

Maritime navigation and radiocommunication equipment and systems — Radar —

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

The European Standard EN 60936-1:2000, with the incorporation of amendment A1:2002 has the status of a British Standard

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National foreword

This British Standard is the official English language version of EN 60936-1:2000, including amendment A1:2002. It is identical with IEC 60936-1:1999, including amendment A1:2002. It supersedes BS EN 60936-1:1993 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee EPL/80, Maritime navigation and radiocommunication equipment and systems, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

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

(includes amendment A1:2002)

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

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

Navigations- und
Funkkommunikationsgeräte und -systeme für
die Seeschifffahrt — Radar —

Teil 1: Radar für die Seeschifffahrt
Leistungsanforderungen — Prüfverfahren und
geforderte Prüfergebnisse

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

(enthält Änderung A1:2002)

This European Standard was approved by CENELEC on 2000-01-01; amendment A1 was approved by CENELEC on 2002-09-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standards without any alteration.

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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Foreword

The text of document 80/235/FDIS, future edition 1 of IEC 60936-1, prepared by IEC TC 80, Maritime navigation and radiocommunication equipment and systems, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 60936-1 on 2000-01-01.

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The following dates were fixed:

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Annexes designated "normative" are part of the body of the standard.

Annexes designated "informative" are given for information only.

In this standard, annexes A, B, C, D and ZA are normative and annex E is informative.

Annex ZA has been added by CENELEC.

Endorsement notice

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

Foreword to amendment A1

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Annexes designated "normative" are part of the body of the standard.

In this standard, annex D is normative.

Endorsement notice

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MARITIME NAVIGATION AND RADIOCOMMUNICATION EQUIPMENT AND SYSTEMS – RADAR –

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

1 Scope

This International Standard specifies the minimum performance requirements, methods of testing and required test results for conformance to performance standards not inferior to those required by IMO resolution MSC.64 (67), Annex 4. In addition, it takes account of IMO resolution A.694 and is associated with IEC 60945. When a requirement of this standard is different from that of IEC 60945, the requirement in this standard shall take precedence.

This standard does not include the optional performance requirements for superimposition of selected parts of SENC information. These are specified in IEC 60936-3.

All text in this standard whose wording is identical to that in IMO resolution MSC.64 (67), Annex 4 is printed in *italics*, and the resolution (abbreviated to – A4) and paragraph numbers are indicated in brackets, for example (A4/3.3).

2 Normative references

The following normative documents contain provisions, which, through reference in this text, constitute provisions of this part of IEC 60936. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of IEC 60936 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative documents referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

IEC 60872-1:1998, *Maritime navigation and radiocommunication equipment and systems – Radar plotting – Part 1: Automatic radar plotting aids (ARPA) – Methods of testing and required test results*

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, *Maritime navigation and radiocommunication equipment and systems – Radar plotting – Part 3: Electronic plotting aid (EPA)*¹⁾

IEC 60936-3, *Maritime navigation and radiocommunication equipment and systems – Radar – Part 3: Shipborne radar with chart facilities – Methods of testing and required test results*¹⁾

IEC 60945:1996, *Maritime navigation and radiocommunication equipment and systems – General requirements – Methods of testing and required test results*

IEC 61023:1999, *Maritime navigation and radiocommunication equipment and systems – Marine speed and distance measuring equipment (SDME). Performance requirements – Methods of testing and required test results*

¹⁾ To be published.

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

IEC 61174:1998, *Maritime navigation and radiocommunication equipment and systems – Electronic chart display and information system (ECDIS) – Operational and performance requirements, methods of testing and required test results*

IEC 61209:1999, *Maritime navigation and radiocommunication equipment and systems – Integrated bridge systems (IBS) – Operational and performance requirements, methods of testing and required test results*

IEC 61996, *Maritime navigation and radiocommunication equipment and systems – Shipborne voyage data recorder (VDR) – Performance requirements – Methods of testing and required test results*¹⁾

ISO 9000 (all parts), *Quality management and quality assurance standards*

IMO A.477:1981, *Performance standards for radar equipment*

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

IMO A.823:1995, *Performance standards for automatic radar plotting aids*

IMO A.824:1995, *Performance standards for devices to indicate speed and distance*

IMO A.861:1997, *Performance standards for shipborne voyage data recorders (VDRs)*

IMO MSC.64 (67):1996, *Annex 4 – Recommendation on performance standards for radar equipment*

IMO MSC SN/Circular 197:1997, *Operation of marine radar for SART detection*

IMO:1997, *International Convention for the Safety of Life at Sea (SOLAS) Consolidated edition*

ITU:1997, *Radio Regulations*

ITU-R M.628-3:1994, *Technical characteristics for search and rescue radar transponders*

ITU-R M.824-2:1995, *Technical parameters of radar beacons (RACONS)*

ITU-R M.1177-1:1997, *Techniques for measurement of spurious emissions of radar systems*

IHO S-52 appendix 2:1997, *Colour and symbol specifications for ECDIS*

3 Performance requirements

The radio frequency of operation of the equipment shall at all times be within the limits defined in the ITU Radio Regulations.

At the World Radio Conference in 1997, the ITU modified Appendix S3 of the Radio Regulations to include maximum permitted spurious emission power levels for radiodetermination services. This Appendix S3 references ITU-R M.1177, a recommendation on measurement methods for spurious emissions of radar systems, as guidance for the measurement of the required levels.

¹⁾ To be published.

ITU-R M.1177 has been used as the basis for the development of annex D, which presents a detailed method of measurement for spurious emissions of shipborne radar systems.

3.1 (A4/1) Introduction

In addition to the general requirements contained in resolution A.694, all radar installations shall comply with the following minimum requirements.

3.2 (A4/2) General

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

3.2.2 Quality assurance

The radar shall be designed, produced and documented by companies complying with the ISO 9000 series standards as applicable.

3.3 (A4/3.1) Range performance

The operational requirement under normal propagation conditions, when the radar antenna is mounted at a height of 15 m above sea level, is that the equipment shall in the absence of clutter give a clear indication of:

3.3.1 (A4/3.1.1) Coastlines

At 20 nautical miles when the ground rises to 60 m.

At 7 nautical miles when the ground rises to 6 m.

3.3.2 (A4/3.1.2) Surface objects

At 7 nautical miles a ship of 5 000 GT, whatever her aspect.

At 3 nautical miles a small vessel of 10 m in length.

At 2 nautical miles an object such as a navigational buoy with a radar reflector height of 3,5 m having an effective echoing area of approximately 10 m².

3.4 (A4/3.2) Minimum range

The surface objects specified in 3.3.2 shall be clearly displayed from a minimum horizontal range of 50 m from the antenna position up to a range of 1 nautical mile, without changing the setting of controls other than the range selector.

The minimum range is the shortest distance at which, using a mandatory range scale of not more than 1,5 nautical miles, a stationary target ahead is still presented separately from the point representing the antenna position.

3.5 (A4/3.3(Display

3.5.1 (A4/3.3.1(The equipment shall provide, without external magnification, a daylight display with a minimum effective diameter within the bearing scale of not less than:

3.5.1.1 (A4/3.3.1.1(180 mm on ships of 150 GT and more but less than 1 000 GT;

3.5.1.2 (A4/3.3.1.2(250 mm on ships of 1 000 GT and more but less than 10 000 GT;

3.5.1.3 (A4/3.3.1.3(340 mm on ships of 10 000 GT and upwards.

3.5.2 (A4/3.3.2(The equipment shall provide the following set of range scales of display: 0,25, 0,5, 0,75, 1,5, 3, 6, 12 and 24 nautical miles.

3.5.3 (A4/3.3.3(Additional larger and smaller range scales may be provided. These additional range scales shall be either smaller than 0,25 nautical miles or greater than 24 nautical miles.

3.5.4 (A4/3.3.4(The range scale displayed and the distance between range rings shall be clearly indicated at all times.

3.5.5 (A4/3.3.5(Within the effective display radar video area, the display shall only contain information which pertains to the use of the radar display for navigation or 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.

3.5.6 (A4/3.3.6(The origin of the range scale (radar video(shall start at own ship, be linear and shall not be delayed.

3.5.6.1 Facilities may be provided to adjust the displayed radar origin to compensate for antenna offsets (e.g. to the conning position(. If used, a clear indication shall be permanently displayed on the screen.

3.5.7 (A4/3.3.7(Multi-colour displays are permitted but the following requirements shall be met:

3.5.7.1 (A4/3.3.7.1(Target echoes shall be displayed by means of the same basic colours and the echo strength shall not be displayed in different colours.

3.5.7.2 (A4/3.3.7.2(Additional information may be shown in different colours.

3.5.7.3 Day and night colours shall be provided.

3.5.8 (A4/3.3.8(The radar picture and information shall be readable under all ambient light conditions. There shall be a means of adjusting monitor 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.

3.5.9 (A4/3.3.9, 3.3.10(Radar with "chart" facilities

These IMO requirements address options that are not mandatory. They are included in IEC 60936-3.

3.5.10 (A4/3.3.11) Frequency band

The frequency band in use shall be indicated to the operator as X-band or S-band, as applicable.

3.6 (A4/3.4) Range measurement

3.6.1 (A4/3.4.1) *Electronic fixed range rings equally spaced from the origin shall be provided for range measurements as follows:*

3.6.1.1 (A4/3.4.1.1) *on the range scale 0,25, 0,5, 0,75 nautical miles at least two and not more than six range rings shall be provided; on each of the other mandatory range scales six range rings shall be provided; and*

3.6.1.2 (A4/3.4.1.2) *where off-centred facilities have been provided, additional range rings shall be provided at the same range intervals on the mandatory range scales indicated in 3.5.2.*

3.6.1.3 Any number of range rings is allowed on the optional additional range scales.

3.6.2 (A4/3.4.2) *An electronic variable range marker (VRM) in the form of a ring shall be provided with a numeric readout of range. This readout 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 which case separate identifiable read-outs shall be provided.*

3.6.3 (A4/3.4.3) *The fixed range rings and the variable range markers shall enable the range of an object to be measured with an error not exceeding 1 % of the maximum range of the scale in use, or 30 m, whichever is greater.*

3.6.4 (A4/3.4.4) *The accuracy of range rings and range markers shall be maintained when the display is off-centred.*

3.6.5 (A4/3.4.5) *The thickness of the fixed range rings shall not be greater than the maximum permissible thickness of the heading line.*

3.6.6 (A4/3.4.6) *On all range scales, it shall be possible to set the variable range marker with the required precision within 5 s in all cases. A range that is set by the user shall not change automatically when the range scale is changed.*

3.6.7 It shall be possible to vary the brilliance of the fixed range rings and the variable range markers, and to remove them independently and completely from the display.

3.7 (A4/3.5) Heading indication (heading line)

3.7.1 (A4/3.5.1) *The heading of the ship shall be indicated by a continuous line on the display with a maximum error of not greater than $\pm 1^\circ$. The thickness of the displayed heading line shall not be greater than $0,5^\circ$ measured at maximum range at the edge of the radar display, when the display is centred. The heading line shall extend from the trace origin (own ship's position) to the edge of the display. A bearing scale shall be provided to give an indication of the heading to within $\pm 1^\circ$ (when the display is centred).*

3.7.2 (A4/3.5.2) *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.*

3.7.3 (A4/3.5.3) *A heading marker (line or mark) shall be displayed on the bearing scale.*

3.8 (A4/3.6) Bearing measurement

3.8.1 (A4/3.6.1) *An electronic bearing line (EBL), shall be provided with a numeric readout of bearing to obtain within 5 s the bearing of any object whose echo appears on the display.*

3.8.2 (A4/3.6.2) *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 the radar system, excluding sensor errors, of not greater than $\pm 1^\circ$.*

3.8.3 (A4/3.6.3) *The EBL shall be displayed on the screen in such a way that it is clearly distinguishable from the heading indicator. It shall not be thicker than the heading indicator.*

3.8.4 (A4/3.6.4) *It shall be possible to vary the brilliance of the EBL. This variation may be separate or combined with the intensity of other markers. It shall be possible to remove the EBL completely from the screen.*

3.8.5 (A4/3.6.5) *The rotation of the EBL shall be possible in both directions continuously or in steps of not more than $0,2^\circ$.*

3.8.6 (A4/3.6.6) *The numeric readout of the bearing of the EBL shall be displayed with at least four digits including one after the decimal point. The EBL readout 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.*

3.8.7 (A4/3.6.7) *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.*

3.8.8 (A4/3.6.8) *The bearing scale shall have division marks for at least each 5 degrees, with the 5 degree and 10 degree divisions clearly distinguishable from each other. Numbers shall clearly identify at least each 30 degree division.*

3.8.9 (A4/3.6.9) *It shall be possible to measure the bearing relative to the heading line in head-up mode, and true bearings relative to North in the stabilised modes.*

3.8.10 (A4/3.6.11) *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. 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 marker.*

3.8.11 Additional EBLs meeting the above requirements may be provided, in which case separate identifiable readouts shall be provided. These may be centred on own ship or off-centred.

3.8.12 (A4/3.6.10) *A minimum of two independent lines or sets of parallel index lines shall be provided, independent of, and clearly distinguishable from, an EBL. They shall also be clearly distinguishable from map lines. They shall be fully adjustable independently in both range and bearing, with accuracy defined according to 3.6.3 and 3.8.2.*

3.9 (A4/3.7) Discrimination

3.9.1 (A4/3.7.1) Range

The equipment shall be capable of displaying as separate indications on a range scale of 1,5 nautical miles or less two small similar (10 m²) targets, in the absence of clutter at a range of between 50 % and 100 % of the range scale and on the same bearing, separated by not more than 40 m in range.

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

3.9.2 (A4/3.7.2) Bearing

The equipment shall be capable of displaying as separate indications two small similar (10 m²) targets both situated at the same range between 50 % and 100 % of the 1,5 nautical mile range scale, and separated by not more than 2,5° in bearing.

3.9.3 Side-lobes

The picture quality shall not be adversely affected by side-lobes.

3.10 (A4/3.8) Roll or pitch

The performance of the equipment shall be such that when the ship is rolling or pitching up to ±10 degrees, the range performance requirements of 3.3 and 3.4 continue to be met.

3.11 (A4/3.9) Antenna scan

The scan shall be clockwise, continuous and automatic through 360 degrees of azimuth. The antenna rotation rate shall be not less than 20 rpm. The equipment shall start and operate satisfactorily in relative wind speeds of up to 100 knots. Alternative methods of scanning are permitted provided that the performance is not inferior.

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

3.12 (A4/3.10) Azimuth stabilisation

3.12.1 (A4/3.10.1) *Means shall be provided to enable the display to be stabilised in azimuth by a gyrocompass, or its equivalent in performance. The accuracy of alignment with the compass transmission shall be within 0,5 degrees with a compass rotation rate of 2 rpm (12°/s).*

3.12.2 (A4/3.10.2) *The equipment shall operate satisfactorily in the head-up unstabilised mode when the azimuth stabilisation is inoperative. An alarm shall be given within 5 s of this failure.*

3.12.2.1 The display shall revert to head-up mode after approximately 1 min of azimuth stabilisation becoming inoperative.

3.12.2.2 Any functional limitations shall be explained in the documentation.

3.12.3 Head-up (unstabilised) and North-up (stabilised) display modes shall be provided. Additionally, a course-up (stabilised) display mode may be provided, in which case the bearing scale shall be true and referenced to the course when the mode is selected.

3.12.3.1 There shall be a positive indication of the display mode in use.

3.12.4 (A4/3.10.3) *The changeover from one display mode to the other shall be possible within 5 s and shall achieve the required bearing accuracy.*

3.13 (A4/3.11) Performance monitoring

3.13.1 (A4/3.11) *Means shall be available, while the equipment is used operationally, to determine readily a significant drop in system performance relative to a calibration standard established at the time of installation. A significant drop in performance shall be an overall reduction of 10 dB or more.*

3.13.2 (A4/3.11) *Separate means shall be provided to check that the equipment is correctly tuned in the absence of targets.*

3.14 (A4/3.12) Anti-clutter devices

3.14.1 (A4/3.12.1) *Suitable means shall be provided for the suppression of unwanted echoes from sea clutter, rain and other forms of precipitation, clouds and sandstorms and from other radars. It shall be possible to adjust manually and continuously the anti-clutter controls. In addition, automatic anti-clutter controls may be provided; however, they shall be capable of being switched off.*

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

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

- a) if they operate by linear movement, they shall be inoperative in the fully left or down position; or
- b) 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.

3.14.3 (A4/3.12.2) *The operational requirement, when the radar antenna is mounted at a height of 15 m above sea level, is that the equipment shall, even in the presence of sea clutter, give a clear indication of a standard reflector up to 3,5 nautical miles.*

3.15 (A4/3.13) Operation

3.15.1 (A4/3.13.1) Availability

3.15.1.1 *After switching on from cold, the equipment shall become ready to be fully operational within 4 min.*

3.15.1.2 *A standby condition shall be provided from which the equipment can be brought to an operational condition within 15 s.*

3.15.2 (A4/3.13.2) Controls

Operational controls shall be accessible and easy to identify and use. Controls shall be identified (see annex B) and easy to operate. (See IEC 60945).

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

It shall be possible to vary the brilliance of the fixed range rings and the variable range markers and electronic bearing lines and to remove them independently and completely from the display.

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

3.16 (A4/3.14) Operation with radar beacons and SARTs

3.16.1 (A4/3.14.1) *Radars shall be able to detect and display signals from radar beacons and 9 GHz (X-band) radars shall also be able to detect and display signals from SARTs.*

3.16.2 (A4/3.14.2) *All radars operating in the 9 GHz band shall be capable of operating in a horizontally polarised mode. If other polarisation modes are available there shall be a positive indication of their use on the display.*

3.16.3 (A4/3.14.3) *It shall be possible to switch off those signal-processing facilities, which might prevent a radar beacon or SART from being shown on the radar display.*

3.16.4 *The operator section of the documentation provided by the manufacturer shall include instructions, based on IMO SN/Circular 197, that describe the optimum setting of the radar controls to observe a SART.*

3.17 (A4/3.15) Display modes

3.17.1 (A4/3.15.1) *The equipment shall be capable of operating in both relative and true motion. In true motion mode, when own ship reaches the offset limit, the display shall automatically reset to the offset limit on the reciprocal heading. Manual resetting shall be provided. The true motion mode shall be available on all range scales between 0,75 nautical miles to 24 nautical miles.*

3.17.2 (A4/3.15.2) *The radar origin shall be capable of being offset to at least 50 % and not more than 75 % of the radius of the display.*

3.17.3 (A4/3.15.3) *The radar shall be capable of sea and ground stabilisation. With sea or ground stabilisation the accuracy and discrimination of the display shall be at least equivalent to that required by this performance standard.*

3.17.4 (A4/3.15.4) *Speed and distance measuring equipment (SDME) providing the ship's speed through the water to the radar shall be capable of providing the speed in the fore and aft direction (in the ahead direction).*

3.17.5 (A4/3.15.5) *The ground-stabilised input shall be two-dimensional. It may be provided from the SDME, where a two-dimensional SDME is fitted, from an electronic position-fixing system, or from radar tracked stationary targets. The speed accuracy shall be in accordance with the requirements of A.824 and IEC 61023.*

3.17.6 (A4/3.15.6) *The speed (3.17.4, 3.17.5 or 3.17.7), type of input (3.17.5) and stabilisation (3.17.3) in use shall be displayed. For compatibility purposes, data used and displayed shall be matching combinations of: SOG/COG or HDG/SPD in the ahead direction.*

3.17.7 (A4/3.15.7) *It shall also be possible to input the ship's speed manually from 0 (zero) knots to 30 knots in steps of not more than 0,2 knots.*

3.17.8 (A4/3.15.8) *Provision shall be made for manual input of set and drift. An indication that this provision is applied shall be given. The values shall be accessible.*

3.18 (A4/3.16) Interference from 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.

3.19 (A4/3.17) Radar installation

The radar installation, including the antenna, shall be in such a manner that the performance of the radar system is not substantially impaired. Guidance on installation shall be given in the manufacturer's documentation.

3.20 (A4/3.18) Failure warnings (alarms) and status indications

3.20.1 *If there is any detectable reason why the information presented to the operator is invalid, an adequate and clear alarm (warning) shall be given to the operator. As a minimum, clear alarms shall be given to the operator, indicating input failure of:*

- a) azimuth;
- b) heading line;
- c) trigger;
- d) compass;
- e) SDME;
- f) electronic position-fixing system (EPFS); or invalid;
- g) radar video.

Picture freeze-up (screen data not refreshed) shall not occur when any of the seven events in 3.20.1 occur or when any other additional input to the radar system fails.

3.20.2 *A fault which prevents the update of a radar picture shall clear the radar display area, and an appropriate alarm shall be given.*

3.20.3 *Functions and data that depend on a failed sensor or signal shall be indicated or inhibited.*

3.20.4 *If the radar is installed as part of an integrated system (see IEC 61209), containing a centralised alarm capability, suitable interfaces¹⁾ (see IEC 61162), if not internal, shall be provided so that the audio alarm can be suppressed remotely whilst the visual indication remains on the radar (see also 3.22.2).*

3.20.5 *Failure alarms shall be displayed in the order of occurrence. The acknowledgement shall only acknowledge each alarm in order.*

¹⁾ Output: Radar status (Operational/failed) IEC 61162 – ALR.

Input: Suppress local 'audible' alarm for radar status only IEC 61162 – ACK.

3.21 (A4/4) Multiple radar installations

3.21.1 (A4/4.1) *Where two radars are required to be carried they shall be so installed that each radar can be operated individually and both can be operated simultaneously without being dependent upon one another. There shall be an indication of the radar and frequency band selected.*

3.21.2 (A4/4.1) *When an emergency source of electrical power is provided in accordance with the appropriate requirements of chapter II-1 of the 1974 SOLAS Convention, both radars shall be capable of being operated from this source.*

3.21.3 (A4/4.2) *Where two radars, or more, are fitted, inter-switching facilities may be provided to improve the flexibility and availability of the overall radar installation.*

3.21.4 (A4/4.2) *They shall be so installed that failure of either radar will not cause the other radar to be adversely affected.*

3.22 (A4/5) Interface

3.22.1 (A4/5.1) *The radar system shall be capable of receiving information from equipment such as gyrocompass, speed and distance measurement equipment (SDME) and electronic position-fixing systems (EPFS) in accordance with international standards (see IEC 61162). The source of received information shall be capable of being displayed. Additional other suitable interfaces are permitted.*

3.22.2 (A4/5.2) *The radar shall provide an indication when any input from an external sensor is absent or invalid. The radar shall also repeat any alarms or status messages concerning the quality of the input data from its external sensors.*

3.22.3 (A4/5.3) *If any radar serial outputs are provided they shall be in accordance with international standards (see IEC 61162).*

3.22.4 *If no suitable IEC 61162 interface is available, another appropriate interface may be used.*

3.22.5 *The equipment shall be capable of providing a dedicated buffered output for screen video (see IMO A.861 and IEC 61996) and associated synchronisation signals. A description of the output shall be given in the manufacturer's documentation.*

3.22.6 *An optional "dead-man's handle" output port facility is permitted as long as such a facility does not affect radar performance.*

3.22.7 *An interface conforming to IEC 61162-3, for input of data for the display of AIS symbology may be provided.*

3.23 (A4/6) Navigational information

The radar display shall be capable of presenting in graphical form, positions, navigational lines and maps, in addition to the radar information (see annex C). It shall be possible to adjust these points, lines and maps relative to a geographical reference. The source of the graphical information and the method of geographical referencing shall be clearly indicated.

Navigation information affected by azimuth stabilisation shall be suppressed after approximately 1 min of the in-use stabilisation sensor becoming inoperative.

3.24 (A4/7) Plotting

Plotting facilities selected from the three possible options shall be provided with the radar as follows:

3.24.1 (A4/7.1) *Ships which are fitted with an electronic plotting aid shall be fitted with an "electronic plotting aid" for manual direct plotting as defined in IEC 60872-3.*

3.24.2 (A4/7.2) *Ships, which are fitted with an auto tracking aid, shall be fitted with an "auto tracking aid" as defined in IEC 60872-2.*

3.24.3 (A4/7.3) *Ships, which are fitted with an automatic radar plotting aid (ARPA), shall be fitted with ARPA with a minimum effective diameter of 250 mm as defined in resolution A.823 and in IEC 60872-1. The second radar shall be fitted with at least an "auto tracking aid".*

3.24.4 (A4/7.4) *Ships of 10 000 gross tonnage and more shall be fitted with ARPAs with a minimum effective diameter of 340 mm as defined in resolution A.823 and in IEC 60872-1.*

3.24.5 (A4/7.5) Target trails

It shall be possible to display the trails by the radar echoes of targets in the form of synthetic afterglow. The trails may be either relative or true. In true motion the trails shall be true. The true trails may be sea or ground stabilised. The trails shall be distinguishable from the targets and shall be capable of being switched off. The length of the trails may be user adjustable and be capable of being reset.

3.25 Standard names – abbreviations and symbols

The standard names, abbreviations and symbols for marine radars, defined in annex B, where appropriate, shall be used.

3.26 (A4/8) Ergonomics

3.26.1 (A4/8.1) *For the purposes of this standard the following functions, shall be directly accessible and immediately effected:*

- | | |
|--|---|
| – On/off switch | – Gain |
| – Standby | – Presentation mode |
| – Monitor brilliance | – Anti-clutter sea |
| – Contrast (where provided and where applicable) | – Variable range marker |
| – Tuning (if manual) | – Marker (cursor) |
| – Range selection | – Acknowledge alarm (where provided) |
| – Anti-clutter rain | – Vector true / relative (where provided) |
| – Electronic bearing line | – Pulse length (where provided) |
| – Dimmer for panel illumination (where applicable) | |

Inappropriate pulse lengths shall be either inhibited or clearly indicated.

These functions may be executed by:

- dedicated controls;
- primary access in an associated menu;
- alternative solutions which meet the functional requirements.

3.26.2 (A4/8.2) *The following functions, shall be continuously variable or in small, quasi-analogue steps:*

- Monitor brilliance
- Tuning (if manual)
- Anti-clutter rain
- Electronic bearing line
- Anti-clutter sea
- Variable range marker
- Marker (cursor)
- Gain

3.26.3 (A4/8.3) *The settings of the following functions shall be readable in all light conditions:*

- Dimmer for panel illumination (where applicable)
- Gain
- Anti-clutter sea
- Tuning (if manual)
- Anti-clutter rain
- Monitor brilliance

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

3.26.4 (A4/8.4) *For the following functions, additional automatic adjustment may be provided. The use of the automatic mode shall be indicated to the operator and be capable of being switched off:*

- Monitor brilliance
- Anti-clutter rain
- Gain
- Anti-clutter sea

3.26.5 (A4/8.5) If discrete controls are available for the EBL and VRM they shall be situated on the left and right hand side respectively.

3.26.6 Display of information

A clear and logical arrangement of data-fields shall be provided. Temporary overlaying of the data fields is permitted.

3.27 Safety precautions

3.27.1 Radiation from the antenna shall be possible only when the beam is scanning, except that override facilities may be provided for maintenance purposes. 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.

3.27.2 Means shall be provided to prevent scanner rotation for maintenance and other purposes.

4 Methods of testing and required test results

This clause defines the type test methods and results required to ensure that equipment complies with the requirements of clause 3.

4.1 General conditions of measurement and definitions

All the general requirements of IEC 60945 shall be carried out on the sample equipment under test (EUT) to verify whether the EUT meets these technical requirements. The equipment shall comply with those requirements of IEC 60945 appropriate to its category, i.e. "protected" (from the weather) or "exposed" (to the weather).

The manufacturer shall declare which equipment or units are "protected" or "exposed". 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.

For the purposes of this standard the following definitions shall apply:

- a) **Performance check:** reconfiguration of the EUT and checking by non-quantitative visual checks that the system is still operative for the purposes of IEC 60945 (see annex E). This shall include the operation of the gain, tune, clutter, EBL, VRM and plotting facilities to confirm normal operation.
- b) **Performance test:** for radar EUT, shall be identical to the performance check for the purposes of IEC 60945, with the addition of the display test specified in 4.5 (see annex E).
- c) **By inspection:** a visual check of the equipment or documentation.
- d) **Clear indication or visibility of test targets:** visible for at least 50 % of the antenna scans with any afterglow or trails facility switched off.
- e) **Standard operating mode:** in the operational condition defined in 3.15.1.2, and in the true motion display mode described in 3.17.1. A manual or simulated log forward speed of 10 knots shall be applied, unless otherwise specified in the test clause.

4.1.1 Test site

Tests will normally be carried out at test sites selected by the type test authority that can present an over water test range containing the test targets and features needed for the specified tests. The manufacturer shall, unless otherwise agreed, set up the equipment and ensure that it is operating normally before type testing commences.

4.1.2 Height of radar antenna

During all appropriate tests, the radar antenna shall be mounted at a height of about 15 m above the surface of the water.

4.1.3 Test targets for range performance

Unless otherwise specified, the effective echoing area of test targets and the target distances and heights used to determine conformity with this standard, shall be referred to a point source target presenting an effective echoing area of 10 m² at the relevant frequency, at a height of 3,5 m, and at a distance of 2 nautical miles, by the method described in annex A.

4.1.4 Sea state

Range performance measurements shall be conducted using a test target in a calm sea (sea state 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.

4.1.5 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 otherwise specified.

4.2 Power supply, cabling distances and technical information

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

4.2.1 Sub-system separation

4.2.1.1 When equipment with separate transmitter and antenna is tested in accordance with this standard, the transmitter / receiver shall be connected to the antenna by 20 m of feeder.

The display shall be connected to other units by 65 m of cable. Where an equipment, in which the transmitter and receiver are always installed within the antenna / pedestal combination, is type tested, the 20 m of antenna feeder shall be omitted. Where necessary the manufacturer shall supply the appropriate cable and antenna feeder.

4.2.1.2 The manufacturer or his representative may propose for consideration by the testing authority 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 distance requested and tested shall be recorded in the test report.

4.2.2 Technical information

4.2.2.1 (3.2) Adequate information shall be provided to enable the equipment to be properly set up, maintained and operated during the type testing.

4.2.2.2 (3.2.1) The installation section of the manufacturer's manual shall be examined to ensure that it contains adequate information to comply with this standard.

4.2.2.3 (3.2.2) By examination of the certification issued to the manufacturer.

4.3 (3.3) Range performance

4.3.1 Method of measurement – Coastlines and surface objects

A test target as specified in 4.1.3 and at a minimum distance of 2,0 nautical miles shall be used as a control for this test. The tune, gain and clutter controls of the radar shall be set such that the reference target paints between 8 out of 10 radar scans and 10 out of 10 radar scans.

Then, as far as is practicable, coastlines and ships shall be observed during the tests, to confirm the detection and display of objects described in 3.3.

4.3.1.1 Results required

The equipment shall give a clear indication of the test target.

Where objects described in 3.3 are included in the test, they shall be clearly indicated on the radar display.

4.3.2 Method of measurement – Excess performance

This method of measurement is only required if the method of measurement according to 4.10.2 is used for roll and pitch performance. The test target used in 4.3.1 shall be used for this test. The tune, gain and clutter controls of the radar shall not be adjusted from that set above. A variable attenuator shall be inserted in the antenna feed. The attenuation applied shall be gradually increased until the test target paints 5 out of 10 radar scans.

4.3.2.1 Results required

The excess performance in dB measured shall be recorded in the test report for later use in the roll and pitch performance test of 4.10.3.

4.4 (3.4) Minimum range

4.4.1 Method of measurement

With the radar adjusted within its specification in such a way that a test target at approximately 1 nautical mile is clearly visible, a second test target shall be moved to approach the radar antenna. The range at which the second test target ceases to be presented separately from the antenna position on the display shall be recorded.

For this measurement the range selector and the sea and gain control only may be adjusted and, after adjustment, a test target shall be visible at the minimum range and at 1 nautical mile with the same setting of the sea control.

4.4.2 Results required

The minimum range shall be not greater than 50 m measured horizontally. The distance measured shall be recorded in the test report.

4.5 (3.5) Display

4.5.1 (3.5.1) Method of measurement

The effective diameter of the display area shall be determined by linear measurement with a rigid ruler, and range scales and number of range rings provided on each scale shall be examined by visual inspection, while the equipment is operating.

4.5.2 Results required

The effective display diameter shall conform to the requirements of 3.5.1.

4.5.3 (3.5.2 - 3.5.8 / 3.5.11) Method of measurement

The requirements shall be checked by inspection during operation of the equipment.

4.5.4 Results required

The equipment shall comply with the requirements of 3.5.2, 3.5.3, 3.5.4, 3.5.5, 3.5.6, 3.5.7, 3.5.8 and 3.5.10.