INTERNATIONAL STANDARD

IEC 60936-2

First edition
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**Maritime navigation and radiocommunication equipment and systems –
Radar –**

**Part 2:
Shipborne radar for high-speed craft (HSC) –
Methods of testing and required test results**

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MARITIME NAVIGATION AND RADIOCOMMUNICATION EQUIPMENT AND SYSTEMS – RADAR –

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FOREWORD

1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, the IEC publishes International Standards. Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. The IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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International Standard IEC 60936-2 has been prepared by IEC technical committee 80: Maritime navigation and radiocommunication equipment and systems. The IEC 60936 series, of which this is part 2, replaces IEC 60936 published in 1988, in order to reflect the new requirements of the International Maritime Organisation (IMO). This part of the series contains some of the specific requirements.

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

FDIS	Report on voting
80/193/FDIS	80/210/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.

Annexes A, B, C, D and E form an integral part of this standard.

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

MARITIME NAVIGATION AND RADIOCOMMUNICATION EQUIPMENT AND SYSTEMS – RADAR –

Part 2: Shipborne radar for high-speed craft (HSC) – Methods of testing and required test results

1 Scope

This International Standard specifies the minimum operational and performance requirements, methods of testing and required test results as required by IMO resolution A.820 and Chapter X of the high-speed craft (HSC) code. It complies with the requirements of 13.13 of the HSC code and incorporates applicable parts of 13.5 of the HSC code on radar installations. In addition it takes account of IMO resolution A.694 and is associated with IEC 60945. When a requirement in this standard is different from IEC 60945, the requirement in this standard takes precedence.

The HSC scenarios, as defined in annex D, apply to equipment intended for use on high-speed craft and to equipment which is tested to IEC 60872-1 and IEC 60872-2 and also intended for use on high-speed craft.

All texts of this standard, whose wording is identical to that in IMO resolution A.820 are printed in *italics* and the resolution and paragraph numbers are indicated in brackets.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of IEC 60936. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and 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. Members of IEC and ISO maintain registers of currently valid International Standards.

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

IEC 60872-2, —, *Maritime navigation and radiocommunication equipment and systems – Radar plotting aids – Part 2: Automatic tracking aids (ATA) – Methods of testing and required test results* [1)]

IEC 60872-3, —, *Maritime navigation and radiocommunication equipment and systems – Radar plotting aids – Part 3: Electronic plotting aids (EPA) – Methods of testing and required test results* [1)]

IEC 60936-1, —, *Maritime navigation and radiocommunication equipment and systems – Radar – Part 1: Shipborne radar – 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*

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1) To be published.

IEC 61162:—, *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 standards, methods of testing and required test results*

ISO 9000, *Quality management and quality assurance standards*

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

IMO A.820:1995, *Performance standards for navigational radar equipment for high speed craft*

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

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

IMO MSC.36 (63):1994, *International code of safety for high-speed craft (HSC)*

IMO MSC SN/Circular 197, *Operation of marine radar for search and rescue radar transponder (SART) detection*

IMO:1992, *Convention for Safety of Life at Sea (SOLAS), as amended*

ITU:1997, *Radio regulations*

IHO S-52:1994, *Specifications for chart content and display aspects of ECDIS*

3 Performance requirements

The radio frequency of operation of the equipment and its characteristics shall at all times be within the limits defined in the ITU Radio regulations. In particular, compliance with those limits is defined in IEC 60936-1.

3.1 (A.820/1) Introduction

3.1.1 (A.820/1.1) *The radar equipment is intended for installation in craft with the following characteristics:*

.1 *A maximum speed of* up to *70 knots;*

.2 *A maximum rate of turn* up to *20°/s; and*

.3 *normally operate between latitudes 70° N and 70° S.*

3.1.2 (A.820/1.2) *In addition to the general requirements contained in resolution A.694*:1991 *the radar equipment* shall *comply with the following minimum performance requirements.*

3.2 (A.820/2) General

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

3.2.1 Equipment shall be installed in such a manner that it is capable of meeting its recommended performance standards.

3.2.2 The operator manual for the radar shall include precautions in the use of the radar under certain combinations of conditions with regard to not performing to specification i.e. picture smearing and target tracking loss when at high speed close to targets.

3.2.3 Quality assurance

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

3.3 (A.820/3) Range performance

The operational requirement, where the radar antenna is mounted 7,5 m above sea level, is that the equipment shall *give a clear indication of surface objects such as a navigational buoy*, with a radar reflector height of 3,5 m, *having an effective echoing area of approximately 10 m^2 at 2,5 nautical miles in the absence of clutter.*

3.4 (A.820/4) Minimum range

The surface objects specified in 3.3 shall *be clearly displayed from a minimum range of 35 m up to a range of one 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 (A.820/5) Display

3.5.1 (A.820/5.1) *The equipment* shall *without external magnification provide a multi-colour daylight display with an effective radar picture diameter of not less than 250 mm.*

3.5.1.1 Target echoes shall be displayed by means of the same basic colours and the echo strength shall not be displayed in different colours.

3.5.1.2 Additional information may be shown in different colours.

3.5.2 (A.820/5.2) *Day and night colours* shall *be provided. It* shall *be possible to adjust brightness.*

3.5.2.1 The radar picture and information shall be readable under all ambient light conditions. If a light shield is necessary to facilitate operation of the display in high ambient levels, then means shall be provided for its ready attachment and removal.

3.5.3 (A.820/5.3) *The equipment* shall *provide the following set of range scales of display:*

0,25; 0,5; 0,75; 1,5; 3; 6; 12; 24 nautical miles.

3.5.4 (A.820/5.4) *Additional range scales may be provided.* These additional range scales shall be either smaller than 0,25 nautical miles or greater than 24 nautical miles.

3.5.5 (A.820/5.5) *The range scale displayed and, when in use, the distance between range rings* shall *be clearly indicated*.

3.5.6 (A.820/5.6) *Off-centre facilities* shall *be provided of* up to *at least a minimum of 50 % and not more than 75 % of range scale in use.*

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

3.5.8 (64 (67)/Annex 4/3.3.5) *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.*

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

3.6 (A.820/6) Range measurement

3.6.1 (A.820/6.1) *Fixed electronic range rings* equally spaced from the origin shall *be provided for range measurements as follows:*

.1 on the range scales of 0,25, 0,5 and 0,75 nautical miles at least two range rings; and

.2 on all other range scales six range rings shall *be provided.*

Any number of range rings are allowed on the voluntary additional range scales. When off-centred facilities are used, additional rings shall be provided at the same range intervals as on the mandatory range scales (see 3.5.3).

3.6.2 (A.820/6.2) *A variable electronic range marker* (VRM) shall *be provided with a numeric readout of range.*

It shall be possible to position a range marker, on any range scale, at any range, within 5 s of operation. The readout shall not display other data. 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, read-outs shall be provided.

3.6.3 (A.820/6.3) *The fixed range rings and the variable range marker* 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 the greater.*

The accuracy of range rings and range marker shall be maintained when the display is off-centred.

3.6.4 (A.820/6.4) *It* shall *be possible to vary the brilliance of the fixed range rings and the variable* range *marker and to remove them* independently and *completely from the display*.

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

3.7 (A.820/7) Heading indicator (heading line)

3.7.1 (A.820/7.1) *The heading of the craft* shall *be indicated by a* continuous *line on the display with a maximum error not greater than ±1°. The thickness of the display heading* shall *not be greater than 0,5° measured at maximum range at the edge of the screen*, when the display is centred. The heading line shall extend from the own ship's position to the edge of the display. A bearing scale shall be provided to give an indication of the heading in all display modes. It shall have an accuracy of ±1° when centred. The radar picture shall be within this scale.

3.7.2 (A.820/7.2) *Provision* shall *be made to switch off the heading indicator* (heading line) *by a device which cannot be left in the "heading marker off"* (heading line off) *position.*

3.7.3 A heading marker shall be displayed on the bearing scale by a mark.

3.8 (A.820/8) Bearing measurement

3.8.1 (A.820/8.1) *Provision* shall *be made to obtain quickly the bearing of any object whose echo appears on the display.* An electronic bearing line (EBL) shall be positioned and give a numeric readout within 5 s.

3.8.2 (A.820/8.2) *The means provided for obtaining bearing* shall *enable the bearing of a target whose echo appears at the edge of the display to be measured with* a radar system, excluding sensor errors, *accuracy of ±1° or better.*

3.8.3 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 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 The rotation of the EBL shall be possible in both directions continuously or in steps of not more than 0,2°.

3.8.6 The numeric readout of the bearing of the EBL shall be displayed with at least 4 digits including one after the decimal point. The EBL readout shall not be used to display any other data. There shall be a positive identification of whether the bearing indicated is a relative or true bearing.

3.8.7 A bearing scale around the edge of the display shall be provided. Linear or non-linear bearing scales may be provided.

3.8.8 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 It shall be possible to measure the bearing relative to the heading line and relative to North.

3.8.10 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 readout shall be provided. These may be centred on own ship or off-centred.

3.8.12 (A.820/8.3) *A minimum* of *two lines for parallel indexing* shall *be provided,* independent of, and clearly distinguishable from, an EBL, and they shall be clearly distinguishable from map lines. They shall be fully adjustable independently in both range and bearing with an accuracy defined in 3.6.3 and 3.8.2.

3.9 (A.820/9) Discrimination

3.9.1 (A.820/9.1) *The equipment* shall *be capable of displaying as separate indications on a range scale of* 1 nautical mile or less, that is, on the 0,75 nautical mile range scale, *in the absence of sea clutter, two 10 m² targets at a range of between 50 % and 100 % of the range scale in use, and on the same azimuth, separated by not more than 35 m in range.*

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

3.9.2 (A.820/9.2) *The equipment* shall *be capable of displaying as separate indications two* stationary *(10 m²) targets both situated at the same range between 50 % and 100 % of 1 mile range, on the 1,5 mile range scale and separated by not more than 2,5° for X band radars and 4° for S band radars.*

NOTE – 9 200 MHz to 9 500 MHz (X-Band) and 2 900 MHz to 3 100 MHz (S-Band).

3.9.3 Side-lobes

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

3.10 (A.820/10) Roll or pitch

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

3.11 (A.820/11) Antenna scan

The scan shall *be clockwise, continuous and automatic through 360° of azimuth. The scan rate* shall *not be less than 40 revolutions per minute. 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 of blanking shall be clearly indicated on the display.

3.12 (A.820/12) Azimuth stabilization

3.12.1 (A.820/12.1) *Means* shall *be provided to enable the display to be stabilized in azimuth by an approved directional sensor. The equipment* shall be *provided with an approved directional sensor input to enable it to be stabilized in azimuth. The accuracy of alignment with the approved directional sensor transmission* shall *be within 0,5° with a rate of turn of 20°/s.*

3.12.2 (A.820/12.2) *The equipment* shall *operate satisfactorily in the unstabilized mode when the main approved directional sensor is inoperative.*

3.12.2.1 The equipment shall operate satisfactorily in the head-up unstabilized mode when the azimuth stabilization is inoperative.

3.12.2.2 The display shall revert to head-up mode after 1 min of stabilization remaining inoperative. An alarm shall be given within 5 s of this failure.

3.12.2.3 Any functional limitation shall be explained in the documentation.

3.12.3 The change over from one display mode to the other shall be possible within 5 s and shall achieve the required bearing accuracy.

3.13 (A.820/13) Performance monitor check

Means shall *be available, while the equipment is used operationally, to determine readily a significant drop in performance relative to calibration standard established at the time of installation, and* separate means shall be provided to check *that the equipment is correctly tuned in the absence of targets*. A significant drop in performance shall be an overall reduction of 10 dB or more.

3.14 (A.820/14) Anti-clutter devices

Suitable means shall *be provided for the suppression of unwanted echoes, i.e. from sea clutter, rain and other forms of precipitation, clouds and sandstorms. It* shall *be possible to adjust manually and continuously the anti-clutter controls*. Anti-clutter controls shall be inoperative in the fully anti-clockwise position. In addition, automatic anti-clutter controls may be provided; however, they must be capable of being switched off.

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 is acceptable on condition that:

.1 if they operate by linear movement they shall be inoperative in the fully left or down position; or

.2 if they operate by a pair of push buttons it shall be operation of the left or lower button which shall render the device inoperative.

An indication of the operative conditions of the anti-clutter controls shall be provided.

3.15 (A.820/15) Operation

3.15.1 (A.820/15.1) *The equipment* shall *be capable of being switched on and operated from the place at which the navigator normally operates the high speed craft.*

3.15.2 (A.820/15.2) *Operator controls* shall *be accessible and easy to identify* (see annex B) *and use.* The controls shall be identified in English by the relevant name or abbreviation given in annex B. *Where symbols are used* additionally *they* shall *comply with the recommendation of the Organization on symbols for control on marine navigational radar equipment.*

3.15.3 (A.820/15.3) *After switching from cold, the system* shall *be operational within 4 min.*

3.15.4 (A.820/15.4) *A standby condition* shall *be provided from which the equipment can be brought to an operational condition within 15 s.*

3.16 (A.820/16) Interference from external magnetic fields

After installation and adjustment on board, the bearing accuracy as prescribed in these performance standards shall *be maintained without further adjustment irrespective of the movement of the craft 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 equivalent technique, to reduce the observable effect of external magnetic fields.

3.17 (A.820/17) Display modes

3.17.1 (A.820/17.1) *The equipment* shall *be capable of operating both in relative and true motion.*

In true motion mode, when own ship reaches the offset limits, the display shall automatically reset to the offset limit on the reciprocal heading. Manual resetting shall be provided. In order to standardize the motion modes of operation the names TM, RM(T) and RM(R) are to be used (see B.4.9).

3.17.2 (A.820/17.2) *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 (A.820/17.3) *Where sea or ground stabilization is provided, the accuracy and discrimination of the display* shall *be at least equivalent to that required by these performance standards.*

3.17.4 Speed and distance measuring equipment (SDME) providing the craft'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 The ground-stabilized 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 resolution A.824.

3.17.6 The type of input (3.17.5) and stabilization (3.17.3) in use shall be displayed.

3.17.7 It shall also be possible to input the craft's speed manually from 0 (zero) to 70 knots in steps of not more than 0,5 knots.

3.18 (A.820/18) Antenna system

3.18.1 (A.820/18.1) *The design of the antenna system* shall *enable it to be installed in such a manner that the operational efficiency of the radar system as a whole is not substantially impaired.*

3.18.2 (A.820/18.2) *The antenna system* shall *be so designed to withstand the forces expected to be experienced by such craft.*

3.19 (A.820/19) Operation with radar beacons and SARTs

3.19.1 (A.820/19.1) *All radars operating in the 3 cm band* shall *be capable of operating in a horizontally polarized mode.*

The radar shall be able to detect and display signals from radar beacons and 9 GHz (X-BAND) radars and shall also be able to detect and display signals from SART's.