Notice No. 9

Rules and Regulations for the Classification of Ships, July 2013

The status of this Rule set is amended as shown and is now to be read in conjunction with this and prior Notices. Any corrigenda included in the Notice are effective immediately.

Issue date: July 2014

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Part 1, Chapter 2

Classification Regulations

Effective Date 1 July 2014

Section 2
Character of classification and class notations

2.1 Definitions

2.1.5 Type notation. A notation indicating that the ship has been arranged and constructed in compliance with particular Rules intended to apply to that type of ship. Type notations that may be assigned are listed in Table 2.2.1.

| Part only shown |

Table 2.2.1 Type notations

<table>
<thead>
<tr>
<th>Dry cargo</th>
<th>Tanker</th>
<th>Passenger</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>Passenger ship</td>
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<td></td>
<td></td>
<td>Passenger yacht</td>
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<td></td>
<td></td>
<td>Roll on-Roll off passenger ship</td>
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</table>

2.3 Class notations (hull)

2.3.21 The following notations may be assigned to ships that comply with standards for noise and vibration levels in different spaces at the time of delivery and during the ship’s life if substantial changes to the machinery installation or interior arrangements are made. These notations are optional and are primarily intended to apply to passenger ships:

PAC Passenger Accommodation Comfort. This notation indicates that the passenger accommodation meets the acceptance criteria.

CAC Crew Accommodation Comfort. This notation indicates that the crew accommodation and work areas meet the acceptance criteria.

PCAC Passenger and Crew Accommodation Comfort. This notation indicates that the passenger and crew spaces both meet the acceptance criteria.

Following the PAC or CAC notation, numerals 1, 2 or 3 will indicate the acceptance criteria to which the noise and vibration levels have been assessed. In the case of the PCAC notation, two numerals will be assigned. The first will indicate the acceptance criteria for passenger accommodation, whilst the second will indicate the crew comfort criteria. These notations are optional and are primarily intended to apply to passenger ships. Spaces that comply with the minimum Rule requirement for noise levels indicated in Pt 7, Ch 13, will meet the requirements of section 4 of IMO Resolution MSC.337(91), when measured in accordance with the requirements of Chapters 2 and 3 of that Resolution.

2.4 Class notations (machinery)

2.4.2 The following class notations are associated with the machinery control and automation, and may be assigned as considered appropriate by the Classification Committee:

IFP This additional notation may be assigned where an integrated fire protection system is fitted to provide control and monitoring of all active fire protection and fixed fire extinguishing systems from a centralised fire-control station. It denotes that the integrated fire protection system has been arranged, installed and tested in accordance with LR's Rules, or is equivalent thereto.

PORT Assigned when equipment is installed for the automation of in-port operations involving manoeuvring, berthing and laying alongside. For the assignment of this notation, the ship is also to be assigned UMS.
2.8 Descriptive notes

2.8.7 **STV.** Where a sailing vessel is used for the offshore training of cadets or trainee seamen, a sailing training vessel **STV** descriptive note may be entered in column 6 of the *Register Book.*

<table>
<thead>
<tr>
<th>Machinery Notations</th>
<th>See 2.4, 2.5, 2.6</th>
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<tbody>
<tr>
<td><strong>IP</strong></td>
<td>Integrated Propulsion</td>
</tr>
<tr>
<td><strong>IFP</strong></td>
<td>Integrated Fire Protection</td>
</tr>
<tr>
<td><strong>PORT</strong></td>
<td>Automation of in-port operation only assigned to addition to UMS</td>
</tr>
<tr>
<td><strong>DP(CM)</strong></td>
<td>Dynamic Position (Centralised Remote Manual Controls)</td>
</tr>
<tr>
<td><strong>PMRL</strong></td>
<td>Propulsion System Redundancy in Separate Compartments with Limited Capacity</td>
</tr>
<tr>
<td><strong>SMRL</strong></td>
<td>Steering System Redundancy with Limited Capacity</td>
</tr>
<tr>
<td><strong>SMRL</strong></td>
<td>Steering System Redundancy in Separate Compartments with Limited Capacity</td>
</tr>
<tr>
<td><strong>PSMRL</strong></td>
<td>Propulsion and Steering System Redundancy with Limited Capacity</td>
</tr>
<tr>
<td><strong>CA</strong></td>
<td>Controlled Atmosphere</td>
</tr>
<tr>
<td><strong>CA (%O2, %CO2)</strong></td>
<td>Controlled Atmosphere</td>
</tr>
<tr>
<td><strong>RH</strong></td>
<td>Relative Humidity</td>
</tr>
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</table>

### Section 3

**Surveys – General**

#### 3.8 Withdrawal/Suspension of class

Class will be automatically suspended from the expiry date of the Certificate of Class in the event that the Special Survey has not been completed by the due date and an extension has not been agreed (see 3.5.9), or is not under attendance by the Surveyors with a view to completion prior to resuming trading.

Classification will be reinstated from suspension of class upon satisfactory completion of the surveys due. The surveys to be carried out are to be based upon the survey requirements at the original date due and not on the age of the ship when the survey is carried out. Such surveys are to be credited from the date originally due. However, the ship’s Class remains suspended from the date of suspension until the date Class is reinstated.

3.8.14 For reclassification and reinstatement of class, see 3.3.2 and 3.8.4.
Part 1, Chapter 3

Periodical Survey Regulations

Effective Date 1 July 2014

Section 1

General

1.5 Definitions

1.5.18 For the application of requirements outlined in Sections 2, 3, 4 and 5, a general dry cargo ship is a self-propelled ship of 500 gross tonnes or above, constructed generally with a ‘tween deck and intended to carry solid cargoes, other than:

- bulk carriers;
- ships dedicated to the carriage of containers;
- dedicated forest product carriers (but not timber or log carriers);
- roll on-roll off ships;
- refrigerated cargo ships;
- dedicated wood chip carriers;
- dedicated cement carriers;
- livestock carriers;
- dock/deck cargo ships;
- general dry cargo ships of double side-skin construction, with double side-skin extending for the entire length of the cargo area, and for the entire height of the cargo hold to the upper deck.

Section 2

Annual Surveys – Hull and machinery requirements

2.2 Annual Surveys

2.2.10 The bilge pumping systems and bilge wells, including operation of extended spindles and level alarms, where fitted, are to be examined so far as practicable. Satisfactory operation of the bilge pumps is to be proven. The bilge pumping systems for each watertight compartment, including bilge wells, extended spindles, self-closing drain cocks, valves fitted with rod gearing or other remote operation, pumps and level alarms, where fitted, are to be examined and operated as far as practicable and all confirmed to be satisfactory. Any hand pumps provided are to be included.

Section 5

Special Survey – General – Hull requirements

5.3 Examination and testing

5.3.5 Double bottom, deep, ballast, peak and other tanks, including cargo holds assigned also for the carriage of salt water ballast, are to be tested with a head of liquid to the top of air pipes or to near the top of hatches for ballast/cargo holds. Boundaries of oil fuel, lubricating oil and fresh water tanks are to be tested with a head of liquid to the highest point that liquid will rise to under service conditions. Tank testing of oil fuel, lubricating oil and fresh water tanks may be specially considered based upon a satisfactory external examination of the tank boundaries, and a confirmation from the Master stating that the pressure testing has been carried out according to the requirements with satisfactory results. Surveyors may extend the testing as deemed necessary.

For oil tankers (including ore/oil and ore/bulk/oil ships) and chemical tankers, the minimum requirements for cargo tank testing are to be in accordance with Sections 7.5 and 8.5, as applicable.

Section 7

Special Survey – Oil tankers (including ore/oil ships and ore/bulk/oil ships) – Hull requirements

7.5 Testing

7.5.1 The minimum ballast tank testing requirements are given in Table 3.7.1 and, where required, the Surveyor may extend the tank testing if deemed necessary. The remaining requirements for tank testing, as applicable, are given in 5.3.5.

Existing paragraph 1.6.11 has been renumbered 1.6.12.
Section 8
Special Survey – Chemical tankers – Hull requirements

8.5 Testing

8.5.1 The minimum ballast tank testing requirements are given in Table 3.8.1 and, where required, the Surveyor may extend the tank testing if deemed necessary. Other arrangements for cargo tank testing will be considered on application. The remaining requirements for tank testing, as applicable, are given in 5.3.5.

8.5.2 The minimum cargo tank testing requirements are given in Table 3.8.1; boundaries of cargo tanks are to be tested to the highest point that liquid will rise to under service conditions. Cargo tank testing carried out by the ship’s crew under the direction of the Master may be accepted by the Surveyor provided the following conditions are complied with:

(a) A tank testing procedure has been submitted by the Owner and reviewed by LR prior to the testing being carried out.

(b) There is no record of leakage, distortion or substantial corrosion that would affect the structural integrity of the tank.

(c) The tank testing has been satisfactorily carried out within the special survey window not more than 3 months prior to the date of the survey on which the overall or close-up survey is completed.

(d) The satisfactory results of the testing are recorded in the ship’s logbook.

(e) The internal and external condition of the tanks and associated structure is found satisfactory by the Surveyor at the time of the overall and close-up survey.

■ Section 9
Ships for liquefied gases

9.7 Special Survey I (ships five years old) – General requirements

9.7.6 For membrane containment systems, a tightness test of the primary and secondary barrier shall be carried out in accordance with the system designer’s procedures and acceptance criteria as approved by LR. Low differential pressure tests may be used for monitoring the cargo containment system performance, but are not considered an acceptable test for the tightness of the secondary barrier. For membrane containment systems with glued secondary barriers, the values obtained shall be compared with previous results or results obtained at the new-building stage. If significant differences are observed for each tank or between tanks, then an evaluation and additional testing, as required by the Surveyor, is to be carried out if the designer’s threshold values are exceeded, an investigation is to be undertaken and additional testing such as thermographic or acoustic emissions testing should be carried out.

14.2 Complete Surveys

14.2.4 Air circuit-breakers for essential or emergency services and rated at 800 A and above are to be surveyed to ensure that the manufacturer’s recommended number of switching options has not been exceeded. See Pt 6, Ch 2.7.3.6. Where a breaker is not fitted with an automatic counter, a written record is to be kept.

Existing paragraphs 14.2.4 and 14.2.5 have been renumbered 14.2.5 and 14.2.6.

14.2.6 Where transformers associated with supplies to essential services are liquid-immersed, the Owner is to arrange for samples of the liquid to be taken and tested for dissolved gases, breakdown voltage, acidity and moisture by a competent testing authority, in accordance with the equipment manufacturer’s requirements, and a certificate giving the test results is to be furnished to the Surveyor on request.

Existing paragraphs 14.2.7 to 14.2.9 have been renumbered 14.2.8 to 14.2.10.

14.2.10 Where the ship is electrically propelled, the propulsion motors, generators, propulsion transformers, propulsion conversion equipment, cables, harmonic filters, neutral earthing resistors, dynamic braking resistors and all ancillary electrical gear equipment that forms part of the propulsion drive and control system, exciters and ventilating plant (including coolers) associated therewith are to be examined and surveyed, and the insulation resistance to earth is to be tested. Special attention is to be given to windings, commutators and
slip-rings. Where practicable, the low voltage and high voltage windings of cast resin propulsion transformers are to be subjected to boroscopic inspection, to assess the physical condition of their insulation and for signs of mechanical and thermal damage. The operation of protective gear and alarm devices is to be checked, so far as practicable. Insulating oil, if used, is to be tested in accordance with 14.2.6 14.2.7. Interlocks intended to prevent unsafe operations or unauthorised access are to be checked to verify that they are functioning correctly. Emergency overspeed governors are to be tested.

Existing paragraphs 14.2.11 and 14.2.12 have been renumbered 14.2.12 and 14.2.13.
### Structural member category

| B1. | Bottom plating, including keel plate |
| B2. | Strength deck plating, excluding that belonging to the Special category |
| B3. | Continuous longitudinal plating of strength members above strength deck, excluding hatch coamings |
| B4. | Uppermost strake in longitudinal bulkhead |
| B5. | Vertical strake (hatch side girder) and uppermost sloped strake in top wing tank |
| **SPECIAL** |
| C4. | Strength deck plating at corners of cargo hatch openings in bulk carriers (see 1.1.3), ore carriers, combination carriers and other ships with similar hatch opening configurations |
| C5. | Trunk deck and inner deck plating at corners of openings for liquid and gas domes in membrane type liquefied gas carriers |
| C6. | Bilge strake in ships with double bottom over the full breadth and length less than 150 m, see Note 1 |
| C7. | Bilge strake in other ships, see Note 1 |
| C8. | Longitudinal hatch coamings of length greater than 0,15L including coaming top plate and flange |
| C9. | End brackets and deck house transition of longitudinal cargo hatch coamings |
| **SHIPS WITH LENGTH EXCEEDING 150 m AND SINGLE STRENGTH DECK ADDITIONAL REQUIREMENTS FOR SINGLE STRENGTH DECK SHIPS OF LENGTH GREATER THAN 150 m:** |
| D1. | Longitudinal strength members of strength deck plating longitudinal plating of strength deck where contributing to the longitudinal strength |
| D2. | Continuous longitudinal plating of strength members above strength deck |
| D3. | Continuous longitudinal trunk deck plating of membrane type liquefied gas carriers |
| D4. | Single side strakes for ships without inner continuous longitudinal bulkhead(s) between bottom and strength deck |

### Notes
1. Single strakes required to be of Class III and within 0,4L amidships are to have breadths not less than 800 + 5L mm, but need not be greater than 1800 mm, unless limited by the geometry of the ship’s design.
2. Single strakes required to be of Grade E/EH and within 0,4L amidships are to have breadths not less than 800 + 5L mm, but need not be greater than 1800 mm, unless limited by the geometry of the ship’s design.
3. For strength members not mentioned, Grade A/AH may be generally used.
4. Steel grade is to correspond to the as-fitted thickness.
5. Plating materials for sternframes supporting the rudder and propeller boss, rudders, rudder horns and shaft brackets are, in general, not to be of lower grades than corresponding to Class II. For rudder and rudder body plates subjected to stress concentrations (e.g., in way of lower support of semi-spade rudders or at upper part of spade rudders) Class III is to be applied.

### Table 2.2.3 Grades of steel for refrigerated spaces with a minimum design temperatures below 0°C
Where the propeller shafting is exposed to the sea for some distance clear of the main hull, it is generally to be supported adjacent to the propeller by independent brackets having two arms. In very small ships, the use of single arm brackets will be specially considered.

Existing paragraphs 7.5.2 and 7.5.3 have been renumbered 7.5.3 and 7.5.4.

7.6.4 The scantlings of shaft brackets will be specially considered and, in the case of certain high powered ships, direct calculations may be required.

Existing paragraph 7.5.5 has been renumbered 7.5.6.

7.6 Double arm shaft brackets (‘A’ – brackets)

7.6.1 The angle between the arms for double arm shaft brackets is generally to be not less than 50°. Proposals for the angle between the arms to be less than 50° will be specially considered with supporting calculations to be submitted by the designers.

7.6.2 The arms of double arm shaft brackets are to have a section modulus, $Z_{xx}$, of not less than that determined from the formula:

$$Z_{xx} = 0.45n^3 \text{ cm}^3$$

where

- $n =$ the minimum thickness, in cm, of a hydrofoil section obtained from:
  $$n = d_{up} \sqrt{\left(\frac{f}{2000}\right)} \left(1 + \sqrt{1 + \frac{0.0112(f/d_{up})^2}{f}}\right) \text{ cm}$$

- $d_{up} =$ the length of the longer strut, in mm, see Fig. 6.7.8
- $f =$ the Rule diameter for an unprotected screwshaft, in mm, or by the applicable Ice Class Rules, see Pt 8, Ch 2.7.8, obtained from:
  $$d_{up} = 128 \left(\frac{P}{R}\right)$$

- $P =$ shaft power, in kW as defined in Pt 5, Ch 1.3.3
- $R =$ revolutions per minute, as defined in Pt 5, Ch 1.3.3
- $f = 400/\sigma_u$
- $\sigma_u =$ ultimate tensile strength of arm material, in N/mm².
Part 3, Chapters 6 & 9

7.6.7 Propeller hull clearances

7.6.7.1 Recommended minimum clearances between the propeller and the sternframe, rudder or hull are given in Table 6.7.5. These are the minimum distances considered desirable in order to expect reasonable levels of propeller excited vibration. Attention is drawn to the importance of the local hull form characteristics, shaft power, water flow characteristics into the propeller disc and cavitation when considering the recommended clearances.

Fig. 6.7.8
Double arm shaft bracket

Part 3, Chapter 9

Special Features

Effective Date 1 July 2014

Section 2
Timber deck cargoes

2.1 Application

2.1.2 In other cases, proposals to carry timber deck cargoes which will impose on the weather deck a mean cargo loading in excess of 8.5 kN/m² (0.865 tonne-f/m²) will be considered on the basis of these requirements. In particular, the requirements of 2.5 to 2.8, 2.9 to 2.12 are to be complied with.

2.3 Statutory Requirements General

2.3.1 Attention is drawn to the requirements of the International Convention for the Safety of Life at Sea, 1974, Chapter VI, as amended, the International Load Line Convention, 1966, concerning timber deck cargoes, and its 1988 Protocol, and also to National Regulations. Attention is also drawn to IMO Resolution A.1048(27) Code of Safe Practice for Ships Carrying Timber Deck Cargoes, 2011.

2.3.2 A timber deck cargo loading and lashing plan, showing the stowage and securing of the timber cargo and the walkway/life-line arrangements, is to be submitted for approval, and a copy placed on board the ship for the information of the Master.

2.3.3 Each cargo securing arrangement for timber deck cargoes detailed in the ship’s Cargo Securing Manual is to be documented by a lashing plan that shows the following:
(a) maximum cargo weight for which the arrangement is designed;
(b) maximum stowage height;
(c) required number and strength of blocking devices and lashings, as applicable;
(d) required pre-tension in lashings;
(e) other cargo properties of importance for the securing arrangement, such as friction, rigidity of timber packages;
(f) illustrations of all securing items that might be used;
(g) any restrictions regarding maximum accelerations, weather criteria, restricted sea areas and for non-winter conditions only;
(h) the walkway/life-line arrangements; and
(i) stowage arrangement, which is to be in accordance with 2.7.

The Cargo Securing Manual is to be submitted for approval, and a copy placed on board the ship.

2.3.4 All timber deck cargoes must be compactly stowed, lashed and secured. Friction alone is not deemed sufficient and such methods are not endorsed by Lloyd’s Register.
Part 3, Chapter 9

Existing paragraphs 2.3.3 to 2.3.5 have been renumbered 2.3.5 to 2.3.7.

2.4.6 It is the Owner’s/Master’s responsibility to supply loose gear (e.g., uprights, wire lashings and life-lines) in accordance with the approved timber deck cargo loading and lashing plan when the ship is carrying timber deck cargoes at timber freeboards. However, it is not a requirement that loose gear remains permanently on board a ship assigned timber freeboards.

2.3.8 It is the Master’s responsibility to ensure loose gear (e.g., uprights, wire lashings and life-lines) are supplied and fitted onboard in accordance with the approved timber deck cargo loading and lashing plan when the ship is carrying timber deck cargoes. However, it is not a requirement that loose gear remains permanently on board a ship assigned timber freeboards.

2.4 Arrangements

2.4.2 A forecastle of at least standard height of a superstructure, defined by Regulation 33 of the International Load Line Convention, as amended, and of length at least 0.07L is to be fitted. In addition, in ships of less than 100 m in length, a poop of at least standard height, or a raised quarterdeck with a deckhouse or strong steel hood of at least the same total height, is to be fitted.

2.5 Uprights

2.5.1 Uprights are to be of adequate strength but are not to exceed the strength of the bulwark. Where timber uprights are used, it is the responsibility of the Master to use timber which is of a type and grade which has proved satisfactory for the purpose. Where a timber load line is not assigned and uprights are not connected to the bulwark, uprights are to be of adequate strength but need not relate to that of the bulwark, see 2.1.2.

2.4.4 Where only packaged timber is to be carried, uprights may be omitted.

2.5.2 Uprights are to be used for all timber deck cargoes with the exception that, where only packaged timber is to be carried, uprights may be omitted, depending on racking strength and not including uprights or stoppers (low uprights) situated either side of hatch covers.

2.4.5 Each upright is to extend above the top of the cargo and be fitted with a strap or bracket support at the top of the bulwark to hold it upright whilst loading.

2.4.6 Strong permanent bulwarks, or efficient rails of specially strong construction, are to be fitted. Steel bulwarks, along with guard rails and stanchions, are acceptable as supports for uprights, provided substantial sockets are built for each upright.

2.4.8 Deck sockets are to be of a size to suit the dimensions of the uprights and are to be not less than 100 mm in depth with drainage provided. They are to be efficiently connected to the hull structure. A locking pin or wedge is to be provided to prevent the upright lifting out of the socket.

2.6 Lashings

2.6.1 The timber deck cargo is to be secured along its length by independent overall top over lashings.

2.6.2 The spacing of top over lashings is to be determined by the height of the cargo above the deck or by the type of timber, see 2.6.3 and 2.6.4:

(a) For a height not exceeding 4 m, the spacing shall not be more than 3 m.
(b) For a height of 6 m and above, the spacing should not be more than 1.5 m where the timber uprights are used.
(c) At intermediate heights, the average spacing is to be obtained by linear interpolation.

(a) For heights not more than 2.5 m, the spacing is to be not more than 3 m.
(b) For heights above 2.5 m, the spacing is to be not more than 1.5 m.

2.6.3 Where only packaged timber is to be carried, and uprights are omitted, see 2.5.2, lashings are to be spaced not more than 1.5 m apart.

2.6.4 Round wood timber deck cargo is to be secured throughout its length by top over lashings spaced not more than 1.5 m apart.

2.6.5 At the fore and aftermost ends of each continuous timber deck stow, the spacing of the lashings determined from 2.6.2, 2.6.3 or 2.6.4 is to be halved.

2.6.6 The spacing of lashings is to be such that lashings are positioned as close as practicable to the ends of each continuous timber deck stow.

2.6.7 Round wood timber deck cargo stowed over and above hatches, in addition to 2.6.4, is to be further secured by a system of athwartship lashings connecting respective port and starboard uprights at three quarters of the height of the stow. If the height of the hatch cover over which the cargo is stowed is less than 2 m, a further athwartship lashing is to be installed 1 m above the hatch cover.

2.6.14 Lashings and fittings are to have a minimum SWL of 2700 kg and 2800 kg respectively. Each component is to be proof loaded to twice the SWL and should not show any sign of damage or deformation afterwards.
**2.6.8** Lashings and fittings must not:
(a) have a breaking strength of less than 133 kN;
(b) elongate more than 5 per cent at 80 per cent of the breaking strength;
(c) show any permanent deformation at less than 40 per cent of the breaking strength.

**2.6.9** Where timber is in lengths of less than 3.6 m, the spacing of lashings is to be reduced, or other suitable provisions made to suit the length of the timber.

**2.6.10** Open hooks, which may loosen if the lashing becomes slack, are not to be used in securing arrangements for timber deck cargoes and web lashing is not to be used in combination with chain or wire lashing.

**2.6.11** Slip hooks or other appropriate methods may be used for quick and safe adjustment of lashings. Pelican hooks, when used, are to be moused.

**2.6.12** Corner protectors are to be used to prevent lashings from cutting into the cargo and to protect lashings from damage at sharp corners.

**2.6.13** Every lashing is to be provided with a tightening device or system, situated so that it can be safely and efficiently operated when required. The magnitude of the components of the resolved load produced by the tightening device or system is not to be less than:
(a) 27 kN in the horizontal; and
(b) 16 kN in the vertical.

**2.6.14** Once the lashings are secured, the tightening device or system is to have not less than half the tightening capacity available for further use.

**2.6.15** If wire rope clips are used to make a joint in a wire lashing, the following conditions are to be observed to avoid a significant reduction in strength:
(a) the number and size of rope clips utilised are to be in proportion to the diameter of the wire rope and no fewer than three, each spaced at intervals of not less than 150 mm.
(b) the saddle portion of the clip is to be applied to the live load segment; and
(c) rope clips are to be initially tightened so that they visibly compress the wire rope and are subsequently to be re-tightened after the lashing has been stressed.

**2.6.16** Bulldog grips are only suitable for a standard wire rope of right-hand lay having six strands. Such grips are not to be used for wire rope of left-hand lay or different construction.

**2.6.17** Rounded angle pieces of suitable material and design are to be used along the upper outboard edge of the stow to bear the stress and permit free reeving of the lashings.

**2.6.18** Eye plates are to be of substantial construction, effectively connected to the hull structure, and placed at intervals determined from 2.4.10, 2.4.11 or 2.4.12 2.6.2 to 2.6.5. The distance from a superstructure end bulkhead to the first eye plate and lashing is to be not more than 2 m.

**2.7** Stowage

**2.7.1** The stowage arrangements are to be detailed within the lashing plan, see 2.3.3.

**2.7.2** Timber deck cargoes are to extend over at least the entire available length, which is the total length of the well or wells between superstructures. Where there is no limiting superstructure at the after end, the timber is to extend to at least the after end of the aftermost hatchway.

**2.7.3** The timber deck cargo is to extend athwartships as close as possible to the ship’s side, due allowance being made for obstructions, provided any gap thus created at the side of the ship does not exceed a mean of four per cent of the breadth.

**2.7.4** The timber is to be stowed as solidly as possible to at least the standard height of a superstructure other than a raised quarter deck. It is not to interfere in any way with the safe navigation and necessary work of the ship.

**2.7.5** On a ship within a seasonal winter zone in winter, the height of the deck cargo above the deck exposed to weather must not exceed one third of the extreme breadth of the ship.

**2.7.6** Cargo which overhangs hatch coamings or other structures in the longitudinal direction by more than a third of their individual or packed length is to be supported at the outer end by other cargo stowed on deck or by structure of adequate strength.

**2.8** Safety arrangements

**2.8.1** If there is no convenient passage on or below the deck of the ship, a walkway is to be provided over the timber deck cargo. This walkway is either to be:
(a) At, or near, the centreline of the ship, consisting of two sets of guard wires, spaced 1 m apart, each with three courses of wires, the lower spaced at 230 mm and the remainder at 380 mm. Stanchions are to be not more than 2 m apart, and these are to be secured to the timber cargo by spikes, or other equivalent means. A polypropylene net, with a mesh not greater than 230 mm x 230 mm, in conjunction with stanchions and top and bottom wires, may also be accepted, or
(b) where the timber uprights are taken up 1 m above the top of the timber cargo, three courses of guard wires spaced not more than 350 mm apart, secured to the uprights from forward to aft, port and starboard, with a single wire life-line fitted at the centreline of the ship adequately supported by stanchions spaced not more than 10 m apart.

**2.8.12** A walkway is to be provided over the timber deck cargo. This walkway is either to be:
(a) At, or near, the centreline of the ship, consisting of two sets of guard wires, spaced 1 m apart, each with more than three courses of wire. The opening below the lowest course is not to exceed 230 mm; the remaining courses are to be spaced not more than 380 mm apart to a height of at least 1 m above the timber deck cargo.
The guard wires are to be secured to stanchions. The stanchions are to be not more than 3 m apart, and these are to be secured to the timber cargo by spikes, or other equivalent means.

(b) Alternatively, where uprights are used, guard wires, spaced vertically not more than 330 mm apart, are to be secured to the uprights along the length of the timber deck cargo on both port and starboard sides to a height of not less than 1 m above the cargo. A wire life-line is also to be fitted at the centreline of the ship, adequately supported by stanchions spaced not more than 10 m apart.

A safe walking surface, not less than 600 mm in width, is to be fitted over the cargo and effectively secured to the top of it in line with the walkway or adjacent to the life-line. All lines are to be taut using tightening devices.

Effective Date 1 July 2014

Section 2

Steel hatch covers

2.4 Allowable stress and deflection

2.4.2 The vertical deflection of primary supporting members due to the vertical weather design load according to 2.3.2, or cargo loads according to 2.3.4, 2.3.5 and Pt 4, Ch 8.11.2, is to be not more than 0.0056\(l_g\) where \(l_g\) is the greatest span of primary supporting members.

For ’tween deck hatch covers not exposed to the vertical weather design load according to 2.3.2, the vertical deflection of primary supporting members due to the cargo loads according to 2.3.4, 2.3.5 and Pt 4, Ch 8.11.2 is to be not more than 0.007\(l_g\) where \(l_g\) is the greatest span of primary supporting members.
Part 3, Chapter 12
Ventilators, Air Pipes and Discharges

Effective Date 1 July 2014

Section 5
Air pipes, ventilator pipes and their securing devices located on the exposed fore deck

5.2 Loading

5.2.1 The pressures, \( p \), in kN/m\(^2\) acting on air pipes, ventilator pipes and their closing devices may be calculated from:

\[
p = 0.5 \rho V^2 C_d C_s C_p \text{ kN/m}^2
\]

where

- \( \rho = \text{density of sea-water (1.025 t/m}^3) \)
- \( V = \text{velocity of water over the fore deck (13.5 m/sec)} \)
- \( d = \text{distance from summer load waterline to exposed deck} \)
- \( d_1 = 0.1L \) but need not be taken as greater than 22 m

5.2.2 Forces acting in the horizontal direction on the pipe and its closing device may be are to be not less than those calculated from 5.2.1 using the largest projected area of each component.

---

Part 3, Chapter 16
ShipRight Procedures for the Design, Construction and Lifetime Care of Ships

Effective Date 1 July 2014

Section 2
Structural design assessment

2.1 Structural Design Assessment notation – SDA

2.1.2 This procedure is mandatory, and additional to normal Rule structural design approval, for:

(a) bulk carriers and oil tankers without a CSR notation (see 1.1.1) greater than 190 m in length;
(b) container ships with a beam greater than 32 m; of Panamax size or greater;
(c) The primary structure of LNG ships;
(d) The primary structure of Type A LPG ships:
(e) Other ships of Type B and C where the type, size and structural configuration demand;
(f) passenger ships where it is considered that the superstructure will be subjected to a significant load from flexure of the hull girder; or, where it is required to utilise the load carrying capability of the superstructure for longitudinal strength; and
(g) other ships where type, size and structural configuration demand, see also Pt 1, Ch 2.2.3 and Ch 2.2.7.
Part 4, Chapters 2 & 5

Part 4, Chapter 2
Ferries, Roll on-Roll off Ships and Passenger Ships

Effective Date 1 July 2014

- Section 4
- Shell envelope plating

4.2 Bow flare and wave impact pressures

(Parts only shown)

4.2.1 This Section is applicable to:
(a) bow flare region;
(b) sides and undersides of sponsons; and
(c) other parts of the side shell plating close to and above the design waterline that are expected to be subjected to wave impact pressures.

\[ V = \text{speed, in knots} \]

For \( \frac{V}{L} \geq 0.5 \)

- is to be taken as the maximum service speed, in knots, as defined in Pt 3, Ch 1.6. For passenger yachts not required to maintain high speeds in severe weather, the value of \( V \) may be specially considered, but is not to be taken as less than the greater of \( \frac{V}{3} \) or 5 knots. Where \( V \) has been specially considered it is to be noted in the classification records as a memorandum that should state: "A design speed of \( \ldots \) knots has been used for the assessment of bow structure with regards to bow flare impacts. It should be noted that this speed may not be appropriate for all conditions and it is the responsibility of the Master to apply good Seamanship to minimise bow flare slamming."

For \( \frac{V}{L} < 0.5 \)

- 0 knots, for passenger ships

Part 4, Chapter 5
Barges and Pontoons

Effective Date 1 July 2014

- Section 8
- Void spaces

8.1 Void spaces on unmanned pontoons not fitted with auxiliary machinery

8.1.1 Drainage arrangements and air pipes are to be provided in accordance with Pt 5, Ch 13,10 and Pt 5, Ch 13,12.4.4 respectively.

8.1.2 Deck openings to allow drainage in accordance with Pt 5, Ch 13,10.1.3 are to be as small as practicable and closed by watertight gasketed covers of steel or equivalent material.
3.2 Longitudinal strength

3.2.1 Longitudinal strength calculations are to be made in accordance with the requirements of Pt 3, Ch 4 and the additional notes contained in this Section and Section 14.

3.2.2 The design vertical wave bending moments and design wave shear forces are to be determined in accordance with Ch 2.2.4 and Ch 2.2.5 and are to be used in Pt 3, Ch 4.

3.2.3 The values of sagging $f_{sS}$ and hogging $f_{sH}$ correction factors due to non-linear effects of the hull shape are to be derived by non-linear ship motion analysis based on equivalent design sea state methods where the following condition applies:

\[ L > 300 \text{ m} \text{ and one or more of}
\]

(i) $f_{sS} > 1.4$

(ii) $RA_{BF} > 0.2$

(iii) $RA_{BFU} > 0.2$

where $f_{sS}$ and $f_{sH}$ are defined in Ch 2.2.4.1. $RA_{BF}$ is the bow flare area ratio for the lower region just above the still waterline

\[ = \left( \frac{A_{BF}}{0.1LB_{WL}} \right) \]

$RA_{BFU}$ is the bow flare area ratio for the upper region near the deck

\[ = \left( \frac{A_{BFU}}{0.1LB_{WL}} \right) \]

$A_{BF}$, $B_{WL}$ are defined in Ch 2.2.4.1. $A_{BFU}$ is the bow flare area in m$^2$ for the region from a waterline of $T_{CU}$ to $T_{C2U}$, calculated in the same way as $A_{BF}$, see Ch 2, 2.4.1. $T_{C2U} = T + C_{1}$ m or the local deck edge height if this is lower. $C_{1}$ is defined in Table 4.5.1 in Pt 3, Ch 4.

The methodology to calculate the non-linear ship motion wave loads is given in LR’s ShipRight Procedure Guidance Notes on the Assessment of Global Design Loads of Large Container Ships and Other Ships Prone to Whipping and Springing.

3.3 Combined longitudinal and torsional strength

3.3.1 The strength of the ship to resist a combination of longitudinal and torsional loads is to be determined in accordance with 15.1.
Part 4, Chapter 8

Existing Section 14 has been deleted in its entirety.

Section 14

Direct calculation

14.1 Procedures for calculation of combined longitudinal and torsional strength

14.1.1 For container ships as defined in 1.3.3(b), (c) and (d) or with beam greater than 33 m, longitudinal strength calculations are to be made in accordance with Parts A and B of LR’s ShipRight SDA Procedure for container ships, see also Table 8.14.1.

14.1.2 The global, primary and local structure scantlings are to be assessed using the vertical and horizontal wave bending moments and shear forces and torsional wave moments derived using non-linear ship motion analysis based on equivalent design sea state methods where one or more of the following conditions applies:
(a) \( B > 60 \) m
(b) \( L > 350 \) m

The methodology to calculate the non-linear ship motion wave loads is given in LR’s ShipRight Procedure Guidance Notes on the Assessment of Global Design Loads of Large Container Ships and Other Ships Prone to Whipping and Springing.

14.2 Procedures for verification of primary structure scantlings

14.2.1 For container ships as defined in 1.3.3, the strength of the ship’s primary structure scantlings of double bottom, side and transverse bulkheads is to be assessed in accordance with Part C of LR’s ShipRight SDA Procedure for container ships. The wave loads to be applied in this assessment are to be calculated in accordance with 3.2.

14.2.2 For other container ships the method for analysis of primary structure of double bottom, side structure and transverse bulkheads is to be agreed with LR.

14.3 Procedures for verification of structural response due to whipping, springing and fatigue

14.3.1 The ultimate strength of the hull girder of container ships is to be assessed against the extreme wave bending moments including whipping and wave impact loads in accordance with LR’s ShipRight Procedure Guidance Notes on the Assessment of Global Design Loads of Large Container Ships and Other Ships Prone to Whipping and Springing where one or more of the following conditions applies:
(a) \( L > 350 \) m
(b) \( L > 300 \) m and one or more of
   (i) \( f_{\text{fs}} \geq 1.4 \)
   (ii) \( RA_{\text{BF}} > 0.2 \)
   (iii) \( RA_{\text{BFU}} > 0.2 \)
(c) Use of HT47 or above for the deck or hatch side coaming
(d) Use of HT36 or above for the bottom shell

where

\( f_{\text{fs}} \) is defined in Ch 2, 2.4.1
\( RA_{\text{BF}} \) and \( RA_{\text{BFU}} \) are defined in 3.2.3
See Table 8.14.1.

14.3.2 The fatigue assessment of container ships including hull girder springing is to be assessed where one or more of the following conditions applies, see Table 8.14.1:
(a) \( L > 350 \) m
(b) \( L > 250 \) m and \( f_c > f_{sp} \)
(c) Use of HT47 or above for the deck or hatch side coaming
(d) Use of HT36 or above for the bottom shell

\[ f_c \] is a wave encounter frequency at which it is expected that springing will become important
\[ f_{sp} \] is the natural frequency of the 2 node hull girder vertical bending mode in Hz. This can be very approximately calculated as:
\[ f_{sp} = \left( \frac{1.1}{\pi L^2} \right) \left( \frac{EI^{105}}{1.8B T_d C_b} \right) \text{ Hz} \]
\( V \) = speed in knots as defined in Pt 3, Ch 1.6.1.10
\( E \) = Young’s modulus in N/mm\(^2\)
   = 206000 N/mm\(^2\) for steel
\( I \) is the midship moment of inertia in m\(^4\), see Pt 3, Ch 4
\( T_d \) is the design (normal standard operating) draught, in metres
\( C_b, L, \) and \( B \) are given in Pt 3, Ch 1.6.

The fatigue assessment is to be carried out in accordance with LR’s ShipRight Procedure Guidance Notes on the Assessment of Global Design Loads of Large Container Ships and Other Ships Prone to Whipping and Springing, which also makes reference to LR’s ShipRight FDA procedures.
Table 8.14.1 Summary of direct calculation analysis requirements for container ships

<table>
<thead>
<tr>
<th>Rule requirement See Note 1</th>
<th>Rule reference</th>
<th>ShipRight notation</th>
<th>Application criteria. If any of the following criteria apply then the appropriate analysis is required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part C of LR’s ShipRight SDA Procedure for container ships</td>
<td>1.1.5</td>
<td>SDA</td>
<td>Length criteria</td>
</tr>
<tr>
<td>Parts A and B of LR’s ShipRight SDA Procedure for container ships</td>
<td>14.1.1</td>
<td>SDA</td>
<td>—</td>
</tr>
<tr>
<td>Non-linear ship motion analysis to calculate hogging and sagging factors</td>
<td>3.2.3</td>
<td>—</td>
<td>$L &gt; 300$</td>
</tr>
<tr>
<td>Non-linear ship motion analysis to calculate combined vertical, horizontal and torsional loads</td>
<td>14.1.2</td>
<td>—</td>
<td>$L &gt; 350$</td>
</tr>
<tr>
<td>Fatigue assessment</td>
<td>14.3.2</td>
<td>FDA (see Note 3)</td>
<td>$L &gt; 350$</td>
</tr>
<tr>
<td>Whipping assessment</td>
<td>14.3.1</td>
<td>—</td>
<td>$L &gt; 350$</td>
</tr>
<tr>
<td>Springing assessment See Note 2</td>
<td>14.3.2</td>
<td>—</td>
<td>$L &gt; 350$</td>
</tr>
</tbody>
</table>

NOTES
1. The stated rule requirements may be deemed applicable to ships that do not meet the application criteria but where the structural configuration is such as to necessitate them.
2. The results of the springing assessment may also need a fatigue assessment procedure to be undertaken.
3. If ShipRight notation FDA is to be assigned, the requirements of LR’s ShipRight FDA procedure are to be complied with; this may require calculations additional to those implied by 14.3.2.

Existing Section 15 has been deleted in its entirety.

Section 15
Combined stress calculations

15.1 Application

15.1.1 The combined stresses due to vertical bending moment, horizontal bending moment and torque are to be calculated as described in this Section.

15.2 Symbols and definitions

15.2.1 The following symbols and definitions are applicable to this Section unless otherwise stated:

- $Z_Y = \text{actual hull section modulus about the transverse neutral axis at the position considered, in m}^3$
- $Z_Z = \text{actual hull section modulus about the vertical neutral axis at the position considered, in m}^3$
- $\varepsilon = \text{maximum shear centre distance below baseline of the ship in the midship region, in metres.} \ \varepsilon \ \text{is taken as positive where the shear centre is below the baseline}$

$M_s = \text{design still water bending moment at the section under consideration, in kN m (tonne-f-m)}$

$\sigma_c = \text{combined stress at the position considered}$

15.3 Design loadings

15.3.1 The design vertical wave bending moment, $M_{WC}$, at any position along the ship is defined as:

$$M_{WC} = 0.0505C_1L^2 \left(C_b + 0.7 \right) C_3 \ \text{kN m}$$

$$= (0.0052C_1C_4_L^2 \left(C_b + 0.7 \right) C_3 \ \text{tonne-f-m})$$

$C_3 = \text{vertical wave bending moment distribution coefficient depending on the length $L_{pp}$ as defined in Table 8.15.1}$$

$C_1$ is given in Table 4.5.1 in Pt 3, Ch 4.

$L, B, C_b$ are given in Pt 3, Ch 1.6.

The sign convention is given in Fig. 8.15.1.

15.3.2 The design horizontal wave bending moments, $M_{HC1}$ and $M_{HC2}$, at any position along the ship are defined as:

$$M_{HC1} = 0.2063C_1C_2L^2 T \left(C_b + 0.7 \right) \ \text{kN m}$$

$$= (0.0210C_1C_4_L^2 T \left(C_b + 0.7 \right) \ \text{tonne-f-m})$$

$$M_{HC2} = 0.2063C_1C_4L^2 T \left(C_b + 0.7 \right) \ \text{kN m}$$

$$= (0.0210C_1C_4L^2 T \left(C_b + 0.7 \right) \ \text{tonne-f-m})$$
**Part 4, Chapter 8**

\[ C_{41}, C_{42} = \text{horizontal wave bending moment distribution coefficient depending on the length, } L_{pp}, \text{ as defined in Table 8.15.2} \]

\[ C_1 \text{ is given in Table 4.5.1 in Pt 3, Ch 4} \]

\[ L, B, T, C_b \text{ are given in Pt 3, Ch 1.6.} \]

The sign convention is given in Fig. 8.15.1.

15.3.3 The design hydrodynamic torques, \( M_{\text{WT}C_1} \) and \( M_{\text{WT}C_2} \), at any position along the ship are defined as:

\[ M_{\text{WT}C_1} = M_{\text{WT}C_{B1}} + M_{\text{WT}C_{Q1}} \]

\[ M_{\text{WT}C_{B1}} = 0.0764 C_1 C_{51} L B^2 (C_b + 0.7) \text{ kN m} \]

\[ = (0.0078 C_1 C_{51} L B^2 (C_b + 0.7) \text{ tonne-f-m}) \]

\[ M_{\text{WT}C_{Q1}} = -0.657 + f_3 \varepsilon Q_{HC1} \text{ kN m (tonne-f-m)} \]

\[ M_{\text{WT}C_{B2}} = M_{\text{WT}C_{B2}} + M_{\text{WT}C_{Q2}} \]

\[ M_{\text{WT}C_{B2}} = 0.0764 C_1 C_{52} L B^2 (C_b + 0.7) \text{ kN m} \]

\[ = (0.0078 C_1 C_{52} L B^2 (C_b + 0.7) \text{ tonne-f-m}) \]

\[ M_{\text{WT}C_{Q2}} = -0.657 + f_3 \varepsilon Q_{HC2} \text{ kN m (tonne-f-m)} \]

\[ C_{51}, C_{52} = \text{hydrodynamic torque distribution coefficient depending on the length, } L_{pp}, \text{ as defined in Table 8.15.2} \]

\[ C_1 \text{ is given in Table 4.5.1 in Pt 3, Ch 4} \]

\[ f_3 = \text{shear centre distribution factor, to be taken as:} \]

\[ -1.0 \text{ at the aft end of } L_{pp} \]

\[ 1.0 \text{ between } 0.15 L_{pp} \text{ and } 0.80 L_{pp} \text{ from aft} \]

\[ -1.0 \text{ at the forward end of } L_{pp} \]

Intermediate values are to be determined by linear interpolation:

\[ Q_{HC1} = 0.8683 C_1 K_{31} L T (C_b + 0.7) \text{ kN} \]

\[ = (0.0886 C_1 K_{31} L T (C_b + 0.7) \text{ tonne-f}) \]

\[ Q_{HC2} = 0.8683 C_1 K_{32} L T (C_b + 0.7) \text{ kN} \]

\[ = (0.0886 C_1 K_{32} L T (C_b + 0.7) \text{ tonne-f}) \]

\[ K_{31}, K_{32} = \text{horizontal wave shear force distribution coefficient depending on the length, } L_{pp}, \text{ as defined in Table 8.15.2} \]

\[ L, B, T, C_b \text{ are given in Pt 3, Ch 1.6.} \]

\[ \varepsilon \text{ is given in 15.2.1} \]

The sign convention is given in Fig. 8.15.1.

---

**Fig. 8.15.1** Sign conventions for hull girder loads
15.3.4 The design value of static cargo torque, $M_{STC}$, at any position along the ship is defined as:

$$M_{STC} = 15.7 C_6 B (n_s \eta_t + 0.7 N_{sd} N_{td}) \text{ kNm}$$

$$= (1.6 C_6 B (n_s \eta_t + 0.7 N_{sd} N_{td}) \text{ tonne-t/m})$$

where:

- $n_s$ = the maximum number of stacks of containers over the breadth of the cargo hold
- $\eta_t$ = the maximum number of tiers of containers in the cargo hold amidships, excluding containers above the main deck or on the hatch covers
- $C_6$ = distribution coefficient depending on the length, $L_{pp}$, as defined in Table 8.15.3

$N_{sd}$ = the maximum number of stacks of containers over the breadth, $B$, on hatch covers or above the main deck

$N_{td}$ = the number of tiers of containers on hatch covers or above the main deck amidships, excluding containers in cargo holds

$B$ is given in Pt 3, Ch 1.6.
15.4 Combined stresses

15.4.1 Combined stress calculations are to be carried out at least at the following positions along the length of the ship:

(a) At the forward and aft ends of the engine room.
(b) At the forward and aft ends of the deck-house for multi-island designs.
(c) At the forward and aft transverse bulkhead positions of each cargo bay.
(d) At the forward and aft transverse bulkhead of fuel oil deep tanks.
(e) At any other sections where there are significant changes in cross-section properties.

15.4.2 The combined stress, \( \sigma_c \), is to be taken as \( \sigma_{\text{chog}} \), calculated as:

\[
\sigma_{\text{chog}} = \left( \sigma_{HC1} + \sigma_{WTC1} \right)^2 + \left( \sigma_{HC2} + \sigma_{WTC2} \right)^2 + \left| f_fH \sigma_{WC} \right| + \left| \sigma_{STC} \right| + \left| \sigma_{SC} \right|
\]

\( \sigma_{SC} \) = longitudinal stress due to hogging or sagging design still water bending moment \( M_s \)
\( \sigma_{WC} \) = longitudinal stress due to vertical wave bending moment
\( \sigma_{HC1}, \sigma_{HC2} \) = longitudinal stress due to horizontal wave bending moment
\( \sigma_{STC}, \sigma_{WTC1}, \sigma_{WTC2} \) = warping stress due to static cargo torque, warping stress due to hydrodynamic torque, hodging vertical bending moment correction factor calculated in accordance with Ch 2.2.4

other symbols are as defined in 15.3 and 15.4.

15.4.3 For ships with a beam greater than or equal to 33 m, longitudinal stresses are to be calculated using a finite element model of the entire hull in accordance with Part A of the LR’s ShipRight SDA procedure for container ships.

15.4.4 For ships with a beam less than 33 m, the longitudinal stresses may be obtained as follows:

\[
\sigma_{SC} = \frac{M_s}{Z_y} \times 10^{-3} \text{ N/mm}^2 (\text{kgf/mm}^2)
\]

\[
\sigma_{WC} = \frac{M_{WC}}{Z_y} \times 10^{-3} \text{ N/mm}^2 (\text{kgf/mm}^2)
\]

\[
\sigma_{HC1} = C_7 \frac{M_{HC1}}{Z_z} \times 10^{-3} \text{ N/mm}^2 (\text{kgf/mm}^2)
\]

\[
\sigma_{HC2} = C_7 \frac{M_{HC2}}{Z_z} \times 10^{-3} \text{ N/mm}^2 (\text{kgf/mm}^2)
\]

15.5 Permissible stress

15.5.1 The maximum tensile or compressive combined stress \( \sigma_c \), at any position along the length is not to be more than indicated in Table 8.15.4.

15.5.2 The assessment of combined stress may conveniently be presented in the form of combined stress diagrams as indicated in Fig. 8.15.2.
Part 4, Chapter 8

Reinforcement in way of large stress peaks above the permissible stress level may be required depending on fine mesh FE analysis.

Large stress peaks identified with dotted circles are to be investigated further using fine mesh FE analysis (see ShipRight SDA Procedure).

Permissible stress level

(a) Longitudinal stress distributions at top of hatch coaming showing contributions from:
1) still water bending moment + vertical wave bending moment + static cargo torque + horizontal wave bending moment and hydrodynamic torque
2) still water bending moment + vertical wave bending moment + static cargo torque
3) still water bending moment + vertical wave bending moment
4) still water bending moment

Z curve

(b) Ship Profile and Section modulus

(c) Oblique Sea longitudinal distribution of vertical and horizontal bending moments and torques

NOTES
1. These diagrams are for illustration only and are not to scale.
2. A similar diagram is to be prepared for the bottom structure.

Fig. 8.15.2 Combined stress diagram for deck — Oblique sea
Part 4, Chapter 9 & Part 7, Chapter 3

Part 4, Chapter 9

Double Hull Oil Tankers

Effective Date 1 July 2014

Section 12
Cargo temperatures

12.4 Low temperature cargoes

12.4.1 The hull structural and engineering systems permit cargoes to be loaded down to \(-10^\circ\text{C}\). For temperatures below \(-10^\circ\text{C}\), hull structural assessment through temperature distribution and thermal stress calculations, as well as engineering systems analysis for the cargo lines/tanks and any precautions taken to minimise thermal shock or effects on associated systems (e.g., IG system), are to be provided. In addition, the cargo tank coating protection at low temperatures is to be confirmed, see 2.4. For low temperature operations, see also Part 8 and the Provisional Rules for the Winterisation of Ships.

Part 7, Chapter 3

Fire-fighting Ships

Effective Date 1 July 2014

Section 3
Fire-extinguishing

3.1 Water monitors

3.1.4 Means are to be provided for preventing the monitor jets from impinging on the ship’s structure and equipment when in external fire-fighting mode. Combined systems for high pressure external fire fighting and deck foam fire fighting may be permitted provided consideration is given to monitor position and to the safety of operating pressures when used in deck foam mode and during changeover between modes. Changeover between modes is to be by a simple operator action. The combined system is to be capable of simple and rapid operation in either mode.

4.2 Water spray systems

4.2.4 The system may be divided into sections, so that it will be possible to close those sections covering surfaces which are not exposed to radiant heat.
12.1.2 The assignment of the notation **Icebreaker(+)** is in addition to the requirements of Section 10 and Section 11 and is assigned in addition to the ice class notations given in Table 2.1.1. See 1.5.

12.2 Operational profile

12.2.1 The operational profile(s) to be used for the basis of assignment of the notation **Icebreaker(+)**, as selected from 12.4, is to be provided and indicated on the midship sections and to be derived from the icebreaker’s function, as selected from 12.4.

12.2.2 Alternative operational profiles from the typical operational profiles, as given in 12.4, are to be determined in accordance with 12.6 and submitted.

12.2.3 The operational profile is only used to select a design basis. It is the responsibility of the Owner and/or Builder to select the appropriate operational profile of the icebreaker.

12.3 Information to be submitted

12.3.1 For assignment of the notation **Icebreaker(+)**, the operational profile information is to be submitted, which may include the following information, where applicable:

(a) the level icebreaking capability, in terms of speed and ice thickness;
(b) the turning capability in level ice, in terms of diameter and ice thickness; and
(c) the ramming capability, in terms of speed and ice condition; and
(d) an ice pressure plan that indicates the design ice pressure used for the determination of the hull structure.

12.3.2 In addition to the information submitted in 12.3.1, a scenario document, which is design specific, is required to document the operational profile and is to include details of the scenarios selected for deriving and applying ice loads.

12.3.3 The scenario document is to address the requirements in Sections 10 and 11 and provide justification for deviation from those requirements.

12.3.4 The following is to be contained within the submitted scenario document:

(a) icebreaker function;
(b) details of ice conditions assumed;
(c) operational scenarios for hull and propulsion machinery;
(d) identification of critical hull and propulsion machinery scenarios;
(e) description of propulsion machinery and/or hull loading areas with reasons for selection;
(f) proposed strengthening standards for each load area;
(g) arrangement of propulsion devices;
Part 8, Chapter 2

12.5 General arrangement

12.5.1 Consideration is to be given to the protection of fuel tanks and other tanks with harmful substances, both in terms of thermal insulation and ice impact protection. A double bottom and double side tanks are to be fitted as specified in Pt 4, Ch 9,1.2.17. However, double side tanks may not be required for small icebreakers (typically less than 60 m), nor complete double bottom height in way of complex hullform arrangements in the fore and aft ends or heeling tanks.

12.5.2 Consideration is to be given to minimise transom sterns, as these hinder the icebreaker's ability to back in ice, and in particular the navigation of ice ridges. A transom stern should not normally extend below the Upper Ice Waterline. Where this cannot be avoided, the transom should be kept as narrow as possible and the scantlings of plating and stiffeners are to be as required for the stern section.

12.5.3 The requirements are based on an effective icebreaker bow form. Icebreaking angles vary depending on the icebreaking form; however, in general, the bow stern angle is not to be greater than 45°, and the bow waterline angle not greater than 40°, see Fig. 2.12.1. Where flare of the side shell amidships is proposed, it is recommended that the slope of the side be at least 8°.

12.5.4 Ice arresters (ice skeg) are recommended for all icebreakers to prevent riding up of the bow and submergence of the aftermost deck edge.

12.5.5 For icebreakers provided with a heel inducing system, it is recommended that the depth of the icebreaker be such that immersion of the deck edge does not occur when the ship, whilst floating at the Upper Ice Waterline, is heeled to an angle of 5° greater than the nominal capacity of the system or 15°, whichever is the greater.

12.5.6 For icebreakers intended to navigate continuously in thick multi-year ice, i.e., PC1, PC2 and PC3, and in relation to the icebreaker function, consideration should be given to the mass of the icebreaker to enable effective ice breaking.

12.5.7 For icebreakers installed with podded propulsion or azimuth thrusters, see the Provisional Rules for Stern First Ice Class Ships.

12.6 Typical operational profiles

12.6.1 The typical operational profiles may be divided into three derived from the icebreaker function. Primary icebreaker functions and are described in Table 2.12.1 to allow the selection of the prescribed function type for hull and machinery strength requirements. These functions are to form the basis of operational scenarios as required in 12.3.4. Where an alternative function is selected a description of the icebreaker's operational functions is to be included in the scenario document.

Table 2.12.1 Primary icebreaker functions

<table>
<thead>
<tr>
<th>No.</th>
<th>Primary function</th>
<th>General description</th>
<th>Assumed criticality of operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Escort</td>
<td>Engaged in icebreaker fleet operations in ice, patrol and search/rescue missions</td>
<td>May attempt to follow easiest course when operating alone. Search and rescue operations are undertaken within the bounds of safe operation to the icebreaker and escorted ship</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Breaking channel for supporting other ships, close manoeuvring, freeing of beset vessels and, where appropriate, towing vessels</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Research</td>
<td>Engaged in independent operations in ice, including deployment of scientists and research equipment</td>
<td>May re-route or re-schedule to avoid perceived difficult ice conditions</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Breaking of channels to reach scientific/research bases and escort of ships for re-supply purposes</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Support</td>
<td>Engaged in independent or icebreaker fleet operations in ice, supply/transit runs to support offshore installations</td>
<td>May actively break large/strong ice features to defend the installation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ice management activities which may include breaking of ice floes and engagement in ice defence of offshore operations/installations</td>
<td></td>
</tr>
</tbody>
</table>

12.7 Operational profiles

12.7.1 The operational profiles are derived from the icebreaker function, primary icebreaker functions and are described in Table 2.12.1 to allow the selection of the prescribed function type for hull and machinery strength requirements. These functions are to form the basis of operational scenarios as required in 12.3.4. Where an alternative function is selected a description of the icebreaker's operational functions is to be included in the scenario document.

12.7.2 The operational profile is to be based on the icebreaker's primary function and the typical operational profiles may be divided into three.

12.7.3 The operational profiles are to be based on the icebreaker's primary function and the typical operational profiles may be divided into three.

12.7.4 The operational envelopes are to be based on the icebreaker's primary function and the typical operational profiles may be divided into three.

12.7.5 The operational envelopes are to be based on the icebreaker's primary function and the typical operational profiles may be divided into three.

12.7.6 The operational envelopes are to be based on the icebreaker's primary function and the typical operational profiles may be divided into three.

12.7.7 The operational envelopes are to be based on the icebreaker's primary function and the typical operational profiles may be divided into three.

12.7.8 The operational envelopes are to be based on the icebreaker's primary function and the typical operational profiles may be divided into three.

12.7.9 The operational envelopes are to be based on the icebreaker's primary function and the typical operational profiles may be divided into three.
12.5 Hull strength

12.6 Propulsion power and machinery arrangements

12.7.1 Icebreakers are to be equipped with means of propulsion that meet the ice performance.

12.7.2 The propulsion power, at 2 knots, for icebreakers may be expressed as follows, where the ice thickness and icebreaker breadth form the dominant role:

\[ P = 1000B^{0.7}h^{1.4} \quad \text{kW} \]

where

- \( B \) = breadth of icebreaker, as defined in Pt 3, Ch 1.6.1, in metres
- \( h \) = nominal level ice thickness, in metres.

12.7.3 The propulsion power, at 2 knots, for icebreakers may be expressed as follows, where 12.7.2 is modified to account for the hullform:

\[ P = 96 \left( \frac{\theta_{stem}}{\tan h} + \frac{\alpha_{waterline}}{\tan B} \right)B^{0.7}h^{1.4} \quad \text{kW} \]

where

- \( L \) = length of icebreaker, as defined in Pt 3, Ch 1.6.1, in metres
- \( B \) = breadth of icebreaker, as defined in Pt 3, Ch 1.6.1, in metres
- \( h \) = nominal level ice thickness, in metres
- \( \theta_{stem} \) = stem angle, see Fig. 2.12.1
- \( \alpha_{waterline} \) = waterline angle, see Fig. 2.12.1.
12.7.4 The following is to be contained within the submitted document:
(a) details of ice conditions assumed;
(b) operational scenarios for hull and propulsion unit;
(c) criticality matrix for hull and propulsion unit scenarios;
(d) supporting load and operational data for the criticality matrix;
(e) description of propulsion unit and/or hull loading areas with reasons for selection;
(f) proposed strengthening standards for each load area;
(g) arrangement of propulsion devices;
(h) derived load data based full scale measurement or other predictive means; and
(i) details of, and justification for, deviation from the Rule philosophy.

12.8 Rudder and steering arrangements

12.8.1 Rudder posts, rudder horns, solepieces, rudder stocks and pintles are to be dimensioned in accordance with Part 3, Chapters 6 and 13 as appropriate. The speed used in the calculations is to be the maximum service speed or that given in Table 2.12.2, whichever is the greater.

Table 2.12.2 Minimum speeds

<table>
<thead>
<tr>
<th>Ice thickness, m</th>
<th>Ship speed, kn</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>25</td>
</tr>
<tr>
<td>1.5</td>
<td>27</td>
</tr>
<tr>
<td>2</td>
<td>29</td>
</tr>
<tr>
<td>3</td>
<td>31</td>
</tr>
</tbody>
</table>

12.8.2 In the case of twin rudders operated by a single steering gear, provision is to be made for each rudder to be readily disconnected and secured.

12.8.3 Rudders should be located inboard, clear of the aft end, and as low as practicable to reduce the impact of ice.

12.9 Towing

12.9.1 For escort icebreakers, arrangements for towing are to be provided, including a notch shape in the stern and provision of two chock pipes and two bitts. Consideration should be given for stern plating and framing to be strengthened to withstand impact loads for escorted ship collisions, as well as the propulsion and steering gear layout and protection from contact with bulbous bows. See Pt 4, Ch 3, Section 7.

12.10 Winterisation

12.10.1 Where a winterisation notation is assigned in compliance with the Provisional Rules for the Winterisation of Ships, the following features are to be additionally considered:
(a) bridge wings are to be fully enclosed;
(b) ice removal measures, through heating arrangements, are to be provided to access routes to towing equipment for escort icebreakers;
(c) provisions for evacuation onto ice;
(d) additional search lights for mooring, astern manoeuvring and towing operations;
(e) consideration of a red (flashing) navigation light to be used to indicate when an escort icebreaker is stopped;
(f) provisions to prevent water freezing in water and fluid systems, including research laboratories and services;
(g) consideration of ice accretion in damage condition; and
(h) protection from ice accretion by enclosed aft walkways for icebreakers with an exposed aft deck.
Section numbering in brackets reflects any Section renumbering necessitated by any of the Notices that update the current version of the Rules for Ships.

Part 1, Chapter 2

3.5.29  Reference to sub-Section Ch3, 14.2.12 now reads 14.2.13

Part 1, Chapter 3

6.3.2  Reference to sub-Section 1.6.11 now reads 1.6.12

7.3.2  Reference to sub-Section 1.6.11 now reads 1.6.12

8.3.2  Reference to sub-Section 1.6.11 now reads 1.6.12

14.3.1  Reference to sub-Section 14.2.11 now reads 14.2.12

Part 3, Chapter 11

1.1.11  Reference to sub-Section Ch9, 2.7 now reads 2.11