



ST. VINCENT AND THE GRENADINES

MARITIME ADMINISTRATION

CIRCULAR N° SOL 027

RADAR PERFORMANCE STANDARDS

**TO: SHIPOWNERS & SHIPS' OPERATORS & MANAGERS
SURVEYORS TO FLAG STATE ADMINISTRATION
CLASSIFICATION SOCIETIES**

APPLICABLE TO: All ships required to be equipped with the radar
ENTRY INTO FORCE: 1st July, 2008

Monaco, 14th July, 2008.

IMO Resolution MSC.192(79) concerning the revised performance standards for radar equipment. These standards are applicable to all radars installed on boards the vessels on or after 01st July 2008.

Considering the prevailing circumstances and the situation that a very few manufacturers' of radar equipment has been "type approved" to the new performance standard so far, the Administration will allow the installation of radar equipment which meets the requirements of MSC.64 (67), Annex 4, until 01st October 2008 provided that the vessel's owner or operator provides confirmation from the radar manufacturer stating that the radar equipment meeting the MSC.192(79) resolution is not available for installation.

Operators who intend to install radar(s) meeting the performance standards in MSC.64(67), Annex 4, on or after 01st July 2008 are strongly recommended to liaise with the radar manufacturer in order to develop possibility to upgrade that equipment in compliance with MSC.192(79).

We hereby highlight the importance of IMO SN.1/Circ.271 dated 22 May 2008 concerning the guidelines for the installation of shipborne radar equipment which is attached to this circular.

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GUIDELINES FOR THE INSTALLATION OF SHIPBORNE RADAR EQUIPMENT

1 The Maritime Safety Committee, at its eighty-fourth session (7 to 16 May 2008), with a view to improving the safety of navigation, approved the circulation of the attached Guidelines for the installation of shipborne radar equipment.

2 Member Governments are invited to bring the information to the attention of all parties concerned.

ANNEX

GUIDELINES FOR THE INSTALLATION OF A SHIPBORNE RADAR

1 General

Information provided by radar is of vital importance for navigators and the safe navigation of ships.

Special care should be taken to ensure the correct installation of the radar, in order to improve the performance of the radar system.

This document contains guidelines for owners, ship designers, manufacturers, installers, yards, suppliers and ship surveyors. It does not replace documentation supplied by the manufacturer.

2 Application

These guidelines apply to all shipborne radar installations mandated by the 1974 SOLAS Convention, as amended. The guidelines take into account resolution MSC.192(79) on Adoption of the revised performance standard for radar equipment.

3 Definitions

- (a) CCRP: Consistent Common Reference Point: A location on own ship, to which all horizontal measurements such as target range, bearing, relative course, relative speed, closest point of approach (CPA) or time to closest point of approach (TCPA) are referenced, typically the conning position of the bridge.
- (b) OOW: Officer of the Watch.

4 Survey

Surveys on Convention ships should be carried out in accordance with the rules laid down in resolution A.948(23) – Revised Survey Guidelines under the harmonized system of survey and certification, and – Protocol of 1988 relating to the International Convention for the Safety of Life at Sea, 1974, as amended.

5 Documentation

Prior to the radar installation, the following documentation should be made available and provided to the installer by the shipyard, owner or manufacturer as appropriate:

- (a) Scaled drawing(s) of the ship with views from the port, starboard, fore, aft and from above the vessel on which the radar and other antenna positions are indicated. Any ship structure or cargo that may obstruct or degrade radar performance should also be shown, for example masts, funnels, superstructure and containers. The possible turning and jib range of movable objects like cranes are to be indicated.

- (b) Scaled drawing of the antenna arrangement including the outline drawing for the rotation radius.
- (c) Drawing(s) of the bridge layout showing the position of the radar display unit(s) and additional locations (for example, electronic rooms) for housing radar units.
- (d) Manufacturers documentation describing the installation and interconnection of the radar system, the equipment units including radar frequency band and antenna size, and equipment type and evidence of type approval documentation.
- (e) List of auxiliary equipment connected with the radar system including manufacturer, type with block diagram (interconnection diagram) and evidence of type approval.
- (f) In the case of retrofit installations, a document agreed by the owner, installer and manufacturer stating that the use of original cabling, transmission lines and auxiliary units of the radar equipment may be retained.

6 Radar antenna installation

Correct location of the radar antenna is an important factor of the performance of the radar system. Interference, either by reflecting constructions or other transmitters, may heavily reduce the radar performance by creating blind sectors, clutter on the radar display or generation of false echoes.

6.1 Interference

Due care should be taken with regard to the location of radar antennas relative to other antennas which may cause interference to either equipment. The location of the antenna should comply with the following:

- (a) The radar antenna should be installed safely away from interfering high-power energy sources and other transmitting and receiving radio antennas.
- (b) The lower edge of a radar antenna should be a minimum of 500 mm above any safety rail.
- (c) Radar antennas in close proximity should have a minimum vertical elevation separation angle of 20° and a minimum vertical separation of 1 m where possible.

6.2 Location relative to masts, funnels and other constructions

Due care should be taken with regard to the location of radar antennas relative to masts, funnels and other constructions.

The location of the antenna should comply with the following:

- (a) The antenna should generally be mounted clear of any structure that may cause signal reflections.

- (b) Ensure that any support or other obstacles are clear of the rotation of the antenna (see specific antenna outline drawing for rotational radius).
- (c) Install antenna and turning unit so that the installation complies with the compass safe distance for the equipment.

6.3 *Blind sectors and range*

To make full benefit from the radar, it is vitally important for the OOW that horizontal and vertical blind sectors for the radar antennae are minimized. The objective is to see the horizon freely through 360° as nearly as possible, noting the requirement of 7.1 below.

For all radar systems and where practical,

- (a) A line of sight from the radar antenna to the bow of the ship should hit the surface of the sea in not more than 500 m or twice the ship length, depending which value is smaller, for all load and trim conditions.
- (b) The radar antenna should be located in an elevated position to permit maximum target visibility.
- (c) Blind sectors should be kept to a minimum, and should not occur in an arc of the horizon from right ahead to 22.5° abaft the beam to either side.

Note: Any two blind sectors separated by 3° or less should be treated as one blind sector.

- (d) Individual blind sectors of more than 5°, or a total arc of blind sectors of more than 20°, should not occur in the remaining arc, excluding the arc in the above subparagraph (c).
- (e) For radar installations with two radar systems, where possible, the antennas should be placed in such a way as to minimize the blind sectors.

6.4 *Lifting radar equipment*

Where special equipment, such as cranes, hoists and jibs are required to install the radar system, consideration should be given to ensure that the radar system(s) are located such that the required equipment can be positioned to facilitate the installation. Radar equipment should be lifted in accordance with the information provided by the manufacturer.

7 General requirements

- (a) All installations should facilitate protection of equipment, including cabling, from damage.
- (b) Safe service access should be provided using service platforms where necessary having a minimum size of 1m² at a suitable height and with a safety rail of suitable height.

- (c) Consideration should be given to the compass safety distance as supplied by the manufacturer when positioning equipment units.
- (d) The design of the mounting platform for the antenna and antenna pedestal should take into account the vibration requirements of resolution A.694(17) and furthermore defined by IEC 60945. In addition to vibration, the design of the mounting platform should consider shock and whiplash due to seagoing conditions.

7.1 Interaction with sea and false echoes

Considerations of interaction with the sea imply that the radar antenna should be only as high as necessary to clear major objects, and as high to be consistent with other requirements regarding acceptable horizon and target detection range. The location of the antenna should minimize sea clutter returns and the-number of multi-path nulls.

7.2 Cables and grounding

The cables and the grounding should comply with the following:

- (a) Cable screens, especially coaxial cable screens, should be installed in accordance with manufacturer's documentation.
- (b) The cables should be kept as short as possible to minimize attenuation of the signal.
- (c) All cables between antenna and radar system units should be routed as directly as possible, consistent with consideration for other equipment, in order to reduce electromagnetic interference effects.
- (d) Cables should not be installed close to high-power lines, such as radar or radio-transmitter lines.
- (e) Crossing of cables should be done at right angles (90°) to minimize magnetic field coupling.
- (f) All outdoor installed connectors should be waterproof by design to protect against water penetration into the cables.
- (g) Cables and microwave transmission lines should not be exposed to sharp bends.
- (h) Cables and microwave transmission lines should be installed with sufficient physical separation, as defined in the manufacturer's documentation.
- (i) Grounding of equipment units should be carried out according to the manufacturer's documentation.

7.3 Power source

The radar should be connected to an emergency power source, as required by SOLAS chapter II-1.

7.4 Radar controls and display

- (a) If the control panel is a separate unit, the functionality of the radar controls should be available for the mariner at all workstations where a radar display is available.
- (b) The orientation of the display unit should be such that the user is looking ahead. The lookout view should not be obscured and the ambient light should cause minimum degradation on the display screen in accordance with MSC/Circ.982.

7.5 Initial installation of radar

Radar systems are functionally integrated with a number of instruments (refer to resolution MSC.192(79), section 8). As various systems are getting increasingly more integrated and complex, correct system settings are very important.

The following documents should be kept on board of the vessel:

- (a) The installation company should sign an installation report that to the best of their knowledge the installation and setup has been carried out according to the manufactures documentation and to these guidelines.
 - (b) Information about possible performance limitations, including blind sectors, due to the radar system installation that may be of vital importance for mariners and should be stated in this documentation.
 - (c) The setup of interfaces and system parameters (including CCRP position offset) should be carried out in accordance with the manufacturer's documentation. This information should be attached as an annex to the installation report noted under paragraph (a) above.
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ANNEX 34

**RESOLUTION MSC.192(79)
(adopted on 6 December 2004)**

**ADOPTION OF THE REVISED PERFORMANCE STANDARDS
FOR RADAR EQUIPMENT**

THE MARITIME SAFETY COMMITTEE,

RECALLING Article 28(b) of the Convention on the International Maritime Organization concerning the functions of the Committee,

RECALLING ALSO resolution A.886(21) by which the Assembly resolved that the functions of adopting performance standards and technical specifications, as well as amendments thereto, shall be performed by the Maritime Safety Committee on behalf of the Organization,

NOTING resolutions A.222(VII), A.278(VIII), A.477(XII), MSC.64(67), annex 4, A.820(19) and A.823(19) containing performance standards applicable to marine radars being produced and installed at different time periods in the past,

NOTING ALSO that marine radars are used in connection/integration with other navigational equipment required to carry on board ships such as, an automatic target tracking aid, ARPA, AIS, ECDIS and others,

RECOGNIZING the need for unification of maritime radar standards in general, and, in particular, for display and presentation of navigation-related information,

HAVING CONSIDERED the recommendation on the revised performance standards for radar equipment made by the Sub-Committee on Safety of Navigation at its fiftieth session,

1. ADOPTS the Revised Recommendation on Performance Standards for radar equipment set out in the Annex to the present resolution;
2. RECOMMENDS Governments to ensure that radar equipment installed on or after 1 July 2008 conform to performance standards not inferior to those set out in the Annex to the present resolution.

ANNEX

**REVISED RECOMMENDATION ON PERFORMANCE STANDARDS
FOR RADAR EQUIPMENT**

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1 SCOPE OF EQUIPMENT

The radar equipment should assist in safe navigation and in avoiding collision by providing an indication, in relation to own ship, of the position of other surface craft, obstructions and hazards, navigation objects and shorelines.

For this purpose, radar should provide the integration and display of radar video, target tracking information, positional data derived from own ship's position (EPFS) and geo referenced data. The integration and display of AIS information should be provided to complement radar. The capability of displaying selected parts of Electronic Navigation Charts and other vector chart information may be provided to aid navigation and for position monitoring.

The radar, combined with other sensor or reported information (e.g. AIS), should improve the safety of navigation by assisting in the efficient navigation of ships and protection of the environment by satisfying the following functional requirements:

- in coastal navigation and harbour approaches, by giving a clear indication of land and other fixed hazards;
- as a means to provide an enhanced traffic image and improved situation awareness;
- in a ship-to-ship mode for aiding collision avoidance of both detected and reported hazards;
- in the detection of small floating and fixed hazards, for collision avoidance and the safety of own ship; and
- in the detection of floating and fixed aids to navigation (see Table 2, note 3).

2 APPLICATION OF THESE STANDARDS

These Performance Standards should apply to all shipborne radar installations, used in any configuration, mandated by the 1974 SOLAS Convention, as amended, independent of the:

- type of ship;
- frequency band in use; and
- type of display,

providing that no special requirements are specified in Table 1 and that additional requirements for specific classes of ships (in accordance with SOLAS chapters V and X) are met.

The radar installation, in addition to meeting the general requirements as set out in resolution A.694(17)*, should comply with the following performance standards.

* IEC Publication 60945.

Close interaction between different navigational equipment and systems, makes it essential to consider these standards in association with other relevant IMO standards.

TABLE 1
Differences in the performance requirements for various sizes/categories of ship/craft to which SOLAS applies

Size of ship/craft	<500 gt	500 gt to <10,000 gt and HSC<10,000 gt	All ships/craft =10,000 gt
Minimum operational display area diameter	180 mm	250 mm	320 mm
Minimum display area	195 x 195 mm	270 x 270 mm	340 x 340 mm
Auto acquisition of targets	-	-	Yes
Minimum <i>acquired</i> radar target capacity	20	30	40
Minimum <i>activated</i> AIS target capacity	20	30	40
Minimum <i>sleeping</i> AIS target capacity	100	150	200
Trial Manoeuvre	-	-	Yes

3 REFERENCES

References are in appendix 1.

4 DEFINITIONS

Definitions are in appendix 2.

5 OPERATIONAL REQUIREMENTS FOR THE RADAR SYSTEM

The design and performance of the radar should be based on user requirements and up-to-date navigational technology. It should provide effective target detection within the safety-relevant environment surrounding own ship and should permit fast and easy situation evaluation.*

5.1 Frequency

5.1.1 *Frequency spectrum*

The radar should transmit within the confines of the ITU allocated bands for maritime radar and meet the requirements of the radio regulations and applicable ITU-R recommendations.

* Refer to MSC/Circ.878 - MEPC/Circ.346 on Interim Guidelines for the application of Human Element Analysing Process (HEAP) to the IMO rule-making process.

5.1.2 Radar Sensor Requirements

Radar systems of both X and S-Bands are covered in these performance standards:

- X-Band (9.2-9.5 GHz) for high discrimination, good sensitivity and tracking performance; and
- S-Band (2.9-3.1 GHz) to ensure that target detection and tracking capabilities are maintained in varying and adverse conditions of fog, rain and sea clutter.

The frequency band in use should be indicated.

5.1.3 Interference susceptibility

The radar should be capable of operating satisfactorily in typical interference conditions.

5.2 Radar Range and Bearing Accuracy

The radar system range and bearing accuracy requirements should be:

- Range** - within 30 m or 1% of the range scale in use, whichever is greater;
- Bearing** - within 1°.

5.3 Detection Performance and Anti-clutter Functions

All available means for the detection of targets should be used.

5.3.1 Detection

5.3.1.1 Detection in Clear Conditions

In the absence of clutter, for long range target and shoreline detection, the requirement for the radar system is based on normal propagation conditions, in the absence of sea clutter, precipitation and evaporation duct, with an antenna height of 15 m above sea level.

Based on:

- an indication of the target in at least 8 out of 10 scans or equivalent; and
- a probability of a radar detection false alarm of 10^{-4} ,

the requirement contained in Table 2 should be met as specified for X-Band and S-Band equipment.

The detection performance should be achieved using the smallest antenna that is supplied with the radar system.

Recognizing the high relative speeds possible between own ship and target, the equipment should be specified and approved as being suitable for classes of ship having normal (<30 kn) or high (>30 kn) own ship speeds (100 kn and 140 kn relative speeds respectively).

TABLE 2**Minimum detection ranges in clutter-free conditions**

Target Description	Target Feature	Detection Range in NM ⁶	
		X-Band NM	S-Band NM
Target description ⁵	Height above sea level in metres		
Shorelines	Rising to 60	20	20
Shorelines	Rising to 6	8	8
Shorelines	Rising to 3	6	6
SOLAS ships (>5,000 gross tonnage)	10	11	11
SOLAS ships (>500 gross tonnage)	5.0	8	8
Small vessel with radar reflector meeting IMO Performance Standards ¹	4.0	5.0	3.7
Navigation buoy with corner reflector ²	3.5	4.9	3.6
Typical Navigation buoy ³	3.5	4.6	3.0
Small vessel of length 10 m with no radar reflector ⁴	2.0	3.4	3.0

5.3.1.2 Detection at Close Range

The short-range detection of the targets under the conditions specified in Table 2 should be compatible with the requirement in paragraph 5.4.

5.3.1.3 Detection in Clutter Conditions

Performance limitations caused by typical precipitation and sea clutter conditions will result in a reduction of target detection capabilities relative to those defined in 5.3.1.1 and Table 2.

5.3.1.3.1 The radar equipment should be designed to provide the optimum and most consistent detection performance, restricted only by the physical limits of propagation.

5.3.1.3.2 The radar system should provide the means to enhance the visibility of targets in adverse clutter conditions at close range.

1 IMO revised performance standards for radar reflectors (resolution MSC.164(78)) – Radar Cross Section (RCS) 7.5 m² for X-Band, 0.5 m² for S-Band.

2 The corner reflector (used for measurement), is taken as 10 m² for X-Band and 1.0 m² for S-Band.

3 The typical navigation buoy is taken as 5.0 m² for X-Band and 0.5 m² for S-Band; for typical channel markers, with an RCS of 1.0 m² (X-band) and 0.1 m² (S-band) and height of 1 metre, a detection range of 2.0 and 1.0 NM respectively.

4 RCS for 10 m small vessel taken as 2.5 m² for X-Band and 1.4 m² for S-Band (taken as a complex target).

5 Reflectors are taken as point targets, vessels as complex targets and shorelines as distributed targets (typical values for a rocky shoreline, but are dependent on profile).

6 Detection ranges experienced in practice will be affected by various factors, including atmospheric conditions (e.g. evaporation duct), target speed and aspect, target material and target structure. These and other factors may either enhance or degrade the detection ranges stated. At ranges between the first detection and own ship, the radar return may be reduced or enhanced by signal multi-path, which depend on factors such as antenna/target centroid height, target structure, sea state and radar frequency band.

5.3.1.3.3 Degradation of detection performance (related to the figures in Table 2) at various ranges and target speeds under the following conditions, should be clearly stated in the user manual:

- light rain (4 mm per hour) and heavy rain (16 mm per hour);
- sea state 2 and sea state 5; and
- and a combination of these.

5.3.1.3.4 The determination of performance in clutter and specifically, range of first detection, as defined in the clutter environment in 5.3.1.3.3, should be tested and assessed against a benchmark target, as specified in the Test Standard.

5.3.1.3.5 Degradation in performance due to a long transmission line, antenna height or any other factors should be clearly stated in the user manual.

5.3.2 *Gain and Anti-Clutter Functions*

5.3.2.1 Means should be provided, as far as is possible, for the adequate reduction of unwanted echoes, including sea clutter, rain and other forms of precipitation, clouds, sandstorms and interference from other radars.

5.3.2.2 A gain control function should be provided to set the system gain or signal threshold level.

5.3.2.3 Effective manual and automatic anti-clutter functions should be provided.

5.3.2.4 A combination of automatic and manual anti-clutter functions is permitted.

5.3.2.5 There should be a clear and permanent indication of the status and level for gain and all anti-clutter control functions.

5.3.3 *Signal Processing*

5.3.3.1 Means should be available to enhance target presentation on the display.

5.3.3.2 The effective picture update period should be adequate, with minimum latency to ensure that the target detection requirements are met.

5.3.3.3 The picture should be updated in a smooth and continuous manner.

5.3.3.4 The equipment manual should explain the basic concept, features and limitations of any signal processing.

5.3.4 *Operation with SARTs and Radar Beacons*

5.3.4.1 The X-Band radar system should be capable of detecting radar beacons in the relevant frequency band.

5.3.4.2 The X-Band radar system should be capable of detecting SARTs and radar target enhancers.

5.3.4.3 It should be possible to switch off those signal processing functions, including polarization modes, which might prevent an X-Band radar beacon or SARTs from being detected and displayed. The status should be indicated.

5.4 Minimum Range

5.4.1 With own ship at zero speed, an antenna height of 15 m above the sea level and in calm conditions, the navigational buoy in Table 2 should be detected at a minimum horizontal range of 40 m from the antenna position and up to a range of 1 NM, without changing the setting of control functions other than the range scale selector.

5.4.2 Compensation for any range error should be automatically applied for each selected antenna, where multiple antennas are installed.

5.5 Discrimination

Range and bearing discrimination should be measured in calm conditions, on a range scale of 1.5 NM or less and at between 50% and 100% of the range scale selected:

5.5.1 Range

The radar system should be capable of displaying two point targets on the same bearing, separated by 40 m in range, as two distinct objects.

5.5.2 Bearing

The radar system should be capable of displaying two point targets at the same range, separated by 2.5° in bearing, as two distinct objects.

5.6 Roll and Pitch

The target detection performance of the equipment should not be substantially impaired when own ship is rolling or pitching up to +/-10°.

5.7 Radar Performance Optimization and Tuning

5.7.1 Means should be available to ensure that the radar system is operating at the best performance. Where applicable to the radar technology, manual tuning should be provided and additionally, automatic tuning may be provided.

5.7.2 An indication should be provided, in the absence of targets, to ensure that the system is operating at the optimum performance.

5.7.3 Means should be available (automatically or by manual operation) and while the equipment is operational, to determine a significant drop in system performance relative to a calibrated standard established at the time of installation.

5.8 Radar Availability

The radar equipment should be fully operational (RUN status) within 4 minutes after switch ON from cold. A STANDBY condition should be provided, in which there is no operational radar transmission. The radar should be fully operational within 5 sec from the standby condition.

5.9 Radar Measurements – Consistent Common Reference Point (CCRP)

5.9.1 Measurements from own ship (e.g. range rings, target range and bearing, cursor, tracking data) should be made with respect to the consistent common reference point (e.g. conning position). Facilities should be provided to compensate for the offset between antenna position and the consistent common reference point on installation. Where multiple antennas are installed, there should be provision for applying different position offsets for each antenna in the radar system. The offsets should be applied automatically when any radar sensor is selected.

5.9.2 Own ship's scaled outline should be available on appropriate range scales. The consistent common reference point and the position of the selected radar antenna should be indicated on this graphic.

5.9.3 When the picture is centred, the position of the Consistent Common Reference Point should be at the centre of the bearing scale. The off-centre limits should apply to the position of the selected antenna.

5.9.4 Range measurements should be in nautical miles (NM). In addition, facilities for metric measurements may be provided on lower range scales. All indicated values for range measurement should be unambiguous.

5.9.5 Radar targets should be displayed on a linear range scale and without a range index delay.

5.10 Display Range Scales

5.10.1 Range scales of 0.25, 0.5, 0.75, 1.5, 3, 6, 12 and 24 NM should be provided. Additional range scales are permitted outside the mandatory set. Low metric range scales may be offered in addition to the mandatory set.

5.10.2 The range scale selected should be permanently indicated.

5.11 Fixed Range Rings

5.11.1 An appropriate number of equally spaced range rings should be provided for the range scale selected. When displayed, the range ring scale should be indicated.

5.11.2 The system accuracy of fixed range rings should be within 1% of the maximum range of the range scale in use or 30 m, whichever is the greater distance.

5.12 Variable Range Markers (VRM)

5.12.1 At least two variable range markers (VRMs) should be provided. Each active VRM should have a numerical readout and have a resolution compatible with the range scale in use.

5.12.2 The VRMs should enable the user to measure the range of an object within the operational display area with a maximum system error of 1% of the range scale in use or 30 m, whichever is the greater distance.

5.13 Bearing Scale

5.13.1 A bearing scale around the periphery of the operational display area should be provided. The bearing scale should indicate the bearing as seen from the consistent common reference point.

5.13.2 The bearing scale should be outside of the operational display area. It should be numbered at least every 30° division and have division marks of at least 5°. The 5° and 10° division marks should be clearly distinguishable from each other. 1° division marks may be presented where they are clearly distinguishable from each other.

5.14 Heading Line (HL)

5.14.1 A graphic line from the consistent common reference point to the bearing scale should indicate the heading of the ship.

5.14.2 Electronic means should be provided to align the heading line to within 0.1°. If there is more than one radar antenna (see 5.35) the heading skew (bearing offset) should be retained and automatically applied when each radar antenna is selected.

5.14.3 Provision should be made to temporarily suppress the heading line. This function may be combined with the suppression of other graphics.

5.15 Electronic Bearing Lines (EBLs)

5.15.1 At least two electronic bearing lines (EBLs) should be provided to measure the bearing of any point object within the operational display area, with a maximum system error of 1° at the periphery of the display.

5.15.2 The EBLs should be capable of measurement relative to the ships heading and relative to true north. There should be a clear indication of the bearing reference (i.e. true or relative).

5.15.3 It should be possible to move the EBL origin from the consistent common reference point to any point within the operational display area and to reset the EBL to the consistent common reference point by a fast and simple action.

5.15.4 It should be possible to fix the EBL origin or to move the EBL origin at the velocity of own ship.

5.15.5 Means should be provided to ensure that the user is able to position the EBL smoothly in either direction, with an incremental adjustment adequate to maintain the system measurement accuracy requirements.

5.15.6 Each active EBL should have a numerical readout with a resolution adequate to maintain the system measurement accuracy requirements.

5.16 Parallel Index lines (PI)

5.16.1 A minimum of four independent parallel index lines, with a means to truncate and switch off individual lines, should be provided.

5.16.2 Simple and quick means of setting the bearing and beam range of a parallel index line should be provided. The bearing and beam range of any selected index line should be available on demand.

5.17 Offset Measurement of Range and Bearing

There should be a means to measure the range and bearing of one position on the display relative to any other position within the operational display area.

5.18 User Cursor

5.18.1 A user cursor should be provided to enable a fast and concise means to designate any position on the operational display area.

5.18.2 The cursor position should have a continuous readout to provide the range and bearing, measured from the consistent common reference point, and/or the latitude and longitude of the cursor position presented either alternatively or simultaneously.

5.18.3 The cursor should provide the means to select and de-select targets, graphics or objects within the operational display area. In addition, the cursor may be used to select modes, functions, vary parameters and control menus outside of the operational display area.

5.18.4 Means should be provided to easily locate the cursor position on the display.

5.18.5 The accuracy of the range and bearing measurements provided by the cursor should meet the relevant requirements for VRM and EBL.

5.19 Azimuth Stabilization

5.19.1 The heading information should be provided by a gyrocompass or by an equivalent sensor with a performance not inferior to the relevant standards adopted by the Organization.

5.19.2 Excluding the limitations of the stabilizing sensor and type of transmission system, the accuracy of azimuth alignment of the radar presentation should be within 0.5° with a rate of turn likely to be experienced with the class of ship.

5.19.3 The heading information should be displayed with a numerical resolution to permit accurate alignment with the ship gyro system.

5.19.4 The heading information should be referenced to the consistent common reference point (CCRP).

5.20 Display Mode of the Radar Picture

5.20.1 A True Motion display mode should be provided. The automatic reset of own ship may be initiated by its position on the display, or time related, or both. Where the reset is selected to occur at least on every scan or equivalent, this should be equivalent to True Motion with a fixed origin (in practice equivalent to the previous relative motion mode).

5.20.2 North Up and Course Up orientation modes should be provided. Head Up may be provided when the display mode is equivalent to True Motion with a fixed origin (in practice equivalent to the previous relative motion Head Up mode).

5.20.3 An indication of the motion and orientation mode should be provided.

5.21 Off-Centring

5.21.1 Manual off-centring should be provided to locate the selected antenna position at any point within at least 50% of the radius from the centre of the operational display area.

5.21.2 On selection of off-centred display, the selected antenna position should be capable of being located to any point on the display up to at least 50%, and not more than 75%, of the radius from the centre of the operational display area. A facility for automatically positioning own ship for the maximum view ahead may be provided.

5.21.3 In True Motion, the selected antenna position should automatically reset up to a 50% radius to a location giving the maximum view along own ship's course. Provision for an early reset of selected antenna position should be provided.

5.22 Ground and Sea Stabilization Modes

5.22.1 Ground and Sea stabilization modes should be provided.

5.22.2 The stabilization mode and stabilization source should be clearly indicated.

5.22.3 The source of own ships' speed should be indicated and provided by a sensor approved in accordance with the requirements of the Organization for the relevant stabilization mode.

5.23 Target Trails and Past Positions

5.23.1 Variable length (time) target trails should be provided, with an indication of trail time and mode. It should be possible to select true or relative trails from a reset condition for all true motion display modes.

5.23.2 The trails should be distinguishable from targets.

5.23.3 Either scaled trails or past positions or both, should be maintained and should be available for presentation within 2 scans or equivalent, following:

- the reduction or increase of one range scale;
- the offset and reset of the radar picture position; and
- a change between true and relative trails.

5.24 Presentation of Target Information

5.24.1 Targets should be presented in accordance with the performance standards for the Presentation of Navigation-related Information on Shipborne Navigational Displays adopted by the Organization and with their relevant symbols according to SN/Circ.243.

5.24.2 The target information may be provided by the radar target tracking function and by the reported target information from the Automatic Identification System (AIS).

5.24.3 The operation of the radar tracking function and the processing of reported AIS information is defined in these standards.

5.24.4 The number of targets presented, related to display size, is defined in Table 1. An indication should be given when the target capacity of radar tracking or AIS reported target processing/display capability is about to be exceeded.

5.24.5 As far as practical, the user interface and data format for operating, displaying and indicating AIS and radar tracking information should be consistent.

5.25 Target Tracking (TT) and Acquisition

5.25.1 General

Radar targets are provided by the radar sensor (transceiver). The signals may be filtered (reduced) with the aid of the associated clutter controls. Radar targets may be manually or automatically acquired and tracked using an automatic Target Tracking (TT) facility.

5.25.1.1 The automatic target tracking calculations should be based on the measurement of radar target relative position and own ship motion.

5.25.1.2 Any other sources of information, when available, may be used to support the optimum tracking performance.

5.25.1.3 TT facilities should be available on at least the 3, 6, and 12 NM range scales. Tracking range should extend to a minimum of 12 NM.

5.25.1.4 The radar system should be capable of tracking targets having the maximum relative speed relevant to its classification for normal or high own ship speeds (see 5.3).

5.25.2 Tracked Target Capacity

5.25.2.1 In addition to the requirements for processing of targets reported by AIS, it should be possible to track and provide full presentation functionality for a minimum number of tracked radar targets according to Table 1.

5.25.2.2 There should be an indication when the target tracking capacity is about to be exceeded. Target overflow should not degrade the radar system performance.

5.25.3 Acquisition

5.25.3.1 Manual acquisition of radar targets should be provided with provision for acquiring at least the number of targets specified in Table 1.

5.25.3.2 Automatic acquisition should be provided where specified in Table 1. In this case, there should be means for the user to define the boundaries of the auto-acquisition area.

5.25.4 Tracking

5.25.4.1 When a target is acquired, the system should present the trend of the target's motion within one minute and the prediction of the targets' motion within 3 minutes.

5.25.4.2 TT should be capable of tracking and updating the information of all acquired targets automatically.

5.25.4.3 The system should continue to track radar targets that are clearly distinguishable on the display for 5 out of 10 consecutive scans or equivalent.

5.25.4.4 The TT design should be such that target vector and data smoothing is effective, while target manoeuvres should be detected as early as possible.

5.25.4.5 The possibility of tracking errors, including target swap, should be minimized by design.

5.25.4.6 Separate facilities for cancelling the tracking of any one and of all target(s) should be provided.

5.25.4.7 Automatic tracking accuracy should be achieved when the tracked target has achieved a steady state, assuming the sensor errors allowed by the relevant performance standards of the Organization.

5.25.4.7.1 For ships capable of up to 30 kn true speed, the tracking facility should present, within 1 min steady state tracking, the relative motion trend and after 3 minutes, the predicted motion of a target, within the following accuracy values (95% probability):

TABLE 3

Tracked Target Accuracy (95% probability figures)

Time of steady state (minutes)	Relative Course (degrees)	Relative Speed (kn)	CPA (NM)	TCPA (minutes)	True Course (degrees)	True Speed (kn)
1 min: Trend	11	1.5 or 10% (whichever is greater)	1.0	-	-	-
3 min: Motion	3	0.8 or 1% (whichever is greater)	0.3	0.5	5	0.5 or 1% (whichever is greater)

Accuracy may be significantly reduced during or shortly after acquisition, own ship manoeuvre, a manoeuvre of the target, or any tracking disturbance and is also dependent on own ship's motion and sensor accuracy.

Measured target range and bearing should be within 50 m (or +/-1% of target range) and 2°.

The testing standard should have detailed target simulation tests as a means to confirm the accuracy of targets with relative speeds of up to 100 kn. Individual accuracy values shown in the table above may be adapted to account for the relative aspects of target motion with respect to that of own ship in the testing scenarios used.

5.25.4.7.2 For ships capable of speeds in excess of 30 kn (typically High-Speed Craft (HSC)) and with speeds of up to 70 kn, there should be additional steady state measurements made to ensure that the motion accuracy, after 3 minutes of steady state tracking, is maintained with target relative speeds of up to 140 kn.

5.25.4.8 A ground referencing function, based on a stationary tracked target, should be provided. Targets used for this function should be marked with the relevant symbol defined in SN/Circ.243.

5.26 Automatic Identification System (AIS) Reported Targets

5.26.1 General

Reported targets provided by the AIS may be filtered according to user-defined parameters. Targets may be sleeping, or may be activated. Activated targets are treated in a similar way to radar tracked targets.

5.26.2 AIS Target Capacity

In addition to the requirements for radar tracking, it should be possible to display and provide full presentation functionality for a minimum number of sleeping and activated AIS targets according to Table 1. There should be an indication when the capacity of processing/display of AIS targets is about to be exceeded.

5.26.3 Filtering of AIS Sleeping Targets

To reduce display clutter, a means to filter the presentation of sleeping AIS targets should be provided, together with an indication of the filter status. (e.g. by target range, CPA/TCPA or AIS target class A/B, etc.). It should not be possible to remove individual AIS targets from the display.

5.26.4 Activation of AIS Targets

A means to activate a sleeping AIS target and to deactivate an activated AIS target should be provided. If zones for the automatic activation of AIS targets are provided, they should be the same as for automatic radar target acquisition. In addition, sleeping AIS targets may be automatically activated when meeting user defined parameters (e.g. target range, CPA/TCPA or AIS target class A/B).

5.26.5 AIS Presentation Status

TABLE 4

The AIS presentation status should be indicated as follows:

Function	Cases to be Presented		Presentation
AIS ON/OFF	AIS processing switched ON/ graphical presentation switched OFF	AIS processing switched ON/ graphical presentation switched ON	Alphanumeric or graphical
Filtering of sleeping AIS targets	Filter status	Filter status	Alphanumeric or graphical
Activation of Targets		Activation criteria	Graphical
CPA/TCPA Alarm	Function ON/OFF Sleeping targets included	Function ON/OFF Sleeping targets included	Alphanumeric and graphical
Lost Target Alarm	Function ON/OFF Lost target filter criteria	Function ON/OFF Lost target filter criteria	Alphanumeric and graphical
Target Association	Function ON/OFF Association criteria Default target priority	Function ON/OFF Association criteria Default target priority	Alphanumeric

5.27 AIS Graphical Presentation

Targets should be presented with their relevant symbols according to the performance standards for the Presentation of Navigation-related Information on Shipborne Navigational Displays adopted by the Organization and SN/Circ.243.

5.27.1 AIS targets that are displayed should be presented as sleeping targets by default.

5.27.2 The course and speed of a tracked radar target or reported AIS target should be indicated by a predicted motion vector. The vector time should be adjustable and valid for presentation of any target regardless of its source.

5.27.3 A permanent indication of vector mode, time and stabilization should be provided.

5.27.4 The consistent common reference point should be used for the alignment of tracked radar and AIS symbols with other information on the same display.

5.27.5 On large scale/low range displays, a means to present the true scale outline of an activated AIS target should be provided. It should be possible to display the past track of activated targets.

5.28 AIS and Radar Target Data

5.28.1 It should be possible to select any tracked radar or AIS target for the alphanumeric display of its data. A target selected for the display of its alphanumeric information should be identified by the relevant symbol. If more than one target is selected for data display, the relevant symbols and the corresponding data should be clearly identified. There should be a clear indication to show that the target data is derived from radar or from AIS.

5.28.2 For each selected tracked radar target, the following data should be presented in alphanumeric form: source(s) of data, actual range of target, actual bearing of target, predicted target range at the closest point of approach (CPA), predicted time to CPA (TCPA), true course of target, true speed of target.

5.28.3 For each selected AIS target the following data should be presented in alphanumeric form: Source of data, ship's identification, navigational status, position where available and its quality, range, bearing, COG, SOG, CPA and TCPA. Target heading and reported rate of turn should also be made available. Additional target information should be provided on request.

5.28.4 If the received AIS information is incomplete, the absent information should be clearly indicated as 'missing' within the target data field.

5.28.5 The data should be displayed and continually updated, until another target is selected for data display or until the window is closed.

5.28.6 Means should be provided to present own ship AIS data on request.

5.29 Operational Alarms

A clear indication of the cause for all alarm criteria should be given.

5.29.1 If the calculated CPA and TCPA values of a tracked target or activated AIS target are less than the set limits:

- A CPA/TCPA alarm should be given.
- The target should be clearly indicated.

5.29.2 The preset CPA/TCPA limits applied to targets from radar and AIS should be identical. As a default state, the CPA/TCPA alarm functionality should be applied to all activated AIS targets. On user request the CPA/TCPA alarm functionality may also be applied to sleeping targets.

5.29.3 If a user defined acquisition/activation zone facility is provided, a target not previously acquired/activated entering the zone, or is detected within the zone, should be clearly identified with the relevant symbol and an alarm should be given. It should be possible for the user to set ranges and outlines for the zone.

5.29.4 The system should alert the user if a tracked radar target is lost, rather than excluded by a pre-determined range or pre-set parameter. The target's last position should be clearly indicated on the display.

5.29.5 It should be possible to enable or disable the lost target alarm function for AIS targets. A clear indication should be given if the lost target alarm is disabled.

If the following conditions are met for a lost AIS target:

- The AIS lost target alarm function is enabled.
- The target is of interest, according to lost target filter criteria.
- A message is not received for a set time, depending on the nominal reporting rate of the AIS target.

Then:

- The last known position should be clearly indicated as a lost target and an alarm be given.
- The indication of the lost target should disappear if the signal is received again, or after the alarm has been acknowledged.
- A means of recovering limited historical data from previous reports should be provided.

5.30 AIS and Radar Target Association

An automatic target association function based on harmonized criteria avoids the presentation of two target symbols for the same physical target.

5.30.1 If the target data from AIS and radar tracking are both available and if the association criteria (e.g. position, motion) are fulfilled such that the AIS and radar information are considered as one physical target, then as a default condition, the activated AIS target symbol and the alphanumeric AIS target data should be automatically selected and displayed.

5.30.2 The user should have the option to change the default condition to the display of tracked radar targets and should be permitted to select either radar tracking or AIS alphanumeric data.

5.30.3 For an associated target, if the AIS and radar information become sufficiently different, the AIS and radar information should be considered as two distinct targets and one activated AIS target and one tracked radar target should be displayed. No alarm should be raised.

5.31 Trial Manoeuvre

The system should, where required by table 1, be capable of simulating the predicted effects of own ships manoeuvre in a potential threat situation and should include own ship's dynamic characteristics. A trial manoeuvre simulation should be clearly identified. The requirements are:

- The simulation of own ship course and speed should be variable.
- A simulated time to manoeuvre with a countdown should be provided.
- During simulation, target tracking should continue and the actual target data should be indicated.
- Trial manoeuvre should be applied to all tracked targets and at least all activated AIS targets.

5.32 The Display of Maps, Navigation Lines and Routes

5.32.1 It should be possible for the user to manually create and change, save, load and display simple maps/navigation lines/routes referenced to own ship or a geographical position. It should be possible to remove the display of this data by a simple operator action.

5.32.2 The maps/navigation lines/routes may consist of lines, symbols and reference points.

5.32.3 The appearance of lines, colours and symbols are as defined in SN/Circ.243.

5.32.4 The maps/navigation lines/route graphics should not significantly degrade the radar information.

5.32.5 The maps/navigation lines/routes should be retained when the equipment is switched OFF.

5.32.6 The maps/navigation lines/route data should be transferable whenever a relevant equipment module is replaced.

5.33 The Display of Charts

5.33.1 The radar system may provide the means to display ENC and other vector chart information within the operational display area to provide continuous and real-time position monitoring. It should be possible to remove the display of chart data by a single operator action.

5.33.2 The ENC information should be the primary source of information and should comply with IHO relevant standards. Status of other information should be identified with a permanent indication. Source and update information should be made available.

5.33.3 As a minimum, the elements of the ECDIS Standard Display should be made available for individual selection by category or layer, but not as individual objects.

5.33.4 The chart information should use the same reference and co-ordinate criteria as the radar/AIS, including datum, scale, orientation, CCRP and stabilization mode.

5.33.5 The display of radar information should have priority. Chart information should be displayed such that radar information is not substantially masked, obscured or degraded. Chart information should be clearly perceptible as such.

5.33.6 A malfunction of the source of chart data should not affect the operation of the radar/AIS system.

5.33.7 Symbols and colours should comply with the performance standards for the Presentation of Navigation-related Information on Shipborne Navigational Displays adopted by the Organization (SN/Circ.243).

5.34 Alarms and Indications

Alarms and indications should comply with the performance standards for the Presentation of Navigation-related Information on Shipborne Navigational Displays adopted by the Organization.

5.34.1 A means should be provided to alert the user of “picture freeze”.

5.34.2 Failure of any signal or sensor in use, including; gyro, log, azimuth, video, sync and heading marker, should be alarmed. System functionality should be limited to a fall back mode or in some cases, the display presentation should be inhibited (see fallback modes, section 9).

5.35 Integrating Multiple Radars

5.35.1 The system should safeguard against single point system failure. Fail-safe condition should be applied in the event of an integration failure.

5.35.2 The source and any processing or combination of radar signals should be indicated.

5.35.3 The system status for each display position should be available.

6 ERGONOMIC CRITERIA

6.1 Operational Controls

6.1.1 The design should ensure that the radar system is simple to operate. Operational controls should have a harmonized user interface and be easy to identify and simple to use.

6.1.2 The radar system should be capable of being switched ON or OFF at the main system radar display or at a control position.

6.1.3 The control functions may be dedicated hardware, screen accessed or a combination of these; however the primary control functions should be dedicated hardware controls or soft keys, with an associated status indication in a consistent and intuitive position.

6.1.4 The following are defined as primary radar control functions and should be easily and immediately accessible:

Radar Standby/RUN, Range scale selection, Gain, tuning function (if applicable), Anti-clutter rain, Anti-clutter sea, AIS function on/off, Alarm acknowledge, Cursor, a means to set EBL/VRM, display brightness and acquisition of radar targets.

6.1.5 The primary functions may also be operated from a remote operating position in addition to the main controls.

6.2 Display Presentation

6.2.1 The display presentation should comply with the performance standards for the Presentation of Navigation-related Information on Shipborne Navigational Displays adopted by the Organization

6.2.2 The colours, symbols and graphics presented should comply with SN/Circ.243.

6.2.3 The display sizes should conform to those defined in Table 1.

6.3 Instructions and Documentation

6.3.1 *Documentation Language*

The operating instructions and manufacturer's documentation should be written in a clear and comprehensible manner and should be available at least in the English language.

6.3.2 *Operating Instructions*

The operating instructions should contain a qualified explanation and/or description of information required by the user to operate the radar system correctly, including:

- appropriate settings for different weather conditions;
- monitoring the radar system's performance;
- operating in a failure or fall-back situation;
- limitations of the display and tracking process and accuracy, including any delays;
- using heading and SOG/COG information for collision avoidance;
- limitations and conditions of target association;
- criteria of selection for automatic activation and cancellation of targets;
- methods applied to display AIS targets and any limitations;
- principles underlying the trial manoeuvre technology, including simulation of own ship's manoeuvring characteristics, if provided;
- alarms and indications;
- installation requirements as listed under section 7.5;
- radar range and bearing accuracies; and
- any special operation (e.g. tuning) for the detection of SARTs; and
- the role of the CCRP for radar measurements and its specific value.

6.3.3 *Manufacturer's Documentation*

6.3.3.1 The manufacturer's documentation should contain a description of the radar system and factors that may affect detection performance, including any latency in signal processing.

6.3.3.2 Documentation should describe the basis of AIS filter criteria and AIS/radar target association criteria.

6.3.3.3 The equipment documentation should include full details of installation information, including additional recommendations on unit location and factors that may degrade performance or reliability.

7 DESIGN AND INSTALLATION

7.1 Design for Servicing

7.1.1 As far as is practical, the radar system should be of a design to facilitate simple fault diagnosis and maximum availability.

7.1.2 The radar system should include a means to record the total operational hours for any components with a limited life.

7.1.3 The documentation should describe any routine servicing requirements and should include details of any restricted life components.

7.2 Display

The display device physical requirements should meet those specified in the performance standards for the Presentation of Navigation-related Information on Shipborne Navigational Displays adopted by the Organization (SN/Circ.243) and those specified in Table 1.

7.3 Transmitter Mute

The equipment should provide a mute facility to inhibit the transmission of radar energy over a preset sector. The mute sector should be set up on installation. An indication of sector mute status should be available.

7.4 Antenna

7.4.1 The antenna should be designed to start operating and to continue to operate in relative wind speeds likely to be encountered on the class of ship on which it is installed.

7.4.2 The combined radar system should be capable of providing an appropriate information update rate for the class of ship on which it is installed.

7.4.3 The antenna side lobes should be consistent with satisfying the system performance as defined in this standard.

7.4.4 There should be a means to prevent antenna rotation and radiation during servicing, or while personnel are in the vicinity of up-mast units.

7.5 Radar System Installation

Requirements and guidelines for the radar system installation should be included in the manufacturers' documentation. The following subjects should be covered:

7.5.1 *The Antenna*

Blind sectors should be kept to a minimum, and should not be placed in an arc of the horizon from the right ahead direction to 22.5° abaft the beam and especially should avoid the right ahead direction (relative bearing 000°). The installation of the antenna should be in such a manner that the performance of the radar system is not substantially degraded. The antenna should be mounted clear of any structure that may cause signal reflections, including other antenna and deck structure or cargo. In addition, the height of the antenna should take account of target detection performance relating to range of first detection and target visibility in sea clutter.

7.5.2 *The Display*

The orientation of the display unit should be such that the user is looking ahead, the lookout view is not obscured and there is minimum ambient light on the display.

7.6 Operation and Training

7.6.1 The design should ensure that the radar system is simple to operate by trained users.

7.6.2 A target simulation facility should be provided for training purposes.

8 INTERFACING

8.1 Input Data

The radar system should be capable of receiving the required input information from:

- a gyro-compass or transmitting heading device (THD);
- a speed and distance measuring equipment (SDME);
- an electronic position fixing system (EPFS);
- an Automatic Identification System (AIS); or
- other sensors or networks providing equivalent information acceptable to the Organization.

The radar should be interfaced to relevant sensors required by these performance standards in accordance with recognized international standards.*

8.2 Input Data Integrity and Latency

8.2.1 The radar system should not use data indicated as invalid. If input data is known to be of poor quality this should be clearly indicated.

8.2.2 As far as is practical, the integrity of data should be checked, prior to its use, by comparison with other connected sensors or by testing to valid and plausible data limits.

8.2.3 The latency of processing input data should be minimized.

8.3 Output Data

8.3.1 Information provided by any radar output interface to other systems should be in accordance with international standards* .

8.3.2 The radar system should provide an output of the display data for the voyage data recorder (VDR).

8.3.3 At least one normally closed contact (isolated) should be provided for indicating failure of the radar.

8.3.4 The radar should have a bi-directional interface to facilitate communication so that alarms from the radar can be transferred to external systems and so that audible alarms from the radar can be muted from external systems, the interface should comply with relevant international standards.

* Refer to IEC publication 61162.

9 BACKUP AND FALLBACK ARRANGEMENTS

In the event of partial failures and to maintain minimum basic operation, the fallback arrangements listed below should be provided. There should be a permanent indication of the failed input information.

9.1 Failure of Heading Information (Azimuth Stabilization)

9.1.1 The equipment should operate satisfactorily in an unstabilized head-up mode.

9.1.2 The equipment should switch automatically to the unstabilized head up mode within 1 minute after the azimuth stabilization has become ineffective.

9.1.3 If automatic anti-clutter processing could prevent the detection of targets in the absence of appropriate stabilization, the processing should switch off automatically within 1 minute after the azimuth stabilization has become ineffective.

9.1.4 An indication should be given that only relative bearing measurements can be used.

9.2 Failure of Speed through the Water Information

A means of manual speed input should be provided and its use clearly indicated.

9.3 Failure of Course and Speed Over Ground Information

The equipment may be operated with course and speed through the water information.

9.4 Failure of Position Input Information

The overlay of chart data and geographically referenced maps should be disabled if only a single Reference Target is defined and used, or the position is manually entered.

9.5 Failure of Radar Video Input Information

In the absence of radar signals, the equipment should display target information based on AIS data. A frozen radar picture should not be displayed.

9.6 Failure of AIS Input Information

In the absence of AIS signals, the equipment should display the radar video and target database.

9.7 Failure of an Integrated or Networked System

The equipment should be capable of operating equivalent to a stand alone system.

Appendix 1 - References

IMO SOLAS chapters IV, V and X	Carriage rules.
IMO resolution A.278(VII)	Supplement to the recommendation on PS for navigational radar equipment.
IMO resolution A.424(XI)	Performance standards for gyro-compasses.
IMO resolution A.477(XII)	Performance standards for radar equipment.
IMO resolution A.694(17)	General Requirements for ship borne radio equipment forming part of the global maritime distress and safety system and for electronically navigational aids.
IMO resolution A.817(19), as amended	Performance Standards for ECDIS.
IMO resolution A.821(19)	Performance standards for gyro-compasses for high-speed craft.
IMO resolution A.824(19)	Performance standards for devices to indicate speed and distance.
IMO resolution MSC.86(70)	Performance standards for INS.
IMO resolution MSC.64(67)	Recommendations on new and amended performance standards (Annex 2 revised by MSC.114(73)).
IMO resolution MSC.112(73)	Revised performance standards for ship borne global positioning (GPS) receiver equipment.
IMO resolution MSC.114(73)	Revised performance standards for ship borne DGPS and DGLONASS maritime radio beacon receiver equipment.
IMO resolution MSC.116(73)	Performance standards for marine transmitting heading devices (THD).
IMO MSC/Circ.982	Guidelines on ergonomic criteria for bridge equipment and layout.
IHO S-52 appendix 2	Colour and symbol specification for ECDIS.
IEC 62388	Radar Test Standard (replacing 60872 and 60936 series of test standards).
IEC 60945	Maritime navigation and radio communication equipment and systems – General requirements – Methods of testing and required test results.
IEC 61162	Maritime navigation and radio communication equipment and systems – Digital interfaces.
IEC 61174	Maritime navigation and radio communication equipment and systems – Electronic chart display and information system (ECDIS) – Operational and performance requirements, methods of testing and required test results.
IEC 62288	Presentation and display of navigation information.
ISO 9000 (all parts)	Quality management/assurance standards.

Appendix 2 – Definitions

Activated AIS target	A target representing the automatic or manual activation of a sleeping target for the display of additional graphically presented information. The target is displayed by an “activated target” symbol including: <ul style="list-style-type: none">? a vector (COG / SOG);? the heading; and? ROT or direction of turn indication (if available) to indicate initiated course changes.
Acquisition of a radar target	Process of acquiring a target and initiating its tracking.
Activation of an AIS target	Activation of a sleeping AIS target for the display of additional graphical and alphanumeric information.
Acquired radar target	Automatic or manual acquisition initiates radar tracking. Vectors and past positions are displayed when data has achieved a steady state condition.
AIS	Automatic Identification System.
AIS target	A target generated from an AIS message. See activated target, lost target, selected target and sleeping target.
Associated target	If an acquired radar target and an AIS reported target have similar parameters (e.g. position, course, speed) complying with an association algorithm, they are considered to be the same target and become an associated target.
Acquisition/activation zone	A zone set up by the operator in which the system should automatically acquire radar targets and activate reported AIS targets when entering the zone.
CCRP	Consistent Common Reference Point: A location on own ship, to which all horizontal measurements such as target range, bearing, relative course, relative speed, closest point of approach (CPA) or time to closest point of approach (TCPA) are referenced, typically the conning position of the bridge.
CPA/TCPA	Closest Point of Approach / Time to the Closest Point of Approach: Distance to the closest point of approach (CPA) and time to the closest point of approach (TCPA). Limits are set by the operator related to own ship.
Course Over Ground (COG)	Direction of the ship's movement relative to the earth, measured on board the ship, expressed in angular units from true north.

Course Through Water (CTW)	Direction of the ship's movement through the water, defined by the angle between the meridian through its position and the direction of the ship's movement through the water, expressed in angular units from true north.
Dangerous target	A target whose predicted CPA and TCPA are violating the values as preset by the operator. The respective target is marked by a “dangerous target” symbol.
Display modes	Relative motion: means a display on which the position of own ship remains fixed, and all targets move relative to own ship. True motion: a display across which own ship moves with its own true motion.
Display orientation	North up display: an azimuth stabilized presentation which uses the gyro input (or equivalent) and north is uppermost on the presentation. Course up display: an azimuth stabilized presentation which uses the gyro input or equivalent and the ship's course is uppermost on the presentation at the time of selection. Head up display: an unstabilized presentation in which own ship's heading is uppermost on the presentation.
ECDIS	Electronic Chart Display and Information System.
ECDIS Display Base	The level of information which cannot be removed from the ECDIS display, consisting of information which is required at all times in all geographic areas and all circumstances. It is not intended to be sufficient for safe navigation.
ECDIS Standard Display	The level of information that should be shown when a chart is first displayed on ECDIS. The level of the information it provides for route planning or route monitoring may be modified by the mariner according to the mariner's needs.
ENC	Electronic Navigational Chart. The database standardized as to content, structure and format according to relevant IHO standards and issued by, or on the authority of, a Government.
EPFS	Electronic Position Fixing System.
ERBL	Electronic bearing line carrying a marker, which is combined with the range marker, used to measure range and bearing from own ship or between two objects.

Evaporation duct	A low lying duct (a change in air density) that traps the radar energy so that it propagates close to the sea surface. Ducting may enhance or reduce radar target detection ranges.
Heading	Direction in which the bow of a ship is pointing expressed as an angular displacement from north.
HSC	High-speed craft (HSC) are vessels which comply with the definition in SOLAS for high speed craft.
Latency	The delay between actual and presented data.
Lost AIS target	A target representing the last valid position of an AIS target before the reception of its data was lost. The target is displayed by a “lost AIS target” symbol.
Lost tracked target	Target information is no longer available due to poor, lost or obscured signals. The target is displayed by a “lost tracked radar target” symbol.
Maps/Nav lines	Operator defined or created lines to indicate channels, Traffic Separation Schemes or borders of any area important for navigation.
Operational display area	Area of the display used to graphically present chart and radar information, excluding the user dialogue area. On the chart display this is the area of the chart presentation. On the radar display this is the area encompassing the radar image.
Past positions	Equally time-spaced past position marks of a tracked or reported target and own ship. The past positions’ track may be either relative or true.
Radar	(Radio direction and ranging) . A radio system that allows the determination of distance and direction of reflecting objects and of transmitting devices.
Radar beacon	A navigation aid which responds to the radar transmission by generating a radar signal to identify its position and identity.
Radar detection false alarm	The probability of a radar false alarm represents the probability that noise will cross the detection threshold and be called a target when only noise is present.
Radar target	Any object fixed or moving whose position and motion is determined by successive radar measurements of range and bearing.

Radar target enhancer	An electronic radar reflector, the output of which is an amplified version of the received radar pulse without any form of processing except limiting.
Reference target	Symbol indicating that the associated tracked stationary target (e.g. a navigational mark) is used as a speed reference for the ground stabilization.
Relative bearing	Direction of a target's position from own ship's reference location expressed as an angular displacement from own ship's heading.
Relative course	Direction of motion of a target relative to own ship's direction. (Bearing).
Relative motion	Combination of relative course and relative speed.
Relative speed	Speed of a target relative to own ship's speed data.
Rate of turn	Change of heading per time unit.
SART	Search And Rescue Transponder.
SDME	Speed and Distance Measuring Equipment.
Selected target	A manually selected target for the display of detailed alphanumeric information in a separate data display area. The target is displayed by a "selected target" symbol.
Sleeping AIS target	A target indicating the presence and orientation of a vessel equipped with AIS in a certain location. The target is displayed by a "sleeping target" symbol. No additional information is presented until activated.
Stabilization modes	<p>Ground stabilization: Display mode in which speed and course information are referred to the ground, using ground track input data, or EPFS as reference.</p> <p>Sea stabilization: Display mode in which speed and course information are referred to the sea, using gyro or equivalent and water speed log input as reference.</p>
Standard display	The level of information that should be shown when a chart is first displayed on ECDIS. The level of the information it provides for route planning or route monitoring may be modified by the mariner according to the mariner's needs.
Standard radar reflector	Reference reflector mounted 3.5 m above sea level with 10 m ² effective reflecting area at X-Band.

Steady state tracking	Tracking a target, proceeding at steady motion: <ul style="list-style-type: none">- after completion of the acquisition process, or- without a manoeuvre of target or own ship, or- without target swap or any disturbance.
Speed Over Ground (SOG)	Speed of the ship relative to the earth, measured on board of the ship.
Speed Through Water	Speed of the ship relative to the water surface.
SOLAS	International Convention for the Safety of Life at Sea.
Suppressed area	An area set up by the operator within which targets are not acquired.
Target swap	Situation in which the incoming radar data for a tracked target becomes incorrectly associated with another tracked target or a non-tracked radar echo.
Target's predicted motion	Prediction of a target's future course and speed based on linear extrapolation from its present motion as determined by past measurements of its range and bearing on the radar.
Target Tracking (TT)	Computer process of observing the sequential changes in the position of a radar target in order to establish its motion. Such a target is a Tracked Target.
Trails	Tracks displayed by the radar echoes of targets in the form of an afterglow. Trails may be true or relative.
Trial manoeuvre	Graphical simulation facility used to assist the operator to perform a proposed manoeuvre for navigation and collision avoidance purposes, by displaying the predicted future status of at least all acquired or activated targets as a result of own ship's simulated manoeuvres.
True bearing	Direction of a target from own ship's reference location or from another target's position expressed as an angular displacement from true north.
True course	Direction of motion relative to ground or to sea, of a target expressed as an angular displacement from north.
True motion	Combination of true course and true speed.
True speed	Speed of a target relative to ground, or to sea.

Vector modes

True vector: Vector representing the predicted true motion of a target, showing course and speed with reference to the ground.

Relative vector: Predicted movement of a target relative to own ship's motion.

User configured presentation

A display presentation configured by the user for a specific task at hand. The presentation may include radar and/or chart information, in combination with other navigation or ship related data.

User dialogue area

Is an area of the display consisting of data fields and/or menus that is allocated to the interactive presentation and entry or selection of operational parameters, data and commands mainly in alphanumeric form.
