RULES FOR
CLASSIFICATION OF

SHIPS

NEWBUILDINGS

SPECIAL EQUIPMENT AND SYSTEMS
ADDITIONAL CLASS

PART 6 CHAPTER 8

NAUTICAL SAFETY

JULY 2004

CONTENTS PAGE

DET NORSKE VERITAS

Veritasveien 1, NO-1322 Høvik, Norway Tel.: +47 67 57 99 00 Fax: +47 67 57 99 11

CHANGES IN THE RULES

General

The present edition of the rules includes amendments and additions decided by the Board in June 2004 and supersedes the January 2003 edition of the same chapter.

The rule changes come into force as described below.

This chapter is valid until superseded by a revised chapter. Supplements will not be issued except for an updated list of corrections presented in Pt.0 Ch.1 Sec.3. Pt.0 Ch.1 is normally revised in January and July each year.

Revised chapters will be forwarded to all subscribers to the rules. Buyers of reprints are advised to check the updated list of rule chapters printed in Pt.0 Ch.1 Sec.1 to ensure that the chapter is current.

Main changes coming into force 1 January 2005

- **General**

— ECS system requirements have been replaced by ECDIS systems.

- **Section 1 General**

— Under sub-section element D300 item D304 has been removed and the subsection renumbered accordingly.

- **Section 2 Design of Workplace**

— A new item B111 on location of means to control speed, heading and control modes has been added.
— Item B305 has been amended with a requirement for a slit in the chart table.
— In item C306 the list of instruments and equipment has been amended to include internal communication equipment. The "internal communication equipment" has been removed from item C308.
— In item C310 the Guidance note has been amended to cover AIS information.
— In item C407 the list of information from instruments and indicators has been amended to cover watch monitoring warnings and alarms.
— Item C503 requiring declarations with respect to trade of the ship has been removed.
— Item C602 has been amended with requirements for protrusion centre console.
— In item C803 the list of equipment available has been amended with a device for acknowledging watch monitoring warnings and alarms.
— In item E304 the Guidance note has been modified.
— In items E401 and E402 the requirements have been clarified.
— New items E403 and 404 have been added to cover cleaning requirements and requirements for a catwalk or similar outside the windows.

- **Section 4 Carriage requirements for navigational systems and equipment**

— Item B601 has been amended to require X-band radar and S-band radar in certain cases.
— A new item B704 with requirements to AIS reported targets on graphical displays has been added.
— In item B802 item list b) has been amended to cover requirements for backup of ECDIS systems.
— In item B902 a guidance note is introduced.
— Item B1002 with requirements to information with respect to environmental forces has been removed.
— Sub-section elements B1300 and B1400 has been amended to cover AIS and VDR systems explicitly.
— Item C210 has been amended with respect to route planning systems
— Under sub-section element C200 Table C1 has been amended to make requirements more clear.

- **Section 5 General Bridge equipment requirements**

— In item A206 the guidance note has been removed.
— In item E202 requirements to software quality assurance plan (SQAP) has been removed.

- **Section 6 Specific requirements for different types of bridge equipment**

— A new item B105 with requirements to gyro compass systems has been added.
— In item B107 (former B106) a new guidance note has been added.
— In item C205 the guidance note has been deleted and item 206 has been made into a guidance note.
— Item F101 has been amended with respect to radar installation coverage.
— Item H401 has been amended with respect to requirements for Receiver Integrity Monitoring algorithm or equivalent.
— Item H403 on accuracy of position fix has been removed.
— In item H404 a guidance note is added.
— Item H406 has been amended to require that at least 6 satellites shall be tracked simultaneously.
— Items H407 and H408 have been amended with respect to antenna receiving characteristics and gain pattern.
— Item H411 on integrity monitoring for **NAT-AW** has been removed.
— Item I402 providing requirements for watch monitoring systems has been added.
— In item I403 lettered list a) and b) has been amended with a specific acceptance interval for detection of operator movements.
— In item I405 a new lettered list c) giving requirements for reset of monitoring intervals has been added.
— Item I406 has been amended with respect to alarm transfer to specified locations.

- **Section 8 Ship manoeuvring information**

— Item A103 has been amended to cover IMO Res. MSC 137(37) and MSC/Circ.1053.
— In item A401 a guidance note on full scale testing is added.
— In item B901 a guidance note on manoeuvring procedures has been added.

Corrections and Clarifications

In addition to the above stated rule requirements, a number of corrections and clarifications have been made to the existing rule text.

Comments to the rules may be sent by e-mail to *rules@dnv.com*
For subscription orders or information about subscription terms, please use *distribution@dnv.com*
Comprehensive information about DNV and the Society's services is found at the Web site http://www.dnv.com

Computer Typesetting (FM+SGML) by Det Norske Veritas
Printed in Norway

CONTENTS

SECTION 1
GENERAL

A. The Classification Concept

A 100 General

101 The text in A describes the concept with regard to objectives and safety philosophy on which the rules for nautical safety are based. Consequently, the contents of A are not to be understood as rule requirements.

A 200 Objectives of the rules

201 The main objectives of the rules for nautical safety are to reduce the risk of failure in bridge operation causing collision, grounding and heavy weather damage.

202 The rules aim at giving requirements to regulate shipboard factors affecting safety and efficiency in bridge operations and, in this context, include:

- relevant requirements and recommendations adopted by the International Maritime Organization (IMO)
- relevant international standards within the subjects of the rules or indicating the points in which they differ.

A 300 Safety philosophy

301 In order to achieve optimum safety and efficiency in bridge operation, the rules address the total bridge system. The total bridge system is considered to comprise four essential parts, see Fig.1:

- *the technical system*, which is to deduce and present information as well as enable the proper setting of course and speed
- *the human operator*, who is to evaluate available information, decide on the actions to be taken and execute the decisions
- *the man and machine interface*, which shall safeguard that the technical system is designed with due regard to human abilities
- *the procedures*, which shall ensure that the total bridge system performs satisfactorily under different operating conditions.

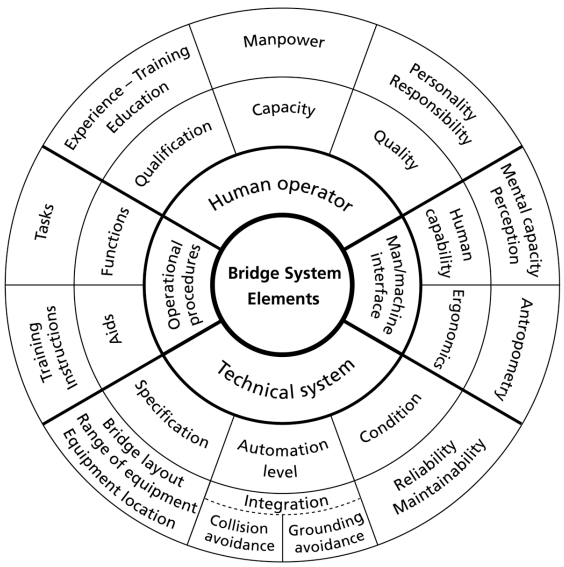


Fig. 1
The total bridge system

This is considered the responsibility of the master of the ship and the officer of the watch.

302 Degradation of one part of the bridge system affects the functioning of all the other parts. In order to reduce the risk of malfunction of the total bridge system, the rule requirements are established to regulate the factors affecting the safe performance of any part of the system and to ensure a consistent level of system reliability in various modes of operation under different operating conditions.

See Fig.1 and Fig.2.

303 The main elements of the various parts of the bridge system are considered to comprise, see Fig.1:

- qualifications, capacity and quality of the human operator in relation to the functions to be carried out
- specification, automation level and condition of the technical system in relation to information needs, workloads and reliability
- physical abilities and information processing capacity of the human operator in relation to working conditions and the technical systems he is to operate
- tasks to be performed and technical aids available under various operating conditions as basis for establishing working routines and operating procedures.

304 With the exception of operator quality, the elements mentioned in 303 form the basis for the rules given. It is believed that improvements within these elements can also have a positive effect on operator quality (personality, responsibility), which in the context of classification is considered to be a matter of selection of personnel.

B. Scope of Classification and Rule Requirements

B 100 General

101 Classification of bridge systems verifies compliance with the rules developed for the safe performance of bridge functions. The classification concept involves affirmation through voluntary class notations that the requirements, of the rules and other standards referred to have been fulfilled for bridge design, instrumentation, working environment, operator quality and procedures.

102 The rules take into consideration that the modes of operation and the manning of the bridge will vary in accordance with the condition of internal technical systems and the availability of relevant external systems, and that operating conditions can be influenced by the waters to be navigated, traffic and weather conditions.

103 The rules aim at safeguarding that the officer of the navigational watch, at his workstation, has full control of all the primary functions he is responsible for, including the look out function, within the operational limits indicated by the class notations **NAUT-OC** and **NAUT-AW**. Furthermore, that the bridge enables safe and efficient co-operation by two navigators when required, and that relevant procedures are established and the officer of the watch is qualified to operate the technical systems as indicated by the suffix **Q**.

Guidance note:

It should be noted that the manning of the navigational watch at all times shall be in accordance with the national regulations of the flag state and for the waters in which the ship is operating.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

104 The bridge system on ships where a grounding avoidance system or an automatic track keeping system is installed and in use is not considered compliant with requirements for safe navigation if the master and the officer of the watch do not hold the certificate of competence in accordance with the knowledge requirements given in Sec.9 B200. See also Sec.9 A300 and Sec.9 B100.

B 200 Scope of classification

201 Safe performance of the bridge system is qualified by its ability to determine, execute and maintain the right course and speed of the ship in relation to the waters, the traffic and the weather. This ability is threatened by:

— internal bridge system failure
— loss of manoeuvrability (steering and propulsion)
— loss of external information.

202 The main concern of the rules for nautical safety is to prevent internal bridge system failures and, in this context, to address all parts of the system as defined in A301.

203 The required reliability of propulsion and steering systems for preventing loss of manoeuvrability is addressed by the rules for main class. The concern of the rules for nautical safety in this context is to safeguard that:

— the implications of failure in propulsion and steering systems are taken into consideration in the design of the bridge system, and that system degradation is brought to the attention of the watch officer by relevant warnings
— the emergency steering system in the steering gear compartment is properly arranged for safe and efficient operation.

204 With regard to loss of external information, the concern of the rules for nautical safety is to safeguard that:

— the shipborne part of an external navigation or communication system detects loss of information caused by failure in the external systems.

205 The technical reliability of any system to be operated from the bridge serving functions additional to those related to the safe navigation of the ship, such as machinery systems, cargo and ballast systems, safety monitoring systems, etc., is addressed in other parts of the rules for main class. The concern of the rules for nautical safety in this context is:

— the location of workstations for additional bridge functions
— the working conditions for performance of additional functions being the responsibility of the officer of the watch
— the man and machine interface of technical systems serving additional bridge functions if the system is to be operated by the officer of the watch
— the integration of any system interfaced to a network for performance of main bridge functions.

B 300 Scope of rule requirements

301 The requirements given in each section address the elements of the bridge system affecting the safety of navigation as specified in A300, and regulate the following areas with the aim to reduce the probability of bridge system failure, see Fig.2:

— *design of workplace*, based on analyses of functions to be performed under various operating conditions and the technical aids to be installed
— *bridge working environment*, based on factors affecting the performance of human operators
— *range of instrumentation*, based on information needs and efficient performance of navigational tasks
— *equipment reliability* applicable to all types of bridge equipment, based on common requirements to ensure their suitability under various environmental conditions
— *performance* of different types of bridge equipment, based on their specific functions
— *man and machine interface*, based on the analyses of human limitations and compliance with ergonomic principles
— *qualifications*, based on the competence required for mastering rational navigational methods and relevant technical systems installed on board the ship
— *operating procedures*, based on the need to make the bridge system function under different operating conditions
— information on the ship's manoeuvring characteristics, based on the knowledge needed for safe performance of manoeuvring operations
— *tests and trials* based on the need to ensure that technical systems perform in accordance with their approved specifications before being relied upon and used in practical operation.

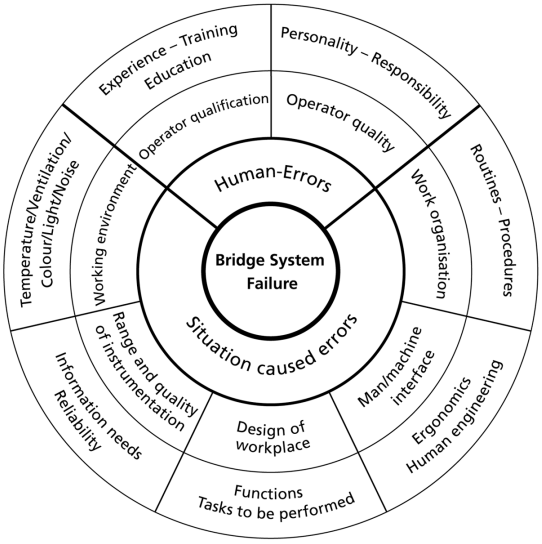


Fig. 2
Overview of bridge system areas affecting safe and efficient operations

B 400 Structure of the rules

401 The rules are structured to:

— establish functional requirements to the greatest possible extent
— give guidance as to how functional requirements can be met by technical solutions or other remedies that safeguard the performance of the function.

402 A functional requirement is as far as possible expressed without quantification. The functional requirements have a principle status and will only be adjusted if the functions to be carried out on the bridge are altered.

403 A Guidance note, as far as possible, quantifies solutions that can be approved, but does not exclude the application of alternative solutions provided the functional requirements are met.

C. Definitions

C 100 Terms

101 *Abnormal operating conditions*. When internal technical

system failures require operation of back-up systems on the bridge or when they occur during an irregular operating condition, or when the officer of the watch becomes unfit to perform his duties and has not yet been replaced by another qualified officer.

102 *Additional bridge functions*. Functions performed on the bridge while the ship is under way, but not related to primary bridge functions. Examples of such functions are:

— general communication functions
— cargo monitoring and planning functions
— extended monitoring and control of machinery
— monitoring and control of domestic systems.

103 *Back-up navigator.* A navigational officer who has been designated by the ship's master to be on call to assist or replace the officer of the watch when required.

104 *Blind sector*. An obstruction in a field of vision with a clear sector on both sides.

105 *Bridge system.* The total system for the performance of bridge functions, comprising bridge personnel, technical systems, man and machine interface and procedures.

106 *Bridge wing*. The part of the bridge on each side of the wheelhouse, which extends to the ship's side.

107 *Bridge.* The area from which the navigation and control of the ship are exercised, comprising the wheelhouse and the bridge wings.

108 *Catwalk.* Arrangement outside the wheelhouse allowing a person safe access to windows along the front bulkhead(s).

109 *Coastal waters.* Waters that encompass navigation along a coast at a distance less than the equivalence of 30 minutes of sailing with the relevant ship speed. The other side of the course line allows freedom of course setting in any direction for a distance equivalent to at least 30 minutes of sailing with the relevant speed.

110 *Collision avoidance functions.* Detection and plotting of other ships and moving objects; determination and execution of course and speed deviations to avoid collision.

111 *Commanding view*. View without obstructions, which could interfere with the navigator's ability to perform his main tasks, at least covering the field of vision required for safe performance of collision avoidance functions.

112 *Conning information display.* A screen-based information system that clearly presents information from sensor inputs relevant to navigation and manoeuvring, as well as all corresponding and upcoming orders given by an automatic navigation system to steering and propulsion systems if connected.

113 *Conning station or position.* Place in the wheelhouse with a commanding view providing the necessary information for conning, and which is used by navigators when monitoring and directing the ship's movements.

114 *Display.* An observable illustration of an image, scene or data on a screen.

115 *Docking.* Manoeuvring the ship alongside a berth and controlling the mooring operations.

116 *Easily accessible.* Within 5 m distance from working position.

117 *Electronic chart display and information system (ECDIS).* A navigation information system, which with adequate back-up arrangements can be accepted as complying with the up-to-date chart required by regulation V/20 of SOLAS, and be accepted as meeting the chart carriage requirements of SOLAS Chapter V, as amended by res. MSC.99(73), by displaying selected information from a system electronic nautical chart (SENC).

118 *Electronic nautical chart (ENC).* The database, standardised as to content, structure and format, issued for use with ECDIS on the authority of government authorised hydrographic offices.

119 *Ergonomics.* Application of the human factors implication in the analysis and design of the workplace and equipment.

120 *Field of vision.* Angular size of a scene that can be observed from a position on the ship's bridge.

121 *Helmsman.* Person who steers the ship under way.

122 *Irregular operating conditions.* When external conditions cause excessive operator workloads.

123 *Manoeuvring.* Operation of steering systems and propulsion machinery as required to move the ship into predetermined directions, positions or tracks.

124 *Monitoring.* Act of constantly checking information from instrument displays and environment in order to detect any irregularities.

125 *Narrow waters.* Waters that do not allow the freedom of course setting to any side of the course line for a distance equivalent to 30 minutes of sailing with the relevant ship speed.

126 *Navigation.* Planning of the ship's route and determination of position and course of the ship, execution of course alterations and speed changes.

127 *Normal operating conditions.* When all shipboard systems and equipment related to primary bridge functions operate within design limits, and weather conditions or traffic, do not cause excessive operator workloads.

128 *Ocean areas*. Waters that encompass navigation beyond the outer limits of coastal waters. Ocean areas do not restrict the freedom of course setting in any direction for a distance equivalent to 30 minutes of sailing with the relevant ship speed.

129 *Officer of the watch.* Person responsible for the safety of navigation and bridge operations until relieved by another qualified officer.

130 *Primary bridge functions.* Functions related to determination, execution and maintenance of safe course, speed and position of the ship in relation to the waters, traffic and weather conditions. Such functions are:

— route planning functions
— navigation functions
— collision avoidance functions
— manoeuvring functions
— docking functions
— monitoring of internal safety systems
— external and internal communication related to safety in bridge operation and distress situations.

131 *Route monitoring.* Continuous surveillance of the ship's sailing (position and course) in relation to a pre-planned route and the waters.

132 *Route planning.* Pre-determination of course lines, radius turns and speed in relation to the waters to be navigated.

133 *Screen.* A device used for presenting visual information based on one or several displays.

134 *SOLAS.* The International Convention for the Safety of Life at Sea, 1974.

135 *Superstructure.* Decked structure, not including funnels, which is on or above the freeboard deck.

136 *System electronic navigational chart (SENC).* A database resulting from the transformation of the ENC by ECDIS for appropriate use, updates to the ENC by appropriate means and other data added by the mariner.

137 *Wheelhouse.* Enclosed area of the bridge.

138 *Wheel-over-line.* The line parallel to the new course line where the ship has to initiate a curved track to eliminate the effect of any offset with respect to the new course, taking into consideration the distance required for the ship to build up the necessary turn rate.

139 *Wheel-over-point.* The point where the ship has to initiate a curved track, taking into consideration the distance required for the ship to build up the necessary turn rate.

140 *Within reach.* The distance the operator can reach and use a control unit:

— from a standing position at a console this distance is regarded to be maximum 800 mm in forward direction and 1400 mm sideways
— from a seated position, at a distance of 350 mm from a console, this distance is regarded to be maximum 1000 mm, and maximum 800 mm for frequently used equipment, which is to be within easy reach.

141 *Workstation for communication.* A work place for operation and control of equipment for distress and safety communication (GMDSS), and shipboard communication for ship operations.

142 *Workstation for primary bridge functions.* A workplace with commanding view used by navigators when carrying out navigation, route monitoring, traffic surveillance and manoeuvring functions, and which enables monitoring of the safety state of the ship.

143 *Workstation for safety operations.* A workplace dedicated organisation and control of internal emergency and distress operations, and which provides easy access to information related to the safety state of the ship.

144 *Workstation.* A work place at which one or several tasks constituting a particular activity are carried out and which provides the information and equipment required for safe performance of the tasks.

D. Class Notations

D 100 General

101 In order to offer classification that meets the individual needs of ship owners, related to different types and trades of ships, as well as bridge procedures and qualifications related to the equipment installed, the rules for nautical safety are divided into two class notations, **NAUT-OC** and **NAUT-AW**, and an additional suffix **Q** which may be attached to either class notation.

102 The class notation **NAUT-OC** give basic requirements within bridge design, instrumentation, and location of equipment and bridge procedures.

103 The class notation **NAUT-AW** extends the basic requirements for bridge design and instrumentation and, in addition, requires an automatic grounding avoidance system and information on the manoeuvring characteristics of the ship.

104 The suffix **Q** covers requirements for navigator qualifications related to the use of the automatic grounding avoidance system installed, bridge procedures for safe watch-keeping and command of the ship under irregular and abnormal operating conditions.

D 200 Contents of class notations and extensions

201 The class notation **NAUT-OC** covers the following main areas:

— mandatory and additional workstations
— field of vision from workstations
— location of instruments and equipment
— bridge working environment
— range of instrumentation
— instrument and system performance, functionality and reliability
— alarm management, including watch monitoring and alarm transfer system.

202 The class notation **NAUT-AW** covers:

a) **NAUT-OC**
b) Extensions within the following areas of **NAUT-OC**:
   — design of workstation for primary bridge functions
   — field of vision astern
   — range of instrumentation, incorporating ECDIS and track control
   — instrument performance, supporting system integration
   — automation level, incorporating an automatic grounding avoidance system.
c) Areas additional to **NAUT-OC**:
   — information on the manoeuvring characteristics of the ship.

203 The suffix **Q** covers:

— qualifications of bridge personnel
— operational procedures.

D 300 Documentation of compliance

301 The class notations **NAUT-OC** and **NAUT-AW** imply that the ship is built and equipped in compliance with the relevant sections of this chapter.

302 The suffix **Q** added to the class notation implies that operational procedures and qualifications are established in compliance with Sec.9.

303 Ships satisfying the requirements for class notation **NAUT-OC** will have the following text entered in the "Appendix to the classification certificate":

— The class notation denotes that the bridge has been designed in accordance with established functional requirements and principles of ergonomics for reduced workload and improved operational conditions. Furthermore, that the bridge arrangement provides the information and equipment required for safe performance of the functions to be carried out at dedicated workstations. The working conditions are considered to enable the officer of the watch to perform all primary bridge functions, including lookout functions, from one workstation under normal operating conditions in ocean areas and coastal waters.

Guidance note:

It should be noted that the manning of the navigational watch at all times should be in accordance with the national regulations of the flag state and for the waters in which the ship is operating. This is considered the responsibility of the master of the ship and the officer of watch.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

304 Ships satisfying the requirements for class notation **NAUT-AW** will have the following text entered in the "Appendix to the classification certificate" in addition to the text for **NAUT-OC**:

— The notation also denotes that, the bridge is equipped with a grounding avoidance system and designed to improve safety of navigation and reduce the workload, enabling the officer of the watch to perform all of the bridge functions he is responsible for from pilot station to pilot station un-

der normal operating conditions. In addition, the notation denotes that the ship has extensive documentation of its manoeuvring characteristics.

305 Ships satisfying the operational requirements given in Sec.9 will have the suffix **Q** added to the class notation and the following text entered in the "Appendix to the classification certificate":

— The suffix **Q** denotes that a qualification assurance system for safe navigation has been established, ensuring appropriate operational procedures and competent operation of the automatic grounding avoidance system.

D 400 Class assignment

401 The ship will be assigned class notation **NAUT-OC** when the relevant requirements given in Sec.2 to Sec.7 are complied with.

402 The ship will be assigned class notation **NAUT-AW** when the relevant requirements given in Sec.2 to Sec.8 are complied with.

403 The class notation assigned the ship will be extended with suffix **Q** when the requirements in Sec.9 are complied with.

E. Documentation for Approval

E 100 Class notation NAUT-OC and NAUT-AW

101 Drawings showing the bridge the configuration and dimensions of the wheelhouse and bridge wings shall be submitted. The documentation shall include:

a) Height of front bulwark with windscreens when relevant.

b) Location, inclination and dimensions of windows.

c) Entrances to the wheelhouse and dimensions of doors.

d) Indication of windows with fresh water wash, wipers, heating and sunscreens.

102 A set of drawings showing compliance with requirements for horizontal and vertical fields of vision shall be submitted. The drawings shall include information on:

a) The vertical field of vision forward of the bow and the distance to the sea surface seen from the conning position and from the workstation for navigation and traffic surveillance in ballast condition. The blind sectors within the field of vision required shall be identified and the size of the arc calculated.

b) The horizontal field of vision from each of the workstations to be used by the watch officer during sea voyages.

c) The blind sectors caused by division between windows and obstructions outside the wheelhouse seen from the workstation for navigation, traffic surveillance and manoeuvring shall be identified and the size calculated. Drawings showing the shape and size of divisions between windows shall be included.

103 A set of drawings and relevant documentation shall be submitted, showing:

a) The bridge layout, including the configuration and location of workstations.

b) Configuration and dimensions of workstation consoles including console foundations.

c) Location of instruments and equipment in the consoles.

d) Location of equipment located elsewhere on the bridge.

e) A list showing all relevant bridge equipment, specifying type, model, manufacturer, supplier and type approval reference with extension date or copy of valid certificates, when applicable.

104 Drawings showing arrangement of lighting (red and white) within the wheelhouse including all adjacent corridors and compartments.

105 Documentation giving information on interior colours for bulkheads, deckheads, framing of windows and consoles shall be submitted. The colours should be indicated by using international standards for colour reference.

106 Information on design and performance of the navigational equipment specified in Sec.6, documenting compliance with the rules, shall be submitted. The documentation shall include:

a) Technical specifications, documenting performance or accuracy data, alarm functions, power supply and also environmental data if the equipment is not type approved.

b) Complete operating instructions or "quick reference guide".

c) Functional description.

d) Drawings or pictures showing displays and operating controls.

107 Description of functions, operation and alarm conditions, including system diagrams shall be submitted for integrated navigation systems, if installed. The documentation shall include a worksheet giving an overview of failure modes and effect analysis (FMEA) as specified in 111 if the system is configured for controlling the ship's course or speed (e.g. to be interfaced to a heading control or track control system or propulsion control system).

108 Documentation shall be submitted to verify compliance with the requirements for the alarm management systems, see Sec.6 I. The documentation shall include flow diagram for the total system configuration and descriptions of the watch monitoring and alarm transfer system.

109 The following drawings and descriptions related to the electric power supply for bridge equipment and systems shall be submitted:

a) Electrical diagrams, showing the sources and distribution of electric power supply identifying navigational equipment connected to uninterruptible power supply (UPS) or battery and emergency power supplies.

b) Specifications for UPS units and batteries.

110 When a grounding avoidance system as required by the class notation **NAUT-AW** is to be installed, the documentation to be submitted shall include:

a) System design philosophy indicating safety features, man and machine interface considerations and system reliability.

b) Functional description including failure modes.

c) List of the equipment included in the configuration.

d) User interface description.

e) System block diagram.

f) Description of functions covered by software, identifying the versions applicable for the system to be installed.

g) Power supply arrangement.

h) Cable routing layout drawing.

i) Data sheets with environmental specifications for equipment not type approved.

j) Test program for application software at manufacturer, see 113 and G102.

k) Test program for on board tests (sea trials).

Guidance note:

Items a, b, c, d and e may be edited as a document serving as basis for the FMEA worksheet required in 111.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

111 The consequences of failures in relation to the functional objectives of the grounding avoidance system shall be documented by a failure mode and effect analysis (FMEA) worksheet.

The FMEA shall refer to a block diagram in a narrative format to enable the failure effects to be understood. The block diagram shall illustrate the interrelationship and functional interdependence of the system elements.

The FMEA worksheet shall comprise the following items:

— the individual equipment name or number and function
— failure modes and failure cause of each individual equipment
— the local effect and end effect (system function)
— failure detection and alarm condition (locally and main system)
— system related corrective measures with indication of system status
— second mode of operations (if applicable).

The worksheet shall also include cells for classification of the severity of the end effect by indicating minor, major or hazardous, but does not necessarily have to be filled in by the supplier. (Basis for evaluation of continued system operations, second mode of operations and redundancy).

Guidance note:

Example of a FMEA analysis worksheet matrix that covers the items specified above (and guidance for the use of FMEA) can be found in IEC 60812.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

112 A test program in compliance with the requirements for on-board testing given in Sec.10, relevant for equipment required in Sec.4, shall be submitted for approval.

113 For integrated systems documented by FMEA, a FMEA test programme drawn up to prove the conclusions of FMEA by on board tests, and by on shore tests by simulation when needed, shall be submitted for approval.

The test programme shall be a self-contained document in report format with full description of the system, including the block diagram and FMEA worksheet, without any need to refer to other plans or documents. The programme should include tests of relevant failure modes of each element of the system and enable observations to be noted about:

— failure type
— failure effect
— failure detection or alarm condition
— system status, including second mode of operation.

Appropriate space shall be given for remarks and summary conclusions.

114 *Class notation* **NAUT-AW**

A test program for manoeuvring trials shall be submitted.

115 *Class notation* **NAUT-AW**

A manoeuvring booklet containing the methods and results of manoeuvring trials shall be submitted for documenting the manoeuvring characteristics of the ship.

116 *Suffix* **Q**

The following documentation shall be submitted by the ship owner:

a) Bridge procedures for normal, irregular and abnormal operating conditions.

b) Copy of the qualification assurance system, including procedures for on board certification of competence.

F. Documentation for Information

F 100 Class notation NAUT-OC and NAUT-AW

101 Operational and technical manuals for the equipment serving primary bridge functions shall be submitted for information.

102 Drawings showing location of sensors and other equipment not located on the bridge, if related to primary bridge functions (e.g. transponders, internal communication equipment, etc.) and the antenna arrangement for satellite communication systems, radars, VHF equipment and other antenna arrangements, shall be submitted for information.

103 A general arrangement drawing showing the bridge configuration and the location on the ship, superstructures and funnel(s) shall be submitted for information.

G. Functional Tests

G 100 Class notation NAUT-OC and NAUT-AW

101 Tests, which give evidence of the satisfactory operation of instruments and integrated navigation systems in accordance with the rules, shall be carried out. Failure modes shall be tested as realistically as possible. The tests shall be based on test programmes approved by the Society, including FMEA worksheets, when applicable, see E113.

102 Approval tests of an integrated navigation system, if installed, shall be conducted in accordance with Pt.4 Ch.9 Sec.1 D. This includes software module testing and integration testing at manufacturers work.

103 Tests in accordance with an approved test program to give evidence of safe performance of integrated navigation systems controlling course or speed, if installed, shall be carried out at the sea trials.

104 Functional testing of the grounding avoidance system (GAS) required for the class notation **NAUT-AW**, shall be carried out at sea. Tests of alarm functions and system failure modes caused by malfunction of each of the individual equipment sensors being part of the integrated system shall also be included, but may be carried out in port prior to sea trials.

105 Tests required to establish information on the ship's manoeuvring characteristics as specified in Sec.8 shall be carried out.

SECTION 2
DESIGN OF WORKPLACE

A. General

A 100 Scope

101 This section specifies the requirements for workstation arrangements and individual workstations, their configuration, location of equipment and the minimum field of vision required to be obtained from each of the workstations. The various sub-sections comprise both the basic requirements for **NAUT-OC** and the additional requirements that are specific for **NAUT-AW**.

A 200 Application

201 Ships requesting class notation **NAUT-OC** shall comply with the rules in A to E.

202 Ships requesting class notation **NAUT-AW** shall comply with the basic rules in A to E and the requirements specifically addressing **NAUT-AW** in these sub-sections. An overview of the requirements specific for **NAUT-AW** is given in F.

B. Bridge and Workstation Arrangement

B 100 General requirements

101 The bridge and workstation arrangement shall be based on relevant functional requirements and designed in accordance with established principles of ergonomics for safe and efficient operations, enabling the navigator to perceive all relevant information and execute pertinent actions with a minimum workload.

102 The safe control and command of the ship while under way shall be allocated to a certain area of the wheelhouse where only instruments, equipment and controls necessary for the performance of primary bridge functions shall be located.

103 From the area allocated safe control and command of the ship while under way, the navigator shall have easy access to additional information for monitoring the safety state of the ship.

104 The individual workstations allocated primary bridge functions shall be designed for easy control by one person and located to allow close co-operation between the various workstations when manned for individual operations, as well as provide sufficient room for unobstructed passage between different workstation areas.

Guidance note:

The workstations for primary bridge functions, except for docking operations, should be located within an area not more than 10 m wide.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

105 Workstations for the safe and efficient performance of primary bridge functions under normal, irregular and abnormal operating conditions in the various phases of the voyage at sea from port to port shall be provided. Such workstations shall include:

— workstation for navigation
— workstation for traffic surveillance and manoeuvring
— workstations for manual steering
— workstation for safety operations
— workstations for docking operations
— workstations for conning
— workstation for re-planning the route.

106 A workstation for planning the intended voyage prior to departure shall be provided, suitably equipped to plan and to check the courses and turns laid down before the voyage commences.

Guidance note:

The workstation may be combined with another workstation not in use during port stays, provided it is suitably equipped for the purpose.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

107 Workstations for additional functions may be located on the bridge provided the performance of such functions does not interfere with the tasks of maintaining safe control of the ship. Workstations for additional functions may include workstations for:

— extended communication functions
— monitoring and control of ballasting and cargo operations
— extended monitoring of machinery
— remote control of accommodation ladder, hatches and side ports
— miscellaneous.

108 The various workstations shall provide the field of vision specified in E200 and be equipped for the safe performance of the relevant tasks in accordance with the requirements in this section.

109 Under all operating conditions, it shall be possible for persons at a workstation to communicate with persons at other workstations of relevance for the function to be performed.

110 Where workstations for different functions are positioned far apart, and on open bridge wings, talk back facilities shall be provided so that unhampered communication can be achieved. All order or action communication systems shall be two-way.

111 Means for controlling speed, heading and control modes shall only be located at workstations intended for the related tasks (e.g. workstations for manual steering (steering control only), docking, navigation, traffic surveillance and manoeuvring).

B 200 Passageways and clear deckhead height

201 There shall be a clear route across the wheelhouse from bridge wing to bridge wing for two persons to pass each other. The width of the passageway shall be 1200 mm and not less than 700 mm at any single point of obstruction.

202 There shall be no obstructions between the points of entry to the bridge from lower decks and the clear route referred to in 201. This passageway shall be at least 700 mm wide.

203 The distance between separate workstation areas shall be sufficient to allow unobstructed passage for persons not working at the stations. The width of such passageways shall not be less than 700 mm including persons sitting or standing at their workstations.

204 The distance from the bridge front bulkhead, or from any console and installation placed against the front bulkhead to any console or installation placed away from the bridge front, shall be sufficient for one person to pass a stationary person. The width of this passageway shall not be less than 800 mm.

205 The clear deckhead height in the wheelhouse shall take into account the installation of deckhead panels and instruments as well as the height of door openings required for easy entrance to the wheelhouse. The following clear heights for

unobstructed passage shall be provided:

a) The lower edge of deck head-mounted equipment in open areas and passageways, as well as the upper edge of door openings to bridge wings and other open deck areas shall be at least 2100 mm above the deck.

b) The lower edge of entrances and doors to the wheelhouse from adjacent passageways should not be less than 2000 mm.

206 It shall be possible to secure bridge wing doors in the open position, and it shall be possible to open doors with one hand. Ships with fully enclosed bridge wings shall at least have one door, providing direct access to the adjacent area outside the wheelhouse.

B 300 Console configuration

301 The console configuration shall enable the navigator to use all instruments and controls necessary for navigation and traffic surveillance and manoeuvring, both in a standing and a sitting position.

Guidance note:

In principle, consoles should be divided into two separate areas: one for the display of information and one for the equipment necessary for taking action on the information. The information area should be located in the upper (vertical) part of the console and the controls in the lower (horizontal) part, see Fig. 3. To enable operation from a standing position, the height of the lower (horizontal) part of the consoles above the bridge deck surface should be 800 mm and not less than 750 mm, see Fig.7. See also Sec.7.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

302 The consoles forming the workstation for navigation and traffic surveillance and manoeuvring shall endeavour not to obstruct the view over the lower edge of the windows seen from a sitting position at the consoles (eye height 1400 mm). In order not to obstruct the line of sight from a sitting position of 350 mm behind a console of average depth, giving a total horizontal distance of 1500 mm between the operator and the steel bulkhead, the height of console shall not exceed 1200 mm. See Fig.7.

Guidance note:

A standard console height of 1200 mm is accepted even if the top of the console should interfere with the line of sight from a sitting eye height of 1400 mm provided the line of sight over the lower edge of the window can be maintained by adjusting the height of the chair 100 mm.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

303 The height of consoles forming a workstation for radio communication or other additional tasks that are to be used by the officer shall not obstruct the field of vision required maintaining a proper lookout from a sitting position at the console. The console height shall not exceed 1300 mm and be at least 100 mm lower than the eye height in the sitting operating position at the console, e.g. 1200 mm if the maximum height of the chair seat to be used is 550 mm above the deck surface.

304 The height of tabletops for chart consoles shall accommodate chart work from a standing position. The height of the tabletop above the bridge deck surface shall be:

— 800 mm and not less than 750 mm to accommodate chart work at the front chart console
— 850 mm and not less than 800 mm to accommodate chart work at a route planning console.

305 The front chart console shall be large enough to accommodate all nautical chart sizes in common use internationally. The effective area of the desktop shall be at least 1200 mm x 750 mm. In order to accommodate charts larger than the table depth, there shall be a slit along the aft and front part of the front chart table.

306 The front chart console shall provide sufficient storage of charts for at least 8 hours of navigation and enable storage of tools for chart work. The console shall include a drawer with dimensions at least 800 mm x 700 mm x 70 mm. Appropriate lighting of the chart shall not cause glare in bridge windows. See Fig.1.

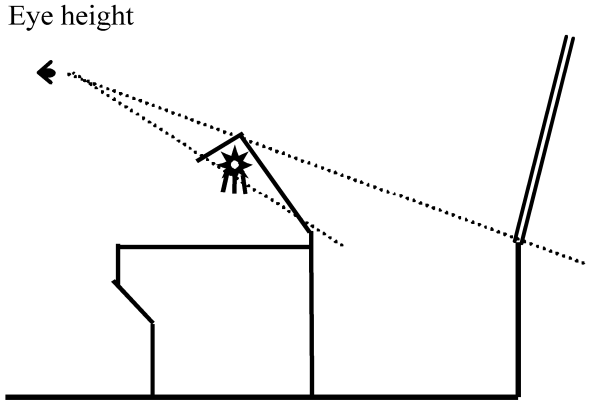


Fig. 1
Lighting of front chart table

307 A route planning console for paper charts shall have an effective area of at least 1600 mm x 800 mm for chart work.

B 400 Chairs

401 If chairs are installed at the workstation for navigation and traffic surveillance and manoeuvring, it shall be easy to adjust the vertical position of the chairs to suit an eye height of 1400 mm. The vertical adjustment of the seat should range from 600 to 800 mm above the deck surface.

402 It shall be possible to move the chairs in fore and aft direction for easy reach of the equipment to be used and to move the chairs away from the consoles to achieve good working conditions from a standing position.

403 It shall be easy to enter and leave the chairs in any position. If the chair includes armrests, it shall be possible to fold them away.

404 Deck rails used to support horizontal movements of the chairs shall be installed flush with the deck surface or in a way that prevents tripping of personnel.

C. Workstations for Primary Bridge Functions

C 100 Scope

101 This sub-section regulates the design solutions of workstations and identifies functions to be performed at the individual workstations, as a basis for listing the equipment to be installed.

C 200 General requirements

201 The design and location of workstations shall enable the ship to be navigated and manoeuvred safely and efficiently by one navigator in ocean areas and coastal waters under normal operating conditions, as well as by two navigators in close co-operation when the workload exceeds the capacity of one person, and when under pilotage.

202 Bridge equipment shall be located in workstations enabling the navigator to take into consideration pertinent information and execute actions in accordance with the functions to be performed.

C 300 Workstations for navigation and traffic surveillance and manoeuvring

301 *Design of workstations*

The workstations for navigation and traffic surveillance and manoeuvring shall be arranged to enable two navigators to carry out their tasks, each at their workstation, in close co-operation.

302 The instruments pertinent to these stations shall be located sufficiently close together to enable a single navigator to carry out all functions and retrieve all necessary information from one working location by having easy access between the workstations.

303 If easy access is hampered by a console protruding more than 400 mm in between the workstation for navigation and the workstation for traffic surveillance and manoeuvring, the workstations will be regarded as separate stations and one of the workstations shall be fully equipped to enable both the navigation and the traffic surveillance and manoeuvring functions to be efficiently carried out by one navigator.

Guidance note:

a) If the workstation for navigation is intended to serve both navigation and traffic surveillance and manoeuvring functions, then essential equipment for traffic surveillance and manoeuvring, such as the ARPA system and a means for controlling speed and course, should be within reach from the workstation for navigation.

b) If the workstation for traffic surveillance and manoeuvring is intended to serve both traffic surveillance and manoeuvring and navigation functions, then essential equipment for navigation, such as a chart table (if ECDIS is not installed) and position-fixing systems, should be within reach from the workstation for traffic surveillance and manoeuvring.

See 306, 307 and 308.

An acceptable solution, instead of the duplication of required equipment, may be to install the essential equipment, indicated under a), within reach from the working position at both workstations.

See Fig.2 (long centre console).

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

304 *Design of workstations* - **NAUT-AW**

The workstation for navigation and traffic surveillance and manoeuvring shall be designed for one-man operation only, and the separate workstation required for navigation shall be installed sufficiently close by to serve as a back up for performance of navigation functions if ECDIS malfunction occurs and to allow good co-operation between two navigators each at their workstation.

Guidance note:

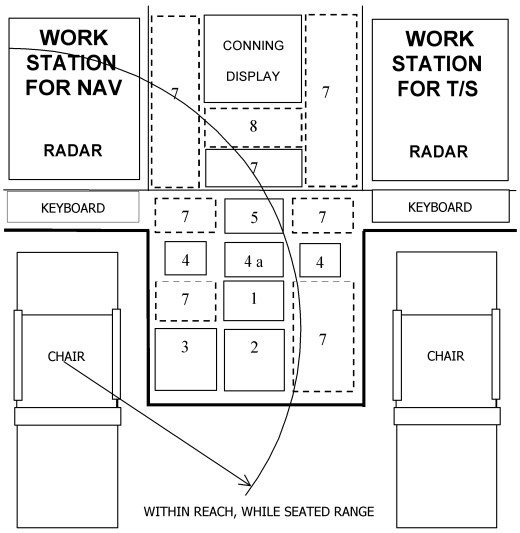
If the chart arrangement at the separate workstation for navigation meets the requirements for serving as part of the grounding avoidance system and the equipment for control of heading and propulsion is located within reach from the working position, this workstation is regarded a fully redundant workstation for navigation and traffic surveillance and manoeuvring.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

305 *Tasks to be performed at the workstation for navigation*

The workstation for navigation shall enable the following tasks to be performed:

— determine and plot the ship's position, course, track and speed
— effect internal and external communication related to navigation
— monitor time, course, speed and track, rudder angle, propeller revolutions and propeller pitch (when applicable)
— adjustment of pre-planned route during the voyage.



Description

1. Steering - autopilot
2. Propulsion, emergency stop
3. Thruster, if provided
4. Steering - override control
4a. Steering - mode selector
5. Communication - external
6. Communication - internal
7. Available space

Fig. 2
Example of locaiton of main equipment in compliance with 303 and Guidance note a)

306 *Equipment to be installed*

The following instruments and equipment that are to be operated by the navigator at the workstation for navigation, and considered essential for safe operations, shall be within reach from a standing position at the workstation:

— navigation radar display and controls
— chart table and ECDIS back-up arrangement when provided
— both DGPS receivers (or one DGPS and one combined GPS/GLONASS)
— VHF unit
— internal communication equipment
— whistle push button
— device for acknowledging watch monitoring warnings or alarms
— central alarm panel
— distance indicator.

Guidance note:

Ships solely using ECDIS as the official chart system and are not required to carry any paper navigational charts, may not install a front chart table.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

307 *Information to be provided*

Instruments, indicators and displays providing information considered essential for operations at the workstation for navigation shall be easily readable from the working position at the workstation. The equipment includes:

— gyro repeater
— rudder angle indicator
— depth indicator
— clock

— propeller revolutions indicator
— pitch indicator, when provided
— speed indicator
— rate-of-turn indicator.

308 *Means to be easily accessible*

Means to be used at intervals for securing safe course and speed in relation to other ships and safety of bridge operation shall be easily accessible from the workstation for navigation. The means include:

— instruments and equipment installed at the workstation for traffic surveillance and manoeuvring
— window wipers and wash controls for the windows within the required field of vision
— workstation light controls
— depth recording device.

309 *Tasks to be performed at the workstation for traffic surveillance*

The workstation for traffic surveillance and manoeuvring shall enable the following tasks to be performed:

— monitor the traffic by sight and hearing as well as by available means
— analyse the traffic situation
— decide on collision avoidance manoeuvres
— alter course
— change speed
— carry out a change of operational steering mode
— effect internal and external communication related to manoeuvring
— operate docking aid systems
— monitor time, course, speed, track, propeller revolutions, thrust indicator, if the ship is equipped with thrusters, pitch indicator, if the ship is equipped with pitch propeller, rudder order, rudder angle and rate of turn
— monitor all alarm conditions on the bridge.

310 *Equipment to be installed*

Instruments and equipment that are to be operated by the navigator at the workstation for traffic surveillance and manoeuvring, and considered essential for safe and efficient performance of his tasks, shall be within reach from a sitting position at the workstation, priority given to location of controls for ARPA, course and speed.

Guidance note:

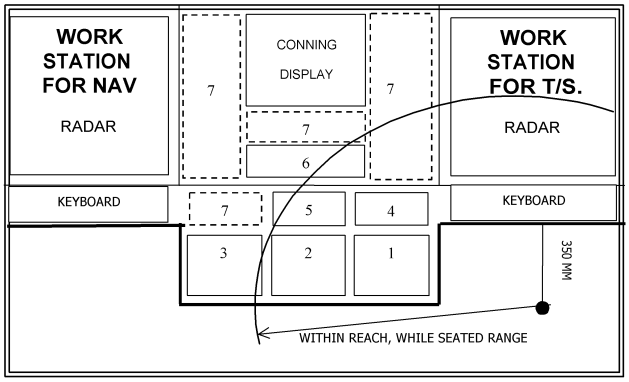
The following instruments and equipment should be installed within reach from a sitting position:

- radar display and controls
- automatic radar plotting aid (ARPA)
- means for use and graphical display of AIS information
- ECDIS, when provided
- propulsion control
- heading control or track control system, as required
- manual steering with tiller override control
- steering mode selector switch
- VHF unit
- whistle push button
- internal communication equipment
- emergency stop for propulsion machinery
- emergency stop for thruster(s), when provided
- device for acknowledging watch monitoring warnings or alarms
- central alarm panel.

The following equipment should be installed within reach from a standing position at the centre console where also controls for propulsion and steering can be operated:

- Thruster control(s), when provided
- Joystick control, when provided.

See Fig.3.



Description

1. Steering - autopilot
2. Propulsion, emergency stop
3. Thruster, if provided
4. Steering - override control and mode selector
5. Communication - external
6. Communication - internal
7. Available space

Fig. 3
Example of priority location of equipment, which is to be within reach while seated, listed in 310

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

311 *Information to be provided*

Instruments, indicators and displays providing information considered essential for the safe and efficient performance of tasks at the workstation for traffic surveillance and manoeuvring shall be easily readable, and audible when relevant, from the working position at the workstation:

— propeller revolution indicator
— thrust indicator, when provided
— pitch indicator, when provided
— speed indicator
— wind direction and speed indicator, when provided
— rudder angle indicator
— rudder order indicator, if the steering system is a follow-up system
— rate-of-turn indicator
— gyro repeater
— depth indicator
— clock
— conning information display, when provided
— alarm indicators, colours
— means for reception of external sound.

312 *Means to be easily accessible*

Means to be used at intervals for securing safe course and speed in the waters to be navigated and for safety of bridge operation shall be easily accessible from the workstation for traffic surveillance and manoeuvring. The means include:

— instruments and equipment installed at the navigation workstation
— engine alarm panel
— window wiper and wash controls for the windows within the required field of vision
— alarm panel for additional functions, such as fire, emergency, cargo, etc.
— searchlight controls, when provided
— dimmer controls for lights to be used at the workstation
— controls for the sound reception system.

313 *Navigational tasks at the workstation for traffic surveillance and manoeuvring* - **NAUT-AW**

The workstation designed for one-man operation only, shall enable performance of the tasks specified in 306 and the following tasks related to navigation:

— monitor the ship's performance in relation to the waters and the pre-planned route on the ECDIS
— carry out changes of input data to the navigational system
— monitor the performance of the automatic navigation in narrow waters by means of radar.

314 *Additional equipment for navigation* - **NAUT-AW**

The instruments used for monitoring and control of the navigation systems at the workstation designed for one-man operation only, shall be within reach of the navigator and the information on the display(s) shall be easily readable The following equipment shall be provided, being part of an integrated grounding avoidance system:

— ECDIS
— conning information display system
— track control system.

315 *Alarm panels to be monitored from the workstation for traffic surveillance and manoeuvring*

Equipment and alarm panels installed for detection of malfunction of essential systems and abnormal operating conditions shall be easy to observe and easily accessible from this workstation. The following equipment is regarded essential for safe operations:

— alarm panels required to be installed at the workstation for safety monitoring and operation
— navigation light panel
— steering gear alarm panel and pump selector or control switches.

C 400 Workstations for conning

401 A workstation for conning of the ship shall be arranged to enable navigators (pilots) to assist in navigating and manoeuvring the ship without interfering with the tasks of the ship's bridge personnel on duty.

402 The workstation for conning shall enable a pilot to observe all relevant external and internal information for determination and maintenance of safe course and speed of the ship in narrow waters, harbour areas and during canal passages.

403 The workstation for conning shall be located sufficiently close to:

— the forward centre window in order to optimise the view of the sea surface close to the sides of the ship
— the workstation for navigation and traffic surveillance and manoeuvring to allow good co-operation between the navigators, each at their workstation.

404 If the view in the centre line is obstructed by large masts, cranes, etc., an additional conning position providing a commanding view shall be located on the starboard side as close to the centre line as possible, but within 5 m from the centre line.

Guidance note:

The Panama Canal Commission requires conning positions directly behind the three centre windows.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

405 If the workstation for navigation and traffic surveillance and manoeuvring is arranged for one-man operation, the additional navigation workstation specified in 304 may serve as a conning workstation if located close to the front windows.

406 *Tasks to be performed*

The workstation for conning shall enable the following tasks to be performed in narrow waters, harbour areas and during canal passages and anchoring:

— determine safe course and speed in relation to the waters and traffic
— give sound signals
— effect communication related to pilotage
— monitor heading, rudder angle, propeller revolutions, pitch (if equipped with controllable pitch propeller) and speed.

407 *Information and equipment to be provided*

The information required for safe performance of the tasks shall be easily readable and means to be used shall be easily accessible from the workstation.

a) Information shall be provided from the following instruments and indicators, or other approved means serving the same functions:
   — gyro repeater
   — rudder angle indicator
   — propeller revolutions indicator
   — pitch indicator, when relevant
   — speed indicator.

b) Means to be easily accessible from the workstation include:
   — whistle push button
   — device for acknowledging watch monitoring warnings or alarms
   — VHF.

C 500 Workstation for route planning

501 Route planning facilities shall be provided to enable the navigator to plan the route for the intended voyage prior to departure and to re-plan the route during the voyage, without interfering with the navigation of the ship. The workstation(s) shall be equipped with means for efficient route planning and direct transfer of the planned route to the navigation workstation.

502 When paper charts are used as the principal chart system and the ship is only to be engaged in regular trades following the same pre-planned routes each voyage, the workstation for navigation may be arranged and equipped for route planning and used in the place of a separate workstation.

503 When ECDIS with back-up system is the legal chart system used for route monitoring and route planning, the separate workstation for navigation serving the back-up functions may be used for re-planning of the route while the ship is under way.

504 Storage of the charts required for the waters in which the ship is to trade shall be provided at the workstation for route planning, if installed, otherwise elsewhere within the wheelhouse.

505 The workstation for route planning shall enable the following tasks to be performed:

— determine the ship's position
— plan the forthcoming voyage on the basis of available information from charts and literature
— specify the detailed route by courses, radius turns and wheel-over lines into the appropriate charts
— estimate time of arrival at various wheel over points
— transfer of the planned route to the navigation workstation.

506 *Equipment to be installed*

In order to enable safe performance of the tasks, the following instruments and equipment, or similar approved means, shall

be installed at the workstation:

— position display
— effective means for route planning and computation for navigation such as calculation of courses, distances and ETAs
— a device for transfer of route plan to the position monitoring system at the workstation for navigation
— clock.

C 600 Workstations for manual steering

601 The main workstation for manual steering shall enable a helmsman to execute and maintain course orders, both by compass readings and external visual means.

602 *Wheelhouse*

The main workstation for manual steering shall preferably be located on the ship's centre line and shall not interfere with the functions to be performed by the officer of the watch. If the main steering position is located as a protrusion of the centre console, the requirements of C303 shall be met. If the view ahead is obstructed by large masts, cranes, etc., the workstation should be located some distance to starboard of the centre line, sufficiently to obtain a clear view ahead.

When the workstation is located off centre or the bow of the ship cannot be seen from the steering position, special steering references (sighting marks) installed in line parallel to the ship's centre line for use by day and by night shall be provided.

Guidance note:

Special steering references may also be required at the docking workstations when these are installed on bridge wings wider than the breath of the ship.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

603 *Steering gear compartment*

The emergency workstation for manual steering provided in the steering gear compartment, shall enable the operator to execute wheel-over orders and maintain the course in accordance with orders received from the bridge from his working position.

604 *Tasks to be performed at the workstation for manual steering.*

The main workstation for manual steering shall enable the following tasks to be performed:

— manual steering
— two-way communication with workstation for docking operation.

605 *Information and equipment to be provided*

The following instruments, indicators and displays, or other approved means providing information considered essential for the safe and efficient performance of the steering functions shall be easily readable from the workstation:

— gyro repeater
— rudder angle indicator
— rudder order indicator, when follow-up steering is provided
— magnetic compass display
— rate-of-turn indicator.

Equipment to be installed for use at the workstation:

— manual steering device
— internal communication equipment.

606 Tasks to be performed at the workstation for emergency steering

The workstation for emergency steering in the steering gear compartment shall enable the following tasks to be performed from the working position:

— change rudder angle by direct control of the steering gear
— monitor rudder angle and heading
— effect two-way communication with the bridge.

607 Equipment to be available for emergency steering

The following equipment, or other approved means essential for the safe conduct of the steering functions shall be available from the position at the steering controls:

— actuators for the hydraulic steering system or equivalent means for altering the rudder angle
— device for hand-free internal communication
— compass heading indicator
— device indicating the rudder angle.

C 700 Workstation for safety monitoring and emergency operations

701 The workstation for safety monitoring and emergency operations shall enable monitoring of the safety state of the ship as well as planning and management of emergency operations, and shall incorporate facilities for storage and use of relevant drawings and safety plans and be equipped for internal communication.

702 The location and configuration of this workstation shall:

— enable a single person to carry out the relevant functions at the workstation without interfering with the tasks to be performed at the workstation for traffic surveillance and manoeuvring
— enable a person at the workstation to observe the workstation for traffic surveillance and manoeuvring and maintain the field of vision for proper lookout
— enable the navigator at the workstation for traffic surveillance and manoeuvring to observe information related to the safety state of the ship which are not located at the traffic surveillance workstation.

703 *Tasks to be performed*

The workstation for safety monitoring and emergency operations shall enable the following tasks to be performed:

— monitor the safety state of the ship, such as fire, emergency, etc.
— monitor and operate distress systems
— take action on alarms and execute relevant measures
— organise emergency operations
— consult the ship's safety plans and drawings.

704 *Information and equipment to be provided*

Information displays, alarm panels, controls and equipment enabling early detection and efficient action in abnormal internal conditions and distress situations shall be easily accessible from the workstation for safety operations. The following safety monitoring systems, when provided, shall be easily accessible from the workstation:

— fire detection and alarm system
— fire pump controls
— control panel for water tight doors, ramps and hatches
— control panel for fire doors
— emergency stop for ventilation fans
— gas and smoke detection systems
— equipment for detection of ships in distress as required by GMDSS
— alarm and safety system for additional functions.

The warnings and alarms to be provided by these systems should be located for easy monitoring from the workstation for traffic surveillance and manoeuvring.

705 *Means to be provided*

The following means to organise and execute emergency operations shall be easily accessible:

— hardcopies of safety plans and drawings with desk top space to accommodate study of drawings or computer system providing all relevant information
— internal communication system
— external communication system, at least a VHF-unit, if not provided at the workstation for communication.

C 800 Workstations for docking operations

801 The workstations for safe docking of the ship shall enable the navigator together with a pilot to observe all relevant external and internal information to direct the manoeuvring of the ship. See Fig.4. The following symbols are used:

D: Distance ≥ 600 and ≤ 800 mm (recommended = 600 mm)
H: Passageway ≥ 600 mm
M1: Master alternative position 1
M2: Master alternative position 2
P: Pilot position
1: External communication - VHF
2: Whistle
3: Thruster controls
4: Propulsion controls
5: Steering controls
6: Internal communication
7: Available space - To include wiper controls

The arcs are indicating the reach from the two alternative positions of master.

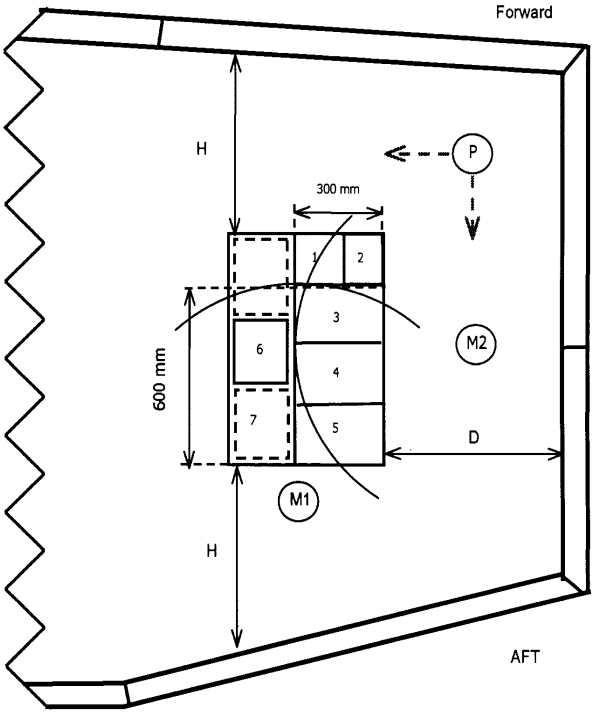


Fig. 4
Recommended location of bridge wing console and main equipment

802 *Tasks to be performed*

The workstation for docking operations shall enable the following tasks to be performed:

— control the ship's heading and speed by having orders effected
— monitor the heading of the ship, rudder angle and propeller revolutions (pitch and thruster effects) when relevant
— release sound signals
— monitor the relevant mooring stations on board and ashore
— control the mooring operations by having orders effected
— effect two-way communication with mooring stations on board and ashore
— effect two-way communication with wheelhouse workstations for manual steering and manoeuvring.

803 *Equipment to be available*

Equipment essential for the safe performance of docking operations shall be available from a specific position providing the required field of vision including:

— whistle push button
— means for two-way communication with mooring stations on board and relevant workstations in the wheelhouse
— VHF unit
— device for acknowledging watch monitoring warnings or alarms.

The VHF unit may be a complete set, a handset enabling selection of channels, or a mobile unit. If a handheld mobile unit is used, a specific location at the working position on the bridge wing shall be dedicated the VHF telephone.

804 *Information and equipment to be provided*

Information essential for safe conduct of the docking operations shall be easily readable from the workstation for docking operations.

Guidance note:

The following information indicators should be easily readable from the workstation:

- propeller revolutions indicator and pitch or thruster indicators, when provided
- rudder angle indicator
- gyro repeater.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

805 *Additional tasks for docking operations* - **NAUT-AW**

The following tasks shall performed:

— effect alteration of rudder angle and propulsion
— acknowledge alarms
— effect two-way communication with machinery space and department offices.

806 *Additional equipment required for docking operations* - **NAUT-AW**

The following additional equipment and displays shall be installed within reach from the working position to enable safe performance of the tasks:

— propulsion control
— thruster control, if provided
— steering control
— internal communication equipment.

The following indicators or displays shall be easily readable from the workstation:

— speed indicator
— rudder order indicator, when follow up steering is provided at this workstation.

D. Additional Workstations

D 100 General requirements

101 In order to maintain the safety level in bridge operation,

also when the officer of the watch performs other functions than those related to primary bridge functions, the following requirements shall be complied with:

a) Each additional function shall be designated a separate workstation (separate workstations may be adjacent).

b) From workstations for additional functions, it shall be possible to monitor the workstation for traffic surveillance and manoeuvring, including the ship's course and rudder angle, and to maintain the field of vision for efficient lookout.

c) The workload at workstations for additional functions shall not prevent the officer of the watch from maintaining a proper lookout.

d) In situations where primary functions may require the immediate attention of the officer of the watch, nothing shall prevent him abandoning a workstation for additional functions.

e) It shall be possible to operate workstations for additional functions without interfering with the operation of workstations for primary functions.

102 Other functions than those related to navigation and manoeuvring may be performed on the bridge by other personnel than the officer of the watch, provided the following requirements are complied with:

a) The location, or the use of a workstation for other functions shall not influence the performance of primary bridge functions.

b) The tasks to be carried out at workstations for other functions shall not in any way affect the performance of primary bridge functions, neither by use of light, noise disturbance nor visual distraction.

c) Furniture arranged for meetings or relaxation inside the wheelhouse shall not be installed within the area of the navigating bridge or the sectors of field of vision required from the workstations for primary bridge functions. If such arrangement is installed close to these areas, the requirements specified under a) and b) shall be met.

Guidance note:

See IMO Res. A.708(17), where IMO urges governments to ensure that ship's navigation bridge is not used for purposes other than navigation, communication and other functions essential to the safe operation of the ship, it's engines and cargo.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

D 200 Workstation for communication

201 Where other external communication equipment than that related to navigation and distress is installed on the bridge, it shall be located in a separate workstation for communication.

202 A workstation for communication shall be located adjacent to the workstation for safety monitoring and emergency operations. If the additional workstation for communication is not to be operated by the officer of the watch, it may be located elsewhere on the bridge in compliance with 102, but easily accessible from the workstation for emergency operations.

203 Communication equipment on the bridge shall be so arranged that whenever the situation does not permit the navigator to operate the additional communication equipment, he shall be relieved of this task.

Guidance note:

The communication workstation, or the navigation workstation if remote control is installed, should include facilities for instantly transferring communication to a position elsewhere in the ship. Alternatively, the navigator should be able to call another person to the communication workstation whenever he is unable to handle such communication due to navigational duties.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

204 It shall be possible to perform radiotelephone public correspondence communication without this communication being audible to the navigator.

Guidance note:

If communication from the communication workstation may be audible to the navigator, then another location or room fulfilling this requirement should be made available for public correspondence.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

E. Bridge Configuration

E 100 General

101 The bridge design shall enable the officer of the watch to perform navigational duties unassisted at all times during normal operating conditions. He shall be able to maintain a proper lookout by sight and hearing as well as by all available means appropriate in the prevailing circumstances and conditions so as to make full appraisal of the situation and the risk of collision, grounding and other hazards to navigation.

Guidance note:

See Rule 5 of the International Convention for Preventing Collisions at Sea, 1972, as amended, and Regulation II/1.9 «Lookout» of the International Convention on Standards of Training, Certification and Watch-keeping for Seafarers, 1978, (as amended in 1995).

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

102 When designing the configuration of the bridge, the main factors to be considered are the overall view required from the inside of the wheelhouse and the field of vision required from each workstation.

103 *Glare in windows*

Glare in bridge windows caused by internal light sources shall be avoided and not obstruct the view required for safe performance of bridge operations.

104 To help avoid reflection (glare) from lights in wheelhouse consoles, all bridge windows shall, as far as practicable, be inclined from the vertical plane top out, at an angle of not less than 15° and not more than 25°. Light sources, which may cause reflection in windows inclined in accordance with this requirement, shall be avoided.

E 200 Field of vision

201 In order to obtain sufficient field of vision for safe navigation and manoeuvring of the ship, every effort shall be made to place the bridge above all other decked superstructures.

202 It shall be possible to watch the area immediately in front of the bridge superstructure from the inside of the wheelhouse by enabling access to at least one front window. If this requirement is met by combining an adequate conning position (see C402) and the required access specified in C402, the width of the total access shall be sufficient to accommodate 2 persons.

203 The ship's side shall be visible from the workstation for docking operations, especially where tugs or pilot boats come alongside and where the ship touches the jetty.

204 Bridge wings shall as far as practicable extend out to the maximum beam of the ship. For ships with enclosed bridge wings, it shall be possible to open one side window to view the ship's side at water surface if:

— the side windows are vertical
— the side windows are inclined but the bridge wing deck is not extended fully to the maximum width of the ship.

It shall be possible for one person to open the windows fully. Other solutions to help achieving the view required may be accepted if it cannot be achieved by opening windows alone.

205 It shall be possible to observe all objects of interest for the navigation, such as ships and lighthouses, in any direction from inside the wheelhouse.

206 *Overall field of vision*

A horizontal field of vision to the horizon of 360° shall be obtained by using not more than 2 positions inside the wheelhouse on either side of the workstation for traffic surveillance, being not more than 15 m apart. See Fig.5.

In order to obtain the required view astern, the distance of 15 m between the two positions inside the wheelhouse may be extended, provided:

— the bridge wings are enclosed and equipped to enable course and speed alterations from the workstation for docking
— pre-approved artificial means, capable of viewing the sector astern not visually seen from workstation for traffic surveillance, are provided at the workstation for traffic surveillance. See Guidance note, to 214.

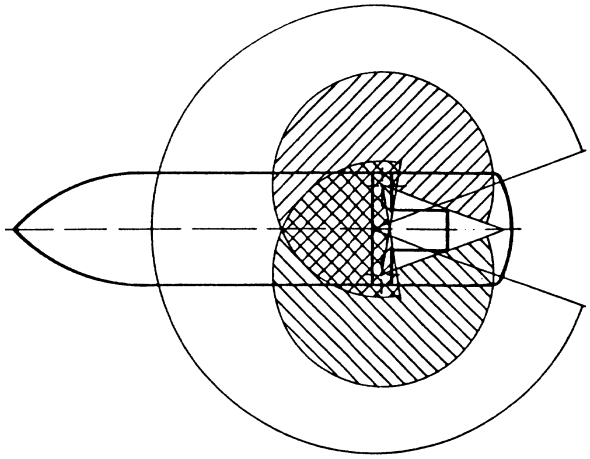


Fig. 5
360° field of vision from inside the wheelhouse

207 The vertical view from the workstations for navigation and traffic surveillance and manoeuvring shall enable the navigator to detect and monitor objects visually on the sea surface up to the horizon within the required horizontal field of vision when the ship is pitching and rolling.

208 The minimum height of the upper edge of bridge windows above the bridge deck surface should be 2000 mm in order to allow a view of the horizon for a person in a standing position at the workstations (eye height 1800 mm).

209 *View forward of the bow*

In order to be able to perform manoeuvres in time to avoid critical situations, the view of the sea surface for a person in a standing position at the workstation for conning and the workstation for traffic surveillance and manoeuvring shall not be obscured by more than two ship lengths or 500 m, whichever is less, forward of the bow to 10° on either side, under all conditions of draught, trim and deck cargo. See Fig.6.

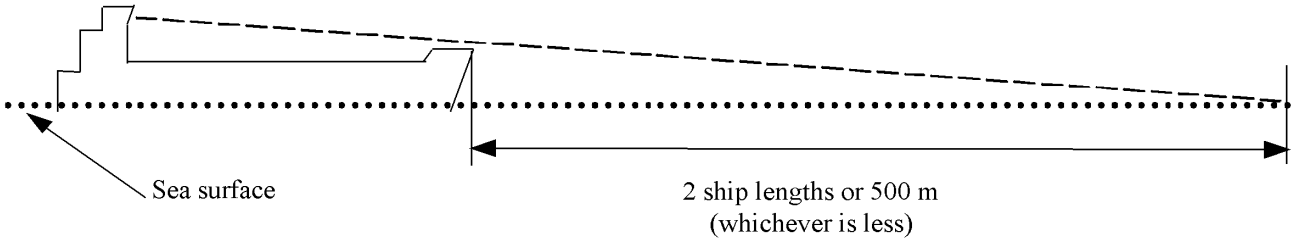


Fig. 6
Forward view

210 In order to obtain a good view of the sea surface for visual navigation in the sector from 010° to 090° on either side of the ship, the height of the lower edge of the windows shall be 1000 mm or less.

a) *Class notation* **NAUT-OC**

When the distance between the windows and the viewing point 350 mm aft of the consoles in sitting position at the workstations for navigation and traffic surveillance and manoeuvring is more than 2300 mm, the height of the lower edge of the windows in the sector from 010 to 090 on each side shall be decreased sufficiently to maintain the line of sight. See Fig.7.

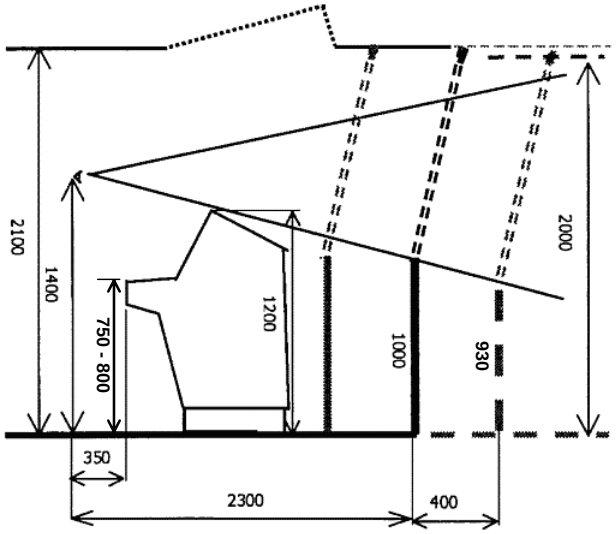


Fig. 7
NAUT-OC. The height of the lower edge of windows to be decreased when the distance to front bulkhead exceeds 2300 mm

b) *Class notation* **NAUT-AW**

When the distance between the windows and the viewing point 350 mm aft of the consoles in sitting positions at the workstation for navigation/traffic surveillance and manoeuvring and the workstation for navigation (**NAUT-AW** back-up) is more than 1500 mm, the height of the lower edge of the windows in the sector from 010 to 090 on each side shall be decreased sufficiently to maintain the line of sight. See Fig.8.

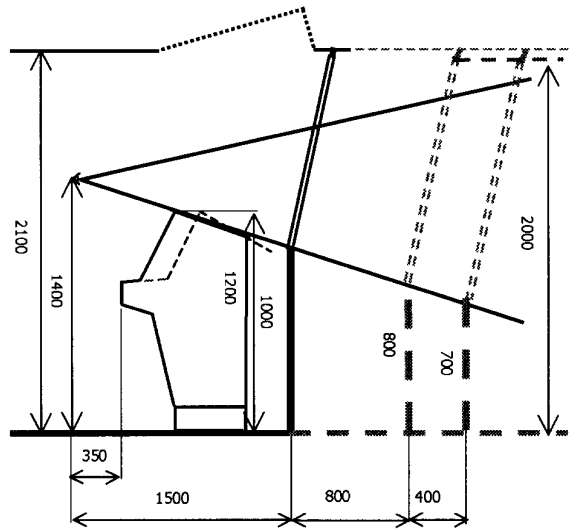


Fig. 8
NAUT-AW. The height of the lower edge of windows to be decreased (lower than 1000 mm) when the distance to front bulkhead exceeds 1500 mm

211 The forward view over the lower edge of the windows and the general view through other windows seen from a sitting position at the workstations for navigation and traffic surveillance and manoeuvring shall not be obstructed by the height of consoles located between the operator and the windows. See B302.

212 The height of consoles adjacent to the workstations for navigation and traffic surveillance and manoeuvring, and other consoles between these workstations and bridge windows shall not exceed 1200 mm.

213 *Horizontal field of vision*

In order to enable the officer of the watch to carry out his functions in compliance with the International Regulations for Preventing Collisions at Sea, the horizontal field of vision the workstations for navigation and traffic surveillance and manoeuvring and for conning shall extend over an arc not less than 225°, that is from dead ahead to not less than 22.5° abaft the beam on either side of the ship. See Fig.9.

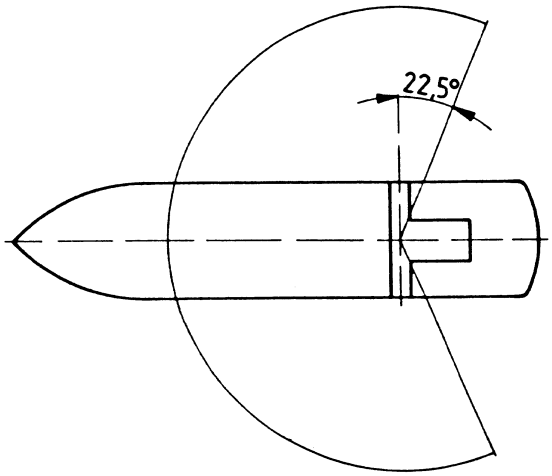


Fig. 9
Field of vision from the workstations for navigation and traffic surveillance and manoeuvring

214 *View astern* - **NAUT-AW**

In order to use lights in line astern of the ship as a visual reference for steering the ship from the workstation for traffic surveillance and manoeuvring, the horizontal field of vision from the workstation shall extend over an arc from dead astern to at least 5° on each side.

No blind sectors shall occur within the required field of vision higher than 1200 mm above the bridge deck surface.

Guidance note:

An adequate optical device or camera may be accepted for the purpose of achieving the required field of vision astern, providing the true picture of the objects to be observed can be continuously reproduced with regard to brightness, direction, colours and scale under all weather conditions. The system and arrangement should be approved by the Society prior to the design of the bridge and adjacent areas.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

215 *Field of vision for conning*

From the workstation for conning, the vertical field of vision shall enable the conning officer to determine the ship's exact heading and position relative to a narrow channel ahead as well as observe the relative nearness of the two sides of the channel.

216 *Field of vision for docking operations*

In order to enable the operator to manoeuvre the ship safely alongside a berth and control the mooring of the ship, the field of vision from each workstation for docking operations on the bridge wings shall extend over an arc of not less than 225°, that is from at least 45° on the opposite bow through dead ahead and then aft to 180° from dead ahead. See Fig.10.

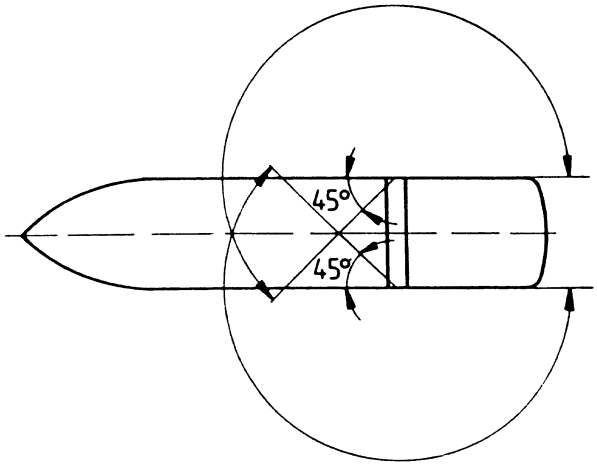


Fig. 10
Field of vision from workstations for docking operations

217 *Field of vision for manual steering*

In order to enable the helmsman to steer the ship safely in narrow channels, the horizontal field of vision from the workstation for manual steering shall extend over an arc from dead ahead to at least 60° on each side. The view of the sea surface, seen from a standing position at the workstation, should be equivalent to the line of sight required from a sitting position at the workstations for navigation and traffic surveillance and manoeuvring. See 210 and Fig.11. The required field of vision shall not be obtained by locating the workstation for manual steering immediately abaft the front windows.

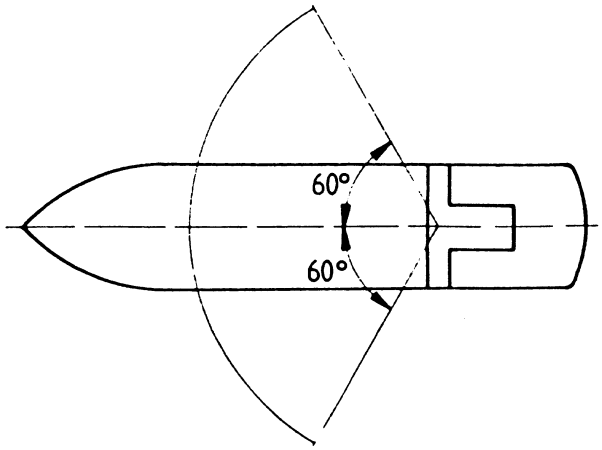


Fig. 11
The field of vision from a workstation for manual steering

218 *Field of vision from rear workstations*

In order to enable the officer of the watch to use workstations for safety monitoring/emergency operations, radio communication and additional bridge functions for short periods of time, the field of vision from these workstations shall extend at least over an arc from 90° on port bow, through forward, to 22.5° abaft the beam on starboard. See Fig.12.

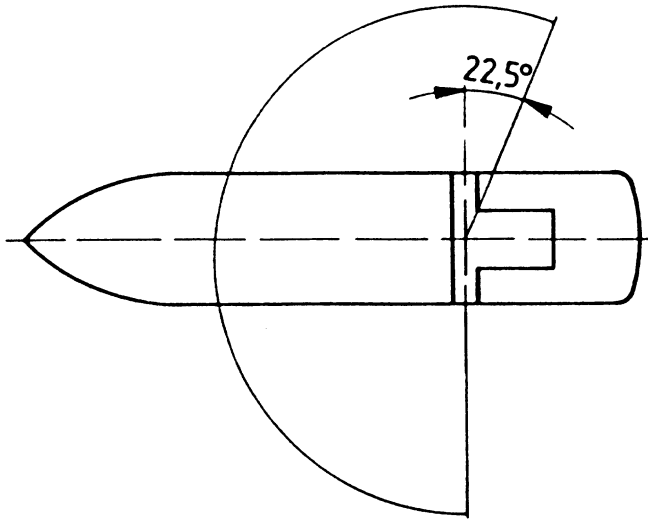


Fig. 12
The field of vision from a workstation for performance of additional functions

E 300 Blind sectors

301 Blind sectors caused by cargo, cargo gear, divisions between windows and other obstructions appearing in the required field of vision of 225°, shall be as few and as small as possible, and in no way hamper a safe lookout from the workstations for navigation and traffic surveillance and manoeuvring. The total arc of blind sectors within this field of vision shall not exceed 30°.

Guidance note:

The front bulkhead of bridge wings should be aligned with the line of sight from the workstations for navigation and traffic surveillance and manoeuvring in order to avoid excessive blind sectors. See Fig.13.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

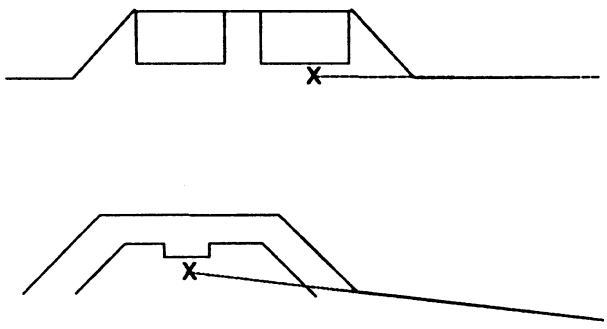


Fig. 13
Front bulkhead of bridge wing in the line of sight from the workstation

302 Over an arc from dead ahead to at least 10° on each side of the bow, the total blind sector shall not exceed 5°. Elsewhere, each individual blind within the required field of vision shall not exceed 10°.

The clear sector between two blind sectors shall be at least 5° and not less than the size of the broadest blind sector on either side of the clear sector. In order to comply with 213 requiring a field of vision of 225° and not less than 22.5° abaft the beam, a clear sector shall extend from 22.5° abaft the beam and forward on either side of the ship.

303 Divisions between windows shall be kept to a minimum

and not placed in front of any workstation, for example, the radars. If stiffeners between windows are to be covered, this shall not cause further obstruction of the field of vision from any position inside the wheelhouse.

304 Windows should be as wide as possible, and not less than 1200 mm wide in the required field of vision from the workstations for navigation and traffic surveillance and manoeuvring.

Guidance note:

The width of the window directly forward of the centre console may be less than 1200 mm in order to avoid that window divisions/ stiffeners are located in front of any workstations (see 303).

The division between windows, especially within the required field of vision, should not exceed 150 mm. If stiffeners are used, the width between window glasses should not exceed 100 mm and the depth of the stiffeners should be less than 120 mm.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

E 400 Clear view through windows

401 A clear view through bridge windows within the field of vision required from the workstations for primary bridge functions shall be provided at all times regardless of weather conditions.

The following installations are required:

— Sunscreens of roller blind type to ensure clear view in bright sunshine.
— Heavy duty wipers and fresh water window washing system on all front windows to ensure a clear view in rain and stormy seas.
— Efficient de-icing and de-misting systems to ensure a clear view in all operating conditions. Systems installed shall comply with appropriate ISO standards. Heated glass panels panes shall be used on board ships to be assigned the class notation for navigation in ice.

Guidance note:

It should be noted that additional sunscreens may be required to prevent direct sunlight from obscuring information on monitor screens and displays, Ref. Sec.7 C202.

The window wipers should be capable of wiping the window centre at a frequency of 0.5 Hz. The window wipers should, as far as practicable, cover 85 %, in both vertical and horizontal direction, of the window area necessary to meet the field of vision requirements. (e.g. window size: 200 cm x 120 cm - minimum wiped area: 170 cm x 102 cm).

Reference is also made to ISO 8863 and ISO 3434 for specifications of de-icing/de-misting system and heated glass panes respectively.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

402 *Additional cleaning requirement for totally enclosed bridge wings*

If the bridge wings are totally enclosed, heavy duty wipers and fresh water window washing to be provided on forward and aft windows within the field of vision required from workstations for docking operations.

403 *Additional cleaning requirement* - **NAUT-AW**

Heavy duty wipers and fresh water window washing to be provided on aft window(s) within the view astern sector required in 214.

404 A fixed catwalk or similar arrangement with means to prevent an accidental fall shall be fitted at the front windows to enable cleaning of windows outside and repair work in the event of failure of the cleaning system.

E 500 Sound signal reception

501 Sound signals that are audible on open deck shall also be audible inside the wheelhouse by means of a sound reception system. If, in addition, windows are arranged to be opened, they shall not be installed close to bridge equipment installations.

Guidance note:

Horizontally sliding windows should not be used.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

F. Requirements Specific for Class Notation NAUT-AW

F 100 General

101 This section gives an overview of the requirements specifically addressing **NAUT-AW** in A to E.

F 200 Workstations for navigation and traffic surveillance and manoeuvring

201 *Design of workstation* - **NAUT-AW**

The workstation for navigation and traffic surveillance and manoeuvring shall be designed for one-man operation only, and a separate workstation for navigation shall be installed sufficiently close by to serve as back-up and to allow good co-operation between two navigators each at their workstation. See C304.

202 *Navigational tasks at the workstation for traffic surveillance and manoeuvring* - **NAUT-AW**

The workstation designed for one-man operation only, shall enable performance of the tasks specified in C305 and the following tasks related to navigation:

— monitor the ship's performance in relation to the waters and the pre-planned route on the ECDIS
— carry out changes of input data to the navigational system
— monitor the performance of the automatic navigation in narrow waters by means of radar.

See C313.

203 *Additional equipment for navigation* - **NAUT-AW**

The instruments used for monitoring and control of the navigation systems at the workstation designed for one-man operation only, shall be within reach of the navigator and the information on the display(s) shall be easily readable from the same position.

The following equipment shall be provided, being part of an integrated grounding avoidance system:

— ECDIS
— conning information display system
— track control system (replacing a heading control system).

See C314.

F 300 Workstations for docking operations

301 *Additional tasks for docking operations* – **NAUT-AW**

The following tasks shall performed:

— effect alteration of rudder angle and propulsion
— acknowledge alarms
— effect two-way communication with machinery space and department offices.

See C805.

302 *Additional equipment required for docking operations* - **NAUT-AW**

The following additional equipment and displays shall be installed within reach from the working position to enable safe

performance of the tasks:

— propulsion control
— thruster control, if provided
— steering control
— internal communication equipment

The following indicators or displays shall be easily readable from the workstation:

— speed indicator
— rudder order indicator, if the steering system is a follow-up system.

See C806.

F 400 Field of vision

401 *Class notation* **NAUT-AW**

In order to obtain a good view of the sea surface for visual navigation in the sector from 010° to 090° on either side of the ship, the height of the lower edge of the windows shall be 1000 mm or less. See E210.

When the distance between the windows and the viewing point 350 mm aft of the consoles in sitting positions at the workstation for navigation and traffic surveillance and manoeuvring and the workstation for navigation (**NAUT-AW** back-up) is more than 1500 mm, the height of the lower edge of the windows in the sector from 010 to 090 on each side shall be decreased sufficiently to maintain the line of sight. See E210 b) and Fig.8.

402 *View astern* - **NAUT-AW**

In order to use lights in line astern of the ship as a visual reference for steering the ship from the workstation for traffic surveillance and manoeuvring, the horizontal field of vision from the workstation shall extend over an arc from dead astern to at least 5° on each side. No blind sectors shall occur within the required field of vision higher than 1200 mm above the bridge deck surface. See E214.

Guidance note:

An adequate optical device or camera may be accepted for the purpose of obtaining the required field of vision astern, providing the true picture of the objects to be observed can be continuously reproduced with regard to brightness, direction, colours and scale under all weather conditions. The system and arrangement should be approved by the Society prior to the design of the bridge and adjacent areas. See E215.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

SECTION 3
BRIDGE WORKING ENVIRONMENT

A. Requirements for Bridge Working Environment

A 100 Application

101 Ships requesting class notation **NAUT-OC** or **NAUT-AW** shall comply with the rules in this section and with Pt.4 Ch.9 Sec.6 F.

A 200 General

201 Throughout the various design stages of the ship, care shall be taken to achieve a good working environment for bridge personnel.

202 Toilet facilities shall be provided on or adjacent to the bridge.

203 Refreshment facilities and other amenities provided for the bridge personnel shall include means for preventing damage to bridge equipment and injury to personnel resulting from the use of such facilities and amenities.

A 300 Vibration

301 Uncomfortable levels of vibration causing both short and long term effects shall be avoided in the bridge area. See Pt.4 Ch.9 Sec.6 F100.

A 400 Noise

401 Uncomfortable levels of noise, or noise which may affect safe and efficient bridge operation, shall not occur in the bridge area. See Pt.4 Ch.9 Sec.6 F200.

402 The noise level produced by individual bridge equipment shall not exceed 60 dB(A)/1m.

A 500 Lighting

501 An adequate level of lighting facilitating the performance of all bridge tasks at sea and in port, daytime and nighttime, shall be provided.

Guidance note:

Workstation areas should have a greater luminance than the ambient lighting level.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

502 Care shall be taken to avoid glare and stray image reflections on window and deckhead surfaces.

Guidance note:

a) High brightness contrast between work areas and surroundings should be avoided.

b) Non-reflective or matt surfaces should be used to reduce indirect glare to a minimum.

c) Lighting arrangements above workstations should be sufficiently retracted into the deckhead ceiling to avoid unwanted horizontal stray of light. Floodlight arrangement should in addition be fitted with a dark raster screen

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

503 A satisfactory degree of flexibility within the lighting system shall enable the bridge personnel to adjust lighting intensity and direction as required in the different areas of the bridge and at individual instruments and controls.

Guidance note:

Vision in dim light has the following characteristics:

- perception of detail and colour is affected
- the eye becomes more sensitive to the blue end of the light spectrum
- peripheral vision is enhanced.

Adaptation to darkness is important to ensure a good visual lookout at night. It takes 30 to 40 minutes for complete adaptation to darkness. The Table below lists recommended general illuminations.

Recommended general illumination	
Place	*Colour and illumination*
Bridge, adjacent compartments, day	White, continuously variable from 0 to at least 300 lux
Bridge workstations, night	Red, continuously variable from 0 to 20 lux
All adjacent corridors and compartments, night	Automatic door switches preventing white light from flooding the bridge area should be fitted
Open staircase inside wheelhouse, night	Red continuously variable from 0 to 20 lux or red indication light installed at steps
Chart table, day and night	White floodlight or spotlights continuously variable from 0 to 300 lux

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

504 During hours of darkness, it shall be possible to discern control devices and read displayed information.

Guidance note:

Except at the chart table, red light should be used whenever possible in areas or on items of equipment requiring illumination in the operational mode, including bridge wing instruments. Provision should be made to prevent red lights from being visible outside the ship.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

A 600 Temperature

601 The wheelhouse shall be equipped with an adequate temperature control system.

Guidance note:

The temperature range in the wheelhouse should be 14°C to 30°C for an external temperature range of -10°C to 35°C.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

602 The temperature gradient from deck level up to 2 m shall be within the range of ±1°C and not exceed ±4°C.

A 700 Ventilation

701 A sufficient range of air movement shall be available to the bridge personnel. See ISO 7547.

Guidance note:

a) In general, air movement should vary with the different temperatures in the wheelhouse: the higher the temperature, the greater the air movement needed for comfort. With temperature maintained in the range 18°C to 23°C, the air movement should be 0.3 m/s to 0.5 m/s.

b) The recommended rate of air circulation for enclosed spaces is 6 complete changes per hour.

c) The A weighted sound pressure level from the air distributing system measured 1 m from the air terminal device should not exceed 55 dB(A).

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

A 800 Surfaces

801 The bridge surface finishes shall have a matt coating and colours with low reflection range in order to reduce reflections and indirect glare to a minimum. Deck head areas above workstations, bulkheads at window heights and consoles are of special importance. See 901 and Table A1.

Table A1 Reflection range for some typical colour densities	
Reflectance range	*Typical colour densities*
5% to 10%	Dark Green Blue or Brown
15% to 30%	Mid Green Blue or Red
50% to 60%	Pale Green Blue or Yellow
80% to 90%	Off White Pale Yellow

802 Wheelhouse, bridge wing and upper bridge decks shall have a non-slip surface when wet or dry.

A 900 Colours

901 Colours shall be chosen to give a calm overall impression and minimise reflection.

Guidance note:

Bright colours should not be used. Dark or mid green colours are recommended; alternatively, blue or brown may be used.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

A 1000 Safety of personnel

1001 The bridge area shall be free of physical hazards to bridge personnel.

Guidance note:

There should be no sharp edges or protuberances that could cause injury to personnel. The bridge deck should be free of trip hazards; such as curled up carpet edges, loose gratings or equipment. Means should be provided for properly securing portable equipment.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

1002 Hand or grab rails shall be fitted to enable personnel to move or stand safely in bad weather. Protection of stairway openings shall be given special consideration.

1003 All safety equipment on the bridge shall be clearly marked and easily accessible and have its stowage position clearly indicated.

SECTION 4
CARRIAGE REQUIREMENTS FOR NAVIGATIONAL SYSTEMS AND EQUIPMENT

A. General

A 100 Scope

101 This section establishes the minimum range and the types of equipment and systems that ships to be assigned class notation **NAUT-OC** and **NAUT-AW** need to install.

A 200 Application

201 Ships requesting class notation **NAUT-OC** and **NAUT-AW** shall comply with the basic rules in A and B. Ships requesting class notation **NAUT-AW** shall also comply with the requirements specifically addressing **NAUT-AW** in B. The requirements specific for **NAUT-AW** in B are listed in C.

202 The navigational systems and equipment to be carried shall comply with the relevant requirements given in Sec.5, Sec.6 and Sec.7.

A 300 General requirements

301 The individual equipment shall be type approved on the basis of relevant IMO performance standards in force, when applicable.

302 The supplier or manufacturer of a grounding avoidance system shall provide a course of competence complying with the knowledge requirements in Sec.9 B200.

B. Carriage Requirements

B 100 General

101 This sub-section establishes basic equipment carriage requirements for all ships and specifies requirements for **NAUT-AW** that are additional to, amends or replace the basic requirements.

B 200 Heading information systems

201 The heading information shall be continuously displayed at the relevant workstations and the system shall enable distribution of the information to other equipment as required.

202 *Main compass system*

Two separate and independent gyrocompasses or other approved means having the capability to determine the ship's heading in relation to geographic (true) North shall be provided. The gyro system shall include repeaters to be readable from each of the steering positions, the conning position and as required for taking bearings 360° around the ship from the bridge deck. The system shall enable distribution of heading information to radar systems, the heading control or track control system, as well as ECDIS when applicable.

203 *Additional gyro repeaters* - **NAUT-AW**

Two digital repeaters shall be installed, each at the workstation for docking operations if bearing repeaters on bridge wings are not readable from the working position.

B 300 Steering systems

301 The ship shall be equipped with means for manual and automatic steering of the ship. The manual steering system shall be redundant and include two separate steering positions, one for a helmsman and one for the watch officer.

302 Information from a gyro repeater display, rudder angle indicator, rate-of-turn indicator and a rudder order indicator (where follow-up steering is provided) shall be provided. The steering position for the watch officer shall in addition include a heading control system, a steering override control and a selector switch for different steering modes and steering positions.

303 *Additional manual steering positions*- **NAUT-AW**

Means for manual steering shall be provided at each docking workstation.

304 Steering tiller systems including programmable electronic systems shall be supported by a failure mode and effect analysis (FMEA) for verification of acceptable fail to safe modes. See Pt.4 Ch.9.

305 A sufficient number of rudder angle indicators and rudder order indicators shall be provided. See 302.

306 *Heading control system*

A heading control system or other approved means for automatic steering of the ship shall be provided.

307 *Rate of turn indicator*

A rate-of-turn indicator or other approved means to assist in monitoring the accuracy of turns during course alterations and safe manoeuvring of the ship shall be provided.

B 400 Speed measuring system

401 A speed log, or other approved means for measuring the ship's speed and distance independently of position-fixing systems shall be provided.

402 The system shall provide radars facilitating automatic tracking aid with input of the ship's speed through the water.

403 *Additional speed log*

Ships of 50 000 gross tonnage and upwards shall in addition to fulfilling the requirement in 401, be fitted with a speed and distance measuring equipment, or other approved means to measure and indicate speed and distance over the ground in the forward direction and the speed in the athwart ship direction.

404 The speed measuring system shall include slave displays to provide speed information to workstations for traffic surveillance and manoeuvring, navigation and conning, and provide speed input to equipment as required.

405 *Additional displays* - **NAUT-AW**

The speed measuring system shall include slave displays providing information to workstations for docking operations.

B 500 Depth measuring system

501 The ship shall be equipped with an echo sounder system or other approved means for measuring the water depth under the keel. The system shall include a separate digital display unit for installation in a deckhead console.

502 *Additional displays* - **NAUT-AW**

The depth measuring system shall include slave displays providing information to workstations for docking operations.

B 600 Radar systems

601 The vessel shall be provided with two separate and independent radar systems enabling inter-switching of the main components, to assist in navigation and traffic surveillance. Each individual radar system installed shall be equipped with a performance monitor. One radar shall be a X-band radar. The second radar shall be a S-band radar or, where considered ap-

propriate based on operational aspects, a X-band radar.

602 If the radar inter-switching is so designed that one single failure may have an impact on both radars, then sufficient by-pass facilities shall be provided.

B 700 Collision avoidance system

701 An automatic plotting aid or other approved means to automatically plot the range and bearing of other surface craft, in order to determine the risk of collision, shall be provided.

702 When radar is used for automatic plotting, at least one of the radar installations shall facilitate automatic radar plotting aids (ARPA).

703 *Additional plotting aid* - **NAUT-AW**

When radar is used for automatic plotting, both installed radars shall facilitate ARPA functions. This is in order to improve the determination of the risk of collision, when operating conditions in narrow waters requires two navigators to maintain safety of navigation.

704 *AIS reported targets on graphical display* - **NAUT-AW**

At least one of the graphical display equipment installed in accordance with this section shall be capable of presenting AIS reported targets in accordance with relevant IMO standards and guidelines.

Guidance note:

The radar installed in accordance with Sec.2 C310 should include means for use and display of AIS information

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

705 *Sound reception system*

A sound reception system, or other approved means to assist in traffic surveillance by receiving sound signals outside the wheelhouse and reproducing such signals inside the wheelhouse shall be provided.

B 800 Nautical chart system

801 The ship shall carry adequate and up-to-date charts and all other nautical publications necessary for the intended voyage as required by SOLAS.

Guidance note:

Electronic chart display and information system (ECDIS) with adequate back-up arrangement displaying selected information from a system electronic nautical chart (SENC) may be carried as the nautical chart system required by SOLAS provided that the relevant maritime authorities have agreed. See Sec.1 C100.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

802 *Back-up arrangement for ECDIS*

When ECDIS is the main chart system, an adequate independent back-up arrangement meeting the requirements of the applicable IMO performance standards shall be provided to ensure safe navigation in case of ECDIS failure. Such arrangements shall include:

a) Facilities enabling a safe take-over of the ECDIS functions to ensure that an ECDIS failure does not result in a critical situation.

b) A means to provide for safe navigation for the remaining part of the voyage in the event of failure in the ECDIS.

Failure of the ECDIS back-up arrangement shall not result in loss of other navigational equipment installed in accordance with IMO carriage requirements.

Guidance note:

ECDIS back-up arrangements, which meet the requirements specified in 802 a) and b) include:

1) An independent electronic chart device meeting the IMO performance standards for ECDIS back-up arrangements and carrying an adequate chart database for the waters to be navigated.

2) A radar display unit meeting the IMO performance standards for shipborne radars in full, including the option of superimposing parts of the ECDIS database (SENC), enabling safe take-over in accordance with 802 a), together with paper charts covering the waters to be navigated, providing for safe navigation for the remaining part of the voyage in accordance with 802 b).

The radar display unit must facilitate route-planning functions and interface to ECDIS and GPS. The paper charts may be up-to-date official charts, or colour printouts from the ECDIS database provided acceptance by maritime authorities and pre-approval of the printing equipment.

3) A radar display unit as specified under 2) meeting the IMO performance standard for ECDIS back-up arrangements carrying an adequate chart database required for back-up arrangements.

4) An independent, type approved ECDIS.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

B 900 Grounding avoidance systems

901 A system for determining and continuously updating the ship's position by automatic means, enabling automatic detection of cross-track-error, shall be provided.

902 The ship shall be equipped with means for utilising position-fixing systems applicable for the waters to be navigated. The total position-fixing installation shall include two separate and independent electronic systems facilitating the functions required in 901.

Guidance note:

The independence of the two position-fixing systems may be achieved by separate antenna systems, display/ control units, power supply and digital interface output/ distribution units.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

903 Ships to be employed in worldwide trade shall carry two separate and electrically independent differential global positioning system (DGPS) receivers, or one DGPS and one combined GPS/GLONASS receiver provided with correction data from a maritime radio beacon receiver equipment or other approved means meeting the requirements in 901 and 902.

See also Table C1.

904 When a separate workstation for planning the route on paper charts is required, another GPS receiver or other approved means for determination of the ship's position and transfer of the planned route, shall be installed at this station.

Guidance note:

This receiver may be a slave display if it enables remote control of main GPS functions. This installation is not required if an ECDIS is part of the means for planning and transfer of the route to other workstations.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

905 *Integrated system for grounding avoidance – GAS* - **NAUT-AW**

An integrated navigation system for grounding avoidance, enabling the planning of a safe route using straight courses and radius turns into an ECDIS and a radar with chart facilities and steer the ship to automatically follow the planned route within the accuracy provided by the position-fixing system, shall be provided.

906 *Position surveillance system* – **NAUT-AW**

An ECDIS with an appropriate database for the waters to be navigated, or other approved means that enables safe route monitoring and efficient grounding avoidance functions shall be provided.

Guidance note:

The position surveillance system is to be part of a grounding avoidance system. See 905.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

907 *Conning display* – **NAUT-AW**

A conning information display, or other approved means enabling continuous visual monitoring of the performance of the integrated grounding avoidance system shall be provided.

B 1000 Heavy weather surveillance system

1001 *Weather information system*

The ship shall be equipped with a weather facsimile, or other means providing graphical information about the weather to be expected in the waters to be navigated, in order to assist in planning and maintaining a safe route.

B 1100 Watch monitoring and alarm transfer system

1101 The ship shall be equipped with a technical system for monitoring the alertness of the officer of the watch and warn other bridge personnel if disability occurs.

1102 A system based on continuous monitoring of the officer of the watch shall be installed. Alternatively, a system based on manual acknowledgement within pre-set intervals may be installed. Either type of system shall include a system for transferring unacknowledged alarms to specific places.

1103 *Central alarm panel*

A central alarm panel, or other approved means for indication of alarms related to navigational functions, equipment and systems and that enables cancelling of the alarm sound shall be provided. The central alarm panel may be an integral part of the conning display.

B 1200 Internal communication systems

1201 A two way internal communication system, independent of the ship's mains and emergency electrical power supply, at least enabling communication between the wheelhouse, bridge wings and all mooring stations, steering gear compartment, the masters and chief engineers living quarters and the radio room if not installed in the wheelhouse, shall be provided.

Guidance note:

Portable communication transceivers may be used for communication between the bridge/bridge wings and the mooring stations

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

1202 The automatic internal telephone system to be installed in accordance with IMO requirements shall facilitate priority call functions.

B 1300 Automatic identification system (AIS)

1301 Automatic identification system (AIS) shall be installed in accordance with the requirements given in SOLAS Chapter V, as amended by res. MSC.99(73).

B 1400 Voyage Data Recorder (VDR)

1401 Voyage data recorder (VDR) shall be installed in accordance with the requirements given in SOLAS Chapter V, as amended by res. MSC.99(73).

C. Carriage Requirements for Class Notation NAUT-AW

C 100 General

101 This sub-section gives an overview of the carriage requirements in B that is specific for class notation **NAUT-AW**. See Table C1.

102 The systems and equipment to be carried in accordance with the requirements listed in C are additional to or replace the basic requirements applicable for **NAUT-OC**.

C 200 Systems and equipment

201 *Additional gyro compass repeaters* - **NAUT-AW**

Two digital repeaters shall be installed, each at the workstation for docking operations if bearing repeaters on bridge wings are not readable from the working position. See B203.

202 *Additional manual steering positions* - **NAUT-AW**

Means for manual steering shall be provided at each docking workstation.

203 *Additional speed log displays* - **NAUT-AW**

The speed measuring system shall include slave displays providing information to workstations for docking operations.

204 *Additional echo sounder displays* - **NAUT-AW**

The depth measuring system shall include slave displays providing information to workstations for docking operations.

205 *Additional plotting aids* - **NAUT-AW**

When radar is used for automatic plotting, both radars to be installed shall facilitate ARPA functions in order to improve the determination of the risk of collision when operating conditions in narrow waters require two navigators to maintain safety of navigation. See B703.

206 *Integrated system for grounding avoidance – GAS* - **NAUT-AW**

A grounding avoidance system enabling the planning of a safe route, using straight courses and radius turns, into an ECDIS shall be provided. The system shall be able to steer the ship to follow the planned route automatically within limits related to the ship's manoeuvrability and turning characteristics.

Guidance note:

The system should be able to steer the ship within a limit equal to the ship's breadth to either side of the course line under calm weather conditions with minor effect of currents or tidal streams.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

207 *Equipment to be integrated* – **NAUT-AW**

The following main components shall be part of the integrated system for grounding avoidance:

— two separate and independent global positioning systems
— ECDIS
— track control system
— radar

supported by input information of:

— course from a gyro system
— speed from a speed log

assisted by:

— a conning display system
— watch monitoring and alarm transfer system.

The integrated system shall include a Kalman position filter or equivalent.

208 *Position surveillance system* – **NAUT-AW**

An ECDIS with appropriate database for the waters to be navigated, or other approved means that enables safe route monitoring and efficient grounding avoidance functions shall be provided.

209 *Route planning functions* - **NAUT-AW**

The ECIS required in 208 shall also serve the functions re-

quired for route planning prior to the voyage. When ECDIS with back-up is installed, the system can also be used for route planning during the voyage.

210 *Interim route planning solution* – **NAUT-AW**

Before ECDIS is fully available and paper charts are the only legal chart system, an interim solution meeting the basic requirements for route planning can be accepted, provided a route planning system enabling the following is installed at the workstation for route planning:

— checking the accuracy and content of the electronic chart by visual comparison with the paper chart
— planning a route in the electronic chart
— manual entry of dangers to navigation in the electronic chart
— direct transfer to the ECDIS at front workstation.

See Sec.2 C500.

211 *Visual monitoring of GAS performance* – **NAUT-AW**

A conning information display, or other approved means enabling continuous visual monitoring of the performance of the integrated grounding avoidance system shall be provided. The conning display shall present status information on all input values used by the integrated grounding avoidance system, and ongoing and upcoming course and turn orders.

Table C1 Typical minimum equipment installation for NAUT-OC and NAUT-AW			
Equipment	**NAUT-OC**	**NAUT-AW**	*Remarks*
Course information system			
Gyro compass	2	2	Or other approved and equivalent means
Bearing repeaters	2	2	
Steering repeaters	1	1	
Digital repeaters	2	4	
Distribution	3	5	
Steering system			
Manual system 1	1	1	Steering stand
Manual system 2	2	4	Tiller or mini wheel
Heading control system	1		
Track control system		1	
Rudder angle indicators	3	5	
Rudder order indicator	1	1	
Rate-of-turn indicators	1 (2)	1 (2)	
Speed measuring system			
Speed log, measuring speed through the water	1	1	
Speed log, measuring speed over ground	1 *	1 *	* Vessels of 50 000 gross tonnage and above
Slave displays	1	3	
Distribution	1	3	
Depth measuring system			
Echo sounder	1	1	
Slave displays	1	3	
Radar system			
Radar	1		
Radar with ARPA functions	1	2 *	* One radar, with chart facilities, part of integrated system
Position-fixing system			
DGPS 	2 1	2 1	1 combined GPS/GLONASS (with Differential correction capabilities) may replace one DGPS
GPS slave unit	1		When required at route planning workstation
Watch monitoring and alarm transfer			Included in the alarm management system
Main system unit	1	1	Collecting signals and distributing alarms
Operating unit			On and off + select back-up/(intervals)
Acknowledge buttons	1	1	In the wheelhouse only
Distribution	8	8	Buzzers
Central alarm panel	1	1	May be an integral part of the conning display
Slave central alarm panels w/acknowledge of sound		2	Complete panel or group alarms only
Sound reception system			
Main system	1	1	Microphones, amplifiers, speakers, control panel
Electronic chart system			
ECDIS		1	Part of integrated system
Back-up for ECDIS		1	When ECDIS is the legal chart system
Route planning system		1	If ECDIS is not the only legal chart system
Conning information display system			
Display unit		1	
Weather information			
Weather facsimile	1	1	
Internal telephone system			See Pt.3 Ch.3 Sec.11
Automatic identification system (AIS)			See B1301
Voyage data recorder (VDR)			See B1302

SECTION 5
GENERAL BRIDGE EQUIPMENT REQUIREMENTS

A. General

A 100 Application

101 Ships requesting class notation **NAUT-OC** or **NAUT-AW** shall comply with the rules in this section.

A 200 General requirements

201 All equipment shall comply with the applicable requirements given in Pt.4 Ch.9.

202 All navigational equipment installed shall comply with IMO Res. A.694(17) "General requirements for shipborne radio equipment forming part of the GMDSS and for electronic navigational aids".

203 Any system or instrument failure is to result in the least critical of any possible new condition.

204 Individual equipment installed shall not degrade the reliability, performance and readability of other equipment it is interfacing.

205 Bridge equipment installed in addition to the carriage requirements shall comply with relevant requirements of this section and relevant IMO performance standards.

206 Additional bridge equipment not type approved, shall prove that the functions, accuracy and reliability do not affect nautical safety. The equipment shall comply with the manufacturer's specification, if approved by the Society.

207 Any equipment or systems that may affect the safety of main functions, that is *steering and propulsion*, shall meet applicable requirements given in Pt.4 Ch.9 and be certified, if not type approved.

B. Environmental Conditions

B 100 Environmental conditions

101 Instruments and equipment shall comply with the requirements given in Pt.4 Ch.9 Sec.5 B.

Guidance note:

Navigation equipment specified in Sec.4 should meet the test requirements specified in IEC 60945.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

C. Location and Installation of Equipment

C 100 Installation

101 All instruments, panels, etc. shall be permanently mounted in consoles or at other appropriate places, taking into account both operational and environmental conditions. All other items, such as safety equipment, tools, lights, pencils etc. to be used by bridge personnel, shall be stored in designated places.

102 Any equipment, antennas and arrangement shall be installed in such a manner that the designed efficiency is not substantially impaired and, unless otherwise specified, follow the instructions and recommendations detailed by the manufacturer.

103 Radar antennas shall be installed to enable detection of targets within 360°. Blind sectors occurring in one radar system should not occur in the other system.

C 200 Interference

201 When placing equipment that is to be used in an exposed position, special care shall be taken to ensure that the location does not impair the performance of the equipment.

202 The antennas for radars, position-fixing receivers and VHF communication systems shall be installed in such a manner that interference is avoided and the designed efficiency is not substantially impaired.

Guidance note:

VHF operating performance is highly dependent upon antenna location and height, and each antenna should be erected as high as possible, away from obstacles, wires, radar beams, etc. To avoid direct VHF-to-VHF radiation, the antennas should be vertically separated from each other at a distance not causing harmful interference.

The antennas for navigation receivers should be mounted in a location permitting a high degree of vertical or horizontal polarised isolation against MF/HF transmitter antenna configuration. The GPS antenna should be positioned outside the main lobe of INMARSAT-C, VHF and transmitting radar antennas.

The S-band radar antenna should preferably be located at heights, which do not interfere with other shipboard obstructions. Nearby location of satellite communication antenna should not degrade the radar performance.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

203 Transmitting and receiving antenna cables shall be widely separated.

C 300 Radiation hazard

301 Antenna units shall be located so as not to constitute a hazard to personnel working in the vicinity.

Guidance note:

The siting of radar wave guides, satellite communication and HF transmitter feed lines should be safeguarded, so as to protect personnel against open wave-guide radiation power and accidental contact with high voltages, by means of isolating trunks or fences.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

302 Satellite communication or radar antenna units are required to have a warning label, detailing safe distances, posted in the vicinity or on the equipment.

303 Radar and satellite communication systems are required to have relevant human risk warnings and instructions in operator handbooks.

C 400 Vibration and shock isolation

401 Above deck equipment shall be sited so as to prevent the installation from being affected by vibration.

402 The antenna system and instrument installation shall withstand vibration to an extent that includes known standards for vibration environment according to the ship's construction, speed trim and the sea state.

403 Antenna systems including active elements shall be provided with a mount design configured to withstand potential shock damage.

C 500 Temperature protection

501 Instruments to be installed shall be located away from excessive heat sources, such as a heating vent or equipment heat exhaust.

502 Instruments to be fitted into a bridge instrument console shall be protected from excessive heat by conduction or, if nec-

essary, by forced air flow.

C 600 Humidity protection

601 Equipment that is not specifically designed for outdoor installation shall not be installed near a doorway, open window or hatch opening, due to the flow of humid salt air, which may cause internal corrosion.

C 700 Compass safe distance

701 When equipment is being installed, care shall be taken to ensure that the accuracy of the ship's magnetic compasses is adequately safeguarded.

Guidance note:

In order not to affect the accuracy of the magnetic compasses, electrical components should be installed at a minimum distance of 1000 mm. Each unit of type-tested equipment should be provided with a label indicating the minimum safe distances at which it may be installed from both steering and standard magnetic compasses.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

D. Electrical Power Supply, Alarms, Performance Confirmation and Failure Protection

D 100 Electrical power supply

101 Bridge equipment shall be connected to electric power supplies as specified in SOLAS.

Guidance note:

SOLAS specifies that a self-contained emergency source of electrical power shall be provided for a period of 36 hours in passenger ships and 18 hours in cargo ships for the following bridge equipment:

- magnetic compass
- means for taking bearings
- gyro compass
- gyro repeaters
- means for providing heading information to emergency steering positions
- radar installations
- echo sounding device
- means for measuring speed and distance through the water
- rudder angle indicator
- rpm indicator
- rate-of-turn indicator
- internal communication equipment required in an emergency.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

102 In addition to the equipment listed in 101, the emergency source of electrical power shall be provided for the global positioning system (GPS) and the ECDIS when installed.

103 Equipment essential for the performance of primary bridge functions shall, unless powered from a battery source, be provided with an uninterruptible power supply (UPS) with a capacity to keep the equipment running during a black-out period of at least 60 s, and be automatically reinstated upon recovery from a black-out lasting from 60 s up to 30 minutes. The equipment regarded essential for the performance of primary bridge functions in this context is:

— gyro compass (at least one)
— radar or ARPA (at least one including antenna)
— position-fixing system – GPS or GLONASS
— ECDIS.

104 The UPS shall be able to function when variations in voltage, frequency and load current, which can be expected on board a ship, occur. The UPS shall not fail due to:

— frequency hunting caused by a shaft driven generator during bad weather conditions
— low or high voltage caused by a diesel generator with variable load conditions.

105 The UPS shall have automatic bypass functionality.

106 Appropriate means for bypassing the UPS manually, in case of failure in the automatic bypass, shall be provided.

107 Sufficient means for monitoring the UPS status shall be provided and located so as to be easily readable from the front workstations, which are used for primary bridge functions.

108 Local distribution panels shall be arranged for all items of electrically operated navigational equipment. These panels are to be supplied by two exclusive circuits, one fed from the main source of electrical power and one fed from an emergency source of electrical power. Each item of navigational equipment is to be individually connected to its distribution panel.

109 The power supplies to the distribution panels shall be arranged with automatic changeover facilities between the two sources. Failure of the main power supply to the distribution panels shall initiate an audible and visual alarm.

D 200 Alarms

201 Means shall be provided to initiate both audible and visual alarms in the case of degraded system performance for primary bridge equipment. The alarm system shall comply with Pt.4 Ch.9 Sec.3 A500, relevant for bridge equipment and systems.

Guidance note:

If there should be any discrepancy in the requirements referred to and the requirements addressing the bridge systems in this section, the requirements in this section take precedence.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

202 An acknowledged alarm shall be clearly distinguishable from an unacknowledged alarm. A rotating flashing light is not permitted.

Guidance note:

An unacknowledged alarm should preferably be identified by a flashing light or character in the alarm text string. After acknowledgement, it should be replaced by a steady light or character. When the monitored parameter returns to normal, the alarm text string should disappear automatically if the alarm is acknowledged.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

203 Alarms shall be maintained until they are accepted and the visual indications of individual alarms should remain until the fault has been corrected, when the alarm shall automatically reset to the normal operating condition. If an alarm has been accepted and a second fault occurs before the first is rectified, the audible and visual alarms shall operate again.

Guidance note:

See first part of the HSC Code 11.4.1.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

204 In colour graphic systems, it shall not be regarded acceptable to distinguish between unacknowledged and acknowledged alarms by means of colour only.

205 If an alarm channel in a computer-based system is inhibited manually, then this shall be clearly indicated by a visual signal.

206 When forced ventilation or cooling of equipment is required for high temperature protection, an alarm shall be initiated in case of failure in the ventilation or cooling system.

D 300 Performance confirmation

301 Essential equipment for performance of bridge functions

shall provide the capability to perform self-testing of major functions, either automatically or manually initiated.

E. Computer-based Systems and Software Quality

E 100 Computer-based systems

101 Computer-based systems shall meet the requirements in E, and in Pt.4 Ch.9 Sec.4, when relevant for bridge equipment and systems. When failure in computer-based systems can affect safe navigation and manoeuvring of the ship, the requirements of 102 and 103 shall be fulfilled.

Guidance note:

The Society may require a Failure Mode and Effect Analysis (FMEA) for evaluating system performance during various failure modes, if found necessary.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

102 When a computer-based system forms part of a navigation or manoeuvring system, a FMEA for the total system performance shall be carried out.

103 If integrated computer-based systems are used for automatic operation of the ship's speed and course according to input parameters from programmed routing, electronic position-fixes and traffic detection devices, a system failure shall not cause a critical situation for the ship.

Guidance note:

A critical situation may occur if a system failure causes abrogation of the orders to be executed or affects execution of the order when the ship is in a collision avoidance manoeuvre or in the process of altering course in narrow waters. To enable the operator to take immediate action should a failure condition occur, manual operation facilities should be provided in accordance with the rules. Built in, system redundancy can be required when dangerous conditions cannot be expected to be counteracted by manual intervention.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

104 The switchover function to a system with built in redundancy shall be simple to execute.

105 Redundancy in programmable electronic systems (PES) shall not be required if an easily accessible and easily operated back-up system is provided.

106 Adequate filtering of analogue and digital input signals shall be provided.

107 Software and data necessary to ensure satisfactory performance of the computer system shall be stored in a non-volatile memory (e.g. ROM), or a volatile memory with an uninterruptible power supply.

108 Access to the computer's operating system shall be highly restricted, and any alteration of system software after final inspection and testing on board shall be subject to approval in advance, by the Society.

E 200 Software quality

201 The relevant software quality attributes are:

— reliability
— safeguard against error and misuse
— fault detection
— fault correction
— fail to safety.

202 Critical software shall be developed and tested according to well documented software development methodology. Software requirement specification, design description, coding and implementation shall be given consideration, as follows:

A. Software requirement specification

This specification shall clearly and precisely describe the requirements for the software and shall, as a minimum, contain the following:

a) Input data description, including the required error tolerance capabilities of the software.

b) Requirements for the individual functions to be performed by the software, including accuracy requirements and requirements for recovery from computation failures, hardware faults, device error, etc.

c) Requirements for the self-testing and diagnostic capabilities of the software.

d) Requirements for outputs, including presentation and accuracy.

e) Requirements for user-operation (man and machine interface).

The requirements shall be explicitly itemised so that they may easily be traced back to the software design description.

B. Software design description

The program structure and organisation shall be described and a standard design representation technique established and followed.

The design shall be organised in a "top down” fashion, that is in a hierarchical tree structure, each level of the tree representing lower levels of detail description of the processing. Tasks performed at each level should be clearly described.

The programs shall be organised as small, well arranged modules and their interaction should be standardised and kept to a minimum. The software design description shall, as a minimum, contain the following:

a) Description of the total program structure, using a standard design representation technique.

b) Description of inputs, outputs, processing and limitation of each module.

c) Memory map giving a total overview of the location of the programs, e.g. located in main memory, sub-module, intelligent terminal or printer, etc., and the programming languages used to develop the programmes.

d) Description of priority of program modules.

e) Description of the convention used.

SECTION 6
SPECIFIC REQUIREMENTS FOR DIFFERENT TYPES OF BRIDGE EQUIPMENT

A. General

A 100 Scope

101 This section specifies requirements that are specific for the systems and equipment required to be installed in accordance with Sec.4.

A 200 Application

201 Ships requesting class notation **NAUT-OC** or **NAUT-AW** shall comply with the rules in this section that are applicable in relation to the carriage requirements in Sec.4.

B. Heading Information System

B 100 Compass systems

101 The compass systems shall conform to appropriate performance standards not inferior to those adopted by IMO.

102 The gyro compass system shall perform continuously according to its specifications for the latitudes where the ship is to operate and at the speed the ship will achieve.

103 The Gyro compass system shall be provided with means for automatic correction of the errors caused by speed and latitude.

104 The two gyro compasses and the distribution system shall be so arranged that no single failure in power supply or distribution units may cause loss of heading information to the repeaters and applicable equipment defined in Sec.4 B200.

105 Gyro compass system dependant on data from positioning receivers shall be arranged in such way that failure of one positioning receiver does not degrade the accuracy of both gyro compasses.

106 A comparison function between the outputs of two compasses shall be arranged. An alarm shall be initiated when a deviation exceeds a pre-set limit.

107 *Integration* - **NAUT-AW**

Two gyrocompasses shall be part of the integrated grounding avoidance system. The two compasses shall be so arranged that the system automatically employs the heading information from the second gyro when, and only when, the signal input from the selected gyro is missing or identified as invalid (by the gyro itself) and the signal input from the second gyro is available and identified as valid (by the gyro itself).

Guidance note:

This automatic function applies to the heading information distributed to or within the integrated grounding avoidance system as described in H, but may additionally be used for heading information distributed to other navigational aids.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

108 *Automatic correction* - **NAUT-AW**

The accuracy of the ship's heading used in the integrated system for grounding avoidance shall be a value that has been corrected for any errors typical to the source of the heading input. Both gyros shall be provided with automatic correction of the errors caused by speed and latitude.

109 When the system is included in the integrated alarm management system, local suppression of audible alarms and warnings shall be possible in accordance with I106.

C. Steering Systems

C 100 General

101 The steering mode in use shall at all times be unambiguously and easily readable on both the navigation and the traffic surveillance workstations.

Guidance note:

The steering modes to be indicated include:

- manual control
- heading control
- track control.

If other modes exist, pertinent indication fulfilling the requirement should be provided.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

102 The design of the steering system shall comply with Pt.4 Ch.9 Sec.2.

C 200 Manual steering systems

201 The heading control system shall conform to appropriate performance standards not inferior to those adopted by IMO.

202 *Ergonomics*

Manual steering tillers shall be designed to turn the ship to starboard with clockwise movement of the axle of the tiller and to port by anti-clockwise movement, regardless of the position of the tiller on the axle. Tillers for follow-up steering (FU) steering systems shall enable indication of the rudder angle ordered.

Guidance note:

Exemption may be given for steering controls used solely for harbour manoeuvring and not for steering the ship. This is applicable to vessels with two or more rudders or azipods and engines, and where the control(s) are used for setting a rudder angle only and not to create a rotation. In such case the control should indicate the position of the rudder. Additionally, when the rudders are used in combined mode a separate tiller fulfilling 202 and also being easily distinguishable from the individual tillers, should be provided.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

203 *Override control*

The manual override control shall enable instant take-over from any steering system installed, including heading control system, track controls system and manual steering. The override controls shall be clearly marked and protected against accidental activation.

Guidance note:

Means may be required to ensure that failure in the override facility does not inhibit steering from bridge.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

204 *Rate of turn indicator (ROT)*

The rate-of-turn indicator shall conform to appropriate performance standards not inferior to those adopted by IMO.

205 The maximum value on the scale of the rate-of-turn indicator shall be in accordance with the turning ability of the ship.

Guidance note:

The rate-of turn-indicator should at least be able to indicate turns of 90 degrees per minute, and at least 120 degrees per minute if the maximum speed of the ship is more than 20 knots.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

C 300 Heading control system

301 The heading control system shall conform to appropriate performance standards not inferior to those adopted by IMO.

302 The off-heading alarm shall not be initiated when setting new course reference.

303 The heading control system shall enable the ship to turn from one heading to another based on a pre-set radius of turn.

304 *Integration* – **NAUT-AW**

To enable an automatic change from track-control to heading-control, as described in 406, the heading control system shall enable storage of the next radius of turn and the course to be steered on the next leg.

305 When the system is included in the integrated alarm management system, local suppression of audible alarms and warnings shall be possible in accordance with I106.

306 The most probable failures are to result in the least critical of any possible new conditions, that is fail-to-safe.

Guidance note:

The heading control system shall upon any failure while in course keeping mode put the rudder to the position that will best possible maintain the pre-set heading order.

The heading control system shall upon any failure while in ROT or radius mode put the rudder to the position that will best possible maintain the pre-set ROT or radius order given. Such data may be obtained from spiral trials, either full-scale trials or model test, in accordance with Sec.8.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

C 400 Track control system

401 The track control system shall conform to appropriate performance standards not inferior to those adopted by IMO.

402 While underway and the track control mode is active the status of the planned track is to be given the highest priority as the order or set point to be attained by the integrated system. Any set point or limit whether programmed or set, in a sub-system shall be given a lower priority. An alarm or warning as appropriate may be given if limits in sub-systems are exceeded.

Guidance note:

For example, a rudder limit set in the heading control system shall not prevent the track control system from employing the rudder needed to stay on track during a turn.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

403 The track control system shall enable the ship to automatically follow a curved track from one course to another based on a pre-set turn radius.

404 The components of the track control system shall have facilities to detect the most probable failures that may cause erroneous system performance.

405 The self-check facilities of the track control system shall at least cover the following failure types:

— power failures
— sensor and actuator failures
— communication errors
— computer hardware failures
— software execution failures
— software logical failures.

Guidance note:

Adequate failure detection may be obtained by combining two mutually independent systems, which together provide the required failure detection properties. Failure in the rudder angle transmitter (feedback unit) may be detected using a second independent feedback unit for monitoring purposes. Failure in the rudder order unit (e.g. a deadlocked relay) of the heading control may be detected by a second output (relay) provided solely for monitoring purposes and a pertinent safety system should break the output circuit upon inconsistency between the two outputs.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

406 If the track control fails and heading control is still available the system design shall provide automatic changeover from track-control to heading-control mode. The heading control shall adapt the actual heading as the pre-set heading when steering on straight legs and adapt the planned radius turn and the next planned course if the changeover takes place during a turn.

407 When the system is included in the integrated alarm management system, local suppression of audible alarms and warnings shall be possible in accordance with I106.

D. Speed Measuring System

D 100 Device to indicate speed and distance

101 The device shall conform to appropriate performance standards not inferior to those adopted by IMO.

102 A speed log shall be part of the automatic grounding avoidance system, when applicable.

103 Any part of the speed measuring system including parts installed below the waterline shall be easily replaceable when the ship is afloat.

104 When the system is included in the integrated alarm management system, local suppression of audible alarms and warnings shall be possible in accordance with I106.

E. Depth Measuring System

E 100 Echo sounding equipment

101 The echo sounder shall conform to appropriate performance standards not inferior to those adopted by IMO.

102 When the system is included in the integrated alarm management system, local suppression of audible alarms and warnings shall be possible in accordance with I106.

F. Radar Systems

F 100 Radar equipment

101 The radar installation shall:

1) conform to appropriate performance standards not inferior to those adopted by IMO.
2) provide coverage over the horizon of 360° by installing the two radar antenna so as to avoid common blind sectors.

102 *Size of radar displays* - **NAUT-AW**

Both radars are to be installed in accordance with the carriage requirements and shall have a daylight display with a minimum effective diameter of not less than 340 mm. See Sec.4 B600.

103 *Radar feature* - **NAUT-AW**

When installed on a ship requesting class notation **NAUT-AW**,

at least one of the radars, shall include the ability to display selected parts of SENC, that is the ECDIS database as specified for this optional feature in the IMO performance standards for radars. This radar shall also be able to display the ship's position and the route plan used on the ECDIS.

104 It shall be possible to bypass the inter-switch system in a simple way in case of failure in the inter-switch.

When the radar system is included in the integrated alarm management system, local suppression of audible alarms and warnings shall be possible in accordance with I106.

G. Collision Avoidance System

G 100 Radar with automatic plotting aid (ARPA)

101 The radar with ARPA shall conform to appropriate performance standards not inferior to those adopted by IMO.

102 *Integration to ECDIS* - **NAUT-AW**

The radar with automatic plotting aid in 101 shall be part of the grounding avoidance system for transfer of acquired targets, or full radar video, as required to enable alignment of the electronic chart to the surrounding waters.

103 When the system is included in the integrated alarm management system, local suppression of audible alarms and warnings shall be possible in accordance with I106.

G 200 Sound reception system

201 *Sound reception system*

The sound reception system shall conform to appropriate performance standards not inferior to those adopted by IMO.

202 *Sound intensity*

The sound intensity of the amplified signal from the sound reception system, measured at the workstation for traffic surveillance and manoeuvring with all bridge windows and doors closed, shall not be lower than the sound intensity which is measured on open deck from the same signal source, or 10 dB(A) above the bridge noise level, whichever is greater.

203 When the volume control of the sound reception system is adjusted in accordance with 202, external noise caused by wind or shipborne fans and other equipment, and internal noise in the amplifier shall not cause discomfort to bridge personnel, that is the noise level should not exceed 62 dB(A)/1m, see Sec.3 A402.

H. Grounding Avoidance System

H 100 General functions

101 *Automatic grounding avoidance system – GAS*

The grounding avoidance system shall facilitate functions that:

- enable planning of a safe route
- enable automatic steering of the ship along the preplanned route
- detect danger of grounding related to time and distance
- enable safe automatic back-to-track functions after deviation from the route
- provide sufficient monitoring and safe second mode of operation to avoid that system failures leads to critical situations.

102 *Functions of GAS*

The functions of the automatic grounding avoidance system shall:

a) ensure that the route is planned in navigable waters by:

- enabling planning in an ECDIS or on paper charts for transfer to an ECDIS if electronic navigational charts (ENC) are not available for the waters to be navigated.

b) ensure that the watch officer has full control of all the functions he is responsible for in all types of waters by:

- enabling continuous visual and automatic monitoring of own ship's position in relation to chart and radar information, planned route and other ships
- displaying radar targets or full video on the ECDIS for continuous visual monitoring of the accuracy of the electronic chart
- displaying electronic chart information on the radar display to be used for collision avoidance functions, enabling continuous visual monitoring of own ship's and other ships' position in relation to both the danger of collision and danger of grounding.

c) ensure that the ship automatically follows the planned route in any type of waters by:

- providing automatic adjustment of the steering in relation to the planned route, both on straight courses and during the turns from one course leg to the other.

d) ensure that the watch officer can easily monitor the reliability of the automatic grounding avoidance system and the performance of its functions by:

- displaying nautical information, operational status and ongoing and future changes on an individual monitor providing situation awareness and safe conning of the ship
- enabling continuous visual monitoring of the sensor input data to the system and the response on the data received, the operational status regarding heading, speed, turns, cross track distance, remaining time and distance to next turn, the upcoming radius of turn, the course and distance of the next leg and other relevant information. See 600.

e) ensure that all types of system failures have consistent fail-to-safe mode, preventing critical situations to occur by:

- safeguarding that the actual heading is maintained by the system in heading control mode, and that the present course change is completed
- enabling instant manual take-over of automatic steering functions or automatic changeover to redundant component.

f) ensure that reliability of both the technical part and the human part of the bridge system are continuously monitored to avoid that sudden change of the operating conditions causes a critical situation by:

- initiating alarms if there is danger of collision or grounding, or if equipment or systems fail or if the watch officer does not take instant action on an initiated alarm
- transferring automatically any alarm that is not acknowledged in order to get another qualified navigator to the bridge instantly.

g) ensure that the human part of the system, the watch officer, has the knowledge and skill required for safe and efficient operation of GAS by:

- requiring that the system supplier provides a training course comprising normal operation and failure modes of both the GAS and the individual equipment included in the integrated system

— requiring that the watch officer holds a certificate of competence issued by the system supplier or by a master that has completed the training and obtained sufficient practical experience in using the system.

H 200 System configuration

201 The grounding avoidance system shall steer the ship automatically along the pre-planned route with the accuracy in metres equal to the ship's breadth to either side of the course line under calm weather conditions with minor effect of currents/tidal streams. To enable this, the integrated system shall comprise the following main systems:

— a position-fixing system that includes a filter to ensure appropriate integrity and smoothing of position jumps
— an ECDIS for route planning and monitoring
— a radar system interfaced to ECDIS for transfer of radar targets or full video and reception of the route and chart information
— a track control system for steering the ship along a pre-planned route consisting of straight course legs and curved tracks with radius turns from one course leg to the next.

202 *Equipment to be integrated* – **NAUT-AW**

The design and installation of the GAS shall comply with the requirements of Pt.4 Ch.9.

The following main components shall be part of the integrated system for automatic grounding avoidance:

— two independent global positioning systems
— ECDIS
— radar
— track control system

supported by input information of:

— heading from a gyro system
— speed from a speed log

assisted by:

— a conning information display system
— an alarm management system, including a system for watch monitoring and transfer of alarms.

203 One of the global positioning systems being part of the integrated system shall be DGPS. The other system shall be GLONASS or a combined DGPS/GLONASS. Alternatively, the second position system may be a deduced reckoning system, continuously calculating the position from heading and speed input. The position fix used by the system shall be a filtered position based on the independent positioning systems installed.

204 The radar system shall at least provide acquired contacts to the electronic chart for accuracy checking and alignment of the chart.

Guidance note:

If the radar system interfacing with ECDIS enables superimposition of an appropriate electronic chart for route monitoring, then this unit may serve as the control unit for the integrated system, while the role of ECDIS may be route planning and supply additional chart information when required during the voyage.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

H 300 System reliability

301 *System reliability - GAS*

The system shall have sufficient built-in redundancy and fail-to-safe mode of operation to ensure safe route keeping, and shall facilitate technical monitoring of critical functions and enable manual monitoring of the automatic functions.

302 *Replacement of integrated components*

It shall only be possible to configure the GAS by the use of approved software, equipment and sensors. If manual or automatic selection of other components replaces any of these parts, then they shall be of the same quality and approved for that purpose. See also Guidance note to 304 c).

303 The integrated system shall include an algorithm or other approved means to detect unreliable positions; help avoiding position jumps and improves the integrity of the position used by GAS.

304 *System malfunction - fail-to-safe - GAS*

An alarm shall be initiated if a malfunction of the GAS occurs. The alarm is to be included in the alarm and warning transfer system specified in I300. Malfunction of the GAS shall result in the least critical of any new condition (fail- to-safe).

a) Alarms from detection of inappropriate watch keeping or system failures, and operational warnings shall be incorporated in the alarm and warning transfer system specified in I300.

b) To ensure the attention and awareness of the navigator at course changes, the system shall initiate a pre-warning alarm at between 3 and 5 minutes and 30 s before the arrival at the wheel-over line. Any pre-warning not acknowledged within 30 s shall be transferred to the master and a back-up navigator if selected.

c) At loss of input from any sensor or equipment required, and at other type of system failures degrading the system performance, the GAS shall immediately abandon the track-keeping mode and automatically change to heading-control mode, if still available.

Guidance note:

When equipment or sensors qualified for GAS fail, these may be automatically replaced by sensor providing information that deviates in quality for a fallback period of maximum 10 minutes, before the track-keeping mode is abandoned.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

d) At automatic change from track-control to heading-control mode, the heading control shall adapt the actual heading when on straight course legs, and the planned radius of turn and the new course if the change-over occurs during a turn.

e) If heading-control mode is not available, the system shall be prepared for instant manual take-over of steering by the navigator using the override control.

f) When the system failure requires a change to manual steering, the rudder angle shall be maintained until manual steering is effected.

g) If the quality of the filtered position used by GAS and presented on ECDIS is not accepted by the system, then this is considered a malfunction condition of the GAS. The alarm to be initiated shall be included in the alarm management system.

305 The design and installation of the GAS shall comply with the relevant requirements of Pt.4 Ch.9.

H 400 Position-fixing systems

401 The shipborne position-fixing equipment shall conform to appropriate performance standards not inferior to those adopted by IMO.

402 Both installed satellite assisted electronic position-fixing systems shall enable automatic detection of cross-track-error and shall be provided with a Receiver Autonomous Integrity Monitoring (RAIM) algorithm, or equivalent Fault Detection and Exclusion (FDE) algorithm.

403 The equipment shall provide position fixes within the accuracy standard to which the radio navigation system is designed.

Guidance note:

The accuracy of a position fix involves both fixed and random errors and can only be determined in terms of probability. The 95% probability figures should be used to describe the accuracy of the position fixes derived by the position-fixing equipment.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

404 The electronic position-fixing receivers shall be able to transfer alarms and warnings to the central alarm panel.

405 When being part of the integrated alarm management system, local suppression of alarms and warnings shall be possible in accordance with I106.

406 The electronic satellite position-fixing receivers shall be able to track a minimum of 6 satellites simultaneously.

407 The antenna shall be able to receive the GNSS signals and provide the GNSS receiver with a navigation signal with signal strength equal to, or better, than that required in the equipment specific performance standard as minimum acquisition and tracking thresholds. The S/N ratio in the navigation signal, as supplied from the antenna, must be in a range suitable for the GNSS receiver in question, and better than the minimum acquisition and tracking thresholds as encountered under normal conditions.

408 The antenna gain pattern shall be omni-directional with high sensitivity for elevation angles above 5°. Effective means for inference mitigation (special consideration should be given to the specific interference sources found on ships) and multi path rejection, should be incorporated in the antenna and/or receiver.

409 *DGPS* - **NAUT-AW**

Both satellite position-fixing receivers shall be capable of receiving and decoding of differential data broadcasted for navigational purposes by maritime radio beacons.

410 The quality of the integrated position-fixing system shall be monitored. If the quality of the position-fixing system is lower than an acceptable limit, a warning shall appear.

411 The system shall enable transfer of the planned route to the electronic chart system at front workstation.

Guidance note:

The accuracy check of electronic charts to be used in addition to paper charts may be done by factual navigation of the waters (only accepted for ships in regular trade) or by comparison with paper charts.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

H 500 Electronic chart display and information system (ECDIS)

501 The ECDIS shall conform to appropriate performance standards not inferior to those adopted by IMO.

502 Position surveillance

An ECDIS with an appropriate database for the waters to be navigated, or other approved means that enables safe route monitoring and efficient grounding avoidance functions shall be part of a grounding avoidance system.

503 It shall be possible to adjust the displayed chart for geographical inaccuracies by comparing the position of radar targets with their position in the chart and harmonise discrepancies by adjusting the chart.

504 *Route planning functions* - **NAUT-AW**

The ECDIS required in 202 shall also serve the functions required for route planning prior to the voyage. When ECDIS with back-up is installed, the system can also be used for route planning during the voyage.

505 *Interim route planning solution* – **NAUT-AW**

If ECDIS charts (SENC) for the waters to be navigated and paper charts are the only legal chart system, an interim solution meeting the basic requirements for safe route planning can be accepted. See Sec.2 C500.

Guidance note:

The accuracy check of electronic charts to be used in addition to paper charts may be done by factual navigation of the waters (only accepted for ships in regular trade) or by comparison with paper charts.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

H 600 Conning information display

601 *Visual monitoring of GAS performance*

The conning information display system shall present status information on all input values used by the integrated grounding avoidance system, and ongoing and upcoming course and turn orders.

602 *Basic requirement*

Information required for efficient monitoring of the automatic navigation and track-keeping functions, and safe performance of primary functions, shall be systematised and displayed for easy and continuous viewing from the positions where navigation and harbour manoeuvring are performed. Information not related to safe navigation and manoeuvring shall be avoided.

603 *Presentation of information*

To enable easy viewing, the conning information display shall utilise graphical display technique and locate relevant sensor input data appropriately around and on a symbol illustrating own ship.

604 *Types of conning information to be displayed*

The information to be displayed shall comprise:

- present orders
- corresponding sensor input data and feed-back
- the status of navigation and manoeuvring situation continuously
- the upcoming (next) orders to be effected
- remaining distance and time to next orders.

Additional sensor input data related to the navigation and manoeuvring of the ship may be included.

605 *Specific conning information to be displayed*

The information shall be systematised in categories for:

a) Present orders:
   - course
   - speed
   - when turning; turn radius (ongoing turn) and the consequential rate of turn related to planned speed
   - rudder angle
   - route-keeping (set off-track limit).

b) Corresponding sensor input data and relevant information providing operational status:
   - heading (and system in use - gyro 1, gyro 2)
   - turn rate
   - rudder angle
   - speed:
     - through the water
     - over ground
     - athwart ships
   - propulsion
   - propeller revolutions
   - pitch indication, when relevant

— thruster indication, when relevant
— distance to wheel over point
— time to wheel over point
— off-track distance
— bearing to wheel-over point.

c) Next orders to be effected and relevant information:

— turn radius (TO-waypoint)
— next track course
— distance of the next leg
— time to sail the next leg at present speed
— remaining distance and time to execution of next orders.

d) Additional relevant information:

— wind speed and direction
— water depth
— distance to destination
— ETA destination.

I. Bridge Alarm Management

I 100 General

101 The alarm management system shall conform to the appropriate IMO resolutions and relevant requirements in Pt.4 Ch.9.

102 Bridge alarms and warnings shall be centralised in one common panel or screen on the bridge enabling easy identification of the source of the alarm and rapid cancellation of the audible alarm.

103 The bridge alarm system shall provide visual and audible indication of system and equipment malfunction, operational warnings related to risk of grounding and collision and improper watch-keeping in one central panel. The alarm system may be part of a computerised system and presented on a screen.

104 The indications displayed on the alarm panel shall be continuously available and readable when the navigation systems are in operation.

105 It shall be possible to cancel the audible alarm on the individual equipment and the corresponding alarm at the central alarm panel by a single operator action.

106 Permanently inhibiting alarm units shall not be possible. Manually inhibiting local audible alarms may be accepted when this is clearly indicated and the unit is part of the alarm management system.

Guidance note:

Suppressing local audible alarms manually may be done by means of an on and off switch located on or close to the equipment or by other means, for example electronically. The off-position should enable suppression of the audible alarm when the equipment is part of a central alarm system and the on-position should engage the local alarm when the equipment serves as a stand-alone unit.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

107 The main alarm system shall be continuously powered and shall have an automatic changeover to a stand-by power supply in case of loss of normal power supply.

I 200 Central alarm panel

201 The central alarm system shall enable visual indication of alarms and warnings initiated by systems and individual equipment serving primary bridge functions performed during the voyage. The central alarm system shall at least include system failure alarms and operational warnings initiated by the following equipment and systems:

— system for detection of operator disability
— collision avoidance system
— grounding avoidance system
— heading monitoring system.

This will normally incorporate the following individual systems and equipment:

— watch monitoring system
— heading information system
— radar and ARPA
— GPS
— ECDIS
— speed log
— echo sounder.

To be considered case by case:

engine watch alarm panel. *

* Not required if the alarm presentation is similar to the central alarm panel and located in the same console. Otherwise, a visual indication on the navigation panel may be required.

202 Acknowledgement of an alarm at either the instrument or the alarm panel shall cancel the audible warning at both sources.

203 Cancellation of the visual warning on the alarm panel shall only be possible at the instrument.

I 300 Alarm and warning transfer system

301 Alarms and warnings shall be initiated and automatically transferred to specific locations, in order to alert another qualified navigator, if the watch monitoring system indicates that the bridge is unmanned or that proper action is not being taken to avoid the danger of collision or grounding.

302 Alarms or warnings that are not acknowledged, neither on the individual equipment nor on the central alarm panel, shall be transferred from the bridge to alert the master and a back-up navigator if appointed.

Guidance note:

The alarms and warnings may be transferred by means of either a wireless system or by a fixed installation to certain areas on the ship.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

303 Alarms and warnings included in the alarm transfer system shall always be transferred by a fixed installation to the following areas:

— master's cabin
— master's office
— officers' office
— officers' mess
— officers' day room
— other relevant public areas.

Guidance note:

From the areas accepting transfer of alarms it should be possible for a person to reach the bridge within 2 minutes.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

304 In addition to the locations listed in 303, it shall be possible to include any of the cabins of the watch officers in the fixed alarm transfer system by selection. Buzzers, not enabling cancelling of the sound, shall be installed in the locations required outside of the wheelhouse.

305 Acknowledgement of alarms and warnings (cancelling the sound) shall only be possible from the bridge.

306 The time allowed for the acknowledgement of alarms and warnings shall be as short as possible, taking into account the time required for moving from a distant position on the bridge to the alarm or warning requiring acknowledgement.

The time allowed for acknowledgement of alarms and warnings shall not exceed 30 s. From at least 15 to 30 s of the 30 s period, both visual and audible alarm shall be given.

307 The alarm and warning transfer system shall be provided with a lockable on and off switch, to which only the master has the key.

I 400 Watch monitoring system

401 Unattended bridge and danger to navigation caused by operator disability, traffic or improper course keeping in relation to planned route shall be monitored.

402 The watch monitoring system shall incorporate the following operational modes:

— Automatic (Automatically brought into operation whenever the ship's heading or track control system is activated and inhibited when this system is not activated)
— anual ON (In operation constantly)
— Manual OFF (Does not operate under any circumstances).

403 The watch monitoring system shall detect operator disability and verify that the bridge is manned and indicate that the officer of the watch is alert. Detection of irregularities shall be transferred to another qualified navigator by the alarm transfer system. The system for verification of operator alertness shall monitor that the bridge is manned at all times and that actions are taken on alarm conditions and operational warnings initiated by systems essential for safety of navigation. To serve these functions, the system shall enable:

— detection of operator disability
— transfer of alarms not acknowledged to specific locations in order to alert another qualified navigator.

System requirements

a) A system based on automatic and continuous detection of operator movements shall initiate a warning if no movements are detected within an interval that may be adjustable down to not less than 3 minutes and up to not more than 12 minutes.

b) A system based on periodic verification requiring manual reset within pre-set intervals, shall be adjustable down to not more than 3 minutes and up to 12 minutes in steps of not more than 3 minutes. The interval shall not be adjustable to more than 12 minutes.

404 The monitoring system for detection of operator disability shall not cause undue interference with the performance of primary bridge functions while the ship is under way.

a) If the monitoring system is based on interval checking, it shall be automatically reset by the acknowledgement of any warning or alarm in the transfer system and by normal operation (e.g. use of keyboard and/ or trackball) of the radar and ECDIS installed at workstations for navigation and traffic surveillance.

b) The acknowledgement button(s) shall be installed as required in Sec.2 at the workstations for navigation and traffic surveillance conning and docking operations.

c) The monitoring system shall incorporate advance warning of the expiry of the interval. The advance warning time shall be included in the pre-set interval.

405 The monitoring system shall be designed to prevent unauthorised or inadvertent operation.

a) The system shall be designed and installed so as to ensure that only the master has access to the operational mode switch key and the device for adjusting the intervals if applicable.

b) A prolonged press on an acknowledgement button shall not reset the time interval continuously and extend the acknowledgement time.

c) Reset of the monitoring system interval (i.e. by manual reset devices and/ or motion detectors) shall only be possible from locations providing proper look-out on the bridge.

406 It shall be possible for the navigator to initiate the alarm transfer system instantly in order to alert another qualified navigator. The alarm shall be transfered to locations specified in paragraphs I303 and I304. The alarm transfer system may be initiated by a prolonged press on an acknowledgement button or by an individual push-button.

407 Acknowledgement of the alarm transfer system (silencing of buzzers) shall only be possible from the bridge.

408 The watch monitoring system shall be part of the alarm transfer system.

J. Nautical Internal Communication Systems

J 100 External communication equipment

101 Within the bridge area, provisions shall be made for the installation of at least two VHF radiotelephone stations.

J 200 Internal communication equipment

201 The battery less telephone system shall meet the requirements in Pt.3 Ch.3 Sec.11.

202 The public address system shall meet the requirements in Pt.3 Ch.3 Sec.11.

203 The automatic telephone system shall meet the requirements in Pt.3 Ch.3 Sec.11, including the requirement for priority function for the extensions installed in the wheelhouse and the engine room.

SECTION 7
MAN AND MACHINE INTERFACE

A. General Requirements

A 100 Application

101 Ships requesting class notation **NAUT-OC** or **NAUT-AW** shall comply with the rules in this section. The section gives requirements for the user interface to ensure a safe and efficient operation of the systems installed according to the following objectives:

— controlled work load adapted to the user(s) in all modes, including for system degradation
— ensure fast and correct decisions
— ensure fast and correct user actions
— avoid unnecessary stress.

102 All instruments shall be logically grouped according to their functions within each workstation. Their location and design shall give consideration to the physical capabilities of the human operator and comply with accepted ergonomic principles.

103 The amount of information presented in conducting the various tasks, including the methods of displaying the information needed, shall give consideration to the capabilities of the human operator, in regard to perception and the processing of available information.

B. Instrument Location and Design

B 100 General

101 Instruments or displays providing visual information to more than one person shall be located for easy viewing by all users concurrently. If this is not possible, the instruments or displays shall be duplicated. See Pt.4 Ch.9 Sec.6 A.

102 The method of presentation shall ensure that the instrument data is clearly visible to the observer at a practicable distance in the light conditions normally experienced on the bridge by day and by night. All menus and displays shall provide a self-explanatory interface to the user.

103 The operation of a control shall not obscure indicator elements where observation of these elements is necessary for adjustments to be made.

B 200 Location

201 Instruments shall be readable from the operating position of the workstation they are providing information to.

202 Instruments meant to be operated or fitted in connection with controls shall be readable from a distance of at least 1000 mm. All other instruments shall be readable from a distance of at least 2000 mm.

Guidance note:

Character height in mm should be not less than 3.5 times the reading distance in m. Letter width should be 0.7 times the letter height, e.g.:

Character height for reading distance 2 m:	2 x 3.5 = 7 mm
Character width for letter height 7 mm:	7 x 0.7 = 4.9, i.e. 5 mm
Resulting minimum character size:	7 mm x 5 mm.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

203 Each instrument shall be placed with its face normal to the navigator's line of sight, or to the mean value if the navigator's line of sight varies through an angle.

204 Controls or combined controls or indicators shall be visually and tactually distinguishable from elements, which only indicate.

Guidance note:

Rectangular buttons should be used for control elements, and round lights for indicator elements.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

205 Instruments shall be designed to facilitate console installation and mounting in a group with instruments of other makes.

Guidance note:

The instruments should have a square or rectangular frame of a dimension to fit console cut-outs based on internationally recognised standards. This does not imply that the instrument display itself has to be rectangular.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

B 300 Design

301 When designing the layout of control and display devices, consideration shall be given to the user interface. Attention shall be paid to the significance of human factors in a critical condition. Graphical information systems are to contain all relevant functions for safe operation and shall be easy to understand and operate.

302 All instruments shall be designed to permit easy and accurate reading by day and by night.

Guidance note:

a) Quantitative and comparative readings should be presented by means of:
   - digital counter, if subject to rare changes
   - clockwise moving index on circular scale or horizontally moving index on linear scale, if subject to frequent changes.

b) Qualitative readings should be presented by means of:
   - vertically moving index on linear scale to indicate trend changes
   - clockwise moving index on circular scale to indicate speed changes.

c) Control readings should be presented by means of:
   - moving index on circular scale, preferably with the index in the 12 o'clock position for normal readings
   - for an index moving relative to a circular scale, the index should move clockwise (or the scale anti-clockwise) for increased readings
   - for an index moving relative to a linear scale, the scale should be horizontal or vertical and the pointer should move to the right or upwards for increased readings.

There may be special cases where these guidelines do not apply, e.g. where the readings may be positive or negative, or where depth is indicated.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

303 Instrument letter type shall be of simple, clear-cut design.

Guidance note:

a) Internationally used and recommended letter type is Helvetica medium. However, light-emitting diode text matrices are acceptable.

b) In descriptive text, lower case letters are easier to read than capitals.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

304 The purpose of each control and indicator shall either be clearly illustrated by symbols where standard symbols have been internationally adopted or indicated by a label in English.

305 Operational controls shall be easily accessible and easy to identify.

306 The shape of mechanical controls shall indicate the method of operation of the control.

Guidance note:

Rotary finite-position controls (e.g. stepping switches) should have toggles or levers, whereas rotary continuous position controls (rheostats) should have knobs or wheels, except the steering control.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

307 The position, function, allocation and purpose of control elements, as well as the function and layout of indicator elements, shall be logically co-ordinated.

Guidance note:

Positioning according to functions should be in accordance with IEC 447 "Standard directions of movements for actuators which control the operation of electrical apparatus".

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

308 The presentation of graphic or mimic diagrams shall be in accordance with ergonomic principles and easy to understand and operate. The status of the information displayed shall be clearly indicated.

Guidance note:

This applies to for example indications not being updated or an indication of an inhibited alarm.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

309 Inadvertent operation of a computer-based bridge instrument shall not cause any loss of data, damage of programmes or malfunction of the system.

C. Illumination and Individual Lighting of Instruments

C 100 General

101 All illumination and lighting of instruments, keyboards and controls shall be adjustable down to zero, except the lighting of warning and alarm indicators and the control of dimmers, which shall remain readable.

C 200 Illumination

201 To avoid unnecessary light sources in the front area of the bridge, only instruments necessary for the safe navigation and manoeuvring of the ship shall be located in this area.

202 Instruments shall be designed and fitted to minimise glare or reflection and prevent being obscured by strong light.

Guidance note:

All instruments should be placed in position relative to the operator, taking into consideration the surrounding light sources. Where a transparent cover is fitted over an instrument, it should be designed to minimise reflection.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

203 The information presented shall be clearly visible to the user and permit easy and accurate reading at a practicable distance in the light conditions normally experienced at the location of the workstation by day and by night.

204 Indicator lights and the illumination of all instruments shall be designed and fitted to avoid unnecessary glare or reflection, or the instruments being obscured by strong light.

Guidance note:

For the illumination of displays, red light (wave length 620 nanometres or higher) should be used.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

205 Operator keyboards and other functional controls shall be illuminated to ensure ease of operation in the dark. Night vision shall be secured by considering the following:

a) Warning and alarm indicators are to show no light in normal position (indication of a safe situation). All instruments shall be fitted with permanent internal or external light source to ensure that all necessary information is visible at all times.

b) Means shall be provided to avoid light and colour changes upon, e.g. start-up and mode changes, which may affect night vision.

c) All information shall be presented on a background of high contrast, emitting as little light as possible by night.

Guidance note:

All ship's bridge instruments should show a light text on a dark non-reflecting background at night. The contrast should be within 1:3 and 1:10.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

206 Means for adjusting the display and keyboard brightness shall be provided.

207 Warning and alarm indicators shall be designed to show no light in normal position that is indication of a safe situation. Means shall be provided to test the lamps.

Guidance note:

Alarm indicator lights should be equipped with red lights of wavelength 620 nanometres or higher.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

208 Each instrument shall be fitted with an individual light adjustment. In addition, groups of instruments normally in use simultaneously may be equipped with common light adjustment.

209 Colour coding of functions and signals shall be in accordance with ISO 2412 "Shipbuilding: Colours of indicator lights".

Guidance note:

Table A4 in ISO 2412 lists recommended colour codes for system functions.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

D. Requirements for the Man and Machine Dialogue of Computer-based Systems

D 100 General

101 The man and machine dialogue of a computer-based system shall enable the operator to perform his tasks as intended in an efficient and user-friendly manner.

Guidance note:

The following criteria should be considered:

a) It should be up to the operator to start, interrupt, proceed and end a dialogue.

b) The system should enable an individual way of carrying out the different operations in a dialogue. The sequence of the operations should, to a minimum extent, be fixed.

c) At any stage in a dialogue, it should be possible for the operator to summon the help function with a single operator action. The help function should be able to provide the operator with relevant help information related to the contents of the dialogue as well as the way of carrying out the dialogue.

d) If the operator provides the system with insufficient input, the system should request the continuation of the dialogue by means of clarifying questions. Under no circumstances should the system end the dialogue.

e) It should be possible for the operator to interrupt the dialogue, alter data and continue the dialogue in the updated state.

f) It should be possible for the operator to recognise whether the system is busy executing an operation, or waiting for additional operator action. When executing time consuming operations, the system should provide the operator with a clear and unambiguous symbol or text.

g) Terms used in a dialogue should be adapted to the users operating the system. Abbreviations and terms used in electronic data processing should be avoided.

h) The system and the dialogue should be clear and consistent to the user. Similar operations should be performed by similar operator actions, and experiences from similar operations should simplify the operator's learning process when he is confronted with unknown functions (transfer effect).

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

SECTION 8
SHIP MANOEUVRING INFORMATION

A. General

A 100 Scope

101 This section gives requirements for the trials for determining the ships manoeuvring characteristics as well as the form and content of information about such characteristics.

102 Information about the ship's manoeuvring characteristics shall be provided and presented as specified in IMO Res. A.601(15) "Provision and display of manoeuvring information on board ships".

103 The trials for providing manoeuvring information shall be performed as specified in IMO Res. MSC 137(37) "Standards for ship manoeuvrability" and MSC/Circ.1053 "Explanatory notes to the standards for ship manoeuvrability".

A 200 Application

201 Ships requesting class notation **NAUT-AW** shall be provided with information about its manoeuvrability fulfilling the requirements of this section.

A 300 General

301 Information about the ship's manoeuvring characteristics enabling the navigator to safely carry out manoeuvring functions shall be provided and presented as specified in the Annex to IMO Res. A.601(15), comprising:

— pilot card
— wheelhouse poster
— manoeuvring booklet.

302 The method of identifying the manoeuvring characteristics of the ship is subject to approval. The results of individual tests, trials and estimations shall be submitted for information.

A 400 Manoeuvring information

401 Before being assigned class notation **NAUT-AW**, the information on the manoeuvrability of the ship shall be established for two loading conditions, whereof information for at least one condition shall be established from full scale testing.

Guidance note:

Full scale testing may be replaced by scale model test and/or computer prediction using mathematical models as described in IMO Res. MSC 137(76) "Standards for ship manoeuvrability" and MSC/Circ. 1053 "Explanatory notes to the standards for ship manoeuvrability". In this case, full scale tests should be carried out as found necessary, on a case by case basis, to validate these results.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

402 Information on the manoeuvrability of the ship not covered by the original data shall be compiled as experience is gained in manoeuvring the ship under different operating conditions.

403 Additional information compiled on the manoeuvring characteristics shall be registered in the manoeuvring booklet and the wheelhouse poster when applicable.

A 500 Sister ships

501 For ships built in series according to identical drawings and parameters, only one ship of the series shall have to undertake a complete trial program according to this section. The other ships of the series can adopt the information from these trials provided a reduced trial programme is satisfactory completed.

502 A sister ship shall make the following full scale trials for demonstrating that its manoeuvring characteristics are identical to the first ship:

— speed trial at full speed ahead
— stopping trial from full speed ahead
— turning circle trials at full speed ahead to both port and starboard, both followed by a pull out trial.

Guidance note:

Except from the pull out trial, the characteristic parameters should be within 15% of the parameters obtained from the first ship. If not, performance of the complete trial program may be required.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

503 All information, which is duplicated from a sister ship shall be marked with a statement to this effect together with the identification of the sister ship.

B. Provision of Manoeuvring Information

B 100 General

101 Information regarding the ship's manoeuvring characteristics shall be provided to give the navigator the best presumption in selecting the correct speed and rudder angle relative to the prevailing conditions and intended manoeuvre.

102 The manoeuvring characteristics shall include the speed ability, stopping ability, turning ability, course change ability, low steering ability, course stability and the effect of auxiliary manoeuvring devices. Rational man-overboard rescue manoeuvre shall be specified.

103 The manoeuvring trials shall be conducted in the calmest weather conditions possible.

104 The turning circle test results shall be used to measure the magnitude and direction of current. The ship's track, heading and the elapsed time should be recorded until 720° change of heading has been completed.

105 Recordings should be made with a sample frequency of at least 0.2 Hz. The accuracy of the positioning system should be better than 10 m, 95% confidence level.

B 200 Speed ability

201 Information about speed ability in terms of the actual speed potential of the ship at various engine settings shall be provided. Trials shall be performed at three engine settings identifying the percentage used for the maximum continuous power rating, (MCR):

— at full speed ahead
— at half speed ahead
— at slow speed ahead.

B 300 Stopping ability

301 Information about the ship's stopping abilities shall be provided. Trials shall be made from an initial full speed ahead and with application of the following astern powers:

— constant full astern power
— with propulsion and engine stopped.

B 400 Turning ability

401 Information about the ship's turning ability at full speed,

from full speed with engines stopped and when accelerating from rest to full speed ahead shall be provided. Turning trial runs shall be made to port and to starboard:

— using maximum rudder angle without changing engine control settings from initial full speed ahead
— from an initial full speed ahead and then stopping the engine at the start of the turn (coasting turn)
— from initial standstill with propeller stopped and applying half speed ahead using maximum rudder simultaneously (accelerated turning trial).

B 500 Course change ability

501 Information about the ship's initial turning ability at various rudder angles shall be provided for full and slow speed situations. Zigzag trials shall be made to port and to starboard for rudder angles equal to 10° and 20° for conventional rudder systems.

B 600 Low speed steering abilities

601 Information about the lowest constant engine revolutions or lowest pitch control setting at which the ship can safely be steered in ballast and loaded conditions shall be provided.

B 700 Course stability

701 Information about the course stability of the ship shall be provided. A pullout trial shall be made to port and starboard. A spiral trial shall be made if the pullout trial indicates that the ship is unstable.

B 800 Auxiliary manoeuvring device trial

801 Information about the performance and effect of auxiliary devices installed in order to improve the manoeuvring abilities of the ship shall be provided. The following trials to establish the performance and limitations of such manoeuvring devices shall be carried out with the ship at:

— standstill, the time required to turn the ship 90° to each side at full thrust should be registered
— initial standstill and full thrust, the forward speed at which the device ceases to be effective should be registered.

B 900 Man-overboard rescue manoeuvre

901 Information about the performance of an effective man-overboard rescue manoeuvre shall be provided. Manoeuvring tests to establish the most effective manoeuvre procedure in case of man over board shall be carried out.

Guidance note:

For large ships and ships with conventional rudder systems, the manoeuvres required to perform an efficient Williamson turn shall be established.
The initial test turn being to apply 15° rudder until a course deviation of 60° has been achieved and then apply 35° rudder to the opposite side to arrive at the opposite course. The course deviation angle or rudder angles should be adjusted and retested until the vessel returning track is within 50 meters from the original track.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

C. Presentation of Manoeuvring Information

C 100 Pilot card

101 A pilot card shall provide the pilot with information on the current condition of the ship with regard to its loading condition, propulsion and manoeuvring equipment and other relevant equipment and be available on the bridge at each port call.

Guidance note:

An example of information content and layout of a pilot card is given in IMO Resolution A.605(15), Appendix 1.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

C 200 Wheelhouse poster

201 A summary of manoeuvring information on the ship shall be worked out in the format of a wheelhouse poster.

Guidance note:

An example of information content and layout of a wheelhouse poster is given in IMO Resolution A.601(15), Appendix 2.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

202 The wheelhouse poster shall be permanently displayed in the wheelhouse. It shall contain general particulars and detailed information describing the manoeuvring characteristics of the ship, and be of sufficient size to ensure ease of use.

203 The wheelhouse poster shall be marked with a warning that the manoeuvring performance of the ship may differ from that shown on the poster due to environmental, hull and loading conditions.

204 A diagram showing the double turn circle of 720° and supplementary data demonstrating the effect of drift registered at the performance of the manoeuvring tests shall be available. See B104.

C 300 Manoeuvring booklet

301 The manoeuvring booklet shall be available on board and shall contain details of the ship's manoeuvring characteristics and other relevant data. The manoeuvring booklet shall include the information shown on the wheelhouse poster together with other available manoeuvring information.

302 Most of the manoeuvring information in the booklet can be estimated, based on the data obtained from the trials specified in this section. The information in the booklet should be supplemented in the course of the ship's life.

Guidance note:

The information recommended to be included in the manoeuvring booklet is specified in IMO Resolution A.605(15), Appendix 3.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

SECTION 9
QUALIFICATIONS AND OPERATIONAL PROCEDURES

A. General

A 100 Scope

101 Modern technology has the potential to improve the awareness of the officer in charge of the navigational watch, hereafter called OOW, with respect to the immediate navigational situation and to aid the process of following a safe pre-planned route. But this potential can only be realised if the OOW has the knowledge and skills to use the technology safely and efficiently.

102 This section specifies requirements for knowledge and navigational procedures related to equipment and systems specified in Sec.4 and Sec.6 of these rules, not required to be installed by IMO.

A 200 Application

201 Ships requesting class notation **NAUT-OC** shall comply with the requirements in C102. If the ship is fitted with a grounding avoidance system, or an automatic track-keeping system, all the requirements of this section apply.

202 Ships requesting class notation **NAUT-AW** shall comply with all requirements in this section.

A 300 Operational assumptions

301 The requirements are based the following assumptions:

- the master ensure that watch-keeping arrangements are adequate for maintaining a safe navigational watch and that OOW is fully competent to operate the equipment and systems to be used for navigating the ship
- the master ensures that the manning of the bridge watch is in accordance with national regulations in the country of registration and for the waters the ship is navigating
- the OOW carefully assesses that the workload is well within his capacity to maintain full control of the functions to be performed and the operational situation
- the master designates individuals who are to provide assistance when needed by the OOW
- the OOW immediately summons assistance to the bridge in case of abnormal operational conditions including situations causing excessive workloads.

B. Qualifications

B 100 General

101 All officers being assigned the responsibility of navigational watch shall be fully qualified to operate the grounding avoidance system. See Sec.6 H. A certificate of competence shall document this qualification.

102 The ship owner and the master of the ship are responsible for ensuring that the watch officers achieve the required competence.

103 It is regarded the responsibility of the ship owners to ensure that the master and officers have completed the course before the ship is put into operation and that documentation has been submitted in accordance with Sec.1 E116.

104 The master, holding a certificate of competence issued by the manufacturer of the grounding avoidance system and having sufficient practical experience, may train and certify navigators through a systematic on board training course. The on board training shall cover all parts of the manufacturer based training course, and include a statement of competence upon completion of the training.

B 200 Knowledge requirements

201 At delivery of the ship all navigating officers shall hold a certificate of competence by having completed a training course provided by the system manufacturer. The course shall at least comprise the following:

- system design
- procedure of operation
- operational modes
- training in mastering the system by use of a quick reference guide
- appropriate use of the grounding avoidance system installed as well as of the individual instruments incorporated in the system
- the systems and the individual instruments capabilities and limitations
- effect of failure in any of the bridge equipment and sensors constituting the grounding avoidance system and the resulting fail-to-safety mode of operation.

Guidance note:

The navigating officer should be capable of utilising all functions described by IMO and Sec.6, by using the quick reference guide, after completion of the course.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

C. Bridge Procedures

C 100 Procedures for safe watch-keeping

101 Procedures for safe watch-keeping shall be established and be easily available on the bridge. Procedures and instructions for irregular and abnormal operating conditions shall be established based on the failure modes and effect analysis for the grounding avoidance system and heavy workload situations caused by external conditions, and combination of external conditions and system failures. This is the responsibility of the owner and the master.

102 If an interval check system is included in the watch monitoring system, then the length of intervals shall be set with due consideration of the time needed for the back-up officer to get to the bridge (response time), and the external conditions to be experienced, including the time to danger of grounding along the route and traffic density. The parameters for setting the intervals shall be known to the watch officer and included in the procedures for safe watch-keeping. This is the responsibility of the master.

SECTION 10
BRIDGE EQUIPMENT TESTS

A. General

A 100 Application

101 Ships requesting class notation **NAUT-OC** or **NAUT-AW** shall comply with the rules in this section.

B. On board Testing of Bridge Equipment

B 100 General

101 After installation of equipment in ships requesting class notation **NAUT-OC** or **NAUT-AW**, on-board testing of the equipment shall be performed in order to ascertain that the equipment, as installed, operates satisfactorily.

102 It should be noted that reliable figures for all aspects of equipment performance or accuracy cannot be established by the on board testing required for classification. Therefore, to ensure that equipment performance is in accordance with specifications, ship owners are advised to choose equipment that is type approved by the Society.

B 200 Test program

201 A detailed program for the on board testing of this equipment shall be submitted for approval at the earliest possible stage before sea trials.

202 The test program shall be in accordance with the requirements for on board testing given in 300 to 1400, and shall specify in detail the tests to be performed for each type of equipment.

B 300 General requirements for the testing of all types of bridge equipment

301 Prior to testing, all equipment shall be checked and calibrated by a representative of the manufacturer or the equipment supplier.

302 Prior to testing, all equipment, etc., necessary for the observation and recording of test results, shall be made available. Charts for the area where the sea trials shall take place must be available. Large-scale charts for the area where the ship is berthed must be available.

303 Equipment and systems that shall be subject to the tests are required to ascertain that all controls, indicators, displays, etc. operate in accordance with their specifications and meet the rule requirements.

304 Failure conditions shall be simulated on equipment and systems.

Guidance note:

These tests should verify the results of previous failure modes and effect analysis.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

305 The instruments for performance of primary bridge functions shall be tested at blackout for a period of up to and over 30 s. At least one of the tests shall be carried out at sea.

306 A demonstration including start-up of the individual systems and changeover from normal conditions to failure conditions shall be carried out.

307 Tests, additional to the approved test program, may be required carried out by the surveyor.

308 If the ship is not assigned the additional class notation **E0**, tests of the remote control system for propulsion machinery as well as blackout tests, shall be carried out as required in Ch.3 Sec.5 B and Ch.3 Sec.5 A400.

B 400 Gyro compass

401 The settle point error of the master compass(es) and the alignment with the ship's centre line shall be determined. The true heading should be taken to be the bearing (direction) of the quay at which the ship is berthed.

402 The bearing repeaters' alignment with the ship's centre line shall be checked. A bearing diopter must be available.

403 The divergence between No. 1 master compass and the gyro repeaters shall be checked. After switching to No. 2 master compass, the divergence with the gyro repeaters shall be checked again.

404 The monitoring functions of the compass system shall be tested.

405 The means for correcting errors caused by speed and latitude shall be tested.

B 500 Automatic steering system

501 The course-keeping performance of the autopilot shall be tested at full sea speed. Adaptive autopilots shall also be tested at reduced speed.

502 The performance of the autopilot shall be checked for a change in course of 10° and 90° to both sides. The overshoot angle shall be observed.

503 The off course alarm shall be tested.

504 The rate-of-turn or radius function shall be tested.

505 Change of operational steering mode shall be tested.

506 The override function shall be tested in all steering modes.

B 600 Rudder indicator(s)

601 The rudder indicator(s) on the bridge shall be checked against the indicator on the rudderstock.

B 700 Rate-of-turn indicator

701 The rate-of-turn indicator shall be tested and, if necessary, calibrated.

B 800 Speed log

801 The speed log shall be checked for accuracy and, if necessary, calibrated.

B 900 Echo sounder

901 Function testing of the echo sounder shall be carried out. Depth shall be measured at a fixed position for exact comparison of accuracy and at full speed ahead on all range scales available.

902 The depth warning or alarm shall be tested.

B 1000 Radar system

1001 Function testing of the radar shall be carried out. The various ranges, presentation modes and the basic radar functions shall be tested.

1002 The accuracy of bearing of the radars shall be tested by the reading of at least 4 fixed positions on the display at a known position of the ship.

1003 The accuracy of range measurement shall be tested by measuring the distance to at least 2 fixed positions at each range while the ship is in a known position.

1004 The heading marker shall be checked against a visible target dead ahead and adjusted if necessary.

1005 Failure mode by disconnecting a fuse shall be observed.

1006 Inter-switching facilities, including bypass function, shall be tested.

1007 Performance monitors shall be checked.

1008 Self-check programs shall be run.

B 1100 ARPA system

1101 The equipment shall be function-tested whilst the ship keeps steady speed and course.

1102 When manoeuvring the ship, the normal functioning of the system, including automatic acquisition, shall be checked.

1103 Indication on the display of the bearing and distance to the object, as well as the heading of own ship, shall be tested.

1104 The trial manoeuvre function of the ARPA shall be tested.

1105 Tests shall be carried out to verify that the system gives warning when the limits of CPA and TCPA are exceeded and that a warning is given when the object enters the guard ring.

1106 Input from speed sensors shall be checked.

B 1200 Electronic position-fixing systems

1201 All electronic position-fixing fitted systems shall be function-tested.

1202 The accuracy of the electronic position-fixing systems shall be checked.

B 1300 Watch monitoring and alarm transfer system

1301 The off-track monitoring system shall be tested. It shall be checked that the off-track alarm is transferred to the places specified if it is not acknowledged within the pre-set limit.

1302 The traffic-monitoring function of the ARPA (guard zones and CPA or TCPA) shall be tested. It shall be checked that the warning is transferred if not acknowledged within the pre-set limit.

1303 The off- heading monitoring system shall be tested. It shall be checked that the off-course alarm from the heading control system and the compass deviation alarm from the compass monitor is transferred to the places specified if it is not acknowledged within the pre-set limit.

1304 It shall be checked that the wheel over point approach alarm from the ECDIS is transferred to the places specified if it is not acknowledged within the pre-set limit.

1305 The watch monitoring (dead-man) alarm system shall be tested and the transfer of alarms checked.

B 1400 Internal communication systems

1401 The automatic telephone system and internal communication system between workstations shall be tested.

1402 The priority function for the telephones in the wheelhouse and engine control room over the other extensions shall be tested.

B 1500 Nautical communication system

1501 VHF systems shall be tested.

B 1600 Sound reception system

1601 The sound reception system shall be tested by measuring and comparing the sound level outside and inside the wheelhouse.

Guidance note:

The fundamental frequency of the sound signal used in testing the system should be within the range 70 to 700 Hz.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

B 1700 Computer system(s)

1701 The tests can be combined with tests specified for the different primary functions. Failure conditions, especially power failure in the computer system as well as the computer equipment, shall be simulated as realistically as possible. Manual re-starts and, if relevant, automatic re-start and automatic back-up shall be tested. Successive power breaks shall be simulated.

1702 If the computer system is used to carry out secondary functions, testing of the system shall be carried out with all primary functions in operation and with maximum load from both primary and secondary functions.

B 1800 Electronic chart display and information system (ECDIS)

1801 The accuracy, functionality and the alarm or warning functions of the ECDIS shall be tested. Performance of automatic functions, such as positioning of the ship by means of dead reckoning and GPS, plotting of the track and updating of the data base, shall be included in the tests together with the following operations:

— route planning
— altering of the route while underway
— positioning by bearings and ranges
— manual adjustment of the ship's position on the screen
— scale changes and zooming functions.

1802 Self-check programs shall be run.

B 1900 Grounding avoidance system

1901 The ECDIS is included in the testing of the grounding avoidance system or any type of track control system if such system is installed. The performance of the system, including alarm or warning functions, shall be tested along a pre-planned route consisting of different courses.

The route shall consist of at least six course changes and include a course change not less than 135° at minimum radius turn to each side as well as a turn of approximately 90° at a radius of not less than 2 nautical miles. The track keeping in a turn during essential speed reduction shall be tested. The alarm and warning functions of the track keeping system shall be tested. Failure conditions shall be simulated to verify conclusions of approved FMEA.

1902 Self-check programs shall be run.

B 2000 Conning display

2001 The performance of the conning display shall be tested as well as the accuracy and readability of the data displayed.

C. On board Check of Qualification Assurance System

C 100 General

101 Appropriate bridge procedures, relevant certificates of competence, an on board training scheme and the owners instructions for on board training and certification of navigators not holding a certificate of competence shall be available on the bridge.