PART 4 CHAPTER 1

MACHINERY SYSTEMS, GENERAL

JANUARY 2011

The July 2010 edition of Pt.4 Ch.1 has been re-instated as of July 2011 entering into force as from 1 July 2011.

The January 2011 edition is given the status tentative and published as appendix to the July 2011 edition and may be used for novel designs/technology.

Link to July 2011 edition.

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DETE NORSKE VERITAS

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CHANGES IN THE RULES

General

The present edition of the rules includes additions and amendments approved by the Executive Committee as of November 2010, and supersedes the January 2005 edition of the same chapter.
The rule changes come into force as described below.
This chapter is valid until superseded by a revised chapter.

Main changes coming into force 1 July 2011

- The whole chapter has been totally revised
  - The scope is to give general requirements for machinery that can be used to evaluate novel designs. The new rules will have no significant effect on conventionally designed ships, for which the present rules are intended. Further, all relevant requirements in the former Pt.4 Ch.1 are maintained or included in the new document, in order to minimise the effect on conventional designs.

Corrections and Clarifications

In addition to the above stated rule requirements, a number of corrections and clarifications have been made in the existing rule text.
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SECTION 1
INTRODUCTION

A. Application

A 100 Application

101 Pt.4 sets requirements to systems and components supporting the below listed main functions to ensure aspects of availability and safety. The following are defined as main functions:

— Propulsion
— Steering
— Power generation
— Ballasting
— Drainage and bilge pumping

102 For other systems and components Pt.4 sets requirements in order to minimize the possibility for hazards to personnel, environment vessel and cargo.

103 Pt.4 Ch.1 sets functional requirements to the availability and capability of the main functions, and sets overall requirements common for systems and components.

104 Pt.4 requirements are applicable to systems and components permanently installed onboard. Temporary installations interfacing or supporting any main function are also to be in compliance.

105 Where references have been given to SOLAS, this shall be understood as SOLAS 74 including amendments currently in force.

A 200 Safety philosophy

201 The safety philosophy shall be based on fail to safe principles.

Upon incidents threatening the safety of the vessel or the availability of main functions, the vessel shall be brought into the least hazardous of the possible operating modes with respect to personnel, environment, vessel and cargo, in this order of priority.

202 A vessel in transit mode, shall, upon incidents as referred to in 201 and whenever possible, continue on set track and with the same speed as before the incident occurred. The officer of the watch shall have the possibility to overrule this principle.

Guidance note:
Overruled by officer on watch also includes the acceptance of preset automatic safety initiatives.

For other operating modes and specified operating conditions, other fail-to-safe principles should be evaluated.

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A 300 General design criteria

301 Environmental conditions

The vessel shall, unless otherwise stated, be designed for North Atlantic weather and sea state conditions.

302 Vessel performance

The vessel shall be able to operate under the environmental conditions in 301 unless otherwise specified.

303 Vessel life time

The vessel shall normally be designed for a minimum operating life time of 20 years.

Planned maintenance and replacements may be utilised to achieve this.

B. Documentation

B 100 Information for assessment

101 Documentation shall be submitted to confirm that all the requirements of Pt.4 are adhered to. Specific documentation requirements are given in the continuation of this part.

102 If it is documented that the prescriptive requirements of Ch.1 and the following subchapters of Pt.4 are fulfilled, the function based requirements of Pt.4 Ch.1 are also considered fulfilled.

103 Any design that does not directly comply with the prescriptive requirements, shall be documented for
compliance with the function based requirements of Pt.4 Ch.1. The documentation shall also confirm that the safety is at least equivalent to what is achieved with a conventional design.

104 When yard proposes to use functional based requirements for the whole or parts of the design, they shall either

— Present the technical solutions as part of the building specification and hence the contract with owner.
— Have the technical solutions approved by owner before final acceptance by the society.

105 It may be required that verification as mentioned in 103 is based on an agreed scheme of analysis that is separately worked out and approved.

Guidance note:
For new technology, Recommended Practice DNV-RP-A203 can be a suitable basis for such scheme

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106 Further, when documentation is done according to 103 and 104, the Society withholds the right to request documents for information as defined in Table B1 as found necessary.

<table>
<thead>
<tr>
<th>Table B1 Documentation requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Object</strong></td>
</tr>
<tr>
<td>Vessel Z050 – Design philosophy</td>
</tr>
<tr>
<td>Z160 – Operation manual</td>
</tr>
<tr>
<td>Z030 – System arrangement plan</td>
</tr>
<tr>
<td>Z140 – Test procedure for quay and sea trial</td>
</tr>
</tbody>
</table>

Guidance note:
Such documentation will usually be required for:

— vessels with novel or unconventional design
— vessels with several defined modes of operation.

Typical modes to be covered:

— transit, manoeuvring, special operations, safe modes

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C. Definitions - Main Functions

C 100 Main Function - Propulsion

101 The function shall have the ability to:

— Move the vessel through the water in a controlled manner.
— Bring the moving vessel to stand still, by use of a pre-defined procedure.
— Keep the vessel with bow against the wind in weather conditions as applied for design.

102 The function is considered to be available when:

— It’s capacity is sufficient to:
  Move the vessel:
  — At navigable speed.
  — To the planned port, or to another safe stopping position.

  Stop the vessel from any speed:
  — According to the predefined procedure.

103 Unless otherwise approved, navigable speed means a speed of 7 knots in calm waters, and ability to maintain position in Beauforts 8 with associated sea state conditions.
Guidance note:
E.g.: ensure sufficient thrust in the longitudinal direction of the ship in order to keep the vessel with bow against the wind in weather conditions as applied for design. Beaufort 8 can be taken as 17 m/s or 33 knots of wind speed.

C 200 Main Function - Steering
201 The function shall have the ability to:
Keep the vessel on course or change course in a controlled manner in weather conditions as applied for design.
202 The function is considered to be available when:
— Its capacity is sufficient to keep on or change course of the vessel to all desired headings at navigable speed.

C 300 Main Function - Power Generation
301 The function shall have the ability to:
— Supply electric power.
302 The function is considered to be available when:
— It’s capacity is such that the vessel main functions and relevant statutory safety related functions are maintained in normal operating mode with redundancy arrangement as detailed in 4.8.

C 400 Main Function - Ballasting
401 The function shall have the ability to:
— Adjust and distribute ballast weight to ensure the vessel stability and keep structural loads within acceptable levels.
402 The function is considered to be available when:
— The ability in 401 is fulfilled.

C 500 Main Function - Drainage & Bilge Pumping
501 The function shall have the ability to:
— Discharge overboard water from leakages and the fire fighting systems.
502 The function is considered to be available when:
— The capacity is sufficient to keep the vessel afloat and stable in designed operating and foreseeable emergency conditions.
— The capacity is maintained throughout the duration of fire pumps running, 18 hours continuous operation as a minimum.

D. Definitions - Other
D 100 Terms - General
101 Availability
A function is considered available when it has the ability to perform the specified action.
102 Active components are components for mechanical transfer of energy, e.g. pumps, fans, electric motors, generators, combustion engines and turbines.

Guidance note:
Heat exchangers, boilers, transformers, switchgear or cables are not considered to be active components.

103 Function based requirements are requirements referring to the main function, independent of the technological solution used.
104 Hidden error is a system or component malfunction not being detected until the system or component is activated in service.
105 Mutual independence between systems/components means that no single failure in one of them will affect the other ones, and the redundant systems/components will still be able to deliver a service.
Prescriptive requirements are direct requirements set to components or systems without reference to the main function served.

Redundancy is the ability to maintain or restore a function when a single failure has occurred. Redundancy can be achieved by the installation of more than one unit within a system or by having two or more separate systems performing the same function.

Restoration time is the time from a function loses its ability to perform, until it again is ready to perform.

<table>
<thead>
<tr>
<th>Redundancy type</th>
<th>Max restoration time</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>R0</td>
<td>0 seconds</td>
<td>No interruption accepted</td>
</tr>
<tr>
<td>R1</td>
<td>45 seconds</td>
<td>Automatic restoration required</td>
</tr>
<tr>
<td>R2</td>
<td>15 minutes</td>
<td>Manual restoration accepted</td>
</tr>
<tr>
<td>R3</td>
<td>3 hours</td>
<td>Repair accepted</td>
</tr>
<tr>
<td>R4</td>
<td>More than 3 hours</td>
<td>Repair</td>
</tr>
</tbody>
</table>

Single failure is to be understood as a single event on system or component level, including it’s immediate consequential effects, rendering the system or component unavailable. Common mode failure is in general not accepted except fire, flooding.

Engine room is any space containing propulsion machinery or machinery for generation of electrical power.

Guidance note:
Rooms within or adjacent to the engine rooms with easy access between the spaces are considered to be part of the engine room.

Machinery spaces of category A are those spaces and trunks to such spaces which contain:
— internal combustion machinery used for main propulsion; or
— internal combustion machinery used for purposes other than main propulsion where such machinery has in the aggregate a total power output of not less than 375 kW; or
— any oil-fired boiler or fuel oil unit.

Machinery spaces are all machinery spaces of category A and all other spaces containing propulsion machinery, boilers, oil fuel units, steam and internal combustion engines, generators and major electrical machinery, oil filling stations, refrigerating, stabilizing, ventilation and air conditioning machinery and similar spaces and trunks to such spaces.

Transit mode is the mode in which the vessel is under voyage in open waters.

Safe mode is one defined mode (of a possible small number of defined modes) where the overall safety is prioritised. The safe mode may differ depending on the prior mode of operation.

Special operations mode is the mode in which the vessel carries out special operations for which the vessel is designed.

Manoeuvring mode is the mode in which the vessel is in narrow waters, entering port, etc. and where the manoeuvring capabilities of the vessel are critical for safe operation.

Crash stop is stopping the vessel from any speed or operational mode in the shortest possible stopping distance without damaging the equipment.

Dead ship condition

Dead ship condition is the condition under which the entire machinery installation is not in operation. All batteries and/or pressure vessels are considered depleted. Emergency generation is considered available.

Load reduction, upon failure, implies that a system/component is brought to a safe state under the prevailing condition, but the reduction is limited to a degree where the main function the unit serves is still available or to another agreed level.

Shut down, upon failure, implies that a system/component is brought to full stop.
brought to idle is considered shut down.

405 Lost redundancy condition is when a single failure has occurred and there is no redundancy left.

D 500 Control arrangement

501 Automatic control implies the control of a system/component by the use of a system independent of direct human interaction.

502 Basic control implies the minimum means for control, including indicators necessary to operate systems/components in a safe and reliable way. Basic control shall be independent of the remote control system.

Guidance note: Basic control may include a dedicated and separate automatic control system. Basic control includes SOLAS Ch II-1 C 31.8 “it shall be possible to control the propulsion machinery locally, even in the case of failure in any part of the remote control system”

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503 Local control implies the control of a system/component from a position in the immediate vicinity of the controlled unit.

504 Main work station is the position from where it is normal to control a main function, and is the only position from where it is possible to take remote control of a main function without acceptance from the work station presently holding the control.

505 Remote control implies the control of a system/component from any other position than the basic control position.

D 600 Piping

601 Piping: Is defined to include the following components:

— pipes
— flanges with gaskets and bolts and other pipe connections
— expansion element
— valves, including hydraulic and pneumatic actuators and fittings
— hangers and supports
— flexible hoses and
— pump housings.

602 Piping system: Is defined to include piping, as well as components in direct connection to the piping, such as pumps, heat exchangers, evaporators, independent tanks, etc. with the exception of main components such as steam and gas turbines, diesel engines, reduction gears and boilers.
SECTION 2
GENERAL SYSTEM REQUIREMENTS

A. Design Principles

A 100  Safety

101  All systems/components shall be so designed and installed that they will not constitute unacceptable hazards to personnel, vessel or cargo and such that the environment is not adversely affected. This also applies to installations not supporting main functions.

102  In the event of malfunction, the system/component shall enter the least hazardous of the possible failure states taking the overall safety statements in Sec.1 into consideration.

Guidance note:
This means that the safety of the system/component itself is of secondary importance compared to the safety of personnel, environment, vessel and cargo.

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A 200  Availability

201  Systems/components shall be designed and arranged so that all main functions are simultaneously available in all relevant operational modes unless specially considered and accepted.

202  Systems/components supporting a main function shall not be used or integrated with other systems/components in such a way that the availability of the main function may be impaired or lost.

203  Systems and components supporting a main function shall be arranged with redundancy so that a single failure does not lead to the unavailability of any main function or inability to start or stop the main function.

Guidance note:
Normally this redundancy is achieved by duplication

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204  Control systems supporting a main function shall be so arranged that, after a single failure, the control of the main function can be restored within 45 seconds.

205  The redundancy requirement of 203 may be waived upon adequate documentation of reliable performance. Adequate documentation of reliable performance may be based on one or more of the following:

— Extensive and relevant maritime service experience.
— Design based on approved and relevant standards/regulations and service experience.
— Risk based assessment following a predefined standard approved by the Society and associated relevant service experience or testing.

Guidance note:
The following systems and components of well proven design, compliant to the Society's requirements, are normally considered to have documented reliable performance (the list is not necessarily complete):

— Main engine
— Shafting
— Gears
— Propulsors
— Pipes.

The following installation is not required redundant:
— Machinery for emergency electrical power supply.

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206  Systems where hidden failures are likely, shall be designed and tested with attention to the potential detrimental effect of the hidden failure on the ship main functions. Occurrence of likely hidden failures is not to be considered as a single failure.

A 300  Design

301  All systems/components supporting main functions, shall:

a) be designed, built and tested in accordance to the class rules. Components and systems not covered by the rules shall comply with a recognised standard suitable for marine use accepted by class.
b) be designed and built such that maintenance tasks normally expected to be handled during voyage and occurring at short intervals, may be carried out without loss of propulsion or steering.

c) be so designed and built that main functions can be brought into operation from the «dead ship» condition within 30 minutes using only the facilities available on board.

**Guidance note:**
In order to restore operation from the «dead ship» condition, the emergency generator may be used. It is assumed that means are available to start the emergency generator at all times.

---end---of---Guidance---note---

**B. Function**

**B 100 Redundancy**

101 Redundant systems/components are to be mutually independent.

102 Redundant systems/components shall have the a capability sufficient to avoid loss of any main function in case of single failure.

**B 200 Functional capability**

201 The performance and capacity of auxiliary systems are to be adapted to the needs of the systems served.

202 Components in a system are to be:

— satisfactorily matched with regard to function, capacity and strength, taking all vessel operating conditions into consideration

— designed with respect to the loads and ambient conditions which are expected to occur. Generally accepted safety margins are to be used.

**B 300 Operation**

301 For vessels having more than one operating mode, the mode in force shall be clearly indicated at relevant command/work stations.

302 Changeover between two normal operating modes is to be possible without significant influence on propulsion or steering.

**C. Arrangement**

**C 100 Installation**

101 All systems and machinery are to be designed and installed taking due consideration to the conditions found in a marine environment.

102 Relative motions between parts of the machinery are to be allowed for without inducing detrimental stresses.

103 All systems and components that are to be operated or subject to inspection and maintenance on board, are to be installed and arranged accessible.

**C 200 Control**

201 **General**

— All systems/components are to be equipped with control and monitoring devices necessary for safe operation.

— All systems/components required to maintain availability of a main function shall have basic control facilities. This basic control shall be mutually independent of remote control system for the same main function

— Control and safety devices for systems/components supporting main functions, shall be independent or designed such that failure of one system does not degrade the performance of another system.

(Interpretation of SOLAS Ch. II-1/31.1 and 31.5.1)

**Guidance note:**
Compliance with Ch.1 and Ch.9 is regarded as fulfilling the above mentioned requirements.

---end---of---Guidance---note---

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--- An engineers' alarm shall be provided with the possibility to alert personnel in the engineers' accommodation that assistance is needed in the engine room.

(Interpretation of SOLAS Ch. II-1/38)

--- At least two independent means shall be provided for communicating orders from the navigating bridge to the position in the machinery space or in the control room from where the speed and direction of thrust of the propulsors can be controlled in basic control mode. One of these shall provide visual indication of the orders and responses both in the machinery spaces and on the navigating bridge. Appropriate means of communication shall be provided from the navigating bridge and the engine-room to any other position from where the speed or direction of thrust of the propellers may be controlled.

(Interpretation of SOLAS Ch. II-1/37)

202 Remote control - general

a) When control is possible from several work stations, only one shall be in control at a time. It shall be clearly indicated at each work station which station is in control.

b) Remote starting of machinery shall be automatically inhibited if conditions exist which may cause hazard, e.g. turning gear engaged.

203 Bridge control – general

For systems/components supporting main functions:

--- Necessary information and alarms shall be given on the bridge in case of overload if automatic load limitation is not arranged for.

--- An alarm shall be initiated on the bridge and in the engine room in case of starting failure.

C 300 Prevention of inadvertent operations

301 The installation shall be so arranged as to minimize the possibility for inadvertent operation and human errors leading to reduced safety or damage of system/components.

302 The installation is to be arranged as to minimize the possibility for sea water, cargo or ballast from reaching dry spaces of the ship, and cargo (oils or chemicals) from being discharged overboard as a consequence of inadvertent operations.

303 The installation is to be so arranged that leakage or operation of valves will not directly lead to increased risk of damage to machinery, ship or personnel due to mixing of different fluids.

304 Open and closed positions of valves are to be easily visible.

305 If a valve's function in the system is not evident, there is to be adequate information on a name plate attached to the valve.

306 All connections to sea are to be marked: SEA DIRECT.

307 For vessels where damage stability requirements apply, precautions are to be taken to prevent intercommunication through damaged pipe lines between flooded and intact compartments. For this purpose, where any part of a pipe system is situated within the defined damaged area and the pipe line has an open end in a compartment assumed to be intact, an isolating valve situated outside the damaged area operable from the freeboard deck or from another position, accessible when the ship is in damaged condition is to be fitted. For bilge lines the remotely operated stop valves may be substituted by a non-return valve.

Guidance note:

Requirements for damage stability may be found in inter alia SOLAS, the International Convention on Load Lines, MARPOL, IMO Gas and Chemical Codes and for the optional class notations SF and Well Stimulation.

C 400 Ventilation capacity

401 All spaces, from which machinery is operated and where flammable or toxic gases or vapours may accumulate, or where a low oxygen atmosphere may occur, are to be provided with adequate ventilation under all conditions.

402 The capacity and arrangement of machinery spaces and emergency generator room ventilation is to cover demands for operating the machinery, boilers and emergency generator at full power in all weather conditions. Ventilation inlets and outlets are to be located not less than 4.5 m above freeboard deck. Supply of air to the engine room is to be ensured even in the event of failure of one ventilation fan.
Guidance note:
Necessary capacity of ventilation may be calculated according to ISO Standard 8861.

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C 500  Fire prevention

501  Fuel oil, lubrication oil, hydraulic oil and thermal oil are regarded as "Flammable oils".

D. Environmental Conditions

D 100  External conditions

101  All machinery, components and systems are generally to be designed to operate under the following environmental conditions, see also Table D1 and Table D3:

— Sea water temperature: \( \leq 32^\circ C \)
— Ambient air temperature: \(-10^\circ C \rightarrow +45^\circ C\)
— Relative humidity of air: \( \leq 100\% \)

D 200  Reference conditions

201  Where the rules have requirements for capacity or power of machinery, these are to be determined at the ambient reference conditions stated in Table D1.

202  The engine manufacturer is not expected to provide simulated ambient reference conditions at a test bed unless specified in the relevant rule chapters.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total barometric pressure</td>
<td>1 bar = 0.1 [Mpa]</td>
</tr>
<tr>
<td>Ambient air temperature</td>
<td>45°C</td>
</tr>
<tr>
<td>Relative humidity of air</td>
<td>60%</td>
</tr>
<tr>
<td>Sea water temperature</td>
<td>32°C</td>
</tr>
</tbody>
</table>

D 300  Ship conditions

301  All machinery, components and systems are generally to be designed to operate under the ship conditions as specified in Table D2 and D3.

302  The Society may consider deviations from the angles of inclination given in Table D2, taking the ship type, size and service conditions into consideration.

<table>
<thead>
<tr>
<th>Installations, components</th>
<th>Angle of inclination (degrees)</th>
<th>Athwartships</th>
<th>Fore and aft</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main and auxiliary machinery</td>
<td>±15</td>
<td>0 ± 22.5</td>
<td>±5 ()</td>
</tr>
<tr>
<td>Safety equipment, e.g. emergency power installations, emergency fire pumps and their devices, switch gear, electrical and electronic appliances (3) and remote control systems</td>
<td>±22.5 ()</td>
<td>0 ± 22.5 ()</td>
<td>±10 ()</td>
</tr>
</tbody>
</table>

1) The Society may consider deviations from these angles of inclination taking into consideration the type, size and service condition of the ship.

2) Athwartships and fore and aft inclinations may occur simultaneously.

3) Up to an angle of inclination of 45°C no undesired switching operations or operational changes may occur.

4) In ships for the carriage of liquefied gases and of chemicals, the emergency power supply must also remain operable with the ship flooded to a final athwartships inclination up to a maximum of 30°C.

5) Where the length of the ship exceeds 100 m, the fore and aft static angle of inclination may be taken as 500/L degrees where \(L = \) length of ship, in m, as defined in Pt.3 Ch.1 Sec.1 B100.
<table>
<thead>
<tr>
<th>Table D3 Temperature, humidity, accelerations, vibrations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ambient air temperature:</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Relative humidity of air:</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Sea water temperature</strong></td>
</tr>
<tr>
<td><strong>Accelerations</strong></td>
</tr>
<tr>
<td><strong>Vibrations</strong></td>
</tr>
</tbody>
</table>

1) All machinery and equipment installed onboard shall be designed for the accelerations that can occur on the location onboard where it is installed. Acceleration figures can be taken from specific calculations of the vessel, or from simplified formulae in Pt.3.

For simplified, conservative calculations, an acceleration of 0.6 g can be assumed in all directions.

2) All machinery and equipment installed on board shall be designed to withstand the vibration level that can occur on the location where it is installed.

A free vibration level of walls and decks of 45 mm/s for frequencies 3 to 13 Hz, and 4 g for frequencies 13 to 100 Hz can be assumed in all directions. The figures can be used directly, or as input for response analyse for installed machinery.
SECTION 3
MAIN FUNCTIONS - REQUIREMENTS

A. General requirements

A 100 Modes of operation

101 For vessels with multiple defined modes of operation (transit mode, manoeuvring mode, etc.), specific availability requirements for the main functions in each mode may be agreed.

B. Main functions

B 100 Propulsion

101 A main work station shall be arranged.

102 The propulsion system shall be so arranged that, after a single failure, it may be restored within 15 minutes without repair.

Guidance note:
The propulsion system may be arranged as a single propulsion line having systems/components arranged with redundancy, unless specifically exempted. Reference is made to Sec.2 A204.

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

103 Propulsion machinery - control

a) The speed, direction of thrust and, if applicable, the pitch of the propeller shall be fully controllable from the navigating bridge under all sailing conditions, including manoeuvring.
(SOLAS Ch. II-1/31.2.1)

b) Propulsion machinery orders from the navigation bridge shall be indicated in the main machinery control room and at the manoeuvring platform.
(SOLAS Ch. II-1/31.2.4)

Guidance note:
Manoeuvring platform is to be understood as the location for basic control.

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

c) The remote control shall be performed, for each independent propeller, by a control device so designed and constructed that its operation does not require particular attention to the operational details of the machinery. Where multiple propellers are designed to operate simultaneously, they may be controlled by one control device.
(SOLAS Ch. II-1/31.2.2)

Guidance note:
For ships less than 500 gross tonnage, two handle control may be accepted and some of the normally programmed operations may instead be carried out manually.

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d) The main propulsion machinery shall be provided with an emergency stopping device on the navigating bridge which shall be independent of the navigating bridge control system.
(SOLAS Ch. II-1/31.2.3)

Guidance note:
If means are provided to stop the propulsion without stopping the main engine(s) (e.g. clutch arrangement) then this will be accepted.

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e) Indicators shall be fitted on the navigation bridge and in the engine control room for:

— propeller speed and direction of rotation in the case of fixed pitch propellers; and
— propeller speed and pitch position in the case of controllable pitch propellers.
(Interpretation of SOLAS Ch. II-1/31.2.8 and 31.5.6)

f) An alarm shall be provided on the navigating bridge and in the machinery space to indicate low starting air pressure which shall be set at a level to permit further main engine starting operations. If the remote control system of the propulsion machinery is designed for automatic starting, the number of automatic consecutive
attempts which fail to produce a start shall be limited in order to safeguard sufficient starting air pressure for starting locally. (SOLAS Ch. II-1/31.2.9)

g) Automation systems shall be designed in a manner which ensures that threshold warning of impending or imminent slowdown or shutdown of the propulsion system is given to the officer of the watch in time to assess navigational circumstances in an emergency. In particular, the systems shall control, monitor, report, alert and take safety action to slow down or stop propulsion while providing the officer of the watch an opportunity to manually intervene, except for those cases where manual intervention will result in total failure of the engine and/or propulsion equipment within a short time, for example in the case of overspeed. (SOLAS Ch. II-1/31.2.10)

Guidance note:
The above is regarded to be fulfilled when:

1) All process parameters initiating slowdown or shutdown shall initiate an alarm before reaching the slowdown / shutdown limit. These alarms shall be individually or in groups indicated on the navigating bridge whenever the propulsion machinery is controlled from this position. Exempted from the requirement to give a pre-warning are the following parameters:
   — overspeed on rotating machinery
   — crankcase explosive condition using oil mist detection on diesel engines
   — short-circuit in electrical propulsion plants.

2) An override facility to manually intervene on all slowdowns and shutdowns shall be available for all parameters except those which will result in total failure of the engine and/or propulsion equipment within a short time, or cause threat to personnel. For multi engine plants this requirement can usually be waived.
   Examples of such parameters:
   — lubricating oil pressure for rotating machinery
   — overspeed for rotating machinery for fluid film bearings
   — crankcase explosive condition on diesel engines
   — short-circuit conditions in electrical installation
   — high vibration for gas turbines.

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

B 200 Steering

201 Main work station shall be the navigation bridge, unless otherwise stated. The total steering system shall be so arranged that the officer on watch may control the course of the vessel without due delay and with acceptable safety and availability.

202 The steering system shall be so arranged that, after a single failure, it may be restored within 15 minutes without repair.

The systems and components shall be arranged with redundancy unless specifically exempted. Reference is made to Sec.2 A204.

203 The main steering system shall have sufficient capacity to change direction of the vessel in a controlled and adequate manner to all desired headings at maximum ahead service speed.

Guidance note:
Compliance with IMO Interim standards for ship manoeuvrability is considered sufficient for fulfilment of the above. Maximum ahead service speed is defined in Pt.4 Ch.14 Sec.1 A208.

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

B 300 Electric Power Generation

301 A main work station shall be arranged.

302 The vessel shall be provided with a minimum of two main sources of power, both independently capable of keeping the vessel in normal operation with regard to main functions and safety, without recourse to the emergency source of power.

303 The power generation system shall be so arranged that, after a single failure, it may be restored within 45 seconds.

B 400 Ballasting

401 A main work station shall be arranged.

402 The ballasting system shall be so arranged that, after a single failure, it may be restored within 15 minutes without repair.
B 500  Drainage and bilge pumping

501  A main work station shall be arranged.

502  The drainage and bilge pumping system shall be so arranged that, after a single failure, it may be restored within 15 minutes without repair.

Guidance note:
The systems and components shall be arranged with redundancy unless specifically exempted. Reference is made to Sec.2 A204.

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SECTION 4
MISCELLANEOUS REQUIREMENTS

A. All Vessels

A 100 Materials

101 Where no specific requirements are given in the rules regarding dimensioning and choice of materials, generally recognised standards and engineering principles may be applied.

102 When it is of essential significance for the safety of the ship that the function of a component is maintained as long as possible in the event of fire, materials with high heat resistance are to be used.

103 Materials with low heat resistance are not to be used in components where fire may cause outflow of flammable or health hazardous fluids, flooding of any watertight compartment or destruction of watertight integrity.

Guidance note:
Materials with high heat resistance are materials having a melting point greater than 925°C. Materials with low heat resistance are all other materials. Deviations from the above requirement will be subject to special considerations.

---end of Guidance note---

104 The use of asbestos is prohibited.
(SOLAS Ch. II-1/3-5.2)

A 200 Controlled atmosphere installations

201 Fixed refrigeration plants (including air condition plants) with a total prime mover rated effect of 100 kW and above, shall comply with safety requirements in Pt.5 Ch.10. Refrigeration plants using Group 2 refrigerants (e.g. ammonia) shall comply with the safety requirements as given in Pt.5 Ch.10 irrespective of size.

202 Controlled atmosphere installations for dry cargoes shall comply with all safety requirements of Pt.5 Ch.10 Sec.5.

203 Spaces containing refrigeration installations and not fitted with mechanical ventilations, shall be provided with an oxygen deficiency monitoring system. Alarm indication shall be located at the entrance to the space.
A. Verification of main functions

A.100 Safety and availability

101 The test program shall demonstrate that the rules requirements are adhered to.

Guidance note:
Several systems and components such as diesel engines have specific requirements to testing and verification in underlying chapters, the motivation for a final test is to ensure that all systems perform together in a safe manner in order to demonstrate availability of main functions in all relevant operational modes.

102 Main function availability

The test program shall demonstrate that the availability requirements of the main functions are met in the different and relevant modes of operations.

103 Test of basic control

Basic controls of main functions have to be tested

104 Main function capability

The test program shall demonstrate, and form basis for a general documentation, of the operating capability of the vessel (speed, turning radius, crash stop length etc.) in the different modes of operation, fallback operation in degraded mode, and specified failure scenarios.