Guideline No.N-01 (201510)

N-01 Marine Radar

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Foreword

This Guideline is a part of CCS Rules, which contains technical requirements, inspection and testing criteria related to classification and statutory survey of marine products.

This Guideline is published and updated by CCS and can be found through http://www.ccs.org.cn. Comments or suggestions can be sent by email to ps@ccs.org.cn.

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Marine Radar

1 Application

1.1 The Guideline applies to the type approval and inspection on the radar required in the active SOLAS convention. Table 1 shows the radar performance requirement difference for different sizes/categories of ships applied in the SOLAS convention.

1.2 Radars used on domestic sailing ships should be subject to type approval and inspection according to the requirements of Annex 3, Chapter 5, Part Four of the *Legal Inspection Rules for Ships and Offshore Facilities - Statutory Inspection Technology Rules for Domestic Sailing Ships* (2011) of the Bureau of Maritime Affairs of the People's Republic of China, as well as the *Marine Automatic Radar Plotting Aid Performance Standard* of the International Maritime Organization Assembly Resolution Res.A.823(19) (if applicable).

1.3 Radars used on inland vessels should be subject to type approval and inspection according to the requirements of Chapter 6, Part Five of the *Legal Inspection Rules for Ships and Offshore Facilities - Statutory Inspection Technology Rules for Inland Vessels* (2011) of the Bureau of Maritime Affairs of the People's Republic of China.

Radar performance requirement difference for different sizes/categories of ships applied in the SOLAS convention

Table 1

	Ship category		
	CAT 3	**CAT 2**	**CAT 1**
Ship size	Less than 500 GT	Ships of not less than 500 GT but less than 10,000 GT and high-speed ships of less than 10,000 GT	All ships of not less than 10,000 GT

Continued Table 1

Min. operating display area diameter	180 mm	250 mm	320 mm
Min. operating display area	195 x 195 mm	270 x 270 mm	340 x 340 mm
Capturing target automatically	-	-	Yes
Min. radar target quantity captured	20	30	40
Min. AIS target quantity activated	20	30	40
Min. dormant AIS target quantity	100	150	200
Trial ship handling function	-	-	Yes
Automatic radar plotting function (ARPA)	-	-	Yes
Automatic tracking function (ATA)	-	Yes	Yes
Electronic plotting function (EPA)	Mandatory for ships of not less than 300 GT	Yes	Yes

Note: The letter H should be provided behind category name of the approved high-speed ship radar (for example, CAT 1H); the letter C should be provided behind category name of the approved chart radar (for example, CAT 1HC).

2 Basis for approval and inspection

2.1 *General Requirements for Shipborne Radio Equipment Forming Part of the Global Maritime Distress and Safety System (GMDSS) and for Electronic Navigational Aids Res.A.694(17)*

2.2 *Performance Standards for the Presentation of Navigation-Related Information on Shipborne Navigational Displays Resolution MSC.191 (79)*

2.3 *Adoption of the Revised Performance Standards for Radar Equipment Resolution MSC.192 (79)*

2.4 *Measuring Technique on the Unwanted Transmission of the Radar System of the International Telecommunications Union Proposal ITU-R M.1177-4(04/2011)*

2.5 *Maritime Navigation and Radio Communication Equipment and Systems –Shipborne Radar – Performance Requirements, Methods of Testing and Required Test Results IEC 62388:2013/COR1:2014 Edition 2.0 (2014-02-12)*

2.6 *Marine Automatic Radar Plotting Aid Performance Standard* (ARPAs) of the International Maritime Organization Assembly Resolution Res.A.823(19)

2.7 *Control Symbols of the Marine Radar Equipment* of International Maritime Organization Assembly Resolution Res.A.278(VIII)

2.8 *Maritime Navigation and Radio Communication Equipment and Systems –Presentation of Navigation-Related Information on Shipborne Navigational Displays – General Requirements, Methods of Testing and Required Test Results (IEC 62288-2014)*

2.9 *Marine Navigation and Radio Communications Equipment and Systems - General Requirement, Test method and Required Test Result (IEC 60945-2002)*

2.10 *Digital Interface of the Marine Navigation and Radio Communications Equipment and Systems (IEC 61162) (Series)*

2.11 The *Performance Standard on Navigation Bridge Alarm Management* of the International Maritime Organization Maritime Safety Committee Resolution MSC.302 (87)

3 Terms and definitions

3.1 AIS: Automatic identification system.

3.2 AIS target: Targets generated by AIS information. See the activated target, missing target, selected target and dormant target.

3.3 AIS target activated: The target indicating that the dormant target is activated automatically or manually, which is used to display the additional chart display information. The target is displayed via the Activated Target sign, including the vector (COG/SOG), ship heading, and ROT or rotation direction indication (if any) used to indicate the course change.

3.4 Radar target capture: Capture the target and start the tracking process.

3.5 AIS target activation: The activation of a dormant AIS target to display additional chart, letter and digit information.

3.6 Radar target captured: The radar target captured via the automatic or manual radar tracking function. When the data is stable, the vector and track is displayed.

3.7 Associated target: If the captured radar target and AIS report target share similar parameters meeting correlation algorithm requirement (such as the position, course and speed), such targets are treated as the same target and become the associated target.

3.8 Capture/Activation area: The area created by the operator; when entering the area, the system should capture automatically the radar target and activate the AIS target reported.

3.9 CCRP: Unified common reference point is a position on the ship (usually the commanding position of the bridge), which should be referred to during the leveling survey (for example, the target range, azimuth, relative course, relative speed, closest point of approach (CPA) or time to closest point of approach (TCPA)).

3.10 CPA/TCPA: Closest point of approach or time to closest point of approach: The range to the CPA or time taken to the closest point of approach. The limit is to be set by the operator of the ship.

3.11 Course over ground (COG): The motion direction of the ship to the land measured on the ship and expressed in the angular unit from the true north.

3.12 Course to water (CTW): The motion direction of the ship to the water defined by the degree between the meridian crossing the position where the ship is located and the motion direction of the ship to the water and expressed in the angular unit from the true north.

3.13 Dangerous target: The CPA and TCPA targets expected to exceed the operator's setting value. Separate target is indicated with the Dangerous Target sign.

3.14 Display mode: Relative motion: A display indicating that the ship position remains stationary and all the targets move relative to the ship. True motion: A display indicating the ship moves in the way of true motion.

3.15 Display direction: Display with the north upward: The display with inputting via the gyroscopic compass (or equivalent one), the north on top of the chart, and steady azimuth. Display with the course upward: The display with inputting via the gyroscopic compass (or equivalent one), the ship course on top of the chart, and steady azimuth. Display with ship heading upward: The unsteady display with the ship heading on top of the chart.

3.16 ECDIS: Electronic chart display and information system.

3.17 Basic display of ECDIS: The information that cannot be deleted from the ECDIS display, which consists of all geographic area information and those required to be displayed at any time and under any circumstance, but are not sufficient to guarantee the safe navigation.

3.18 Standard display of ECDIS: The information that should be displayed when the chart is displayed on the ECDIS for the first time. It is the information used for ship route formulation and monitoring, which can be modified as per the navigator's requirement.

3.19 ENC: Electronic navigation chart. The database issued by the government or with the authorization of the government and standardized as per the IHO standard in respect of contents, structure and format.

3.20 EPFS: Electronic position fixing system.

3.21 ERBL: Electronic range and bearing line with indicator that is used to measure the range and azimuth of the ship and the object or two objects.

3.22 Atmospheric duct: Low duct that captures radar energy for transmission close to the sea surface (air density change). The duct can increase or reduce the radar target detection range.

3.23 Heading: The direction of the ship bow expressed with the angular rotation to the true north.

3.24 HSC: High-speed craft (HSC) meeting the high-speed craft definition in SOLAS.

3.25 Waiting time: The time delay between the time when the data is received by the equipment and that when it is displayed.

3.26 Missing AIS target: The AIS target displayed is the target displayed at the last effective position before data missing during receipt. Such target is displayed via the Missing AIS Target sign.

3.27 Missing tracked target: The target that does not receive any information due to weak, missing or shielded signal. Such target is displayed via the Missing Tracked Radar Target sign.

3.28 Map/ship route: The route defined or formulated by the operator for marking the shipping lane, traffic separation scheme, or boundary of key sailing areas.

3.29 Operation display area: The area on the display used to display the chart and radar information, excluding the user dialogue area. It is the chart display area on the chart display. It is the radar image display area on the radar display.

3.30 Track: The track with same time interval used to indicate the position of certain tracked target, reported target or the ship. The track can be relative or true.

3.31 Radar (radio direction finding and ranging): The radio system used to determine the range and direction of the reflective object and transmission device.

3.32 Radio beacon: NAVAID that responds to the radar transmission by generating radar signal to indicate its position and identification.

3.33 False alarm (rate) of radar detection: The probability that the independent noise is judged to be the target when exceeding the detection threshold.

3.34 Radar target: The static or moving object that can be detected by the radar system and the movement of which can be determined via continuous range and azimuth measurement.

3.35 Radar target intensifier: The electronic radar reflector that amplifies, clips and outputs the radar pulse received without any other processing.

3.36 Reference target: The tracked dormant target associated is used as the sign for ground stable speed reference.

3.37 Relative azimuth: The direction of the target position from the reference position of the ship expressed with the angular rotation from the ship heading.

3.38 Relative course: The target movement direction (azimuth) relative to the ship direction.

3.39 Relative movement: The combination of relative course and relative speed.

3.40 Relative speed: The target speed relative to the ship speed data.

3.41 Rate of turn: The ship heading change in every time unit.

3.42 SART: Search and rescue radar transponder.

3.43 SDME: Speed and range measuring equipment.

3.44 Selected target: The target selected manually and used to display letter and digit information in the separate data display area. Such target is displayed via the Selected Target sign.

3.45 Dormant AIS target: The target indicating the existence and direction of the ship equipped with AIS at specific position. Such target is displayed via the Dormant Target sign. No additional information is displayed before activation.

3.46 Stability mode: Stability over the ground: The display mode that adopts the ground track input data or EPFS as reference and the ground as the reference in respect of navigational speed and course information. Stability over the water: The display mode that adopts the input data of the gyroscopic compass (or the equivalent) and the log as reference and the sea surface as the reference in respect of navigational speed and course information.

3.47 Standard radar reflector: The benchmark reflector installed at a position 3.5 m above the sea surface with effective reflection area of $10m^2$ in the X band.

3.48 Steady state tracking: Starting to track a target during steady movement: After the capture process, the target or the ship is not operated, or there is no target exchange or interference.

3.49 Speed over ground (SOG): The ship speed over the ground measured on the ship.

3.50 Speed over water: The ship speed over the water.

3.51 SOLAS: International Convention for the Safety of Life at Sea.

3.52 Shielded area: The area set by the operator without target capturing operation.

3.53 Target exchange: The situation when the radar data of the tracked target is associated wrongly with another tracked target or the non-tracking radar echo.

3.54 Expected target movement: The prediction on the future course and speed of the target conducted via the linear extrapolation method based on the current movement of the target according to the target range and azimuth measured previously on the radar.

3.55 Target tracking: The computer program used to establish target movement to observe the radar target position change. Such target is the tracked target.

3.56 Wake: The ship route displayed via the target radar echo in the form of afterglow. The wake can be true or relative.

3.57 Trial ship handling function: The image simulation function used to help operator on manipulation and drilling of navigation and collision prevention that displays the expected status of at least all the captured or activated targets as the manipulation and drilling result of the ship.

3.58 True azimuth: The target direction from the baseline position or other target position expressed with the angular rotation of the true north.

3.59 True course: The target movement direction over the ground and sea surface expressed with the angular rotation of the true north.

3.60 True movement: The combination of the true course and true speed.

3.61 True speed: The target speed over the ground and sea surface.

3.62 Vector mode: True vector: The vector representing the expected true movement of the target and displaying the course and navigational speed over the reference ground. Relative vector: The expected movement of the target over the ship movement.

3.63 Display of user setting: The image displayed on the display that is set by the user for specific operation on hand. The image display can involve the radar and /or chart information as well as other related navigation or ship data.

3.64 User dialogue area: The display area that involves the data field and /or menu (which should be displayed interactively) and in which the parameter, data and command are input or selected mainly in the form of letter or digit.

4 Plans and documents

4.1 The following plans and documents should be submitted for review, and the plans/documents submitted for review should at least include the following contents:

4.1.1 Complete machine outline and structure diagram (including the arrangement diagram of the front panel and back plate);

4.1.2 Diagram of main components, such as the antenna unit, transmit-receive unit, display unit, and mainframe unit;

4.1.3 Circuit schematic diagram;

4.1.4 System block diagram;

4.1.5 External wiring diagram;

4.1.6 Technical product condition;

4.1.7 Product operation, installation and maintenance manual;

4.1.8 Software instructions;

4.1.9 List of key materials and components.

4.2 The following plans and documents should be submitted for review, and the approved plan/data should at least include the following contents:

4.2.1 Factory overview: Factory name, address, production history, production capacity, technical and inspection personnel, main products, affiliation, and product brand;

4.2.2 Detailed list of products applied for approval;

4.2.3 List of main production equipment;

4.2.4 List of main test equipment;

4.2.5 Brief manufacturing process of the product applied for approval, including at least such key processes as the assembly and debugging;

4.2.6 Quality management document or quality system certificate;

4.2.7 Enterprise registration certificate;

4.2.8 Qualification certificate and / or production certificate (if applicable);

4.2.9 Sample of product quality certificate or certification;

4.2.10 Quality control plan (if applicable);

4.2.11 List of qualified suppliers;

4.2.12 Type test program.

5 Technical requirement

5.1 Environmental conditions

5.1.1 The radar equipment should work normally under the conditions during normal ship operation, including the vibration and shock generated, as well as the humidity and temperature encountered. (Article 5 of A.694 (17))

5.2 System power supply

5.2.1 The equipment should work normally during the power supply fluctuation specified below: During AC power supply, the steady-state voltage is +10%~-10% of the rated value, and frequency is ±5% of the rated value; the transient voltage is ±20% of the rated value, and the restoring time is 1.5 s; the frequency is ±10% of the rated value, and the restoring time is 5 s. During DC power supply, the steady-state voltage is -10%~+30% of the rated value. (Article 4.1 of A.694(17) and Articles 5.2.2 and 10.7 of IEC60945)

5.2.2 The equipment should be provided with protective device to avoid overcurrent, overvoltage, power transient, and unexpected reverse connection of electrical polarity. (Article 4.2 of A.694(17) and Article 5.2.3 of IEC60945)

5.3 Transmission and interference

5.3.1 The radar should transmit signals within the marine radar band allocated by ITU, and meet the requirements of the radio regulation and the applicable *ITU-R Recommendation*. (Article 5.1.1 of MSC.192 (79) and Article 6.2.1.1 of IEC62388)

5.3.2 The Guideline involves the radar systems with the X band (9.2-9.5 GHz) and S-bank (2.9-3.1 GHz). The band being used should be marked. (Article 5.1.2 of MSC.192 (79) and Article 6.2.1.1 of IEC62388)

5.3.3 The radar should work normally under typical interference environment. (Article 5.1.3 of MSC.192 (79) and Article 6.2.2.1 of IEC62388)

5.4 Radar performance optimization and tuning

5.4.1 Measures should be taken to ensure the radar system works in the optimal performance status. If any radar technology is applicable, both manual and automatic tuning should be provided. (Article 5.7.1 of MSC.192 (79) and Article 6.3.2.1 of IEC62388)

5.4.2 If no targets are available, relevant indication should be provided to ensure the optimal working performance of the system. (Article 5.7.2 of MSC.192 (79) and Article 6.3.2.1 of IEC62388)

5.4.3 Automatic or manual operation should be available to judge the deterioration of the system performance during system operation (with respect to the verification standard used during equipment installation). (Article 5.7.3 of MSC.192 (79) and Article 6.3.2.1 of IEC62388)

5.5 Gain and clutter interference prevention

5.5.1 Measures should be taken as far as possible to reduce redundant echo, including the interference of clutter echo from the sea surface, rain, other rainfall, cloud, sandstorm, and other radars. (Article 5.3.2.1 of MSC.192 (79) and Article 6.4.1 of IEC62388)

5.5.2 The gain control function should be provided to set the system gain or signal sensitiveness limit level. (Article 5.3.2.2 of MSC.192 (79) and Article 6.4.2.1 of IEC62388)

5.5.3 Effective manual and automatic clutter interference prevention function should be provided. (Article 5.3.2.3 of MSC.192 (79) and Article 6.4.3.1 of IEC62388)

5.5.4 The clutter interference prevention function with the combination of both automatic and manual operations is allowed. (Article 5.3.2.4 of MSC.192 (79) and Article 6.4.3.1 of IEC62388)

5.5.5 The status and degree of the gain and all clutter interference preventions should be marked clearly and permanently. (Article 5.3.2.5 of MSC.192 (79) and Article 6.4.3.1 of IEC62388)

5.6 Signal processing

5.6.1 In case of any close-range clutter, the radar system should strengthen the visibility of the target. (Article 5.3.1.3.2 of MSC.192 (79) and Article 6.5.2.1 of IEC62388)

5.6.2 The target definition displayed on the display should be improved. (Article 5.3.3.1 of MSC.192 (79) and Article 6.5.2.1 of IEC62388)

5.6.3 Sufficient effective signal processing and image renewal cycle should be provided, and the min. delay time should meet the requirement on the inspection and relevant processing of the target. (Article 5.3.3.2 of MSC.192 (79) and Article 6.5.4.1 of IEC62388).

5.6.4 The image should be renewed steadily and continuously. (Article 5.3.3.3 of MSC.192 (79) and Article 6.5.7.1 of IEC62388)

5.7 Operation on search and rescue radar transponder and radar beacon

5.7.1 The X band radar system should detect the radar beacon at relevant band. (Article 5.3.4.1 of MSC.192 (79) and Article 6.6.2.1 of IEC62388)

5.7.2 The X band radar system should detect the SART and radar target intensifier. (Article 5.3.4.2 of MSC.192 (79) and Article 6.6.2.1 of IEC62388)

5.7.3 The signal processing function hindering the detection and display of the X band radar beacon or SART should be disenabled, including the polarization mode change. The status should be marked. (Article 5.3.4.3 of MSC.192 (79) and Article 6.6.2.1 of IEC62388)

5.8 Min. detection range and range compensation

5.8.1 If multiple antennas are installed, each antenna selected should be capable of automatic range error compensation. (Article 5.4.2 of MSC.192 (79) and Article 6.7.2.1 of IEC62388)

5.8.2 During short-range detection of the target under the condition specified in Table 5.8.2, the requirements of 5.8.1 and 5.8.3 should be met. (Article 5.3.1.2 of MSC.192 (79) and Article 6.7.3.1 of IEC62388)

5.8.3 When the ship speed is zero, the antenna is at a position 15 m higher than the sea surface, and the sea is calm, the guidance beacons listed in the table below should be detected in the area from the place with the shortest horizontal range of 40 m to the antenna to the place 1NM away without changing the settings of the control function (except for the range selector). (Article 5.4.1 of MSC.192 (79) and Article 6.7.3.1 of IEC62388)

Initial detection range without clutter echo **Table 5.8.2**

Target description	**Target feature**	**Detection range, NM**	
Target description	**Height above the sea surface, m**	**X band, NM**	**S band, NM**
Coastline	Rise to 60	20	20
Coastline	Rise to 6	8	8
Coastline	Rise to 3	6	6
SOLAS ship (over 5,000 GT)	10	11	11
SOLAS ship (over 500 GT)	5.0	8	8
Boat equipped with radar reflector meeting the IMO performance standard	4.0	5.0	3.7
Guidance beacon provided with corner reflector	3.5	4.9	3.6
Typical guidance beacon	3.5	4.6	3.0
Boat of 10 m in length without radar reflector	2.0	3.4	3.0
Beacon	1.0	2.0	1.0

5.9 Range and azimuth resolution

5.9.1 The range and azimuth resolution should be measured when the sea is calm with range scale of not more than 1.5 NM and 50%~100% of the selected range scale. (Article 5.5 of MSC.192 (79) and Article 6.8.2 of IEC62388)

5.9.2 The radar system should display the targets at 2 points representing different targets show in Table 5.8.2 in the same azimuths with space of 40 m. (Article 5.5.1 of MSC.192 (79) and Article 6.8.3.1 of IEC62388)

5.9.3 The radar system should display the targets at 2 points representing different targets show in Table 5.8.2 in the same azimuths with bearing interval of 2.5°. (Article 5.5.2 of MSC.192 (79) and Article 6.8.4.1 of IEC62388)

5.9.4 The requirements on radar range and azimuth accuracy are as follows:

Range accuracy: 30 m or within 1% of the range scale used, whichever is bigger;

Azimuth accuracy: Within 1°. (Article 5.2 of MSC.192 (79) and Article 6.8.5.1 of IEC62388)

5.10 Target detection

5.10.1 For long-range target and coastline detection without clutter echo, the requirement on the radar system is based on the normal transmission status, with no clutter echo, rainfall and atmospheric duct on the sea surface, and antenna located 15 m higher than the sea surface.

It is based on the following:

- The target is displayed at least 8 times out of 10 times of scanning (or the equivalent); and

The radar detection and false alarm probability is 10^{-4},

which should meet the requirements on the X-band and S-band equipment in Table 5.8.2. (Article 5.3.1.1 of MSC.192 (79) and Article 6.9.2.1 of IEC62388)

5.10.2 Compared with the detection capacities listed in 5.10.1 and Table 5.8.2, the performance limitation due to typical rainfall and clutter echo on the sea surface can reduce the target detection performance. (Article 5.3.1.3 of MSC.192 (79) and Article 6.9.3.1.1 of IEC62388)

5.10.3 The radar should be designed to guarantee the optimal and consistent detection performance (which is limited only by the physical limit of transmission). (Article 5.3.1.3.1 of MSC.192 (79) and Article 6.9.3.1.1 of IEC62388)

5.10.4 The smallest antenna provided for the radar system should meet the detection performance requirement. (Article 5.3.1.1 of MSC.192 (79) and Article 6.9.3.1 1 of IEC62388)

5.11 Radar antenna (including rolling and pitching)

5.11.1 The target detection performance of the equipment should not be affected seriously when the ship is subject to rolling or pitching of +/-10°. (Article 5.6 of MSC.192 (79) and Article 6.10.2.1 of IEC62388)

5.11.2 The antenna sidelobe should meet the system performance requirement defined in MSC.192 (79). (Article 7.4.3 of MSC.192 (79) and Article 6.10.4.1 of IEC62388)

5.12 Radar availability

5.12.1 The radar equipment should enter the operation and transmission status completely from the cold status four minutes after starting. There should also be standby status in which the radar doesn't transmit. The radar should enter completely the operation status from the standby status in five seconds. (Article 5.8 of MSC.192 (79) and Article 6.11.1 of IEC62388)

5.13 Display requirement

5.13.1 The displayed image should meet the requirement of MSC.191 (79) resolution. (Article 6.2.1 of MSC.192 (79) and Article 7.1.1 of IEC62388)

5.13.2 The displayed color, symbol and chart must meet SN.1/Circ.243/Rev.1. (Article 6.2.2 of MSC.192 (79), and SN.1/Circ.243/Rev.1 is the currently valid version)

5.14 Linearity and delay of display

5.14.1 The radar target should be displayed via range linear scale without delay starting from the zero range. (Article 5.9.5 of MSC.192 (79) and Article 7.2.1 of IEC62388)

5.15 Unified common reference point (CCRP)

5.15.1 The CCRP should lie in the center of the azimuth scale after the image is centered. The eccentric limit should apply to the position of the antenna selected. (Article 5.9.3 of MSC.192 (79) and Article 8.1.2.1 of IEC62388)

5.15.2 The range should be measured from the ship (such as the range ring, target range and azimuth, vernier and trace data) relative to the CCRP (for example, the commanding position). (Article 5.9.1 of MSC.192 (79) and Article 5.9.1 of IEC62388)

5.15.3 Equipment used to compensate the deviation between the antenna position and the CCRP during installation should be provided. In case that multiple antennas are installed, provisions should be available for deviation at different place for each antenna used in the radar system. When the radar sensor is selected, the deviation is activated automatically. (Article 5.9.1 of MSC.192 (79) and Article 8.1.4.1 of IEC62388)

5.16 Ship outline and heading marking line

5.16.1 The scale shape of the ship should be available on proper range scale. The image should be marked with the CCRP and the position of the radar antenna selected. (Article 5.9.2 of MSC.192 (79) and Article 8.2.2.1 of IEC62388)

5.16.2 The line from the CCRP to the azimuth scale should indicate the ship heading. (Article 5.14.1 of MSC.192 (79) and Article 8.2.3.1 of IEC62388)

5.16.3 Electronic means should be adopted to adjust the stem line to 0.1° or less. In case of multiple radar antennas, the antenna should be saved after being selected, and the heading compensation adopted automatically (azimuth deviation). (Article 5.14.2 of MSC.192 (79) and Article 8.2.3.1 of IEC62388)

5.16.4 The heading marking line should be capable of being canceled temporarily. Such function can be used together with the cancellation of other icons. (Article 5.14.3 of MSC.192 (79) and Article 8.2.3.1 of IEC62388)

5.17 Measurement unit

5.17.1 The unit of the range should be nautical mile (NM). However, the metric system can be used on the short-range scale. All the range values measured should be clear and accurate. (Article 5.9.4 of MSC.192 (79) and Article 9.2.1 of IEC62388)

5.18 Displaying range scale

5.18.1 Scales of 0.25, 0.5, 0.75, 1.5, 3, 6, 12 and 24 NM should be available. The range scale can be provided in addition to the mandatory equipment. In addition to the mandatory equipment, the short-range scale with metric system can also be provided. (Article 5.10.1 of MSC.192 (79) and Article 9.4.1.1 of IEC62388)

5.18.2 The range scale selected should be marked permanently. (Article 5.10.2 of MSC.192 (79) and Article 9.4.1.1 of IEC62388)

5.19 Variable range marker (VRM)

5.19.1 Two variable range markers should be provided at least. Each active variable range marker should be provided with digital readings and resolution ratio matching with the current range. (Article 5.12.1 of MSC.192 (79) and Article 9.5.2.1 of IEC62388)

5.19.2 The VRM should be used by the user to measure the target range in the operating display area, and the max. system error is 1% of the range scale being used or 30 m, whichever is bigger. (Article 5.12.2 of MSC.192 (79) and Article 9.5.2.1 of IEC62388)

5.20 Electronic bearing line (EBL)

5.20.1 At least 2 EBLs should be provided to measure the bearing of any point target in the operating display area and the uncertainty at the position ±0.5° from the display edge. The max. radar system error is 1°. (Article 5.15.1 of MSC.192 (79) and Article 9.6.2.1 of IEC62388)

5.20.2 Each active EBL should be provided with digital readings, and the definition should be sufficient enough to meet the requirement on system measurement accuracy. (Article 5.15.6 of MSC.192 (79) and Article 9.6.2.1 of IEC62388)

5.20.3 EBL should be capable of measurement relative to the ship heading and true north. The azimuth reference (true or relative) should be marked clearly. (Article 5.15.2 of MSC.192 (79) and Article 9.6.2.1 of IEC62388)

5.20.4 The starting point of the EBL can be moved from the CCRP to any point in the operating display area, and EBL can be reset to the CCRP via quick and simple operation. (Article 5.15.3 of MSC.192 (79) and Article 9.6.3.1 of IEC62388)

5.20.5 The EBL starting point can be fixed or moved at the ship speed. (Article 5.15.4 of MSC.192 (79) and Article 9.6.3.1 of IEC62388)

5.20.6 Measures should be taken to ensure that the user can position the EBL at any direction, and the incremental adjustment should be sufficient to meet the requirement on system measurement accuracy. (Article 5.15.5 of MSC.192 (79) and Article 9.6.3.1 of IEC62388)

5.21 User cursor

5.21.1 User cursor should be provided to quickly and compactly indicate the position in the operating display area. (Article 5.18.1 of MSC.192 (79) and Article 9.7.2.1 of IEC62388)

5.21.2 The cursor position should be easily determined on the display. (Article 5.18.4 of MSC.192 (79) and Article 9.7.2.1 of IEC62388)

5.21.3 The cursor position should be provided with continuous readings to indicate the range and azimuth measured at the CCRP, and/or the latitude and longitude of the cursor position displayed alternately or at the same time. (Article 5.18.2 of MSC.192 (79) and Article 9.7.2.1 of IEC62388)

5.21.4 The range and azimuth measurement accuracy of the cursor should meet relevant requirement of the VRM and EBL. (Article 5.18.5 of MSC.192 (79) and Article 9.7.2.1 of IEC62388)

5.21.5 The cursor can be used to select and cancel the target, chart or object in the operating display area. In addition, the cursor can also be used to select mode and function, change parameter and control the menu outside the operating display area. (Article 5.18.3 of MSC.192 (79) and Article 9.7.3.1 of IEC62388)

5.22 Range and azimuth deviation measurement

5.22.1 Means should be provided in the operating display area to measure the range and azimuth from one point to any other position. (Article 5.17 of MSC.192 (79) and Article 9.8.2.1 of IEC62388)

5.23 Parallel index lines (PI)

5.23.1 At least 4 independent parallel index lines should be provided, each of which can be shortened or closed separately. (Article 5.16.1 of MSC.192 (79) and Article 9.9.2.1 of IEC62388)

5.23.2 The azimuth and spacing of the PI can be set quickly and simply. The azimuth and spacing of any PI selected can be provided if required. (Article 5.16.2 of MSC.192 (79) and Article 9.9.2.1 of IEC62388)

5.24 Azimuth scale

5.24.1 Azimuth scale should be provided around the operating display area, which should indicate the azimuth viewed from the CCRP. (Article 5.13.1 of MSC.192 (79) and Article 9.10.2.1 of IEC62388)

5.24.2 The azimuth scale should lie outside the operating display area. The scale should be marked every 30° at least and the separation mark of at least 5° should be provided. The separation marks of 5° and 10° should be distinguished clearly. The separation mark of 1° can also be adopted if it can be distinguished. (Article 5.13.2 of MSC.192 (79) and Article 9.10.2.1 of IEC62388)

5.25 Scale ring with fixed range

5.25.1 Range scale rings with equal space should be provided for the selected range scale. The range scale ring should be marked during displaying. (Article 5.11.1 of MSC.192 (79) and Article 9.11.2.1 of IEC62388)

5.25.2 The system accuracy of the scale ring with fixed range should be 1% of the max. range of the range scale being used or 30 m, whichever is bigger. (Article 5.11.2 of MSC.192 (79) and Article 9.11.2.1 of IEC62388)

5.26 Display of map, ship route and waterway

5.26.1 The user should be able to establish, change, save, load and display the simple map/ship route/waterway with respect to the ship or geographic position. The operator should be able to cancel the data display via simple operation. (Article 5.32.1 of MSC.192 (79) and Article 9.12.2.1 of IEC62388)

5.26.2 When the equipment is shut down, the map/ship route/waterway should be saved. (Article 5.32.5 of MSC.192 (79) and Article 9.12.3.1 of IEC62388)

5.26.3 The map/ship route/waterway data can be transferred when relevant equipment module is to be replaced. (Article 5.32.6 of MSC.192 (79) and Article 9.12.3.1 of IEC62388)

5.26.4 The map/ship route/waterway can involve line, symbol, and datum point. (Article 5.32.2 of MSC.192 (79) and Article 9.12.4.1 of IEC62388)

5.26.5 The definitions on the line appearance, color and symbol are provided in SN.1/Circ.243/Rev.1. (Article 5.32.3 of MSC.192 (79), Article 9.12.4.1 of IEC62388, and SN.1/Circ.243/Rev.1 is the currently valid version)

5.26.6 The map/ship route/waterway chart should not reduce the radar information quality seriously. (Article 5.32.4 of MSC.192 (79) and Article 9.12.4.1 of IEC62388)

5.27 Azimuth angle stability

5.27.1 The heading information should be provided with the gyroscopic compass or equivalent sensor with performance not lower than relevant standard approved by CCS. (Article 5.19.1 of MSC.192 (79) and Article 10.2.1.1 of IEC62388)

5.27.2 The azimuth accuracy displayed by the radar at the rate of turn that may be reached by the ship should be within 0.5° regardless of the effect of the stability sensor and transmission system type. (Article 5.19.2 of MSC.192 (79) and Article 10.2.1.1 of IEC62388)

5.27.3 The ship heading information should be displayed with the digital definition that is subject to tight alignment of the ship compass system. (Article 5.19.3 of MSC.192 (79) and Article 10.2.2.1 of IEC62388)

5.27.4 The ship heading information should refer to the CCRP. (Article 5.19.4 of MSC.192 (79) and Article 10.2.2.1 of IEC62388)

5.28 Motion and direction mode

5.28.1 True motion display mode should be provided. The automatic ship resetting can be conducted according to the position and relevant time displayed on the display or started according to such both conditions. If the resetting is to be carried out during each scanning or under equivalent condition, it should be equal to the true movement with fixed starting point (which is actually equal to the previous relative motion mode). (Article 5.20.1 of MSC.192 (79) and Articles 10.3.2.1 and 10.4.3.1 of IEC62388)

5.28.2 The direction mode with the north upward and course upward should be provided. If the display mode is equal to the true movement with fixed starting point (which is actually equal to the relative motion mode with stem upward), the display mode with stem steadily upward can be provided. (Article 5.20.2 of MSC.192 (79) and Item10.4.4.1 of IEC62388)

5.28.3 The motion and direction mode indication should be provided. (Article 5.20.3 of MSC.192 (79) and Article 10.4.4.1 of IEC62388)

5.29 Eccentricity

5.29.1 Manual eccentricity operation should be available to position the antenna at any point located within at least 50% of the radius away from the operating display area center. (Article 5.21.1 of MSC.192 (79) and Item10.4.2.1 of IEC62388)

5.29.2 During selection of the eccentricity display, the antenna position selected should be positioned on the display till it lies at any point located within at least 50% but not more than 75% of the radius away from the operating display area center. (Article 5.21.2 of MSC.192 (79) and Item10.4.2.1 of IEC62388)

5.29.3 During true motion, the antenna position selected should be able to reset automatically (50% of the radius at most) to the position where the max. viewing angle along the ship route can be guaranteed. Provision should be provided for early resetting of the antenna position selected. (Article 5.21.3 of MSC.192 (79) and Article 10.4.3.1 of IEC62388)

5.30 Stability mode over the ground and water

5.30.1 Stability mode over the ground and water should be provided. (Article 5.22.1 of MSC.192 (79) and Article 10.5.1.1 of IEC62388)

5.30.2 The stability mode and stability source should be marked clearly. (Article 5.22.2 of MSC.192 (79) and Article 10.5.1.1 of IEC62388)

5.30.3 The ship speed source should be indicated and provided by the sensor meeting relevant stability mode requirement of the CCS. (Article 5.22.3 of MSC.192 (79) and Article 10.5.1.1 of IEC62388)

5.31 Target wake and track

5.31.1 The variable length (time) target wake should be provided with wake time and mode indication. For all true motion display modes, the true wake or relative wake should be selected in the resetting state. (Article 5.23.1 of MSC.192 (79) and Article 11.2.2.1 of IEC62388)

5.31.2 The wake should be distinguished from the target. (Article 5.23.2 of MSC.192 (79) and Article 11.2.2.1 of IEC62388)

5.31.3 After the following operations, the wake or track or both with reduced scale should be kept and displayed during scanning for 2 times or under equivalent conditions.

- Increase and decrease of the range scale;

- Compensation and reset of radar image position; and

- Change between true wake and relative wake. (Article 5.23.3 of MSC.192 (79) and Article 11.2.3.1 of IEC62388)

5.32 General requirement on target tracking

5.32.1 The radar target is provided by the radar sensor (transceiver). The signal can be filtered via relevant clutter control device. The radar target can be captured or tracked manually or automatically via the automatic target tracking equipment. (Article 5.25.1 of MSC.192 (79) and Article 11.3.1.1 of IEC62388)

5.33 Target information display

5.33.1 The target should be displayed as per the requirement of MSC.191 (79) with relevant signs specified in SN.1/Circ.243/Rev.1. (Article 5.24.1 of MSC.192 (79), Article 11.3.2.1 of IEC62388, and SN.1/Circ.243/Rev.1 is the currently valid version)

5.33.2 The target information can be provided by the radar target tracking function and automatic identification system (AIS). (Article 5.24.2 of MSC.192 (79) and Article 11.3.2.1 of IEC62388)

5.33.3 The course and ship speed of the radar target or reported AIS target should be tracked according to the predicted motion vector instructions. The vector time should be adjustable and valid to any target image display, regardless of its source. (Article 5.27.2 of MSC.192 (79) and Article 11.3.2.1 of IEC62388)

5.33.4 The UI for operating, displaying and marking the AIS and radar tracking information as well as the data format should be consistent as far as possible. (Article 5.24.5 of MSC.192 (79) and Article 11.3.2.1 of IEC62388)

5.34 Tracking calculation

5.34.1 The automatic target tracking calculation should be based on the relative radar target position and the measured ship motion value. (Article 5.25.1.1 of MSC.192 (79) and Article 11.3.3.1 of IEC62388)

5.34.2 Any other information source (if any) can be used to get the optimal tracking performance. (Article 5.25.1.2 of MSC.192 (79) and Article 11.3.3.1 of IEC62388)

5.35 Target tracking realizability

5.35.1 The TT device should be provided on the 3, 6 and 12 NM range scale at least. The tracking range should be expanded to 12 NM at least. (Article 5.25.1.3 of MSC.192 (79) and Article 11.3.4.1 of IEC62388)

5.36 Capacity of the tracked target

5.36.1 Table 1 lists the displayed target quantity related to the display size. When the radar target tracking capacity or AIS report target processing/displaying capacity reaches such limit, relevant indication should be displayed. (Article 5.24.4 of MSC.192 (79) and Article 11.3.5.1 of IEC62388)

5.36.2 In addition to handling the target reported AIS, it should track the min. quantity of radar tracking target as per Table 1 and provide full image displaying function. (Article 5.25.2.1 of MSC.192 (79) and Article 11.3.5.1 of IEC62388)

5.36.3 Indication should be available when the limit of the target tracking capacity is to be reached. The radar system performance should not be lowered due the target overflow. (Article 5.25.2.2 of MSC.192 (79) and Article 11.3.5.1 of IEC62388)

5.37 Capturing

5.37.1 The radar target should be captured manually, and the min. target quantity should meet the requirement in Table 1. (Article 5.25.3.1 of MSC.192 (79) and Article 11.3.6.1 of IEC62388)

5.37.2 Automatic capturing function should be provided as per Table 1. In this case, the method to determine the boundary of the automatic capturing zone should be provided to the user. (Article 5.25.3.2 of MSC.192 (79) and Article 11.3.7.1 of IEC62388)

5.38 Motion tendency

5.38.1 When capturing targets, the system should display the target motion tendency in 1 min. and predict the target motion in 3 min. (Article 5.25.4.1 of MSC.192 (79) and Article 11.3.8.1 of IEC62388)

5.39 Visibility

5.39.1 The system should track the radar target continuously, and distinguish clearly such target for 5 times (or the equivalent situation) out of 10 times of continuous scans on the display. (Article 5.25.4.3 of MSC.192 (79) and Article 11.3.9.1 of IEC62388)

5.40 Tracking algorithm

5.40.1 The TT should be designed to guarantee the fairing and effectiveness of the target vector and data and early detection on target manipulation. (Article 5.25.4.4 of MSC.192 (79) and Article 11.3.10.1 of IEC62388)

5.41 Target exchange

5.41.1 Design should be provided to minimize the probability of tracking error (including target exchange). (Article 5.25.4.5 of MSC.192 (79) and Article 11.3.11.1 of IEC62388)

5.42 Stopping tracking

5.42.1 Independent equipment should be provided to cancel one or all targets. (Article 5.25.4.6 of MSC.192 (79) and Article 11.3.12.1 of IEC62388)

5.43 Target motion and tracking accuracy

5.43.1 TT should track and update automatically the information of the targets captured. (Article 5.25.4.2 of MSC.192 (79) and Article 11.3.14.1 of IEC62388)

5.43.2 If the sensor error allowed by relevant performance standard of CCS is assumed, the automatic tracking accuracy should be reached when the tracked target enters the stable status. (Article 5.25.4.7 of MSC.192 (79) and Article 11.3.14.1 of IEC62388)

5.43.3 For ships with max. true speed of 30 kn, the tracking equipment should display the relative motion in the 1 min. of stable status tracking, and the predicted motion of a target in 3 min. within the following accuracy range (with probability of 95%): (Article 5.25.4.7.1 of MSC.192 (79) and Article 11.3.14.1 of IEC62388)

Accuracy of tracked targets (probability value of 95%) Table 5.43.3

Stable status time min.	Relative course °	Relative speed kn	CPA NM	TCPA min	True course °	True ship speed kn
1min.: Tendency	11	1.5 or 10% (whichever is bigger)	1.0	-	-	-
3min：Motion	3	0.8 or 1% (whichever is	0.3	0.5	5	0.5 or 1% (whichever

		bigger)				is bigger)

5.43.4 For ships with speed of more than 30 kn (generally the HSC) or 70 kn at most, additional stable state measurement should be conducted, so as to maintain the motion accuracy when the relative target speed reaches 140 kn after the 3 min. of stable state tracking. (Article 5.25.4.7.2 of MSC.192 (79) and Article 11.3.14.1 of IEC62388)

5.43.5 When the ship sails at normal or high speed, the radio system should be able to track the target with max. relative speed corresponding to its level. (Article 5.25.1.4 of MSC.192 (79) and Article 11.3.14.1 of IEC62388)

5.44 Radar range and azimuth accuracy

5.44.1 The accuracy may be lowered dramatically during and after target capturing, ship manipulation, target manipulation, or tracking interference, which also depends on the ship motion and sensor accuracy. The target range and azimuth measured should be within 50m (or +/-1% of the target range) and 2° respectively. (Article 5.25.4.7.1 of MSC.192 (79) and Article 11.3.15.1 of IEC62388)

5.45 Reference target

5.45.1 The ground reference function based on the static tracking target should be provided. The target applied to such function should adopt relevant signs defined in SN.1/Circ.243/Rev.1 for marking. (Article 25.4.8 of MSC.192 (79), Article 11.3.16.1 of IEC62388, and SN.1/Circ.243/Rev.1 is the currently valid version)

5.46 Tracking limit

5.46.1 The test standard should involve specific target simulation test to verify the target accuracy when the relative speed reaches 100 kn. Some accuracy value in the table can be changed to indicate the relative situation of the target motion in the test scenario adopted for the ship. (Article 5.25.4.7.1 of MSC.192 (79) and Article 11.4.1.1 of IEC62388)

5.47 General requirement on the automatic identification system (AIS)

5.47.1 The target reported can be filtered as per the parameter defined by the user. The target can be dormant or activated. The method to handle the activated target is similar with that of the radar tracking target. (Article 5.26.1 of MSC.192 (79) and Article 11.5.1 of IEC62388)

5.48 AIS target capacity

5.48.1 In addition to the radar tracking requirement, it should display the min. quantity of dormant or activated AIS targets as per Table 1, and provide full image display function. Indication should be available when the limit of the AIS target handling/displaying capacity is to be reached. (Article 5.26.2 of MSC.192 (79) and Article 11.5.2.1 of IEC62388)

5.49 Filtering of AIS dormant target

5.49.1 To reduce the clutter display, method to filter the AIS dormant target image and filtering status indication (via such means as the target range, CPA/TCPA or AIS target A/B level) should be provided. Separate AIS target should not be deleted from the display. (Article 5.26.3 of MSC.192 (79) and Article 11.5.3.1 of IEC62388)

5.50 AIS target activation

5.50.1 The method to activate a dormant AIS target or prevent an activated AIS target from being active again should be provided. The area to activate the AIS target automatically, if any, should be the same with the automatic radar target capturing area. In addition, in case of any user-defined parameter (such as the target range, CPA/TCPA or AIS target A/B level), the dormant AIS target should be activated automatically. (Article 5.26.4 of MSC.192 (79) and Article 11.5.4.1 of IEC62388)

5.51 AIS display

5.51.1 The AIS display status is shown in Table 5.51. (Article 5.26.5 of MSC.192 (79))

AIS display status **Table 5.51**

Function	**Status to be displayed**		**Display**
AIS enabling/disenabling	AIS processing enabling/graph display disenabling	AIS processing enabling /graph display enabling	Letter, digit or icon
Filtering of dormant AIS target	Filtering condition	Filtering status	Letter, digit or icon
Target activation		Activation criterion	Icon
CPA/TCPA alarm	Function enabling/disenabling Including dormant target	Function enabling/disenabling Including dormant target	Letter, digit and icon
Missing target alarm	Function enabling/disenabling Filtering criterion of missing target	Function enabling/disenabling Filtering criterion of missing target	Letter, digit and icon

Continued Table 5.51

Target association	Function enabling/disenabling Association criterion Default target priority	Function enabling/disenabling Association criterion Default target priority	Letter and digit

5.51.2 Proper signs should be used to display targets as per the requirement of MSC.191 (79) and SN.1/Circ.243/Rev.1. (Article 5.27 of MSC.192 (79), Article 11.5.5.1 of IEC62388, and SN.1/Circ.243/Rev.1 is the currently valid version)

5.51.3 If the displayed AIS target is missing, it should be displayed as the dormant one. (Article 5.27.1 of MSC.192 (79) and Article 11.5.5.1 of IEC62388)

5.51.4 The course and ship speed of the radar target or reported AIS target should be tracked according to the predicted motion vector instructions. The vector time should be adjustable and valid to any target image display, regardless of its source. (Article 5.27.2 of MSC.192 (79) and Article 11.5.5.1 of IEC62388)

5.51.5 The mode, time and stability of the vector should be indicated permanently. (Article 5.27.3 of MSC.192 (79) and Article 11.5.5.1 of IEC62388)

5.51.6 During alignment of the tracked radar and AIS sign with other information on the display, the CCRP should be adopted. (Article 5.27.4 of MSC.192 (79) and Article 11.5.5.1 of IEC62388)

5.51.7 The true-scale outline of an activated AIS target should be displayed on a high-proportion/low-range display. The previous trace of the activated target should also be displayed. (Article 5.27.5 of MSC.192 (79) and Article 11.5.5.1 of IEC62388)

5.52 Radar and AIS target data

5.52.1 Any tracked radar or AIS target should be able to be selected, so that the data can be displayed with letters and digits. The target selected to be displayed with letter and digit information should be marked with relevant signs. If more than one targets are selected to be displayed with data, relevant signs and corresponding data should be marked clearly. It should be marked clearly that the target data is from the radar or AIS. (Article 5.28.1 of MSC.192 (79) and Article 11.6.1 of IEC62388)

5.52.2 For each tracked radar target selected, the following data should be displayed in the form of letter and digit: data source, actual target range, actual target azimuth, expected target range of the CPA, expected TCPA, true target course, and true target speed. (Article 5.28.2 of MSC.192 (79) and Article 11.6.1 of IEC62388)

5.52.3 For each AIS target selected, the following data should be displayed in the form of letter and digit: data source, ship identification, navigation status, position (if any) and its mass, range, azimuth, COG, SOG, CPA and TCPA. The target heading and rate of turn reported should also be

provided. The target information should also be affixed if required. (Article 5.28.3 of MSC.192 (79) and Article 11.6.1 of IEC62388)

5.52.4 If the AIS information received is not complete, the missing information should be marked "Missing" clearly in the target data field. (Article 5.28.4 of MSC.192 (79) and Article 11.6.1 of IEC62388)

5.52.5 The updated data should be displayed and maintained before selecting another target display data or closing the window. (Article 5.28.5 of MSC.192 (79) and Article 11.6.1 of IEC62388)

5.52.6 The ship AIS data should be displayed if required. (Article 5.28.6 of MSC.192 (79) and Article 11.6.1 of IEC62388)

5.53 Operation alarm

5.53.1 If the CPA and TCPA values of the tracked or activated AIS target are calculated to be smaller than the settings, then:

- CPA/TCPA alarm should be sent.

- The target should be marked clearly. (Article 5.29.1 of MSC.192 (79) and Article 11.7.1.1 of IEC62388)

5.53.2 The CPA/TCPA limit values of the preset radar target and AIS target should be the same. In case of any missing, the CPA/TCPA alarm function should apply to all the activated AIS targets. If the user requires, the CPA/TCPA alarm function can also apply to the dormant target. (Article 5.29.2 of MSC.192 (79) and Article 11.7.1.1 of IEC62388)

5.53.3 If there are user-defined capturing/activation settings, proper signs should be used to mark clearly the targets not captured/activated previously that enter or are found in the area, and an alarm should be given at the same time. The user should be able to set the range and outline of the area. (Article 5.29.3 of MSC.192 (79) and Article 11.7.2.1 of IEC62388)

5.53.4 If the tracked radar target is missing, the system should remind the user rather than eliminate the target via the preset range or parameters. The last position of the target should be marked on the display clearly. (Article 5.29.4 of MSC.192 (79) and Article 11.7.3.1 of IEC62388)

5.53.5 The missing alarm function of the AIS target can be enabled or disenabled. If such function is disenabled, relevant indication should be provided.

If the missing AIS target meets the following circumstances:

- The alarm function of the AIS Missing target alarm is enabled.

- The target is important according to the filtering criterion of missing target.

- No information is received in the specified time (depended on the nominal report rate of the AIS target).

Then:

- The missing target should be clearly marked and an alarm given at the last known position.

- The missing target display should disappear when the signal or alarm response is received again.

- The limited history data in previous report should be restored. (Article 5.29.5 of MSC.192 (79) and Article 11.7.4.1 of IEC62388)

5.54 Target association

5.54.1 For the same physical target, 2 target signs should not be displayed when the automatic target association function based on the consistency criterion is enabled. (Article 5.30 of MSC.192 (79) and Article 11.8.2.1 of IEC62388)

5.54.2 If both the AIS and radar tracking target data are available and meet the consistency criterion (such as the position and motion), the AIS and radar information can be assumed to be the same physical target. In case of any missing, the letter and digit data of the activated AIS target sign and AIS target should be selected and displayed automatically. (Article 5.30.1 of MSC.192 (79) and Article 11.8.2.1 of IEC62388)

5.54.3 The user should be able to change the missing status into displaying the tracked radar target, as well as select the radar tracking data or AIS letter and digit data. (Article 5.30.2 of MSC.192 (79) and Article 11.8.2.1 of IEC62388)

5.54.4 For associated target, if the AIS and radar information are totally different, they should be treated as 2 different targets, and displayed as an activated AIS target and a tracked radar target. No alarm should be given. (Article 5.30.3 of MSC.192 (79) and Article 11.8.2.1 of IEC62388)

5.55 Trial ship handling function

5.55.1 The system should (if required in Table 1) be able to simulate the expected impact of potential danger on the ship manipulation, including the dynamic feature of the ship. The longitudinal simulation of the trial ship handling function should be marked clearly. The specific requirements are as follows:

- The simulated ship course and speed should be changeable.

- Count-down of the simulated manipulation time should be carried out.

- During the simulation, the target tracking should be continued, and the actual target data should be indicated.

- The trial ship handling function should be applied to all tracked targets and all the activated AIS targets at least. (Article 5.31 of MSC.192 (79) and Article 11.9.2.1 of IEC62388)

5.56 Chart operation (optional) and source

5.56.1 The radar information should be displayed with priority. The chart information should be displayed in such a way that the radar information will not be shielded, get dimmed or downgraded. The chart information should be clear and visible. (Article 5.33.5 of MSC.192 (79) and Article 12.1.2.1 of IEC62388)

5.56.2 To provide continuous and real-time position monitoring, the radar system should be capable of displaying ENC and other vector chart information in the operation display area. The operator should be able to cancel the chart data display via simple operation. (Article 5.33.1 of MSC.192 (79) and Article 12.1.2.1 of IEC62388)

5.56.3 The ENC information should be the main information source and comply with relevant IHO standards. The status of other information should adopt fixed indication for marking. The source and latest information should be provided. (Article 5.33.2 of MSC.192 (79) and Article 12.1.2.1 of IEC62388)

5.57 Chart (optional) element and realizability

5.57.1 As a minimum requirement, the components of the ECDIS standard display should be used when a type or layer of targets rather than single target are selected. (Article 5.33.3 of MSC.192 (79) and Article 12.1.3.1 of IEC62388)

5.58 Chart (optional) reference

5.58.1 The chart information should adopt the same reference and coordinate rules with those of the radar/AIS, including the data, ruler, direction, CCRP and stability mode. (Article 5.33.4 of MSC.192 (79) and Article 12.1.4.2 of IEC62388)

5.59 Chart (optional) sign and color

5.59.1 The sign and color should comply with MSC.191 (79) and SN.1/Circ.243/Rev.1. (Article 5.33.7 of MSC.192 (79), Article 12.1.9.1 of IEC62388, and SN.1/Circ.243/Rev.1 is the currently valid version)

5.60 Chart (optional) display size

5.60.1 The display size should meet the requirement of Table 1. (Article 6.2.3 of MSC.192 (79) and Article 12.1.10.1 of IEC62388)

5.61 Chart (optional) failure

5.61.1 The failure of the chart data source should not affect the radar/AIS system operation. (Article 5.33.6 of MSC.192 (79) and Article 12.1.12.1 of IEC62388)

5.62 Man - machine engineering rule

5.62.1 The radar system design should facilitate the operation. The operation and control equipment should be provided with coordinated UI featuring easy recognition and operation. (Article 6.1.1 of MSC.192 (79) and Article 13.2.1 of IEC62388)

5.62.2 The radar system should be able to be switched on or off on the main system radar display or at the control position. (Article 6.1.2 of MSC.192 (79) and Article 13.2.1 of IEC62388)

5.62.3 The control equipment function can be realized via special hardware, HMI or combination of both; the main control function should be realized via special hardware controller or virtual key with relevant status indicated at the unified and intuitive position. (Article 6.1.3 of MSC.192 (79) and Article 13.2.1 of IEC62388)

5.62.4 The main radar control functions are defined as follows, which should be able to be operated at any time: Radar backup/RUN, range scale selection, gain, tuning function (if applicable), rain interference prevention, wave disturbance prevention, AIS function enabling/disenabling, alarm response, vernier, method of setting EBL/VRM, display brightness and radar target capture. (Article 6.1.4 of MSC.192 (79) and Article 13.3.1 of IEC62388)

5.62.5 In addition to the main controller, the main functions can also be operated from the remote control position. (Article 6.1.5 of MSC.192 (79) and Article 13.2.1 of IEC62388)

5.62.6 The quantity, design, function type, position, arrangement and size of the operation controller should facilitate the purposes of simpleness, quickness and effectiveness. The arrangement of the controller should reduce the risk of careless operation. (Article 3.1 of A.694(17))

5.62.7 The controller should be able to be adjusted for easy operation, and be recognized easily at the general operation position. (Article 3.2 of A.694(17))

5.62.8 Sufficient illumination should be provided in the equipment to facilitate the recognition of the controller and indicator at any time. Means to reduce the light source output of any equipment should be available to avoid any impact on the sailing. (Article 3.3 of A.694(17))

5.62.9 The equipment design should guarantee that any controller maloperation will not cause equipment damage or personnel injury. (Article 3.4 of A.694(17))

5.63 Input data

5.63.1 The radar system should receive the input information required by the following equipment:

- Gyroscopic compass or heading transmission device (THD);

- Speed and distance measurement equipment (SDME);

- Electronic position fixing system (EPFS);

- Automatic identification system (AIS); or

- Other sensor or network accepted by CCS for providing equivalent information.

According to the accepted international standard IEC61162, the radar should be connected to relevant sensor meeting the requirement of performance standard. (Article 8.1 of MSC.192 (79) and Article 14.2.1.1 of IEC62388)

5.64 Input data integration and waiting time

5.64.1 The radar system should not use the data marked as invalid. If the input data are of inferior quality, they should be marked clearly. (Article 8.2.1 of MSC.192 (79) and Article 14.2.2.1 of IEC62388)

5.64.2 If practical, the data should be subject to integration verification before use via the comparison with other sensor connected or testing at effective or proper data limit. (Article 8.2.2 of MSC.192 (79) and Article 14.2.2.1 of IEC62388)

5.64.3 The waiting time for processing input data should be minimized. (Article 8.2.3 of MSC.192 (79) and Article 14.2.2.1 of IEC62388)

5.65 Output data

5.65.1 All the information provided from the radar output interface to other system should comply with the international standard IEC61162. (Article 8.3.1 of MSC.192 (79) and Article 14.3.1.1 of IEC62388)

5.65.2 The radar system should provide the voyage data recorder (VDR) with display data output. (Article 8.3.2 of MSC.192 (79) and Article 14.3.3.1 of IEC62388)

5.66 Work design

5.66.1 If practical, the radar system should be designed to facilitate the failure diagnosis and provide the max. usability. (Article 7.1.1 of MSC.192 (79) and Article 15.2.1 of IEC62388)

5.66.2 For any key parts with limited service life, the radar system should provide means to record the total hours of use. (Article 7.1.2 of MSC.192 (79) and Article 15.2.1 of IEC62388)

5.66.3 The document should describe all daily maintenance requirements, including detailed description on parts with limited service life as well as the recommended replacement description. (Article 7.1.3 of MSC.192 (79) and Article 15.2.1 of IEC62388)

5.67 Display requirement

5.67.1 The physical requirement on the display equipment should comply with the provisions of MSC.191 (79), SN.1/Circ.243/Rev.1, and Table 1. (Article 7.2 of MSC.192 (79), Article 15.3.1 of IEC62388, and SN.1/Circ.243/Rev.1 is the currently valid version)

5.68 Transmitter silence

5.68.1 The equipment should be provided with silence device to prevent the radar energy from being transmitted in the preset sector. Sector silence status indication should be provided. (Article 7.3 of MSC.192 (79) and Article 15.4.2.1 of IEC62388)

5.69 Antenna

5.69.1 The antenna should be designed to guarantee that the ship using the antenna can work continuously under the relative wind speed it may encounter. (Article 7.4.1 of MSC.192 (79) and Article 15.5.1 of IEC62388)

5.69.2 The combined radar system should be capable of providing the ship using the antenna with proper information updating rate. (Article 7.4.2 of MSC.192 (79) and Article 15.5.1 of IEC62388)

5.69.3 Means should be provided to prevent the antenna from rotation or transmission during operation or when there is any person near the topmast device. (Article 7.4.4 of MSC.192 (79))

5.70 Combined multiple radars

5.70.1 The system should avoid single point system failure. In case of any resultant failure, the automatic failure protection condition should be adopted. (Article 5.35.1 of MSC.192 (79) and Article 15.6.2.1 of IEC62388)

5.70.2 The source, processing or combination of the radar signals should be indicated. (Article 5.35.2 of MSC.192 (79) and Article 15.6.3.1 of IEC62388)

5.70.3 The system status of each display position should be obtained. (Article 5.35.3 of MSC.192 (79) and Article 15.6.4.1 of IEC62388)

5.71 Alarm and indication

5.71.1 The alarm and indication should comply with MSC.191 (79) and MSC302(87). (Article 5.34 of MSC.192 (79) and Articles 16.1.2.1 and 16.1.1 of IEC62388)

5.71.2 At least one normally-closed contact (independent) should be provided to indicate the radar failure. (Article 8.3.3 of MSC.192 (79) and Article 16.1.3.1 of IEC62388)

5.71.3 The radar should be provided with a two-way interface for communication, so as to transmit the radar alarm to the external system, and silence or confirm the audio radar alarm from external system. The alarm should meet relevant international standard. (Article 8.3.4 of MSC.192 (79) and Article 16.1.4.1 of IEC62388)

5.71.4 When the "Image is static", warning sign should be provided for the user. (Article 5.34.1 of MSC.192 (79) and Article 16.1.8.1 of IEC62388)

5.71.5 In case of any failure of signal or sensor being used (including the gyroscopic compass, log, azimuth angle, video, synchronization and heading mark), an alarm should be given. The system function should be limited to the backup mode, or forbid displaying of the display under certain circumstance. (Article 5.34.2 of MSC.192 (79) and Article 16.1.9.1 of IEC62388)

5.72 Heading information failure (azimuth angle stability)

5.72.1 The equipment should work normally in the unsteady mode with ship bow line upward. (Article 9.1.1 of MSC.192 (79) and Article 16.2.2.1 of IEC62388)

5.72.2 Within 1 min. after the azimuth stabilization failure, the equipment should be started automatically to the unsteady mode with ship bow line upward. (Article 9.1.2 of MSC.192 (79) and Article 16.2.2.1 of IEC62388)

5.72.3 If the automatic clutter processing prevention will prevent the target from being detected in unsteady status, the processing should be stopped automatically in 1 min. after the azimuth stabilization failure. (Article 9.1.3 of MSC.192 (79) and Article 16.2.2.1 of IEC62388)

5.72.4 Indication should be provided that only the relative azimuth can be used for measurement. (Article 9.1.4 of MSC.192 (79) and Article 16.2.2.1 of IEC62388)

5.73 Information failure of ship speed over the water

5.73.1 Manual speed input method should be provided and relevant operating method marked clearly. (Article 9.2 of MSC.192 (79) and Article 16.2.3.1 of IEC62388)

5.74 Information failure of course and ship speed over the ground

5.74.1 During equipment operation, the course and ship speed over the water can be adopted. (Article 9.3 of MSC.192 (79) and Article 16.2.4.1 of IEC62388)

5.75 Failure of position input information

5.75.1 If only single reference target or manual input position is defined and used, the superposition of the chart data and geographic reference chart should be canceled. (Article 9.4 of MSC.192 (79) and Article 16.2.5.1 of IEC62388)

5.76 Failure of radar video input information

5.76.1 If there is no radar signal, the equipment should display the target information according to the AIS data. The static radar image should not be displayed. (Article 9.5 of MSC.192 (79) and Article 16.2.6.1 of IEC62388)

5.77 AIS input information failure

5.77.1 If there is no AIS signal, the equipment should display the radar image and target database. (Article 9.6 of MSC.192 (79) and Article 16.2.7.1 of IEC62388)

5.78 Failure of combined or network system

5.78.1 The equipment should work like an independent system. (Article 9.7 of MSC.192 (79) and Article 16.2.8.1 of IEC62388)

5.79 Antenna installation

5.79.1 The dead zones should be minimized, and not located in the horizontal arc from the straight ahead position of the ship to a position 22.5° behind the abeam of the ship, especially the straight ahead position (relative azimuth of 000°). The antenna installation should guarantee that the radar system performance should not be affected seriously. The antenna should be installed on a structure that will not cause signal reflection, including other antenna and duck structure or cargo. In addition, the radar detection performance related to the initial detection range and target visibility with clutter on the sea surface should be considered when determining the antenna height. (Article 7.5.1 of MSC.192 (79) and Article 18.3.2.2.1 of IEC62388)

5.80 Display installation

5.80.1 The display direction should guarantee that the user can look forward, the image view will not dim, and the ambient light on the display should be as dim as possible. (Article 7.5.2 of MSC.192 (79) and Article 18.3.2.3.1 of IEC62388)

5.81 Safety protection

5.81.1 When the combined peak voltage of the DC and AC in the circuit (except for the radio-frequency voltage) exceeds 55 V, protective measures should be taken on places easy to be touched by human body, and alarm marks should be provided at visible locations in the equipment. (Article 7.1 of A.694(17))

5.81.2 Measures should be taken to guarantee that the exposed metal parts of the equipment are grounded and no power cord ends are grounded. (Article 7.2 of A.694(17))

5.81.3 The mechanical noise of the equipment should be limited so that it will not affect the sound on which the ship may relay for safety. (Article 6.2 of A.694(17))

5.82 Mark and identification

5.82.1 The equipment should be provided with the following clear and visible marks:

(1) Manufacturer name or identification mark;

(2) Equipment model;

(3) Equipment number or serial number. (Article 9 of A.694(17))

5.82.2 For equipment generally installed near the standard magnetic compass or steering magnetic compass, the min. distance to such compass should be marked clearly. (Article 6.3 of A.694(17))

5.83 Maintenance

5.83.1 The manufacturing and installation of the equipment should facilitate the inspection and maintenance. (Article 8 of A.694(17))

5.84 Operation and training

5.84.1 The radar system design should facilitate the operation of trained users. (Article 7.6.1 of MSC.191 (79) and Article 18.1.2 of IEC62388)

5.84.2 Target simulation means and auxiliary materials should be provided to realize the operation training and familiarization on specific types of radars. (Article 7.6.2 of MSC.191 (79) and Article 18.1.2 of IEC62388)

5.85 Instructions and documents

5.85.1 Operation instructions

(1) The operation instructions should include proper explanations and/or descriptions on the information required by the user for proper radar operation, including:

- Proper setting on different weather conditions;

- Monitoring radar system performance;

- Operation in case of failure or under backup conditions;

- Limitation on display, tracking process and accuracy, including delay;

- Collision prevention via ship heading and SOG/COG information;

- Target association limit and condition;

- Selection criteria on automatic target activation and cancellation;

- Method of displaying and limiting AIS target;

- Technical criterion on trial ship handling function, including simulation on the ship manipulation feature (if any);

- Alarm and indication;

- Installation requirement on radar system;

- Radar range and azimuth accuracy; and

- Special operation on SART detection (for example, tuning); and

- CCRP's role during radar detection and its specific value. (Article 6.3.2 of MSC.192 (79) and Articles 11.4.3 and 18.2.3.1 of IEC62388)

(2) The user manual should specify the detection performance deterioration in the following circumstances with different ranges and target speeds (with respect to the data listed in Table 5.8.2):

- Light rain (4 mm/h) and heavy rain (16 mm/h);

- Sea states 2 and 5; and

- Combination of the above. (Article 5.3.1.3.3 of MSC.192 (79) and Article 6.9.3.1.1 of IEC62388)

(3) The user manual should specify the performance deterioration due to long transmission line, antenna height or other factors. (Article 5.3.1.3.5 of MSC.192 (79) and Article 6.9.4.1 of IEC62388)

(4) The equipment manual should explain the basic concept, feature and limit of signal processing. (Article 5.3.3.4 of MSC.192 (79) and Article 6.5.9.1 of IEC62388)

5.85.2 Manufacturer documents

(1) The manufacturer document should describe the radar system and the factors that may affect the detection performance, including waiting time for signal processing. (Article 6.3.3.1 of MSC.192 (79) and Article 18.2.2.1 of IEC62388)

(2) The document should describe the AIS filtering criterion and basis of the AIS/radar target association criterion. (Article 6.3.3.2 of MSC.192 (79) and Article 18.2.2.1 of IEC62388)

(3) The equipment document should involve detailed installation information, including the additional recommendations on the device position and factors that may lower the performance or reliability. (Article 6.3.3.3 of MSC.192 (79) and Article 18.3.1 of IEC62388)

(4) The requirement and Guideline on the radar system installation should be included in the manufacturer document. (Article 7.5 of MSC.192 (79) and Article 18.3.1 of IEC62388)

5.85.3 Maintenance documents

(1) Sufficient documents should be provided for proper equipment operation and maintenance. The documents should include the following:

① Detailed circuit diagram, component arrangement diagram and component list (if the equipment failure recognition and repairing is based on components);

② Sufficient documents for determining, distinguishing and replacing the module with failure (if the equipment unit is module and it is not practical to conduct equipment failure recognition and repairing based on components). (Article 8 of A.694(17))

6 Materials and components

It should be included in the list of qualified suppliers, and the materials and components of the manufacturer cannot be changed without the approval of CCS, including at least the following:

6.1 Antenna unit (including the housing, viscose, and slotted waveguide pipe);

6.2 Transmit-receive unit (including the performance monitor, receiving module, transmitting module, limiter, frequency mixer, magnetron, circulator, electromotor, and power module);

6.3 Mainframe unit (including data processing module, storage medium, and power module);

6.4 Display unit.

7 Type test

7.1 The item, method and technical index of the type test should meet the following:

Marine Navigation and Radio Communication Equipment and System- Marine Radar - Performance Requirement, Test Method and Required Test Result (IEC 62388-2013/COR1:2014 Edition 2.0 (2014-02-12))

Marine Navigation and Radio Communications Equipment and Systems - General Requirement, Test Method and Required Test Result (IEC 60945-2002)

Marine Navigation and Radio Communications Equipment and Systems - Notation on the Navigation-related Information on the Ship Navigation Display - General Requirement, Test Method and Required Test Result (IEC 62288-2014)

7.2 Type test items

Type test items **Table 7.2(1)**

E. Environmental test			
No.	**Test items**	**Test requirement**	**Supplementary instruction**

E.1	Dry heat	IEC 60945, 8.2 & 7.1	
E.2	Damp heat	IEC 60945, 8.3	
E.3	Low temperature	IEC 60945, 8.4 & 7.1	
E.4	Vibration	IEC 60945, 8.7	

Continued Table 7.2(1)

E.5	Rain and water spraying	IEC 60945, 8.8	Apply to exposed equipment with min. requirement of IPX6
E.6	Salt mist	IEC 60945, 8.12	
E.7	Max. steady surge of the power supply	IEC 60945, 7.1	Normal temperature
E.8	Power abnormality	IEC 60945, 7.2	
E.9	Conduction emission	IEC 60945, 9.2	
E.10	Radiation emission at the enclosure port	IEC 60945, 9.3	
E.11	Radio-frequency field conducted disturbance immunity	IEC 60945, 10.3	
E.12	Radio-frequency electromagnetic field radiated immunity	IEC 60945, 10.4	
E.13	Electrical fast transient immunity	IEC 60945, 10.5	
E.14	Surge (impact) immunity	IEC 60945, 10.6	
E15	Immunity of power short-term changes	IEC 60945, 10.7	
E16	Immunity of power failure	IEC 60945, 10.8	
E.17	Electrostatic discharge immunity	IEC 60945, 10.9	
E.18	Noise and audible signal	IEC 60945, 11.1	Apply to all equipment in the navigation bridge
E.19	Safety distance of the compass	IEC 60945, 11.2	

Continued Table 7.2(1)

E.20	Avoid touching dangerous voltage	IEC 60945, 12.1	At least IP2X for the enclosure
E.21	Emission of video display unit (VDU)	IEC 60945, 12.3	
E.22	MME and HMI test	IEC 60945, 6.1	Test according to IEC62288
E.23	Hardware test	IEC 60945, 6.2	The test will be conducted at the functional test site.
E.24	Software test	IEC 60945, 6.3	Test together with the functional test.
E.25	Associated module test	IEC 60945, 6.4	Document inspection
E.26	Antenna impact test	IEC 62388, 17.3.2	
E.27	Antenna design	IEC 62388, 15.5	The antenna/base combination should be placed in the wind tunnel.

Type test items **Table 7.2(2)**

P1. IEC62388 test part - radar performance			
No.	**Test items**	**Test requirement**	**Supplementary instruction**
P1.1	Emission frequency	IEC 62388, 6.2.1	
P1.2	Interference	IEC 62388, 6.2.2	
P1.3	Optimal performance	IEC 62388, 6.3.2	

Continued Table 7.2(2)

P1.4	Gain function	IEC 62388, 6.4.2	
P1.5	Manual or automatic restraint of sea clutter	IEC 62388, 6.4.3	
P1.6	Restraint of rain clutter	IEC 62388, 6.4.4	
P1.7	Target enhancement	IEC 62388, 6.5.2	
P1.8	Radar signal correlation	IEC 62388, 6.5.3	
P1.9	Signal processing and radar image delay	IEC 62388, 6.5.4	
P1.10	Secondary reflection echo	IEC 62388, 6.5.5	
P1.11	Emission mode	IEC 62388, 6.5.6	
P1.12	Image updating	IEC 62388, 6.5.7	
P1.13	Additional operation	IEC 62388, 6.5.8	
P1.14	Signal processing description	IEC 62388, 6.5.9	
P1.15	Radar beacon, search aid radar transponder (SART) and target enhancement device	IEC 62388, 6.6.2	
P1.16	Range compensation	IEC 62388, 6.7.2	
P1.17	Min. range	IEC 62388, 6.7.3	
P1.18	Range resolution	IEC 62388, 6.8.3	
P1.19	Azimuth resolution	IEC 62388, 6.8.4	

Continued Table 7.2(2)

P1.20	Basic radar accuracy	IEC 62388, 6.8.5	
P1.21	Within the first detection range of the min. clutter	IEC 62388, 6.9.2	
P1.22	Clutter - General requirement	IEC 62388, 6.9.3.1	
P1.23	Rain clutter	IEC 62388, 6.9.3.2	
P1.24	Sea clutter	IEC 62388, 6.9.3.3	
P1.25	Performance at sea and in the rain	IEC 62388, 6.9.3.4	
P1.26	Radar performance document	IEC 62388, 6.9.4	Document inspection
P1.27	Height pattern /rolling and pitching	IEC 62388, 6.10.2	
P1.28	Horizontal pattern	IEC 62388, 6.10.3	
P1.29	Antenna sidelobe	IEC 62388, 6.10.4	
P1.30	Radar availability - Standby and transmission	IEC 62388, 6.11	

Type test items **Table 7.2(3)**

P2. IEC62388 test part - CCRP and the ship			
No.	**Test items**	**Test requirement**	**Supplementary instruction**
P2.1	CCRP position	IEC 62388, 8.1.2	
P2.2	Measurement	IEC 62388, 8.1.3	

Continued Table 7.2(3)

P2.3	Antenna compensation	IEC 62388, 8.1.4	
P2.4	Ship outline and required min. signs	IEC 62388, 8.2.2	
P2.5	Ship bow line	IEC 62388, 8.2.3	
P2.6	Ship stern line	IEC 62388, 8.2.4	
P2.7	Measurement unit	IEC 62388, 9.2	
P2.8	Display	IEC 62388, 9.3	
P2.9	Mandatory range	IEC 62388, 9.4.1	
P2.10	VRM measurement	IEC 62388, 9.5.2	
P2.11	Electronic bearing line measurement	IEC 62388, 9.6.2	
P2.12	EBL origin	IEC 62388, 9.6.3	
P2.13	Vernier measurement	IEC 62388, 9.7.2	
P2.14	Selection via vernier	IEC 62388, 9.7.3	
P2.15	Electronic range and bearing line (ERBL)	IEC 62388, 9.8.2	
P2.16	PI line and positioning	IEC 62388, 9.9.2	
P2.17	Azimuth scale display	IEC 62388, 9.10.2	
P2.18	Display and measurement of range marker ring	IEC 62388, 9.11.2	

Continued Table 7.2(3)

P2.19	Map function and display of simple user-defined map	IEC 62388, 9.12.2	
P2.20	Map storage and transfer	IEC 62388, 9.12.3	
P2.21	Map display feature	IEC 62388, 9.12.4	
P2.22	Route display and monitoring	IEC 62388, 9.13.2	
P2.23	Azimuth - Aiming accuracy	IEC62388,10.2.1.2.1	
P2.24	Azimuth accuracy - analog sensor	IEC62388,10.2.1.2.2	
P2.25	Calibration accuracy - digital sensor	IEC62388,10.2.1.2.3	
P2.26	Heading reading and reference	IEC 62388, 10.2.2	
P2.27	Azimuth stability updating	IEC 62388, 10.2.3	
P2.28	True motion and relative motion	IEC 62388, 10.3.2.	
P2.29	Manual and automatic decentration	IEC 62388, 10.4.2	
P2.30	Automatic resetting	IEC 62388, 10.4.3	
P2.31	Display direction	IEC 62388, 10.4.4	
P2.32	Mode and source	IEC 62388, 10.5.1	
P2.33	Stability over the ground	IEC 62388, 10.5.2	
P2.34	Stability over the water	IEC 62388, 10.5.3	

Type test items **Table 7.2(4)**

P3. IEC62388 test part - auxiliary collision prevention			
No.	**Test items**	**Test requirement**	**Supplementary instruction**
P3.1	Time and plotting requirement	IEC 62388, 11.2.2	
P3.2	Usability of wake/history position	IEC 62388, 11.2.3	
P3.3	TT general requirement	IEC 62388, 11.3.1	
P3.4	Target display	IEC 62388, 11.3.2	
P3.5	Tracking calculation	IEC 62388, 11.3.3	
P3.6	Target tracking availability	IEC 62388, 11.3.4	
P3.7	Classification and target tracking capability	IEC 62388, 11.3.5	
P3.8	Manual capturing	IEC 62388, 11.3.6	
P3.9	Automatic capturing	IEC 62388, 11.3.7	
P3.10	Motion tendency	IEC 62388, 11.3.8	
P3.11	50% visibility	IEC 62388, 11.3.9	
P3.12	Tracking algorithm	IEC 62388, 11.3.10	
P3.13	Target exchange	IEC 62388, 11.3.11	
P3.14	Stopping tracking	IEC 62388, 11.3.12	

Continued Table 7.2(4)

P3.15	Target motion and tracking accuracy	IEC 62388, 11.3.14	
P3.16	Radar range and azimuth accuracy	IEC 62388, 11.3.15	
P3.17	Reference target	IEC 62388, 11.3.16	
P3.18	Tracking limit - tracking alarm	IEC 62388, 11.4.1	
P3.19	Tracking limit - document	IEC 62388, 11.4.2	Manual inspection
P3.20	AIS target and data capacity	IEC 62388, 11.5.2	
P3.21	AIS target filtering	IEC 62388, 11.5.3	
P3.22	Activation and dormant AIS target	IEC 62388, 11.5.4	
P3.23	AIS function and display	IEC 62388, 11.5.5	
P3.24	Radar and AIS target data	IEC 62388, 11.6.1-2	
P3.25	Range and time of passing the ship bow	IEC 62388, 11.6.3	
P3.26	Target alarm CPA and TCPA	IEC 62388, 11.7.1	
P3.27	New task alarm	IEC 62388, 11.7.2	
P3.28	Missing radar tracking target	IEC 62388, 11.7.3	
P3.29	Missing AIS target criterion	IEC 62388, 11.7.4	
P3.30	Association and priority	IEC 62388, 11.8.2	
P3.31	Trial ship handling function	IEC 62388, 11.9	

Type test items **Table 7.2(5)**

P4.IEC 62388 test part - chart radar (optional) - (same with IEC62288 6.2.4)			
No.	**Test items**	**Test requirement**	**Supplementary instruction**
P4.1	Chart operation and source	IEC 62388, 12.1.2	
P4.2	Chart element and availability	IEC 62388, 12.1.3	
P4.3	Chart reference	IEC 62388, 12.1.4	
P4.4	Main chart information setting	IEC 62388, 12.1.5	
P4.5	Chart stability and re-plotting	IEC 62388, 12.1.6	
P4.6	Chart positioning and delay	IEC 62388, 12.1.7	
P4.7	Calibration and adjustment	IEC 62388, 12.1.8	
P4.8	Chart sign, color and size	IEC 62388, 12.1.9	
P4.9	Chart display size	IEC 62388, 12.1.10	
P4.10	Chart alarm and display	IEC 62388, 12.1.11	
P4.11	Chart failure	IEC 62388, 12.1.12	
P4.12	Chart radar failure	IEC 62388, 12.1.13	
P4.13	Chart information positioning and updating	IEC 62388, 12.2.2	
P4.14	Contents and structure of the chart data	IEC 62388, 12.2.3	
P4.EB	Additional requirement on ECDIS backup (optional)	IEC 62388, 12.3	

Type test items **Table 7.2(6)**

P5.IEC 62388 test part - human engineering interface, design service and installation			
No.	**Test items**	**Test requirement**	**Supplementary instruction**

P5.1	Human engineering requirement	IEC 62388, 13	
P5.2	Interface	IEC62388, 14	
P5.3	Failure diagnosis and maintenance	IEC 62388, 15.2	
P5.4	Display design	IEC 62388, 15.3	
P5.5	Transmit-receive unit design - section silence	IEC 62388, 15.4	
P5.6	Antenna design	IEC 62388, 15.5	
P5.7	Internal switchover and multiple radars	IEC 62388, 15.6	
P5.8	Multi-display operation - additional information and consistence	IEC 62388, 15.7	
P5.9	Safety - antenna and radiation	IEC 62388, 15.8	
P5.10	Alarm and instruction	IEC 62388 16.1.2	
P5.11	Alarm contact output	IEC 62388 16.1.3	
P5.12	Alarm management interface	IEC 62388 16.1.4	
P5.13	Unconfirmed warning	IEC 62388 16.1.5	
P5.14	Unconfirmed alarm	IEC 62388 16.1.6	

Continued Table 7.2(6)

P5.15	Remote confirmation and alarm erasure	IEC 62388 16.1.7	
P5.16	Image freezing	IEC 62388 16.1.8	
P5.17	Sensor failure alarm	IEC 62388 16.1.9	
P5.18	Heading information failure (azimuth angle stability)	IEC 62388 16.2.2	
P5.19	Information failure of speed over the water	IEC 62388 16.2.3	
P5.20	Information failure of course and ship speed over the ground	IEC 62388 16.2.4	
P5.21	Position information input failure	IEC 62388 16.2.5	
P5.22	Failure of radar video input information	IEC 62388 16.2.6	
P5.23	AIS input information failure	IEC 62388 16.2.7	
P5.24	Failure of combined or network system	IEC 62388 16.2.8	
P5.25	User requirement	IEC 62388, 18.1	
P5.26	Manual and document	IEC 62388, 18.2	
P5.27	Radar system installation	IEC 62388, 18.3	
P5.28	Maintenance equipment information update	IEC 62388, 18.4	

Type test items **Table 7.2(7)**

PN. IEC62388 and IEC62288 test parts - human engineering and display appearance			
No.	**Test items**	**Test requirement**	**Supplementary instruction**
PN.1	Linear exponential delay	IEC 62388, 7.2	
PN.2	Color usage and distinction	IEC 62388, 7.3	
PN.3	Operation control	IEC 62388, 13.2	
PN.4	Basic control	IEC 62388, 13.3	
PN.5	Control feature	IEC 62388, 13.4	
PN.6	Default control setting and user control setting saving	IEC 62388, 13.5	

Type test items **Table 7.2(8)**

N. Navigation display - operation information			
No.	**Test items**	**Test requirement**	**Supplementary instruction**
N.1	Ship information display	IEC 62288, 5.2	
N.2	Chart information modification	IEC 62288, 5.3.1	
N.3	Chart information color and sign	IEC 62288, 5.3.2	
N.4	Radar video image	IEC 62288, 5.4.1	
N.5	Target wake	IEC 62288, 5.4.2	

Continued Table 7.2(8)

N.6	Target information provision	IEC 62288, 5.5.1	
N.7	Consistence of target information UI	IEC 62288,5.5.2	
N.8	Indication of exceeding target capacity	IEC 62288,5.5.3	
N.9	Integration of multi-source AIS target	IEC 62288,5.5.4	
N.10	Dormant AIS information filtering	IEC 62288,5.5.5	
N.11	AIS target activation	IEC 62288,5.5.6	
N.12	Target chart display	IEC 62288,5.5.7	
N.13	Target selection	IEC 62288,5.5.8	
N.14	Target source display	IEC 62288,5.5.9	
N.15	Radar tracking target display	IEC 62288,5.5.10	
N.16	AIS target information display	IEC 62288,5.5.11	
N.17	Continuous target information updating	IEC 62288,5.5.12	
N.18	Ship AIS information	IEC 62288,5.5.13	
N.19	Operation display area mixing-up	IEC 62288,5.5.14	
N.20	Alarm status	IEC 62288,5.6.1	
N.21	CPA/TCPA alarm	IEC 62288,5.6.2	

Continued Table 7.2(8)

N.22	Capture/activation area alarm	IEC 62288,5.6.3	
N.23	Target missing alarm	IEC 62288,5.6.4	
N.24	Target association	IEC 62288,5.7.1	
N.25	AIS display status	IEC 62288,5.7.2	
N.26	Trial ship handling function	IEC 62288,5.7.3	
N.27	Ship measurement	IEC 62288,5.8.1	
N.28	Range and azimuth measurement	IEC 62288,5.8.2	
N.29	Range marker ring	IEC 62288,5.9.2	
N.30	Variable range marker	IEC 62288,5.9.3	
N.31	Azimuth scale	IEC 62288,5.9.4	
N.32	Electronic bearing line	IEC 62288,5.9.5	
N.33	Parallel index lines	IEC 62288,5.9.6	
N.34	Range and azimuth deviation measurement	IEC 62288,5.9.7	
N.35	User cursor	IEC 62288,5.9.8	

Type test items **Table 7.2(9)**

C. Navigation display– IEC62388 and IEC62288 – radar and chart display (if applicable)			
No.	**Test items**	**Test requirement**	**Supplementary instruction**
C.1	Multi-function display	IEC 62288,6.1.2	
C.2	Synchronous display of radar and chart data	IEC 62288,6.1.3	
C.3	Range scale	IEC 62288,6.1.4	
C.4	Operation display area	IEC 62288,6.1.5	
C.5	Motion display mode	IEC 62288,6.1.6	
C.6	Azimuth mode	IEC 62288,6.1.7	
C.7	Eccentricity	IEC 62288,6.1.8	
C.8	Stability mode	IEC 62288,6.1.9	
C.9	Radar video image	IEC 62288,6.2.2	
C.10	Radar information brightness	IEC 62288,6.2.3	
C.11	Chart information display on the radar	IEC 62288,6.2.4	
C.12	Radar information priority	IEC 62288,6.2.5	
C.13	Map graph display	IEC 62288,6.2.6	
C.14	Chart information display	IEC 62288,6.3.2	

Continued Table 7.2(9)

C.15	IMO ECDIS display category	IEC 62288,6.3.3	
C.16	Adding or deleting information on the display	IEC 62288,6.3.4	
C.17	Safety isobath	IEC 62288,6.3.5	
C.18	Safe depth	IEC 62288,6.3.6	
C.19	Chart scale	IEC 62288,6.3.7	
C.20	Radar and target information display	IEC 62288,6.3.8	
C.21	Additional information display	IEC 62288,6.3.9	
C.22	User configuration information display	IEC 62288,6.4.1	
C.23	Current task information	IEC 62288,6.4.2	

Type test items **Table 7.2(10)**

N. Navigation display -IEC62288 - general requirement			
No.	**Test items**	**Test requirement**	**Supplementary instruction**
N.1	Layout consistency	IEC 62288, 4.3.1	
N.2	Information display consistency	IEC 62288, 4.3.2	
N.3	Partition operation display	IEC 62288, 4.3.3	
N.4	Readability under different environmental conditions	IEC 62288, 4.4.1	

Continued Table 7.2(10)

N.5	Letter, digit and text	IEC 62288, 4.4.2	
N.6	Test display	IEC 62288, 4.4.3	
N.7	Icon	IEC 62288, 4.4.4	
N.8	Color and brightness	IEC 62288, 4.5	
N.9	Sign - operational information	IEC 62288, 4.6.1	
N.10	Sign - Electronic chart information	IEC 62288, 4.6.2	
N.11	Color code discrimination	IEC 62288, 4.7.1	
N.12	Information color code	IEC 62288, 4.7.2	
N.13	Color code combined with other properties	IEC 62288, 4.7.3	
N.14	Information flashing	IEC 62288, 4.7.4	
N.15	Indication of information source, validity and integrity	IEC 62288, 4.8.1	
N.16	Color code validity and integrity	IEC 62288, 4.8.2	
N.17	Display failure mark	IEC 62288, 4.8.3	
N.18	Operation status	IEC 62288, 4.9.1	
N.19	Alarm list	IEC 62288, 4.9.2	

Continued Table 7.2(10)

N.20	Alarm information from multiple information sources	IEC 62288, 4.9.3	
N.21	Voice output - alarm and warning	IEC 62288, 4.9.4	
N.22	Display mode	IEC 62288, 4.10	
N.23	User Manual	IEC 62288, 4.11	
N.24	Contrast and brightness	IEC 62288, 7.2.1	
N.25	Electromagnetic interference	IEC 62288, 7.2.2	
N.26	Time stability	IEC 62288, 7.2.3	
N.27	Physical control and status indication	IEC 62288, 7.2.4	
N.28	Screen size	IEC 62288, 7.3	
N.29	Color display equipment	IEC 62288, 7.4	
N.30	Screen resolution	IEC 62288, 7.5	
N.31	Screen viewing angle	IEC 62288, 7.6	

8 Unit/batch inspection

8.1 After the type approval certificate has been granted, product inspection should be carried out after the products are assembled and subject to 100% factory test as per the test item requirement specified in Table 8.2 at least by the manufacturer.

8.2 CCS can conduct sampling inspection with sampling proportion of 10% and at least 2 sets (except the situation that only 1 set is applied for inspection), so as to verify the following test items:

Test items **Table 8.2**

No.	Test items	Test requirement
1	Appearance inspection	The equipment should be clean, and free of splodge, corrosion, missing or breakage in appearance; the equipment surface painting should be free of falling-off or scratching. There should be no sundries inside, and the wiring should be in order. The fastener should be in place. The nameplate and sign should be fixed via riveting, and nameplate data verified to be corrected.
2	Software version inspection	The software version or current radar software program version should be inspected via the radar interface or other means respectively, which should be consistent with the approved one. Any software version change should be reported to CCS.
3	Optimal performance (including performance monitor)	IEC 62388, 6.3.2
4	Emission frequency (center frequency inspection)	IEC 62388, 6.2.1 (only measuring the frequency deviation)
5	Radar availability - Standby and transmission	IEC 62388, 6.11
6	Alarm and indication	IEC 62388 16.1.2
7	Ship bow line	IEC 62388, 8.2.3
8	Ship stern line (if applicable)	IEC 62388, 8.2.4
9	Measurement unit	IEC 62388, 9.2

Continued Table 8.2

10	Display	IEC 62388, 9.3
11	Mandatory range	IEC 62388, 9.4.1
12	VRM measurement	IEC 62388, 9.5.2
13	Electronic bearing line measurement	IEC 62388, 9.6.2
14	EBL origin	IEC 62388, 9.6.3
15	Vernier measurement	IEC 62388, 9.7.2
16	Selection via vernier	IEC 62388, 9.7.3
17	Electronic range and bearing line (ERBL) (if applicable)	IIEC 62388, 9.8.2
18	PI line and positioning	IEC 62388, 9.9.2
19	Azimuth scale display	IEC 62388, 9.10.2
20	Display and measurement of range marker ring	IEC 62388, 9.11.2