RESOLUTION MSC.86(70)
(adopted on 8 December 1998)
ADOPTION OF NEW AND AMENDED PERFORMANCE
STANDARDS FOR NAVIGATIONAL EQUIPMENT

ANNEX 17

RESOLUTION MSC.86(70)
(adopted on 8 December 1998)

ADOPTION OF NEW AND AMENDED PERFORMANCE STANDARDS FOR NAVIGATIONAL EQUIPMENT

THE MARITIME SAFETY COMMITTEE,

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

RECALLING ALSO resolution A.825(19), by which the Assembly resolved that the functions of adopting performance standards for radio and navigational equipment, as well as amendments thereto, shall be performed by the Maritime Safety Committee on behalf of the Organization,

HAVING CONSIDERED new performance standards and amendments to existing performance standards adopted by the Assembly and prepared by the forty-fourth session of the Sub-Committee on Safety of Navigation,

1. ADOPTS the following new recommended performance standards, set out in Annexes 1 to 3 to the present resolution:

.1 Recommendation on Performance Standards for Sound Reception Systems (Annex 1);

.2 Recommendation on Performance Standards for Marine Transmitting Magnetic Heading Devices (TMHDs) (Annex 2); and

.3 Recommendation on Performance Standards for an Integrated Navigation System (Annex 3);

2. ADOPTS ALSO the amendments to the Recommendation on Performance Standards for Electronic Chart Display and Information Systems (ECDISs) (resolution A.817(19)) set out in Annex 4 to the present resolution;

3. RECOMMENDS Member Governments to ensure that:

.1 sound reception systems, marine transmitting heading devices and integrated navigation systems installed on or after 1 January 2000 conform to performance standards not inferior to those set out in Annexes 1 to 3 to the present resolution;

.2 ECDIS installed on or after 1 January 2000 conform, respectively, to performance standards not inferior to those set out in resolution A.817(19), as amended, and Annex 4 to the present resolution;

.3 ECDIS installed on 1 January 1999 and before 1 January 2000 conform at least to the performance standards set out in resolution A.817(19), as amended by resolution MSC.64(67), Annex 5; and

.4 ECDIS installed before 1 January 1999 conform at least to performance standards set out in resolution A.817(19).

ANNEX 1

RECOMMENDATION ON PERFORMANCE STANDARDS FOR SOUND RECEPTION SYSTEMS

1 INTRODUCTION

1.1 Sound reception systems are acoustical electronic navigational aids to enable the officer on the watch to hear outside sound signals inside a totally enclosed bridge in order to perform the look-out function as required in the International Regulations for Preventing Collisions at Sea, 1972.

1.2 Sound reception systems should, in addition to the general requirements contained in resolution A.694(17), comply with the following minimum requirements.

2 FUNCTIONAL REQUIREMENTS

2.1 Sound reception systems should be capable of:

.1 receiving sound signals from all directions in the audio band 70 Hz - 820 Hz;

.2 reproducing incoming sound signals acoustically inside the bridge;

.3 indicating the approximate direction of incoming sound signals to determine at least whether the sound signal being detected is forward or abaft of the beam and from which side of the ship it is being detected;* and

.4 suppressing unwanted background noise and allowing reception of meaningful sounds.

3 METHOD OF PRESENTATION

3.1 Incoming sound signals should be reproduced inside the bridge by means of at least one loudspeaker.

3.2 The volume should be adjusted by means of one volume control only. The volume control should be capable of being set so that the sound pressure level of an incoming signal only is at least 10 dB(A) above the bridge noise level.

3.3 There should be a display which gives a visual indication for at least 3 s of the incoming signals and their approximate direction.

*This may be accomplished by means of at least four microphones and separate reception channels.

4 INSTALLATION

4.1 The microphones should be installed in such a way that they are as far from noise sources in the ship as is reasonably practicable and wind induced noise and mechanical vibrations are reasonably reduced.

4.2 The display should be installed so that it is visible at least from the conning position.

4.3 The loudspeaker(s) should be installed so that incoming sound signals are audible at all positions inside the bridge.

ANNEX 2

RECOMMENDATION ON PERFORMANCE STANDARDS FOR MARINE TRANSMITTING MAGNETIC HEADING DEVICES (TMHDs)

1 SCOPE

1.1 A TMHD is an electronic device which uses the geomagnetic field to obtain and transmit information about the ship's heading.

1.2 In addition to the general requirements contained in resolution A.694(17)* all marine TMHD equipment should comply with the following minimum requirements.

2 APPLICATION

2.1 A TMHD complying with the requirements contained in this recommendation, can be used to meet the carriage requirements for a suitable device providing heading information contained in Chapter V of the SOLAS Convention.

2.2 In addition such THMD can meet the dynamic requirements contained in the HSC Code chapter 13 for the carriage of a suitable device providing heading information.

3 COMPOSITION

3.1 Transmitting magnetic heading devices (TMHDs) may comprise of:

.1 a standard magnetic compass equipped with a magnetic sensor and electronics for generating a suitable output signal for other devices. The compass used should be the standard magnetic compass provided under SOLAS chapter V; or

.2 an electromagnetic compass consisting of the sensor part and electronics for generating a suitable output signal for other devices; or

.3 any type as defined under .1 and .2 additionally equipped with a rate gyro to improve dynamic performance.

4 CONSTRUCTION

4.1 Fore-and-aft mark

4.1.1 A fore-and-aft mark should be inscribed on the magnetic sensor housing, which should be installed in parallel to the ship's fore-and-aft line.

*See also IEC Publication 60945

4.1.2 The accuracy of the fore-and-aft mark should be within ± 0.5° to the fore-and-aft direction of the housing.

4.1.3 If a rate gyro is installed it should be marked in the same way and additionally be marked with top or bottom.

4.2 **Fitting**

4.2.1 Provision should be made, in the mounting arrangements of the magnetic sensor, for correction of any misalignment, up to ± 5°, with respect to the fore-and-aft line.

4.2.2 The fitting of the sensor arrangement to the compass in paragraph 3.1 above should still enable the compass to comply with resolution A.382(X) with particular reference to accuracy, gimbling and use of the azimuth reading device.

4.3 **Compensation of deviation and heeling error**

Provision should be made to correct the deviation and heeling error and it should be possible to correct the following values:*

.1 vertical component of the ship's magnetic field (producing the heeling error): up to ±75 μT;

.2 coefficient A: up to ±3°;

.3 coefficient B: up to ±(720/H)°;

.4 coefficient C: up to ±(720/H)°;

.5 coefficient D: up to ±7°; and

.6 coefficient E: up to ± 3°,

where H is the horizontal component of the geomagnetic flux density in microteslas (μT).

4.3.1 **Indication of compensation**

The values used for electronic compensation should be indicated by adequate means and should be stored such that values are automatically recovered on switch-on.

4.3.2 **Protection of compensation**

The compensating devices should be protected against inadvertent operation.

*See also ISO Publications 11606 and 1069

4.4 **Heading output**

All displays and outputs of heading should indicate true heading. An indication of any deviation and variation applied to compensate the heading should be capable of being displayed or included in the output.

4.5 **Interfaces**

The TMHD should be so designed to transmit heading information to other equipment. At least one output should be in accordance with the relevant international marine interface standard.*

5 **PERFORMANCE**

The following performance standards are required to be achieved under the conditions of a value of 18 µT of the horizontal component of the geomagnetic field and the environmental conditions experienced on board ships.**

5.1 **Accuracy of heading**

5.1.1 **Static**

The static accuracy of the heading indication should be within ± 1.0°.

5.1.2 **Dynamic**

The dynamic accuracy of the heading indication or output should be within ± 1.5° in addition to the static accuracy as defined. Periods of oscillation of the error should not be shorter than 30 s under the conditions of various sea states and ship's motion likely to be experienced in ships.***

5.2 **Follow-up accuracy of the transmission system**

The follow-up accuracy of the transmission system should be within ± 1.5°, when the sensor is rotated at a rate of 20°/s.

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*IEC Publication 61162

**See also IEC Publication 60945

***See also IEC Publication 721-3-6

6 ELECTROMAGNETIC COMPATIBILITY

The compass system, with regard to electromagnetic interference and immunity, should, in addition to resolution A.694(17), comply with resolution A.813(19).*

7 FAILURE CONDITIONS

An alarm should be provided to indicate a failure of the power supply to the compass system.

*See also IEC Publications 60945 and 533

ANNEX 3

RECOMMENDATION ON PERFORMANCE STANDARDS FOR AN INTEGRATED NAVIGATION SYSTEM (INS)

1 SCOPE

1.1 The purpose of an integrated navigation system (INS) is to provide 'added value' to the functions and information needed by the officer in charge of the navigational watch (OOW) to plan, monitor or control the progress of the ship.

1.2 The INS supports mode and situation awareness.

1.3 The INS supports safety of navigation by evaluating inputs from several independent and different sensors, combining them to provide information giving timely warnings of potential dangers and degradation of integrity of this information. Integrity monitoring is an intrinsic function of the INS.

1.4 The INS aims to ensure that, by taking human factors into consideration, the workload is kept within the capacity of the OOW in order to enhance safe and expeditious navigation and to complement the mariner's capabilities, while at the same time to compensate for their limitations.

1.5 The function of passage execution in an Integrated Bridge System (lBS), as defined by the Organization*, may be performed by an INS.

2 APPLICATION

2.1 These performance standards are applicable to any combination of navigational aids that provides functions beyond the general intent defined in the respective performance standards adopted by the Organization for individual equipment.

2.2 The purpose of these performance standards is to support the proper and safe integration of navigational equipment and information.

2.3 These performance standards define three categories of INS:

.1 INS(A) for systems that provide the minimum functional requirements of the INS including a consistent common reference system;

.2 INS(B) for systems that, in addition to the functional requirements of INS(A), provide the information needed for decision support in avoiding hazards; and

.3 INS(C) for systems that, in addition to the functional requirements of INS(B), provide the automatic control functions of heading, track or speed.

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*Resolution MSC.64(67), Annex 1- Recommendation on performance standards for Integrated Bridge Systems

3 DEFINITIONS

For the purpose of these standards the following definitions apply.

3.1 **Automatic control system** - A control system that may include a heading, track or speed control system.

3.2 **Consistent common reference system** - A sub-system of an INS for acquisition, processing, storage and distribution of data and information providing identical and obligatory reference to sub-systems within an INS.

3.3 **Integrated navigation system** - An INS is a combination of systems that are interconnected to increase safe and efficient navigation by suitably qualified personnel.

3.4 **Integrity -** Ability of the system to provide the user with information within the specified accuracy in a timely, complete and unambiguous manner, and alarms and indications within a specified time when the system should be used with caution or not at all.

3.5 **Multifunction display** - A single visual display unit that can present, either simultaneously or through a series of selectable pages, information from more than one operation of a system.

3.6 **Sensor** - A navigational aid, with or without its own display and control as appropriate, automatically providing information to the INS.

4 OPERATIONAL REQUIREMENTS

4.1 Functionality

General

4.1.1 In addition to meeting the relevant requirements of resolution A.694(17)[*], the INS should comply with the requirements of these performance standards.

4.1.2 Each part of the INS should comply with all applicable requirements adopted by the Organization, including the requirements of these performance standards. Parts executing multiple operations should meet the requirements specified for each individual function they can control, monitor or perform.

4.1.3 When functions of equipment connected to the INS provide facilities in addition to these performance standards, the operation and, as far as is reasonably practicable, the malfunction of such additional facilities should not degrade the performance of the INS below the requirements of these standards.

4.1.4 A failure of one part should not affect other parts except for those functions directly dependent upon the information from the defective part.

[*] See also IEC Publication 60945

Basic functions

4.1.5 An INS should combine, process and evaluate data from all sensors in use. The integrity of data from different sensors should be evaluated prior to distribution.

4.1.6 An INS should ensure that the different types of information are distributed to the relevant parts of the system, applying a 'consistent common reference system' for all types of information.

4.1.7 The INS(A) should as a minimum provide the information of position, speed, heading and time, each clearly marked with an indication of integrity.

4.1.8 The INS(B) should be able to automatically, continually and graphically indicate the ship's position, speed and heading and, where available, depth in relation to the planned route as well as to known and detected hazards.

4.1.9 The INS(C) should, in addition, provide means to automatically control heading, track or speed and monitor the performance and status of these controls.

Integrity monitoring

4.1.10 The integrity of information should be verified by comparison of the data derived independently from two or more sources if available.

4.1.11 The integrity should be verified before essential information is displayed or used. Information with doubtful integrity should be clearly marked by the INS and should not be used for automatic control systems.

Data exchange

4.1.12 Stand-alone equipment for which performance standards adopted by the Organization exist, when connected to the INS, should comply with the applicable international standards* for data exchange and interfacing.

4.1.13 Data latency should be consistent with the data requirements of the individual parts.

4.1.14 The integrity of data exchange within the INS should be ensured.

4.1.15 A failure of data exchange should not affect any independent functionality.

Integration

4.1.16 The INS should provide functional integration meeting the following requirements:

.1 where a display or control is presented on a multifunction display unit then these should be redundantly available; and

*IEC Publication 61162

.2 validity* of the data should be provided for each part to be integrated.

Configuration control

4.1.17 It should be possible to display the complete system configuration, the available configuration and the configuration in use.

4.2 Information and accuracy

Display of information

4.2.1 The INS should be able to display the information available in accordance with paragraphs 4.1.7, 4.1.8 and 4.1.9 as applicable.

4.2.2 The INS should be capable of displaying output data available from the sensors.

4.2.3 The information should be displayed together with the indication of its source (sensor data, result of calculation or manual input), unit of measurement and status, including mode (see sub-section Integrity monitoring).

Accuracy

4.2.4 As a minimum, the accuracy of information should meet the requirements of the resolutions* adopted by the Organization. Additionally the INS should not degrade the accuracy of the data provided by the sensors.

4.3 Malfunctions, alarms and indications

Fail safe operation

4.3.1 The system's automatic response to malfunctions should result in the safest of any other configuration accompanied by clear indications and alarms.

Reversionary mode

4.3.2 The INS should allow simple and effective operator action to override or by-pass any automated functions. The INS should resume automatic functions only after an appropriate message and intended operator action, considering all necessary starting conditions.

*Resolutions A.529(13) and A.815(19)

Alarm management

4.3.3 An alarm management system should be provided.

4.3.4 The INS alarm management system, as a minimum, should comply with the requirements of the Organization.*

4.3.5 The number of alarms should be kept as low as possible by providing indications for information of lower importance.

4.3.6 Alarms should be displayed so that the alarm reason and the resulting functional restrictions can be easily understood. Indications should be self-explanatory.

5 ERGONOMIC CRITERIA

5.1 Cognitive ergonomics

5.1 1 Integrated display and control functions should adopt a consistent human machine interface (HMI) philosophy and implementation.

5.1.2 The HMI should be so designed that the provided information is clearly understood using a consistent presentation style.

5.1.3 The HMI should be so designed that the requested manual inputs can be easily executed.

5.1.4 For manual inputs that may cause unintended results, the INS should request confirmation before acceptance, thus providing a plausibility check.

5.2 Physical ergonomics

Controls and displays

5.2.1 Particular consideration should be given to:

- symbols;
- controls; and
- layout.

Operational controls

5.2.2 The INS should be designed and implemented so that the OOW easily operates basic functions from work stations.

*Resolution A.830(19)

Presentation of information

5.2.3 Continuously displayed information should be optimised and should include position, speed, heading and time. Supplementary information should be readily accessible.

6 DESIGN AND INSTALLATION

General

6.1 The INS should meet the relevant requirements of resolution A.694(17) and appropriate international standards*.

Failure analysis

6.2 A failure analysis** should be performed and documented for the installed configuration of the INS which includes all parts connected to or integrated into the system, including devices for manual override of automatic functions and their locations on the bridge.

Installation requirements

6.3 The INS should be installed so that it can meet the requirements of the relevant International Standards***.

Power supply requirements

6.4. Power supply requirements applying to parts of the INS as a result of other IMO requirements should remain applicable.

6.5 The INS should be supplied:

.1 from both the main and the emergency source of electrical power with automated changeover through a local distribution board with provision to preclude inadvertent shutdown; and

.2 from a transitional source of electrical power for a duration of not less than 45 s.

Power interruptions and shutdown

6.6 After a power interruption full functionality of the INS should be available after recovery of all subsystems. The INS should not increase the recovery time of individual subsystem functions after power restoration.

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*IEC Publication 60945

**See also IEC Publication 61508

***IEC Publications 92-101 and 533

6.7 If subjected to a power interruption the INS should, upon restoration of power, maintain the configuration in use and continue automated operation, as far as practicable. Safety related automatic functions, should only be restored upon confirmation by the operator.

7 INTERFACING

Interfacing to, and from, the INS should comply with international standards*, as appropriate.

8 FALL-BACK ARRANGEMENTS

8.1 The INS should, after a failure, support the availability of essential information through the use of appropriate fallback arrangements.

8.2 Normal operation, after use of a fall-back arrangement, should only be restored upon confirmation by the operator.

* IEC Publication 61162

ANNEX 4

AMENDMENTS TO THE RECOMMENDATION ON PERFORMANCE STANDARDS FOR ELECTRONIC CHART DISPLAY AND INFORMATION SYSTEMS (ECDISs) (RESOLUTION A.817(19))

Add a new paragraph 1.9

1.9 When the relevant chart information is not available in the appropriate form (see section 4), some ECDIS equipment may operate in the Raster Chart Display System (RCDS) mode as defined in Appendix 7. Unless otherwise specified in Appendix 7, the RCDS mode of operation should conform to performance standards not inferior to those set out in this Annex.

Modify paragraph 10.5.7 as follows:

10.5.7 ECDIS should provide an alarm when the input from the position-fixing system is lost. ECDIS should also repeat, but only as an indication, any alarm or indication passed to it from a position-fixing system.

In Appendix 5, paragraph 10.5.7 change the word "indication" to "alarm".

Add a new Appendix 7 to the Annex to the resolution:

APPENDIX 7

RCDS MODE OF OPERATION

Whenever in this appendix a reference is made to provisions of the Annex related to ECDIS, ECDIS should be substituted by RCDS, SENC by SRNC and ENC by RNC, as appropriate.

All paragraphs of the Annex related to ECDIS are indicated as to whether they apply to RCDS, do not apply to RCDS, or are modified in order to apply to RCDS. These paragraphs are followed by additional requirements for ECDIS equipment in the RCDS mode.

1 INTRODUCTION

1.1 Paragraph applies to RCDS.

1.2 When operating in the RCDS mode, ECDIS equipment should be used together with an appropriate portfolio of up-to-date paper charts.

1.3-1.7 Paragraphs apply to RCDS.

1.8 RCDS should provide appropriate alarms or indications with respect to the information displayed or malfunction of the equipment (see Table 1 of this Appendix).

2 DEFINITIONS

2.1 Raster Chart Display System (RCDS) means a navigation information system displaying RNCs with positional information from navigation sensors to assist the mariner in route planning and route monitoring and, if required, display additional navigation-related information.

2.2 Raster Navigational Chart (RNC) means a facsimile of a paper chart originated by, or distributed on the authority of, a government-authorized hydrographic office. RNC is used in these standards to mean either a single chart or a collection of charts.

2.3 System Raster Navigational Chart Database (SRNC) means a database resulting from the transformation of the RNC by the RCDS to include updates to the RNC by appropriate means.

2.4-2.5 Paragraphs do not apply to RCDS.

2.6 Paragraph applies to RCDS.

3 DISPLAY OF SRNC INFORMATION

3.1 Paragraph applies to RCDS.

3.2 SRNC information available for display during route planning and route monitoring should be subdivided into two categories:

.1 the RCDS standard display consisting of RNC and its updates, including its scale, the scale at which it is displayed, its horizontal datum, and its units of depths and heights; and

.2 any other information such as mariner's notes.

3.3 Paragraph applies to RCDS.

3.4 When a RNC is displayed on the RCDS, it should provide an indication advising the mariner if a more detailed (larger scale) RNC is available for the displayed area.

3.5 It should be easy to add to, or remove from, the RCDS display any information additional to the RNC data, such as mariner's notes. It should not be possible to remove any information from the RNC.

3.6-3.7 Paragraphs do not apply to RCDS.

3.8-3.10 Paragraphs apply to RCDS.

3.11 There should always be an indication if the ECDIS equipment is operating in the RCDS mode.

4 PROVISION AND UPDATING OF CHART INFORMATION

4.1 The RNC used in RCDS should be the latest edition of that originated by, or distributed on the authority of, a government authorized hydrographic office and conform to IHO standards. RNCs not on WGS-84 or PE-90 should carry meta-data (i.e., additional data) to allow geo-referenced positional data to be displayed in the correct relationship to SRNC data.

4.2 The contents of the SRNC should be adequate and up-to-date for that part of the intended voyage not covered by ENC.

4.3-4.8 All paragraphs apply to RCDS.

5 SCALE

This section applies to RCDS.

6 DISPLAY OF OTHER NAVIGATIONAL INFORMATION

6.1-6.3 All paragraphs apply to RCDS.

7 DISPLAY MODE AND GENERATION OF THE NEIGHBOURING AREA

7.1 It should always be possible to display the RNC in "chart-up" orientation. Other orientations are permitted.

7.2-7.4 All paragraphs apply to RCDS.

8 COLOURS AND SYMBOLS

8.1 IHO recommended colours and symbols should be used to represent SRNC information.

8.2 Paragraph applies to RCDS.

8.3 Paragraph does not apply to RCDS.

8.4 Paragraph applies to RCDS.

9 DISPLAY REQUIREMENTS

9.1-9.2 Paragraphs apply to RCDS.

9.3 Paragraph does not apply to RCDS.

9.4 Paragraph applies to RCDS.

9.5 RCDS should be capable of displaying, simply and quickly, chart notes which are not located on the portion of the chart currently being displayed.

10	**ROUTE PLANNING, MONITORING AND VOYAGE RECORDING**
10.1-10.2	Paragraphs apply to RCDS.
10.3	Paragraph does not apply to RCDS.
10.4	Route Planning
10.4.1-10.4.3	Paragraphs apply to RCDS.
10.4.4-10.4.5	Paragraphs do not apply to RCDS.
10.4.6	Paragraph applies to RCDS.
10.4.7	It should be possible for the mariner to enter points, lines and areas which activate an automatic alarm. The display of these features should not degrade the SRNC information and it should be clearly distinguishable from the SRNC information.
10.5	Route monitoring
10.5.1	Paragraph applies to RCDS.
10.5.2	It should be possible to display a sea area that does not have the ship on the display (e.g. for look ahead, route planning), while route monitoring. If this is done on the display used for route monitoring, the automatic route monitoring functions in 10.4.6 and 10.4.7 should be continuous. It should be possible to return to the route monitoring display covering own ship's position immediately by single operator action.
10.5.3-10.5.4	Paragraphs do not apply to RCDS.
10.5.5-10.5.8	Paragraphs apply to RCDS.
10.5.9	The RCDS should only accept data referenced to the WGS-84 or PE-90 geodetic datums. RCDS should give an alarm if the positional data is not referenced to one of these datums.
10.5.10-10.5.13	Paragraphs apply to RCDS.
10.5.14	RCDS should allow the user to manually align the SRNC with positional data. This can be necessary, for example, to compensate for local charting errors.
10.5.15	It should be possible to activate an automatic alarm when the ship crosses a point, line, or is within the boundary of a mariner-entered feature within a specified time or distance.
10.6	Voyage recording
10.6.1-10.6.4	All paragraphs apply to RCDS.

11 ACCURACY

11.1-11.2 All paragraphs apply to RCDS.

12 CONNECTIONS WITH OTHER EQUIPMENT

12.1-12.2 All paragraphs apply to RCDS.

13 PERFORMANCE TESTS, MALFUNCTION ALARMS AND INDICATIONS

13.1-13.2 All paragraphs apply to RCDS.

14 BACK-UP ARRANGEMENTS

All paragraphs apply to RCDS.

15 POWER SUPPLY

15.1-15.2 All paragraphs apply to RCDS.

Table 1

ALARMS AND INDICATORS IN THE RCDS MODE OF OPERATION

Paragraph	Requirement	Information
10.4.6, 10.5.5	Alarm	Deviation from route
10.4.7, 10.5.15	Alarm	Approach to critical point, line, area or mariner-entered feature
10.5.7	Alarm	Positioning system failure
10.5.8	Alarm	Approach to critical point
10.5.9	Alarm	Different geodetic datum
13.2	Alarm	Malfunction of RCDS mode
3.11	Indication	ECDIS operating in the raster mode
3.4, 5.1	Indication	Information under-scale or overscale
5.2	Indication	Larger scale RNC available for the area of the vessel

The definitions of alarms and indicators are given in Appendix 5.

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