NOTE:
- This TB is published to improve the transparency of CSRs and increase the understanding of CSRs in the industry.
- The content of the TB is not to be considered as requirements.
- This TB cannot be used to avoid any requirements in CSRs, and in cases where this TB deviates from the Rules, the Rules have precedence.
- This TB provides the background for the first version (January 2006) of the CSRs, and is not subject to maintenance.
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5.1 General

The requirements for structural arrangements, structural details and compartment arrangement considerations were taken from existing Rule requirements and internal practices of LR, ABS, and DNV. In particular, this includes the more highly prescriptive limitations on the minimum depth of primary support structures, which were taken from existing rule requirements, but were also formulated in a manner consistent with what was used in the requirements addressing cargo block region.

Criteria related to scantling requirements and design loads have been formulated in a manner consistent with the approach used amidships.

Where possible, and as applicable, scantling criteria refer to the amidships criteria and other criteria applicable to all structures, i.e., buckling criteria of Section 10 of the Rules. Formulations for structure at the aft end of the ship are somewhat simplified, as the permissible stress factors do not explicitly address hull girder stress components. Such components are accounted for in a less direct manner. Further, the criteria for stiffeners and primary support members incorporates flexibility and judgment with respect to analysis of the required bending and shear strength by way of the selection of bending moment and shear force distribution factors. The applied bending moment and shear force distribution factors are based on selected formulas for simple beam analysis. This analysis approach is consistent with criteria in portions of existing Rule requirements of LR, ABS, and DNV.

With respect to loads, the loads in the aft end are calculated in a consistent manner with the load in the amidships region, however, some simplifications have been made to the internal tank loads and external pressures for structure outside of the cargo region.

The load basis, structural models and acceptance criteria for the scantling requirements for plating, local support member (stiffeners) and primary support members are incorporated by reference to Section 8/3 of the Rules, meaning the load basis, structural models and acceptance criteria for the fore and aft ends are the same.

5.1.1 Application

5.1.1.a The requirements of Section 8/5.1 to 5.9 of the Rules apply to structure between the aft peak bulkhead and the aft end of the ship.

5.1.1.b It is considered that for Section 8/5.1.1.2 of the Rules, no information in addition to that shown in the Rules is necessary to explain the background.

5.1.1.c The relation between the net scantlings and the gross scantlings as specified in Section 8/5.1.1.3 of the Rules is general and consistent with that used in cargo tank region.

5.1.2 General scantling requirements

5.1.2.a It is considered that for Section 8/5.1.2.1 of the Rules, no information in addition to that shown in the Rules is necessary to explain the background.
5.1.2.b The text of Section 8/5.1.2.2 of the Rules is based on LR Rules Pt 3, Ch 5.2.2.4.

5.1.2.c It is considered that for Section 8/5.1.2.3 of the Rules, no information in addition to that shown in the Rules is necessary to explain the background.

5.1.2.d Section 8/5.1.2.4 of the Rules specifies the extent of application of the section modulus and shear requirements to local and primary support members. Considering possible particular hull shape in the end region, the application of shear and bending requirements is decided to take “between end supports” instead of “clear of end brackets” for this region taking account the possibility of less effectiveness of the end brackets.

5.1.2.e The general notes of Section 8/5.1.2.5 of the Rules are introduced based on the paragraph in ABS Rules Pt.5 Ch.1 Sec.4/1.5.

5.1.2.f Section 8/5.1.2.6 of the Rules includes the general requirements for air and drain holes, which are consistent with the criteria in portions of existing Rule requirements of ABS, DNV and LR (e.g. LR Rules Pt 4, Ch 9.5.8, DNV Rules Pt.3 Ch.1 Sec.6/A406).

5.1.3 Structural continuity

5.1.3.a This subsection includes the general requirements for structural continuity of longitudinal strength members, which are consistent with the criteria in portions of existing Rule requirements of ABS, DNV and LR (e.g. DNV Rules Pt.3 Ch.1 Sec.5/C104 and C105, LR Rules Pt.3 Ch.6/1.3).

5.1.4 Minimum thickness

5.1.4.a The requirements of minimum thickness in amidships are generally applicable to the structure aft of the aft peak bulkhead. In addition, required minimum thickness for pillar bulkheads are derived from the criteria and practice in the existing Rule requirements of ABS, DNV and LR and calibration with the existing ships.

5.2 Bottom Structure

5.2.1 General

5.2.1.a The requirements of Section 8/5.2.1.1 of the Rules are based on LR Rules Pt 3, Ch 6,6.1. Similar requirements are contained in ABS Rules Pt.3, Ch.2 Sec.5/9.1 and DNV Rules Pt.3 Ch.3 Sec.2/E405.

5.2.1.b The requirement of Section 8/5.2.1.2 of the Rules that the centreline girder extend as far aft as practicable comes from ABS Rules Pt.3 Ch.2 Sec.4/3.1. The intent of the second part of Section 8/5.2.1.2 of the Rules is that the centreline structure continues, usually in the form of a diaphragm plate, on to the stern frame to provide continuity of strength and support to the stern structure.

5.2.2 Aft peak floors and girders

5.2.2.a The requirements in Section 8/5.2.2.1 of the Rules are based on recent work undertaken by DNV. The requirements have been introduced as a result of ships experiencing fatigue cracks in AP tanks due to propeller induced vibration. Typical 80–100rpm for the propeller with 4-6 blades will result in a blade frequency in the range of 5.3–10Hz. To avoid vibration it is generally recommended to keep the
natural frequency 15% above the 2nd harmonic excitation (equals two times the blade frequency). Based on this, a vibration analysis has been carried out for typical stiffeners (length and scantlings) on floors and girders, assuming various end constraints (hinged to clamped). From this analysis the criteria as given were obtained.

5.2.2.b The requirements in Section 8/5.2.2.3 of the Rules are based on ABS Rules ABS Rules Pt.3, Ch.2 Sec.13/5.5 and DNV Rules Pt.3 Ch.3 Sec.2/E405.

5.2.3 Stern frames

5.2.3.a The requirements of Section 8/5.2.3.1 to 5.2.3.7 of the Rules are based on ABS Rules ABS Rules Pt.3, Ch.2 Sec.13/3.

5.2.3.b It is considered that for Section 8/5.2.3.8 of the Rules, no information in addition to that shown in the Rules is necessary to explain the background.

5.3 Shell Structure

5.3.1 Shell plating

5.3.1.a The requirements of Section 8/5.3.1.1 of the Rules are based on ABS Rules Pt.3, Ch.2 Sec.2/5.1 with adjustments for the net thickness requirements.

5.3.1.b The requirements of Section 8/5.3.1.2 and 5.3.1.3 of the Rules are based on ABS Rules ABS Rules Pt.3, Ch.2 Sec.2/5.13 with adjustments for the net thickness requirements.

5.3.1.c It is considered that for Section 8/5.3.1.4 of the Rules, no information in addition to that shown in the Rules is necessary to explain the background.

5.3.1.d The requirements of Section 8/5.3.1.5 of the Rules are based on LR Rules Pt 3, Ch 6,7,3.2.

5.3.2 Shell local support members

5.3.2.a It is considered that for this topic, no information in addition to that shown in the Rules is necessary to explain the background.

5.3.3 Side shell primary support members

5.3.3.a It is considered that for requirements of Section 8/5.3.3.1 to 5.3.3.4 of the Rules, no information in addition to that shown in the Rules is necessary to explain the background.

5.3.3.b The requirements of Section 8/5.3.3.5 of the Rules are consistent with that for cargo tank region.

5.4 Deck Structure

5.4.1 Deck plating

5.4.1.a It is considered that for Section 8/5.4.1.1 of the Rules, no information in addition to that shown in the Rules is necessary to explain the background.

5.4.1.b The requirements of Section 8/5.4.1.2 of the Rules are based on ABS Rules Pt.3 Ch.2 Sec.3/Table 2 with slight modification.
5.4.2 Deck stiffeners
5.4.2.a It is considered that for this topic, no information in addition to that shown in the Rules is necessary to explain the background.

5.4.3 Deck primary support members
5.4.3.a It is considered that for Section 8/5.4.3.1 of the Rules, no information in addition to that shown in the Rules is necessary to explain the background.

5.4.3.b The requirements of Section 8/5.4.3.2 of the Rules are in line with the requirements of Section 8/2.6.4.1 of the Rules for cargo tank region.

5.4.3.c The requirements of Section 8/5.4.3.3 of the Rules are general and common to existing Rule requirements of ABS, DNV and LR.

5.4.4 Pillars
5.4.4.a The requirements of this subsection are derived from the criteria and practice in portions of existing Rule requirements of ABS, DNV and LR (e.g. LR Rules Pt 4, Ch 1/4.4, ABS Rules Pt.3 Ch.2 Sec.8/3 and DNV Rules Pt.3 Ch.1 Sec.3/C800).

5.5 Tank Bulkheads
5.5.1 General
5.5.1.a The requirements are general and common to existing Rule requirements of ABS, DNV and LR.

5.5.2 Construction
5.5.2.a The requirements are general and common to existing Rule requirements of ABS, DNV and LR.

5.5.3 Scantlings of tank boundary bulkheads
5.5.3.a It is considered that for Section 8/5.5.3.1 to 5.5.3.3 of the Rules, no information in addition to that shown in the Rules is necessary to explain the background.

5.5.3.b The requirements of Section 8/5.5.3.4 of the Rules are in line with the requirements of Section 8/2.6.6.1 of the Rules for cargo tank region.

5.6 Watertight Boundaries
5.6.1 General
5.6.1.a It is considered that for this topic, no information in addition to that shown in the Rules is necessary to explain the background.

5.6.2 Aft peak bulkhead
5.6.2.a It is considered that for Section 8/5.6.2.1 and 5.6.2.2 of the Rules, no information in addition to that shown in the Rules is necessary to explain the background.
5.6.3 Scantlings of watertight boundaries

5.6.3.a It is considered that for Section 8/5.6.3.1 to 5.6.3.3 of the Rules, no information in addition to that shown in the Rules is necessary to explain the background.

5.6.3.b The requirements are in accordance with ABS Rules Pt.3 Ch.2 Sec.9/5.7.2 with modification to a rounded ratio to suit the format of similar requirements of web depth in other sections.

5.7 Miscellaneous Structures

5.7.1 Pillar bulkheads

5.7.1.a The requirements are based on DNV Rules Pt.3 Ch.1 Sec.9/E300.

5.7.2 Rudder trunk

5.7.2.a The rudder trunk is to be made watertight and is to be designed to withstand a water heads equivalent to that of shell plating in the same location. Present Rule requirements are generally not as descriptive as JIP criteria. Existing class criteria are contained in LR Rules Pt 3, Ch 13,2.6.6, DNV Rules Pt.3 Ch.1 Sec.8/A500 and ABS internal guidance.

5.7.3 Stern thruster tunnels

5.7.3.a The requirements are based on ABS Rules Pt.5 Ch.5 Sec.6/5.7.