

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

Background Document

SECTION 8/4 – SCANTLING REQUIREMENTS MACHINERY SPACE

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4 MACHINERY SPACE

4.1 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.

Formulations for structure in the machinery space are somewhat simplified. 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.

The loads are calculated in a consistent manner with the loads in the amidships region, and are similar to fore and aft ends and some simplifications have been made to the internal tank loads and external pressures.

4.1.1 Application

- 4.1.1.a The requirements are formulated assuming conventional single screw, single engine propulsion arrangements. According to the statistical data, except for special demand, the engine rooms of tankers of 150m or more in length are situated in the aft end region where the after peak bulkhead is the aft end of the engine room. The framing systems employed are longitudinal, transverse, or a combination of the two.
- 4.1.1.b The relation between the net scantlings and the gross scantlings as specified in *Section 8/4.1.1.2* of the Rules is general and consistent with that used in cargo tank region.

4.1.2 General scantling requirements

- 4.1.2.a It is considered that for *Section 8/4.1.2.1* of the Rules, no information in addition to that shown in the Rules is necessary to explain the background.
- 4.1.2.b It is considered that for *Section 8/4.1.2.2* of the Rules, no information in addition to that shown in the Rules is necessary to explain the background.
- 4.1.2.c *Section 8/4.1.2.3* 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 machinery space and end regions, 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.

- 4.1.2.d The general notes of *Section 8/4.1.2.4* of the Rules are introduced based on the paragraph in ABS Rules Pt.5 Ch.1 Sec.4/1.5.
- 4.1.2.e *Section 8/4.1.2.5* 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).

4.1.3 Structural continuity

- 4.1.3.a *Section 8/ 4.1.3.1* of the Rules includes general requirements for tapering of hull girder strength elements consistent with *Section 8/1.6.1.2* of the Rules and has requirements to address continuity of strength for changes of structural arrangements, including items such as deck openings, common to the machinery space region.
- 4.1.3.b *Section 8/4.1.3.2 to 4.1.3.5* of the Rules include 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).

4.1.4 Arrangements

- 4.1.4.a The requirements of *Section 8/4.1.4.1 to 4.1.4.4* of the Rules are, in general, taken from the ABS Rules Pt3 Ch.2 Sec.12/1.
- 4.1.4.b In view of the effect upon the structure of the necessary openings in the machinery space, the difficulty of securing adequate support for the decks, of maintaining the stiffness of sides and bottom and of distributing the weight of the machinery, special attention is directed to the need for arranging for the provision of plated through beams and such casing and pillar supports as are required to secure structural efficiency.
- 4.1.4.c The requirements are formulated assuming conventional single screw, single engine propulsion arrangements. In twin-screw vessels, and in other vessels of high power, it may be necessary to make additions to the strength of the structure and the area of attachments, which are proportional to the weight, power and proportions of the machinery, more especially where the engines are relatively high in proportion to the width of the bed plate.
- 4.1.4.d Attention is drawn the importance for submittal of machinery foundation drawings to assure that the foundations for main propulsion units, reduction gears, shaft and thrust bearings, and the structure supporting those foundations are adequate to maintain required alignment and rigidity under all anticipated conditions of loading.
- 4.1.4.e Requirements of a cofferdam to separate the cargo tanks from the machinery space come from SOLAS Chapter II-2/Regulation 4.5.1.

4.1.5 Minimum thickness

- 4.1.5.a The requirements of minimum thickness in amidships are generally applicable to the structure in the machinery space. However, the required minimum thickness for the inner bottom, floors and longitudinal girders are modified as appropriate for the

machinery space in conjunction with portions of the existing Rule requirements of ABS, DNV and LR and calibration with existing ships.

4.2 Bottom Structure

4.2.1 General

4.2.1.a Though not required for tankers, a double bottom is to be fitted in way of the machinery space on cargo ships (other than tankers) as required by SOLAS II-1/Regulation 12-1. Text similar to that of *Section 8/4.2.1.1* of the Rules is common to existing classification rule requirements and fitting of a double bottom is considered standard practice for tankers with a length of 150m or more. Reference is made to ABS Rules Pt 3 Ch2, Sec.4/1 and DNV Rules Pt.3 Ch.1 Sec5/A400.

4.2.2 Bottom shell plating

4.2.2.a It is considered that for *Section 8/4.2.2.1* and *4.2.2.2* of the Rules, no information in addition to that shown in the Rules is necessary to explain the background.

4.2.3 Bottom shell stiffeners

4.2.3.a It is considered that for *Section 8/4.2.3.1* of the Rules, no information in addition to that shown in the Rules is necessary to explain the background.

4.2.4 Girders and floors

4.2.4.a The requirements contained in this subsection are derived from the criteria and practice in portions of existing Rule requirements of LR, ABS and DNV (e.g. LR Rules Pt 3, Ch 7,4.1, ABS Rules Pt.3 Ch.2 Sec.4/3 - 4/5, and DNV Rules Pt.3 Ch.1 Sec.6/D.)

4.2.5 Inner bottom plating

4.2.5.a The text of *Section 8/4.2.5.1* of the Rules is derived from ABS Rules Pt.3 Ch.2 Sec.4/9.7. It is noted that in way of tanks and watertight boundaries the inner bottom plate scantlings will be required to meet the additional requirements of *Section 8/4.6* and *4.7* of the Rules, as appropriate.

4.2.6 Sea chests

4.2.6.a The requirements contained in this subsection are derived from the criteria and practice in portions of existing Rule requirements of LR, ABS and DNV (e.g. LR Rules Pt 3, Ch 1,5.4.2).

4.3 Side Structure

4.3.1 General

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

4.3.2 Side shell plating

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

4.3.3 Side shell local support members

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

4.3.4 Side shell primary support members

4.3.4.a The requirements of *Section 8/4.3.4.1* and *4.3.4.2* of the Rules are derived from LR Rules Pt 3, Ch 7,3.2 and are similar to requirements in the ABS and DNV Rules.

4.3.4.b It is considered that for *Section 8/4.3.4.3* of the Rules, no information in addition to that shown in the Rules is necessary to explain the background.

4.3.4.c The requirements of *Section 8/4.3.4.4* and *4.3.4.5* of the Rules are consistent with that for cargo tank region.

4.4 Deck Structure

4.4.1 General

4.4.1.a The requirements of *Section 8/4.4.1.2* to *4.4.1.6* of the Rules are derived from LR Rules Pt 3, Ch 7,2.2.

4.4.1.b It is considered that for *Section 8/4.4.1.1*, *4.4.1.7* and *4.4.1.8* of the Rules, no information in addition to that shown in the Rules is necessary to explain the background.

4.4.2 Deck scantlings

4.4.2.a Except as noted below, it is considered that for this topic, no information in addition to that shown in the Rules is necessary to explain the background.

4.4.2.b The requirements of *Section 8/4.4.2.3* of the Rules come from LR Rules Pt 3, Table 6.2.3, Note 5.

4.4.2.c The requirements of *Section 8/4.4.2.5* of the Rules are in line with the requirements of *Section 8/2.6.4.1* of the Rules for cargo tank region.

4.4.3 Pillars

4.4.3.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).

4.5 Machinery Foundations

4.5.1 General

4.5.1.a The requirements for this item come from LR Rules Pt 3, Ch 7,6.1.

4.5.2 Foundations for internal combustion engines and thrust bearings

4.5.2.a The requirements for this item come from DNV Rules DNV Rules Pt.3 Ch.1 Sec.6/D102.

4.5.3 Auxiliary foundations

4.5.3.a The requirements for this item come from LR Rules Pt 3, Ch 7,6.5.1.

4.6 Tank Bulkheads

4.6.1 General

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

4.6.2 Construction

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

4.6.3 Scantlings of tank boundary bulkheads

4.6.3.a It is considered that for *Section 8/4.6.3.1* to *4.6.3.3* of the Rules, no information in addition to that shown in the Rules is necessary to explain the background.

4.6.3.b The requirements of *Section 8/4.6.3.4* of the Rules are in line with the requirements of *Section 8/2.6.6.1* of the Rules for cargo tank region.

4.7 Watertight Boundaries

4.7.1 General

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

4.7.2 Scantlings of watertight boundaries

4.7.2.a It is considered that for *Section 8/4.7.2.1* to *4.7.2.3* of the Rules, no information in addition to that shown in the Rules is necessary to explain the background.

4.7.2.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 Rule requirements of web depth in other sections.

4.8 Scantling Requirements

4.8.1 Plating and local support members

4.8.1.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.

4.8.1.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. Hull girder stress components due to horizontal bending are considered to be negligibly small in the machinery space region. Hence, the requirements do not include the horizontal bending hull girder stress component.

4.8.1.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.

- 4.8.1.d The loads in the machinery space 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.

4.8.2 Primary support members

- 4.8.2.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.
- 4.8.2.b The permissible bending and shear stress coefficients for primary support members are also consistent with that used in cargo tank region.
- 4.8.2.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.
- 4.8.2.d The loads in the machinery space 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.

4.8.3 Corrugated bulkheads

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

4.8.4 Pillars

- 4.8.4.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).
- 4.8.4.b The loads in the machinery space 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.
- 4.8.4.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.