautical mile.

5.6.3.2 Results required

- a) The minimum range shall be 50 m for class A, (60 m for class B) and (75 m for class C) or less measured horizontally.
- b) The test target return remains visible from the minimum-recorded range up to 1 nautical mile.

5.7 Display

5.7.1 Display size

5.7.1.1 Method of test

Measure the linear effective diameter of the display area with a rigid ruler. Visually inspect the range scales and number of range rings provided on each scale while the equipment is operating. (4.7.1)

5.7.1.2 Result required

The size of the screen meets the requirement for each class; not less than 150 mm for class A (85 mm for class B) (75 mm for class C) and the range scales/rings comply with the requirement.

5.7.2 Standard ranges

5.7.2.1 Method of test

By measurement and inspection. (4.7.2)

5.7.2.2 Results required

Confirm that the requirement is met.

5.7.3 Additional range scales

Check that if any additional range scale is provided the requirement is met. (4.7.3)

5.7.3.1 Method of test

By inspection.

5.7.3.2 Results required

Confirm that the requirement is met.

5.7.4 Additional range units

Check that the selection of alternative range units can only be carried out in the standby mode and the relationship between the standard range units and the alternative range units is maintained as detailed in the requirement. (4.7.4)

5.7.4.1 Method of test

By inspection.

5.7.4.2 Result required

Confirm that the requirement is met.

5.7.5 Displayed range scales

Check that the range scale in use and the distance between range rings is clearly indicated. (4.7.5)

5.7.5.1 Method of test

By inspection.

5.7.5.2 Result required

Confirm that the requirement is met.

5.7.6 Displayed information

5.7.6.1 Method of test

- a) Check that the displayed information meets the requirement. (4.7.6)
- b) Display a user menu and take no further action. Ensure that the display reverts to normal radar/RP mode within 10 s.

5.7.6.2 Result required

- a) Confirm that the requirement is met.
- b) Confirm that the requirement is met.

5.7.7 Radar video origin

5.7.7.1 Method of test

Check that the radar video origin starts at own ship, is linear and is not delayed. (4.7.7)

5.7.7.2 Results required

Confirm that the requirement is met.

5.7.8 Zoom function

5.7.8.1 Method of test

If a zoom function is provided, check that the radar origin cannot be moved outside the radar effective area. Check that the resultant zoom image is 2x the original and the spacing of the range rings is equal. Check that an indication of zoom is provided and the associated scale is half of the original, prior to zoom. (4.7.8)

5.7.8.2 Result required

Confirm that the requirement is met.

5.7.9 Display colour presentation

5.7.9.1 Method of test

By inspection. (4.7.9)

5.7.9.2 Result required

Confirm that the requirement is met.

5.7.10 Display view under various light conditions**5.7.10.1 Method of test**

By inspection. (4.7.10)

5.7.10.2 Result required

Confirm that the requirement is met.

5.8 Frequency band**5.8.1 Method of test**

By inspection. (4.8)

5.8.2 Results required

Confirm that the requirement is met.

5.9 Range markers**5.9.1 Fixed range rings****5.9.1.1 Method of test**

Check that the requirement is met for the class under examination (4.9.1):

- a) check that the range rings are equally spaced;
- b) exercise the ranges of the EUT and check that at least two and not more than six range rings are displayed;
- c) if off-centre facility is available, check that additional range rings are provided and meet the requirement;
- d) if a zoom function facility is provided, check that, if a different number of range rings are provided, they meet the requirement.

5.9.1.2 Results required

- a) Confirm that the requirement is met.
- b) Confirm that the requirement is met.
- c) Confirm that the requirement is met.
- d) Confirm that the requirement is met.

5.9.2 Range ring thickness**5.9.2.1 Method of test**

By inspection. (4.9.2)

5.9.2.2 Results required

Confirm that the requirement is met.

5.9.3 Variable range marker

5.9.3.1 Method of test

By inspection. (4.9.3)

5.9.3.2 Results required

Confirm that the requirements are met.

5.9.4 VRM thickness

5.9.4.1 Method of test

By inspection. (4.9.4)

5.9.4.2 Results required

Confirm that the requirement is met.

5.9.5 Time to set VRM

5.9.5.1 Method of test

A known target shall be placed at approximately 75 % of the selected range scale and at relative bearing of 90°. A range measurement shall be taken, using the variable range marker starting at the radar origin, or by using other means as appropriate. (4.9.5)

5.9.5.2 Results required

A range measurement with a precision of ± 2 % of the range scale in use shall be capable of being taken within 10 s of switching on a VRM.

5.9.6 Fixed range rings and VRM accuracy when off-centred

5.9.6.1 Method of test

Off-centre the display and check that the accuracy of the range rings is maintained. (4.9.6)

5.9.6.2 Results required

Confirm that the requirement is met.

5.9.7 Fixed range ring and VRM display

5.9.7.1 Method of test

Check that the fixed range rings and VRM can be independently and completely removed from the display. (4.9.7)

5.9.7.2 Results required

Confirm that the requirement is met.

5.10 Range measurement using range rings and VRM**5.10.1 Method of test**

Using the 'standard operating mode', measure the accuracy of the range rings and VRM using known targets echoes or other means as appropriate. Check, at least one known target echo on each range scale up to 12 nautical miles. (4.10)

5.10.2 Results required

Confirm that the requirement is met.

5.11 Heading line**5.11.1 Heading line indication****5.11.1.1 Method of test**

Check the requirements for the heading indication by inspection. (4.11.1)

5.11.1.2 Result required

Confirm that the requirement is met.

5.11.2 Heading line thickness**5.11.2.1 Method of test**

Check that the requirement is met. (4.11.2)

5.11.2.2 Results required

Confirm that the requirement is met.

5.11.3 Heading line origin**5.11.3.1 Method of test**

By inspection. (4.11.3)

5.11.3.2 Results required

Confirm that the requirement is met.

5.11.4 Heading line bearing scale**5.11.4.1 Method of test**

By inspection. (4.11.4)

5.11.4.2 Results required

Confirm that the requirement is met.

5.11.5 Heading line off facility

5.11.5.1 Method of test

Operate heading line off, hold and release. (4.11.5)

5.11.5.2 Result required

The heading line is removed from the display during the time that the heading line off operation is held and returns when heading line off operation is released.

5.12 Electronic bearing line (EBL)

5.12.1 EBL indication

5.12.1.1 Method of test

By inspection. (4.12.1)

5.12.1.2 Result required

Confirm that the requirement is met.

5.12.2 EBL rotation

5.12.2.1 Method of test

Rotate the EBL in both directions using the control provided. (4.12.2)

5.12.2.2 Results required

Confirm that the requirement is met.

5.12.3 EBL display

5.12.3.1 Method of test

Check that the EBL can be completely removed from the display. (4.12.3)

5.12.3.2 Results required

Confirm that the requirement is met.

5.12.4 Time to set EBL

5.12.4.1 Method of test

Switch on the EBL and simultaneously start a timer, obtain the bearing of a target. (4.12.4)

5.12.4.2 Result required

The bearing of a target can be obtained within 10 s.

5.12.5 EBL read-out**5.12.5.1 Method of test**

By inspection. (4.12.5)

5.12.5.2 Result required

Confirm that the requirements are met.

5.12.6 EBL measurement accuracy**5.12.6.1 Method of test**

With the display centred, align the EBL with at least 12 equally spaced bearing marks in 360° and ensure that the EBL read-out indicates the same angle as the corresponding bearing mark. (4.12.6)

5.12.6.2 Result required

Confirm that the requirement is met.

5.12.7 EBL origin shift**5.12.7.1 Method of test**

Check that the EBL origin can be moved away from own ship, returned to origin by a fast simple operator action and that a VRM mark can be applied to the EBL. (4.12.7)

5.12.7.2 Required result

Confirm that the requirements are met.

5.12.8 Additional EBLs**5.12.8.1 Method of test**

Check that any EBL provided meets the requirements of 5.12.2 through to 4.12.7 and that separate identifiable read-outs are provided. (4.12.8)

5.12.8.2 Results required

Confirm that the requirements are met.

5.13 Bearing scale**5.13.1 Linear or non linear bearing scale****5.13.1.1 Method of test**

By inspection. (4.13.1)

5.13.1.2 Results required

Confirm that the requirement is met.

5.13.2 Minimum division marks around bearing scale

5.13.2.1 Method of test

By inspection. (4.13.2)

5.13.2.2 Results required

Confirm that the requirement is met.

5.13.3 Labelling of bearing scale division marks

5.13.3.1 Method of test

By inspection. (4.13.3)

5.13.3.2 Results required

Confirm that the requirement is met.

5.13.4 Bearing measurement using EBL

5.13.4.1 Method of test

Using the 'standard operating mode', with own ship at zero. Compare the overall accuracy of bearings taken by the radar equipment with the known bearings of identifiable point targets. (4.13.4)

Mount the antenna unit on a rotating table and using the EBL, with reference to the heading line, measure the bearing of a known identifiable point target, then rotate the table clockwise by 30°. Re-measure the bearing of the same identifiable point target and ensure that the EBL bearing measurement matches the angular movement of the antenna unit. Repeat this test by progressively moving the table by 30° until the antenna unit has been fully rotated back to the original orientation. Repeat this test rotating the table in the counter clockwise direction.

Repeat the above test at any one position with reference to North in the stabilized mode, if provided.

Alternative equivalent methods of testing may be used.

5.13.4.2 Results required

Confirm that the requirements are met.

5.14 Discrimination

5.14.1 Range

5.14.1.1 Method of test

Place two equivalent test targets with a radar cross-section of 10 m² at 3,5 m height, on the same bearing with respect to the radar antenna. The two test targets are to be placed at a range of between 0,375 nautical miles and 0,75 nautical miles and separated from each other by a distance of not more than 60 m class A, (60 m class B) and (75 m class C). Set the radar to a range scale of

0,75 nautical miles, set the effective pulse length of the range scale in use and the rain control (where available) to their minimum values. Adjust the sea clutter (where possible) and gain control so that the two target echoes are displayed separately for at least 8 out of 10 antenna scans. (4.14.1)

5.14.1.2 Results required

The two test target echoes are displayed separately and the recorded separation distance of the two targets is included in the test report.

5.14.2 Off-centred display

5.14.2.1 Method of test

With the display off-centred repeat the test as detailed in 5.14.1 (4.14.2)

5.14.2.2 Results required

Confirm that the two test target echoes are displayed separately and the recorded separation distance of the two targets is included in the test report.

5.14.3 Bearing

5.14.3.1 Method of test

Make the following measurements at display inter-cardinal points $\pm 5^\circ$ i.e. 40° to 50° , 130° to 140° etc. (4.14.3)

Place two equivalent test targets with a radar cross-section of 10 m^2 at a height of 3,5 m and at the same range, between 0,5 nautical miles and 0,75 nautical miles, with respect to the radar antenna. These test targets are to be separated from each other in bearing by $4,5^\circ$ class A (6° class B) (8° class C).

Set the radar to a range scale of 0,75 nautical miles, set the effective pulse length of the range scale in use and the rain control (where available) to their minimum values. Adjust the sea clutter (where possible) and gain control such that the two target echoes are displayed separately for at least 8 out of 10 antenna scans. Decrease the angular separation between the two targets until they cease to be displayed separately. Measure the linear distance between the two targets and calculate the angle with respect to the known range of the test targets.

Alternative methods of testing may be used.

5.14.3.2 Results required

Measure and record the angular separation at which the targets cease to be displayed separately. The angle of separation meets the requirement.

5.15 Antenna radiation pattern

5.15.1 Antenna horizontal radiation pattern

Is defined as a graph to show the relative response of the antenna plotted against angular displacement in the horizontal plane.

5.15.1.1 Method of test

Examine the polar diagram provided by the manufacturer. The polar diagram contents shall be from direct measurements in the far field region at the nominal operating radio-frequency of the equipment.

The far field distance (D) value must be calculated for the antenna length (L) under test as per the following equation (all in SI units):

$$D \geq 2L^2/\lambda$$

Alternative test method using the near field region (from 3λ to $2L^2/\lambda$) for meeting these requirements may be demonstrated by submission of the measurements and of the processing methods for achieving the required results.

Measurement method in the Evanescent region ($< 3\lambda$) shall not be used.

Table 4 – 3 dB points for main beam

Class of radar	Position relative to maximum of main beam (X-band) degrees	Position relative to maximum of main beam (S-band) degrees
A	4,0	4,0
B	5,5	4,0
C	7,5	4,0

5.15.1.2 Results required

Confirm that the limits defined in Table 4 are met.

5.15.2 Antenna side-lobes

Antenna horizontal radiation pattern: Is defined as a graph to show the relative response of the antenna plotted against angular displacement in the horizontal plane. (4.15.2)

5.15.2.1 Method of test

Examine the polar diagram provided by the manufacturer. The polar diagram contents shall be from direct measurements in the far field region at the nominal operating radio-frequency of the equipment.

The far field distance (D) value shall be calculated for the antenna length (L) under test as per the following equation (all in SI units):

$$D \geq 2L^2/\lambda$$

Alternative test method using the near field region (from 3λ to $2L^2/\lambda$) of meeting these requirements may be demonstrated by submission of the measurements and of the processing methods for achieving the required results.

Measurement method in the Evanescent region ($< 3\lambda$) may not be used.

5.15.2.2 Results required

Confirm that the effective side-lobe parameters meet the values shown in Table 5.

Table 5 – Effective side-lobes

Class of radar	Position relative to maximum of main beam degrees	Maximum power relative to maximum of main beam dB
A	Within ± 10	-20
	Outside ± 10	-23
B	Within ± 10	-18
	Outside ± 10	-19
C	Within ± 10	-18
	Outside ± 10	-19

5.16 Roll or pitch performance

Determine the vertical radiation pattern. (4.16)

5.16.1 Method of test

Tilt the antenna both up and down by 10° . Verify that the test target detailed in 4.6.1 and 4.6.2 continues to present a clear indication.

Alternative testing methods may be used.

5.16.2 Results required

Confirm that the requirements 4.6.1 and 4.6.2 continue to be met.

5.17 Antenna scan

5.17.1 Antenna rotation

5.17.1.1 Method of test – Open array type antenna

Place the EUT rotating open arrays antenna/pedestal combinations in a wind tunnel capable of producing an air stream of up to 60 knots (31 m/s). Alternative approved methods may be used. Provide the antenna motor with a power source at its nominal voltage and frequency. (4.17.1)

- Ensure the antenna rotates continuously and clockwise as viewed from above through 360° of azimuth.
- Ensure the antenna rotation rate is not less than 20 rpm.
- The equipment starts and operates satisfactorily in relative wind speeds of up to 60 knots.

Alternative methods of scanning are permitted, if adopted, ensure that the performance is not inferior to that of a rotating scanner.

5.17.1.2 Required results – Open array type antenna

- Confirm the scanner rotates continuously in a clockwise direction as viewed from above through 360° of azimuth.
- Confirm the antenna rotation rate is not less than 20 rpm.

- c) Confirm the equipment starts and operates satisfactorily in relative wind speeds of up to 60 knots.

If alternative methods of scanning are used confirm that the performance is not inferior to that of a rotating scanner.

5.17.1.3 Method of test – Radom enclosed type array antenna

Provide the antenna motor with a power source at its nominal voltage and frequency. (4.17.1)

- a) Ensure the antenna rotates continuously and clockwise as viewed from above through 360° of azimuth.
- b) Ensure the antenna rotation rate is not less than 20 rpm.

Alternative methods of scanning are permitted, if adopted, ensure that the performance is not inferior to that of a rotating scanner.

5.17.1.4 Required results – Radom enclosed type array antenna

- a) Confirm the scanner rotates continuously in a clockwise direction as viewed from above through 360° of azimuth.
- b) Confirm the antenna rotation rate is not less than 20 rpm.

If alternative methods of scanning are used confirm that the performance is not inferior to that of a rotating scanner.

5.17.2 Sector blanking

5.17.2.1 Method of test

If a sector blanking facility is provided, blank sector or sectors shall be checked to confirm that they are clearly identifiable on the display. (4.18.2)

5.17.2.2 Result required

Confirm that the requirements are met.

5.18 Modes

Check by inspection during operation of the equipment. (4.18)

Exercise the display modes described in the requirement by use of THD/compass and speed log simulators. If provided, the manual input of speed, set and drift are also to be verified.

NOTE Simulator signals should be in accordance with IEC 61162. Where proprietary interfaces are used the manufacturer is to provide alternative means for testing.

5.18.1 Head-up mode

5.18.1.1 Method of test

Check the radar operates in the head-up mode. (4.18.1)

5.18.1.2 Results required

Confirm that the requirement is met.

5.18.2 Azimuth stabilization -optional

5.18.2.1 Method of test

Where applicable, connect the output from an HSD or HSD simulator in compliance with the manufacturer's standards to the radar. Check that the HSD information is provided. (4.18.2)

Change from one presentation mode to another (e.g. north-up to head-up). Check that an accuracy of $2,0^\circ$ within 5 s is achieved.

5.18.2.2 Results required

Confirm that the requirements are met.

5.18.3 Automatic reversion to head-up mode

5.18.3.1 Method of test

Where applicable, with the radar working in a stabilized mode remove the HSD input, simultaneously start a timing device and observe the display. (4.18.3)

5.18.3.2 Result required

The display reverts to head-up unstabilized mode within 1 min and the appropriate alarm is initiated within 5 s of azimuth stabilization failure.

5.18.4 Azimuth stabilization where no heading sensor is available

5.18.4.1 Method of test

Where applicable, ensure that azimuth selection is not possible. (4.18.4)

5.18.4.2 Result required

Confirm that the requirement is met.

5.18.5 Display mode indication

5.18.5.1 Method of test

By inspection, where applicable. (4.18.5)

5.18.5.2 Results required

Confirm that the requirement is met.

5.18.6 Display mode changeover

5.18.6.1 Method of test

Where applicable, with the radar working in any display mode, change the mode and measure the time for the changeover. (4.18.6)

5.18.6.2 Results required

Confirm that the change from one display mode to another occurs within 15 s and that a bearing display accuracy of 2° is achieved.

5.18.7 Relative motion mode

5.18.7.1 Method of test

By inspection. (4.18.7)

5.18.7.2 Result required

Confirm that the requirement is met.

5.18.8 True motion mode (option)

5.18.8.1 Method of test

By inspection. (4.18.8)

5.18.8.2 Result required

Confirm that the requirement is met.

5.18.9 Origin offset

5.18.9.1 Method of test

By inspection. (4.18.9)

5.18.9.2 Result required

Confirm that the requirement is met.

5.18.10 Stabilization indication

5.18.10.1 Method of test

By inspection. (4.18.10)

5.18.10.2 Result required

Confirm that the requirement is met.

5.19 Tuning indication

5.19.1 Method of test

By inspection. (4.19)

5.19.2 Results required

Confirm that the requirement is met.