

IACS Common Structural Rules for Double Hull Oil Tankers, January 2006

Background Document

SECTION 8/3 – SCANTLING REQUIREMENTS STRUCTURE FORWARD OF THE FORWARD CARGO TANK

NOTE:

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3 STRUCTURE FORWARD OF THE FORWARD CARGO TANK

3.1 General

The requirements for structural arrangements, structural details and compartment arrangement considerations were taken from existing Rule requirements of LR, ABS, and DNV. In particular, this includes the more highly prescriptive limitations on spacing, span and depth of primary support structures. Such items 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 forward 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 fore 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.

3.1.1 Application

- 3.1.1.a The requirements of 3.1 through 3.9 of the Rules apply to structure forward of the foremost cargo tank. Provided that the forward end of the foremost cargo tank is forward of $0.1L$ from the F.P., formulations for structure at the forward end of the ship are somewhat simplified assuming that the hull girder stress components are negligibly small. Where the forward end of the foremost cargo tank is aft of $0.1L$ from the F.P., special consideration needs to be given.
- 3.1.1.b The relation between the net scantlings and the gross scantlings as specified in *Section 8/3.1.1.2* of the Rules is general and consistent with that used in cargo tank region.

3.1.2 General scantling requirements

- 3.1.2.a It is considered that for *Section 8/3.1.2.1* of the Rules, no information in addition to that shown in the Rules is necessary to explain the background.
- 3.1.2.b The text of *Section 8/3.1.2.2* of the Rules is based on LR Rules Pt 3, Ch 5,2.2.4.
- 3.1.2.c It is considered that for *Section 8/3.1.2.3* of the Rules, no information in addition to that shown in the Rules is necessary to explain the background.

- 3.1.2.d *Section 8/3.1.2.4* 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.
- 3.1.2.e The general notes of *Section 8/3.1.2.5* of the Rules are introduced based on the paragraph in ABS Rules Pt.5 Ch.1 Sec.4/1.5.
- 3.1.2.f *Section 8/3.1.2.6* 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).
- 3.1.2.g *Section 8/3.1.2.7* of the Rules includes the general requirements for web stiffening, which are consistent with the criteria in portions of existing Rule requirements of ABS, DNV and LR (e.g. ABS Rules Pt.3 Ch.2 Sec.3/3.7 and Pt.5 Ch.1 Sec.4/11.15, DNV Rules Pt.3 Ch.2 Sec.3/C601, LR Rules Pt 3, Ch 5,1.5.6 and 1.6.7, Pt.4 Ch.9./10.5 and 10.9).

3.1.3 Structural continuity

- 3.1.3.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. ABS Rules Pt.5 Ch.1 Sec.6/5, DNV Rules Pt.3 Ch.1 Sec.5/C104 and C105, LR Rules Pt.3 Ch.5/1.3).

3.1.4 Minimum thickness

- 3.1.4.a The requirements of minimum thickness in amidships are generally applicable to the structure forward of the forward cargo tank. In addition, required minimum thickness for pillar bulkheads, breasthooks, floors and web plating of primary support structures are derived from the criteria and practice in the existing Rule requirements of ABS, DNV and LR and calibration with the existing ships.

3.2 Bottom Structure

3.2.1 Plate keel

- 3.2.1.a It is considered that no information in addition to that shown in the Rules is necessary to explain the background.

3.2.2 Bottom shell plating

- 3.2.2.a It is considered that no information in addition to that shown in the Rules is necessary to explain the background.

3.2.3 Bottom longitudinals

- 3.2.3.a The requirements of *Section 8/3.2.3.1* of the Rules for extension and transition of bottom longitudinals are based on existing Rule requirements and internal practices of ABS, DNV and LR.

3.2.3.b It is considered that for *Section 8/3.2.3.2* of the Rules, no information in addition to that shown in the Rules is necessary to explain the background.

3.2.4 Bottom floors

3.2.4.a The requirements contained in this subsection are derived from the criteria and practice in portions of existing Rule requirements of ABS, DNV and LR.

3.2.5 Bottom girders

3.2.5.a The requirements contained in this subsection are derived from the criteria and practice in portions of existing Rule requirements of ABS, DNV and LR (e.g. ABS Rules Pt.3 Ch.2 Sec.4/3.9, Pt.5 Ch.5 Sec.6/15.1, DNV Rules Pt.3 Ch.1 Sec.6/G100, LR Rules Pt 3, Ch 5,5, 6.2 and 7.2).

3.2.6 Plate stems

3.2.6.a The requirements of *Section 8/3.2.6.1* of the Rules are based on LR Rules Pt 3, Ch 5,3.3.2.

3.2.6.b The requirements of *Section 8/3.2.6.2* of the Rules are based on ABS Rules Pt.5 Ch.5 Sec.6/5.5 with modification to include correction for material yield strength.

3.2.7 Floors and girders in spaces aft of the collision bulkhead

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

3.3 Side Structure

3.3.1 Side shell plating

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

3.3.2 Side shell local support members

3.3.2.a The requirements are based on LR Rules Pt 3, Ch 5,4.1 to 4.3.

3.3.3 Side shell primary support structure

3.3.3.a The requirements of *Section 8/3.3.3.1* to *3.3.3.3* of the Rules are primarily based on LR Rules Pt 3, Ch 5,4.4, 4.5 and 6.3.

3.3.3.b The requirements of *Section 8/3.3.3.4* of the Rules are generally based on ABS Rules Pt.5 Ch.1 Sec.4/11.7.

3.3.3.c The requirements of *Section 8/3.3.3.5* of the Rules are consistent with that for cargo tank region.

3.4 Deck Structure

3.4.1 Deck plating

3.4.1.a It is considered that for *Section 8/3.4.1.1* of the Rules, no information in addition to that shown in the Rules is necessary to explain the background.

- 3.4.1.b The requirements of *Section 8/3.4.1.2* of the Rules are based on ABS Rules Pt.3 Ch.2 Sec.3/Table 2 with slight modification.

3.4.2 Deck stiffeners

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

3.4.3 Deck primary support structure

- 3.4.3.a It is considered that for *Section 8/3.4.3.1* of the Rules, no information in addition to that shown in the Rules is necessary to explain the background.
- 3.4.3.b The requirements of *Section 8/3.4.3.2* of the Rules are in line with the requirements of *Section 8/2.6.4.1* of the Rules for cargo tank region.
- 3.4.3.c The requirements of *Section 8/3.4.3.3* of the Rules are general and common to existing Rule requirements of ABS, DNV and LR.

3.4.4 Pillars

- 3.4.4.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).

3.5 Tank Bulkheads

3.5.1 General

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

3.5.2 Construction

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

3.5.3 Scantlings of tank boundary bulkheads

- 3.5.3.a It is considered that for *Section 8/3.5.3.1* to *3.5.3.3* and *3.5.3.5* of the Rules, no information in addition to that shown in the Rules is necessary to explain the background.
- 3.5.3.b The requirements of *Section 8/3.5.3.4* of the Rules are in line with the requirements of *Section 8/2.6.6.1* of the Rules for cargo tank region.

3.6 Watertight Boundaries

3.6.1 General

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

3.6.2 Collision bulkhead

- 3.6.2.a It is considered that for *Section 8/3.6.2.1* and *3.6.2.2* of the Rules, no information in addition to that shown in the Rules is necessary to explain the background.
- 3.6.2.b The requirements are based on DNV Rules Pt.3 Ch.1 Sec.3/A605. LR and ABS Rules also have similar requirements.
- 3.6.2.c The requirements are based on DNV Rules Pt.3 Ch.1 Sec.3/A801. LR and ABS Rules also have similar requirements.

3.6.3 Scantlings of watertight boundaries

- 3.6.3.a It is considered that for *Section 8/3.6.3.1* to *3.6.3.3* and *3.6.3.5* of the Rules, no information in addition to that shown in the Rules is necessary to explain the background.
- 3.6.3.b The requirements of *Section 8/3.6.3.4* 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.

3.7 Superstructure

3.7.1 Forecastle structure

- 3.7.1.a The requirements are based on ABS Rules Pt.3 Ch.2 Sec.11/9 with a slight modification of the maximum limit of the spacing between deep beams, web frames, and/or girders.

3.7.2 Forecastle end bulkhead

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

3.8 Miscellaneous Structures

3.8.1 Pillar bulkheads

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

3.8.2 Bulbous bow

- 3.8.2.a The requirements are based on LR Rules Pt 3, Ch 5,6.5.

3.8.3 Chain lockers

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

3.8.4 Bow thruster tunnels

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

3.9 Scantling Requirements

3.9.1 General

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

3.9.2 Plating and local support members

- 3.9.2.a This subsection includes the general scantling requirements of plate thickness, stiffener section modulus and stiffener web shear, respectively, which are consistent with that used in the cargo tank region.
- 3.9.2.b The “Permissible bending stress coefficients” for plating (C_a factor) and for stiffeners (C_s factor) are also consistent with that used in cargo tank region, but they are somewhat simplified taking account that the hull girder stress components are assumed to be negligibly small in the fore end region (forward of $0.1L$ from the F.P.). Where the forward end of the foremost cargo tank is aft of $0.1L$ from the F.P., special consideration needs to be given.
- 3.9.2.c The criteria for local support members (stiffeners) 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 (as per *Table 8.3.5* of the Rules). 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.
- 3.9.2.d The loads in the fore end region are calculated in a consistent manner with the load in the cargo tank region, however, some simplifications have been made to the internal tank loads and external pressures.
- 3.9.2.e The scantlings of collision bulkhead are to be evaluated for the design loads of accidental flooding with the acceptance criteria set AC1, which is generally used for static loading to reflect criticality of the collision bulkhead.

3.9.3 Primary support members

- 3.9.3.a This subsection includes the general scantling requirements of section modulus and web shear of primary support members, which are consistent with that used in the cargo tank region.
- 3.9.3.b The permissible bending and shear stress coefficients for primary support members are also consistent with that used in cargo tank region.
- 3.9.3.c The criteria for 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 (as per *Table 8.3.5* of the Rules). 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.

- 3.9.3.d The loads in the fore end region are calculated in a consistent manner with the load in the cargo tank region, however, some simplifications have been made to the internal tank loads and external pressures.
- 3.9.3.e The scantlings of collision bulkhead are to be evaluated for the design loads of accidental flooding with the acceptance criteria set AC1, which is generally used for static loading to reflect criticality of the collision bulkhead.

3.9.4 Corrugated bulkheads

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

3.9.5 Pillars

- 3.9.5.a This subsection includes the general scantling requirements for pillar, which are consistent with the criteria 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.14/C).
- 3.9.5.b The loads in the fore end region are calculated in a consistent manner with the load in the cargo tank region, however, some simplifications have been made to the internal tank loads and external pressures.
- 3.9.5.c The critical buckling stress of pillar is to be obtained in accordance with *Section 10/3.5.1* of the Rules. The utilization factors for pillar are also consistent with that used for cross tie in cargo tank region.