NEWBUILDINGS
SPECIAL SERVICE AND TYPE – ADDITIONAL CLASS

Offshore Service Vessels, Tugs and Special Ships

JULY 2012

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The Rules lay down technical and procedural requirements related to obtaining and retaining a Class Certificate. It is used as a contractual document and includes both requirements and acceptance criteria.

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CHANGES

General
This document supersedes the January 2012 edition.

Text affected by the main changes in this edition is highlighted in red colour. However, if the changes involve a whole chapter, section or sub-section, normally only the title will be in red colour.

Main changes coming into force 1 January 2013

- **Sec.8 Offshore Service Vessels for Transportation of Low Flashpoint Liquids (LFL)**
  - Sec.8 has been updated to ensure improved safety through closer alignment with IMO Res.A673(16) which has reduced gap between LFL* rules and statutory requirements.
  - The whole section has also been revised to make the rules clearer and improve user friendliness for all parties.

- **Sec.10 Recovered Oil Reception and Transportation**
  - Sec.10 has been updated with additional safety requirements for ships with heated tanks for recovered oil.
  - The whole section has also been revised to make the rules clearer and improve user friendliness for all parties.

- **Sec.13 Escort Vessels**
  - Escort rating number changed from (n,V) to (Fs,t,v) to improve clarity.
  - Winch supporting structure to be approved as for Tug, but with FW force replacing BP.
  - C202: Clear definition of heeling arm.
  - D101: Sea trial tests to be undertaken are now described in the Rules.
  - Classification Note CN 57.2 containing guidelines for the test execution.
  - D102: Requirement added for vessel to be loaded in accordance to predefined and approved loading conditions from stability booklet to increase safety.
  - D202: Criterion for acceptance of sea trial results introduced.
  - Rest of the text-material re-arranged as deemed necessary to be more understandable and consistent.

- **Sec.14 D Hull Strength - Concrete Barge (Tentative rule)**
  - Table A4: Additional documentation requirements for Barge Concrete introduced.
  - D100: Material requirements for concrete are in general based on DNV-OS-C502.
  - D200: The strength verification is to be based on the LRFD method for the limit states ULS, ALS, FLS and SLS according to DNV-OS-C502, applying loads defined in DNV Rules for Classification of Ships. The environmental loads may be based on wave load analysis applying site specific scatter diagram.
  - D300: Hull girder loads are taken from Pt.3 Ch.1 Sec.5 combined with partial load factors from DNV-OS-C502.
  - D400: Local loads are based on Pt.3 Ch.1 Sec.4 combined with partial load factors from DNV-OS-C502.
  - D500: The design resistance of the concrete structures are based on DNV-OS-C502.
  - D600: The construction of concrete barge is to be planned and executed in accordance with DNV-OS-C502.
  - D700: Concrete barges are in general to follow survey intervals and extent for hull and equipment as of steel barges. However, the requirements to dry-docking may be dispensed from, provided bottom survey is carried out afloat according to BIS requirements. Concrete barges are also to follow an in-service inspection scheme.

- **Sec.21 Semi-Submersible Heavy Transport Vessels**
  - A301: Revised definition of Semi-submersible heavy transport vessel.
  - Table A1: Inserted new row for DocReq item B030 - Internal Watertight Integrity Plan.
  - B202: Included reference to loadline flooding scenarios.
  - D302: New paragraph regarding flooding extent has been added.
  - E202: Clarifying text regarding escape requirements has been added.
  - G101: Clarifying text regarding un-obscured view has been added.

- **Sec.24 Seismographic Research Vessels (New section)**
  - Two class notations for seismic vessels introduced – Seismic Vessel and Seismic Vessel (A).
  - Requirements to hull, high-pressure systems, redundant propulsion, navigation systems and certification of equipment and pulling/towing appliances established in cooperation with the industry in order to ensure an improved safety and reliability of seismic vessel operations.

Corrections and Clarifications

In addition to the above stated rule requirements, a number of corrections and clarifications have been made to the existing rule text.
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B 300 Strengthening for Side-By-Side Mooring

C. Systems and Equipment

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C 200 Work Boat Davits and winches
C 300 High pressure air system
SECTION 1
INTRODUCTION

A. General

A 100 Introduction
The rules in this chapter apply to vessels intended for offshore service, towing and pushing, and other specialised offshore and harbour services.

101 Scope
The scope of this chapter includes requirements regarding hull strength, system and equipment, stability and the relevant procedural requirements for the vessels as introduced.
In addition, this chapter describes additional requirements on strength, stability and specific functions relevant for these vessels.

102 Objective
The objective of this chapter is to define additional vessel design requirements supporting safe and reliable operation.

103 Application
The requirements shall be regarded as supplementary to those given for the assignment of main class.
Vessels complying with the different requirements of this chapter will be assigned class notations as described in Table A1.

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In addition to the listing above, notations Anchor Handling, Towing, Supply, AHTS and Windfarm Maintenance shall comply with the requirements of Sec.2.

Vessels equally intended for more than one special duty may be assigned a combination of the class notations mentioned in Table A1.

B. Definitions

B 100 General

101 Symbols

\[ \begin{align*}
L &= \text{rule length [m]} \quad 1) \\
B &= \text{rule breadth [m]} \quad 1) \\
D &= \text{rule depth [m]} \quad 1) \\
T &= \text{rule draught [m]} \quad 1) \\
C_B &= \text{rule block coefficient} \quad 1) \\
V &= \text{service speed (knots)} \quad 1) \\
s &= \text{stiffener spacing [m]} \\
s_s &= \text{standard frame spacing [m]} \\
&= 0.48 + 0.002 \times L \\
&= \text{maximum } 0.61 \text{ m forward of collision bulkhead and aft of the after peak bulkhead} \\
l &= \text{stiffener span [m]} \\
f_1 &= \text{material factor depending on material strength group} \quad 2) \\
\end{align*} \]

1) For details see Pt.3 Ch.1
2) For details see Pt.3 Ch.1 Sec.2.

C. Documentation

C 100 General

101 Details related to additional classes regarding design, arrangement and strength are in general to be included in the plans specified for the main class.

102 Additional documentation not covered by the main class is specified in appropriate sections of this chapter.
SECTION 2
OFFSHORE SERVICE VESSELS

A. General

100 Introduction

The requirements in this section apply to vessels designed specially for support services to offshore installations.

102 Scope

This section contains requirements to hull arrangement, systems and equipment, strength and stability applicable to offshore service vessels.

103 Objective

— provide a design standard enabling safe and reliable offshore service operation
— provide additional requirements enabling operations in harsh weather conditions.

104 Application

Vessels built in compliance with the relevant requirements in A, B, C and D may be given the class notation Offshore Service Vessel.

If in addition the vessel complies with the additional requirements given in E, the notation may be extended to Offshore Service Vessel +.

Guidance note:
The extended notation Offshore Service Vessel + is recommended for vessels primarily to operate in harsh weather conditions, e.g. the North Sea.

105 Vessels built in compliance with the requirements in this section and requirements specified in Table A1 may be assigned the additional notations, as follows:

<table>
<thead>
<tr>
<th>Additional Notation</th>
<th>Services</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anchor Handling</td>
<td>Offshore service vessels intended for towing of floating objects in open waters and objects on seabed in addition to subsurface deployment and lifting of anchoring equipment.</td>
<td>Sec.3</td>
</tr>
<tr>
<td>Towing</td>
<td>Offshore service vessels intended for towing of floating objects in open waters.</td>
<td>Sec.3</td>
</tr>
<tr>
<td>Supply</td>
<td>Offshore service vessels intended for supply services to offshore units or installations.</td>
<td>Sec.4</td>
</tr>
<tr>
<td>AHTS</td>
<td>Multipurpose Offshore Service Vessels intended for towing of floating objects in open waters and objects on seabed, subsurface deployment and lifting of anchoring equipment and supply services.</td>
<td>Sec.3 &amp; Sec.4</td>
</tr>
<tr>
<td>Windfarm Maintenance</td>
<td>Offshore service vessels intended for maintenance and service of offshore wind farms</td>
<td>Sec.23</td>
</tr>
</tbody>
</table>

106 Compliance with notations Anchor Handling and Supply qualifies for notation AHTS.

107 If the damage stability requirements in Sec.5 are satisfied in addition to the general requirements in D, then the additional notation SF may be given.
A 200 Documentation requirements

201 Plans and particulars for the following shall be submitted:

<table>
<thead>
<tr>
<th>Table A2 Documentation Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Object</strong></td>
</tr>
<tr>
<td>-------------------------------------</td>
</tr>
<tr>
<td>Independent cargo tanks and their supporting structures</td>
</tr>
<tr>
<td>Stow racks and their supporting structures</td>
</tr>
<tr>
<td>Windows</td>
</tr>
</tbody>
</table>

B. Hull Arrangement and Strength

B 100 Ship's sides and stern

101 Longitudinal fenders are normally to be fitted on the ship’s sides at freeboard cargo deck and second deck above. The fenders shall extend not less than 0.02 L forward of the section where the deck has its full breadth. Additional fenders shall be arranged aslopes between the longitudinal fenders. The fenders may be omitted if the side shell scantlings are increased as specified in 102.

102 The thickness of side plating including bilge strake, up to second deck above freeboard deck, is generally not to be less than:

\[
t = \left( 4.5 + 0.05L \right) \frac{s}{s_s} + 2 \text{ [mm], minimum 9 mm}
\]

The ratio \(s/s_s\) shall not be taken as less than 1.0, and \(L\) does not need to be taken more than 90 m. Requirements given for side plating in Pt.3 Ch.1 and Pt.3 Ch.2 are also to be complied with as applicable.

In way of fender area described in 101, fenders can be omitted when the side plating is at least twice that required above, for a breadth not less than 0.01 L, along the level of the freeboard deck and the second deck above.

103 Section modulus of frames or side longitudinals shall not in any region be less than 1.15 \(Z\) [cm\(^3\)].

\[Z = \text{general requirement as given in Pt.3 Ch.2 Sec.6.}\]

All frames up to second deck above freeboard deck, and forward of 0.2 L from F.P. up to forecastle deck, shall have end connections with brackets. Scallop welds shall not be used in connections between side frames and shell plating.

104 Flat part of bottom in way of stern shall be efficiently stiffened.

B 200 Weather deck for cargo

201 The deck shall have scantlings based on a minimum cargo load of 1.5 t/m\(^2\), in combination with 80% of the design sea pressure as specified for the main class. If the deck scantlings are based on cargo load exceeding 1.5 t/m\(^2\), the notation DK(+) may be added. The design cargo load in t/m\(^2\) will be given in the “Appendix to the classification certificate”. Cargo loads exceeding 4 t/m\(^2\) need not be combined with sea pressure. For intermediate loads the percentage of the design sea pressure to be added shall be varied linearly.

For vessels less than 100 meters, the \(k\) factor given in Pt.3 Ch.2 Sec.7 B101, shall be:

\[A = \text{total deck area between the stow racks.}\]
Acceptable stress levels for the stow rack scantlings and respective supporting structure resulting from bending moments and shearing forces calculated for the load given above are:

\[
\begin{align*}
\sigma_b &= 160 \, f_1 \, [\text{N/mm}^2] \\
\tau &= 90 \, f_1 \, [\text{N/mm}^2] \\
\sigma_e &= (\sigma_b^2 + 3 \, \tau^2)^{1/2} \\
&= 200 \, f_1 \, [\text{N/mm}^2]
\end{align*}
\]

205 Air pipes, valves, smaller hatches etc. shall be located outside stow racks, and shall be protected and adequately strengthened.

206 Scantlings of flush hatch covers in the cargo deck area shall be based on a load not less than the specific design cargo load.

B 300 Weathertight doors

301 Where necessary, an arrangement for protecting the doors against deck cargo shall be provided.

302 For scuttles or windows fitted in weathertight doors, they shall comply with Pt.3 Ch.3 Sec.6 L.

B 400 Freeing ports and scuppers

401 The area of the freeing ports in the side bulwarks on the cargo deck is at least to meet the requirements of Pt.3 Ch.3 Sec.6 M.

The disposition of the freeing ports shall be carefully considered to ensure the most effective drainage of water trapped in pipe deck cargoes and in recesses at the after end of the forecastle. In such recesses appropriate scuppers with discharge pipes led overboard may be required.

If an emergency exit is located in a recess, freeing ports should be located nearby.

C. Systems and Equipment

C 100 Steering gear

101 The steering gear shall be capable of bringing the rudder from 35° on one side to 30° on the other side in 20 s, when the vessel is running ahead at maximum service speed.

C 200 Exhaust outlets

201 Exhaust outlets from diesel engines shall have spark arrestors.

C 300 Anchoring equipment

301 For vessels without means for dynamic positioning, but intended for anchoring close to offshore installations/fields, safety precautions have to be considered.

Guidance note:
Safety precautions may consist of increasing the diameter and length of the chain cables above the minimum class requirements given in Pt.3 Ch.3 Sec.3. In such case, for operation in the North Sea or areas with similar environmental conditions, it is recommended to have the diameter of chain cables based on an equipment letter at least two steps higher than the corresponding vessel's equipment number and length of the chain cables 85% greater than the table value corresponding to the increased diameter.

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

D. Intact Stability

D 100 Stability manual

101 The requirements of this sub-section are applicable to vessels with a length \( L_F \) of 24 m and above.

102 The stability information as presented in the required stability manual shall enable the master to assess with ease and certainty the stability of the vessel in different service conditions.

103 The stability manual shall contain the following information:

— report on inclining test and determination of light ship data
— capacities and centres of gravity of all tanks and spaces intended for cargo and consumables
— free surface particulars for all tanks
— information on types, weights, centres of gravity and distribution of deck cargoes that can be carried within the limits as set out in Pt.3 Ch.3 Sec.9 D. Possible restrictions, such as plugging of pipes, shall be clearly stated...
— where applicable, instructions related to the vessel when towing shall be included
— hydrostatic data
— cross curves of stability
— loading conditions including righting lever curves and calculation of metacentric height GM including free surface corrections
— curves for limiting VCG (centre of gravity above keel) or GM values for intact conditions and a curve showing the permissible area of operation.
— stillwater bending moment and shear force limit curves

D 200 Loading conditions

201 The following loading conditions shall be presented:
— vessel in fully loaded departure condition with cargo distributed below deck and with deck cargo specified by position and weight, with full stores and fuel, corresponding to the worst service condition in which all stability criteria are met
— vessel in fully loaded arrival condition with cargo as specified, but with 10% stores and fuel
— vessel in ballast departure condition, without cargo but with full stores and fuel
— vessel in ballast arrival condition, without cargo but with 10% stores and fuel
— vessel in the worst anticipated operating condition
— if the vessel is equipped with towing gear, vessel in a typical condition ready for towing.

202 Assumptions for calculating loading conditions:
— if a vessel is fitted with cargo tanks, the fully loaded conditions as described in 201 shall be modified, assuming first the cargo tanks full and then the cargo tanks empty
— if in any loading condition water ballast is necessary, additional diagrams shall be calculated and shown in the stability manual
— in all cases when deck cargo is carried a realistic stowage weight shall be assumed and stated in the stability information, including the height of the cargo and its centre of gravity
— where pipes are carried on deck, a quantity of trapped water equal to a certain percentage of the net volume of the pipe deck cargo shall be assumed in and around the pipes. The net volume shall be taken as the internal volume of the pipes plus the volume between the pipes. This percentage shall be 30 if the freeboard amidships is equal to or less than 0.015 L and 10 if the freeboard amidships is equal to or greater than 0.03 L. For intermediate values of the freeboard amidships the percentage may be obtained by linear interpolation
— free surface for each type of consumable liquid shall be assumed for at least one transverse pair of tanks or a single centre line tank. The tank(s) to be considered are those where the effect of free surface is the greatest. The actual free surface effect may be applied.

203 If the vessel is intended to operate in zones where icing is expected, this shall be included in the calculation of the stability. The vessel must in any service condition satisfy the stability criteria set out in Pt.3 Ch.3 Sec.9 including the additional weight imposed by the ice. Weight distribution shall be taken as at least 30 kg/m² for exposed weather decks, passageways and fronts of superstructures and deckhouses, and at least 15 kg/m² for projected lateral planes on both sides of the vessel above the waterline. The weight distribution of ice on un-composite structures such as railings, rigging, posts and equipment shall be included by increasing the total area for the projected lateral plane of the vessel's sides by 5%. The static moment of this area shall be increased by 10%.

D 300 Intact stability

301 In addition to the stability criteria for main class the vessel shall comply with the requirements in Sec.12 E in all towing conditions.

302 The freeboard at the stern in the upright condition shall not be less than 0.005 L in any loading condition.

E. Enhanced Strength

E 100 Bulwark

101 Bulwark plating thickness shall not be less than 7 mm. Bulwark stays shall have a depth not less than 350 mm at deck. Stays shall be fitted on every second frame. Open rails shall have ample scantlings and efficient supports.

E 200 Weathertight doors

201 The arrangements and sill heights of weathertight doors are in general to comply with Pt.3 Ch.3 Sec.6. Unprotected doors in exposed positions on a weather deck for cargo shall be made of steel.
For doors located in exposed positions in sides and front bulkheads, the requirements to sill heights apply one deck higher than given by Pt.3 Ch.3 Sec.6 B.

Doorways to the engine room and other compartments below the weather deck are, as far as is practicable, to be located at a deck above the weather deck. Alternatively, two weathertight doors in series may be accepted.

For scuttles or windows fitted in weathertight doors, they shall comply with E600.

**E 300 Ship's sides and stern**

Where subjected to heavy loads when handling anchors for offshore floating units drilling rigs, the stern shall be adequately strengthened. The plate thickness adjacent to the stern roller and shark jaw shall not be less than:

\[ t = 10 + 0.2 L \text{ (mm)} \]

The deck adjacent to the stern shall be strengthened accordingly. If a substantial sheathing is fitted on the deck, the requirement may be modified.

The thickness of the side plating up to forecastle deck shall not be less than as given in B102.

Section modulus of frames or side longitudinals up to second deck above the freeboard deck shall not be less than:

\[ Z_1 = \frac{1.5 L / s}{f_1} \text{ [cm}^3\text{]} \]

*If fenders are omitted*

\[ Z_1 = \frac{2.5 L / s}{f_1} \text{ [cm}^3\text{]} \]

The section modulus of main frames or tween deck frames shall, however, not in any region be less than:

\[ Z_{\text{min}} = 1.25 Z \text{ [cm}^3\text{]} \]

\( Z \) = general requirement as given in Pt.3 Ch.1 Sec.7 C and Pt.3 Ch.2 Sec.6 C.

\( L \) = rule length [m], but not greater than 90 m

\( l \) = span [m]

\( s \) = spacing [m].

The requirement for \( Z_1 \) given above refers to frames, which have an inclination to the vertical (along the ship’s depth) less than 15°. For greater inclinations the requirement given for \( Z_{\text{min}} \) shall be applied.

All frames up to second deck above freeboard deck, and frames forward of 0.2 L from F.P. up to forecastle deck, shall have end connections with brackets. Scallop welds shall not be used in connections between side frames and shell plating up to second deck above the freeboard deck.

In the ship sides up to second deck above freeboard deck, the section modulus of web frames and stringers shall not be less than:

\[ Z_2 = \frac{1.5 L S}{f_1} \]

*If fenders are omitted*

\[ Z_2 = \frac{2.5 L S}{f_1} \]

However, it shall not be less than

\[ Z_{\text{min}} = 1.25 Z \text{ [cm}^3\text{]} \]

\( Z \) = general requirement in Pt.3 Ch.1 Sec.7 D and Pt.3 Ch.2 Sec.6 D

\( S \) = span [m].

The web frames are assumed to have substantial end connections at both ends.

**E 400 Support of heavy components**

Pillars and girders supporting deck cargo and equipment, foundations for separate cargo tanks, as well
as supports of other heavy components, shall have scantlings based on the supported mass. The design loads shall not be less than:

For $L < 100$ m

aft of $0.2$ L from A.P. and forward of $0.2$ L from F.P.

\[ p = 20q \text{ [kN/m}^2\text{]} \]

between $0.2$ L and $0.8$ L from A.P.  \( p = 16q \text{ [kN/m}^2\text{]} \)

For $L > 100$ m

\[ p = (g_0 + a_v)q \text{ [kN/m}^2\text{]} \]

**Vertical force alone**

For $L < 100$ m

aft of $0.2$ L from A.P. and forward of $0.2$ L from F.P.

\[ P_v = 20M \text{ [kN]} \]

between $0.2$ L and $0.8$ L from A.P, \( P_v = 16M \text{ [kN]} \)

For $L > 100$ m

\[ P_v = (g_0 + a_v)M \text{ [kN]} \]

**Transverse force alone**

For $L < 100$ m

\[ P_T = 7.5M \text{ [kN]} \]

For $L > 100$ m

\[ P_T = a_tM \text{ [kN]} \]

**Vertical force to be combined with transverse force**

For $L < 100$ m

\[ P_{VC} = 10M \text{ [kN]} \]

For $L > 100$ m

\[ P_{VC} = g_0M \text{ [kN]} \]

**Longitudinal force alone**

For $L < 100$ m

\[ P_L = 6.0M \text{ [kN]} \]

For $L > 100$ m

\[ P_L = a_lM \text{ [kN]} \]

**Vertical force to be combined with longitudinal force**

For $L < 100$ m

\[ P_{VC} = 20M \text{ [kN]} \]

For $L > 100$ m

\[ P_{VC} = (g_0 + a_v)M \text{ [kN]} \]

$q$ = deck cargo load [t/m²] as specified

$M$ = mass of equipment, heavy components, etc. in tonnes

$a_v$ = combined vertical acceleration as given in Pt.3 Ch.1 Sec.4 B600

$a_t$ = combined vertical acceleration as given in Pt.3 Ch.1 Sec.4 B700

$a_l$ = combined vertical acceleration as given in Pt.3 Ch.1 Sec.4 B800

Acceptable stress level for the above mentioned girders are:

\[ \sigma_b = 160f_1 \text{ [N/mm}^2\text{]} \]

\[ \sigma_c = 90f_1 \text{ [N/mm}^2\text{]} \]

\[ \sigma_c = (\sigma_b^2 + 3\tau^2)^{1/2} = 200f_1 \text{ [N/mm}^2\text{]} \]
E 500 Deckhouses and end bulkheads of superstructures

501 The section modulus of stiffeners and beams shall not be less than:

$$Z = \frac{0.7 t^2}{f_1} \times p \text{ [cm}^3\text{]}$$

$$p = \text{design pressure in kN/m}^2$$

- for exposed decks and bulkheads: minimum 10 kN/m$^2$ for weather decks
- minimum 5 kN/m$^2$ for top of the wheelhouse
$$= 8 \text{ kN/m}^2 \text{ for accommodation decks, aft of 0.2 L from A.P. and forward of 0.2 L from F.P.}$$
$$6.5 \text{ kN/m}^2 \text{ elsewhere}$$

$$a = 2 \text{ for front bulkheads}$$

$$1.2 \text{ for sides, aft end bulkheads and weather decks}$$

$$p_2 = \text{ design sea pressure as given in Pt.3 Ch.2 Sec.7 B100 and Pt.3 Ch.2 Sec.10 C100 as applicable.}$$

502 Beams and stiffeners shall have end connections. Stiffeners on lower front bulkhead on weather deck forward shall have brackets at lower end.

503 The plate thickness in deckhouses and end bulkheads of superstructures shall not be less than:

$$t = \left( \frac{t_o + 0.02L}{\sqrt{f_1}} \right) \times c \text{ [mm]}$$

$$t_o = 6 \text{ for front bulkheads and weather deck forward of the lowest tier of the front bulkhead}$$

$$= 5 \text{ for sides and aft end bulkheads and weather decks elsewhere}$$

$$= 4.5 \text{ for deckhouse decks (in way of accommodation).}$$

$$c = \frac{s}{0.65} \times \text{minimum 1.0}$$

E 600 Windows and side scuttles

601 Typical arrangements complying with the requirements given below are shown in Fig.2 and Fig.3. Side scuttles will normally not be accepted in the ship sides below 3rd tier forward of 0.1 L from forward perpendicular.

Guidance note:
Side scuttles below 3rd tier forward of 0.1 L from forward perpendicular may be accepted upon special consideration with respect to strength and position.

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

602 In the after end bulkhead of deckhouses and superstructures, in sides of deckhouses and of superstructures that are not part of the shell plating, windows will be accepted in second tier and higher, above the freeboard deck. In front bulkheads of deckhouses and superstructures, windows will normally be accepted in third tier and higher, above the freeboard deck. In the first tier of the front bulkhead above the weather deck (forecastle deck) side scuttles only will be accepted.

603 Hinged deadlights shall be fitted to:
- side scuttles in the vessel’s hull (shell plating)
- windows and side scuttles in the sides of deckhouses and superstructures up to and including the third tier above the freeboard deck.
- all windows and side scuttles in front bulkheads of superstructures and deckhouses.
- windows and side scuttles in the after end of bulkheads of superstructures and deckhouses, casings and companionways in the first and second tier above the freeboard deck.
- windows and side scuttles in all bulkheads of the first tier on the weather deck.

604 Deadlights fitted in the side of third tier may be portable if they are stored near by.

For tier four and above, unless it is the first tier above the forward weather deck, the deadlights may be portable if they are stored near by.

In the second tier above the freeboard deck and higher, deadlights on windows may be arranged externally, provided there is easy and safe access for closing.

Other deadlights shall be internally hinged.

605 Deadlights shall be available for each type of window sited on the front of a wheelhouse that is located...
on the forward part of the vessel, unless the wheelhouse is located on fifth tier (or above) and is at least two decks above the forward weather deck. For externally fitted deadlights an arrangement for easy and safe access shall be provided (e.g. gangway with railing). The deadlights of portable type shall be stowed adjacent to the window for quick mounting. For the wheelhouse front windows, at least two deadlights shall have means for providing a clear view.

606 The strength of side scuttles with internally hinged deadlights and toughened glass panes shall comply with International Standard ISO 1751 as follows:

*Type A (heavy):* In the hull, in the sides of superstructures and in the front of superstructures and deckhouses (weather deck tier).

*Type B (medium):* In the after end of superstructures and in the sides and ends of deckhouses (except front in weather deck tier).

607 Windows shall have toughened safety glass panes of thickness determined as given below.

\[
t = \frac{b}{S} \sqrt{\frac{p}{\beta}} \quad [\text{mm}]
\]

\(\beta\) = factor obtained from the Fig.1

\(S\) = safety factor obtained from the Table D1

\(b\) = smaller dimension of the glass pane [mm]

\(p\) = local sea pressure as given in 501 [kN/m²]

---

**Fig. 1**

*Curve for factor \(\beta\) based on window size ratio*

Furthermore, the thickness of windows should not be taken less than 10 mm.

When laminated glass panes are used, equivalent thickness according to formula given in Pt.3 Ch.3 Sec.6 L203 is to be applied.

**Table D1 Safety factor (S)**

<table>
<thead>
<tr>
<th>Window and tier</th>
<th>2nd</th>
<th>3rd</th>
<th>4th and above</th>
</tr>
</thead>
<tbody>
<tr>
<td>Front or side</td>
<td>100</td>
<td>100</td>
<td>150</td>
</tr>
<tr>
<td>Aft</td>
<td>100</td>
<td>150</td>
<td>200</td>
</tr>
</tbody>
</table>

608 Windows of design not in accordance with recognised international standards shall be especially approved by the Society. Drawings showing details of the frame design, its fixation and material specification shall be submitted for approval.

609 For large windows with the lower edge positioned at or less than 900 mm above the deck, provision of handrails at a level approximately 1 m above the deck shall be considered when applicable.
Fig. 2
Side scuttles and windows in supply vessel with complete superstructure and uppermost forecastle

Fig. 3
Side scuttles and windows in supply vessel with forecastle only
SECTION 3
OFFSHORE SERVICE VESSELS FOR ANCHOR HANDLING AND TOWING

A. General

A 100 Introduction

101 The requirements in this section apply to vessels intended for anchor handling and towing operations offshore.

102 Anchor handling operations implies towing of floating objects in open waters and objects on sea bed in addition to subsurface deployment and lifting of anchoring equipment.

103 Towing operations implies towing of floating objects in open waters.

104 Scope

The following is covered by this section:

— design and testing requirements to towing and anchor handling equipment
— hull arrangement and supporting structure
— stability and watertight integrity.

Basic requirements for anchor handling/towing vessels are given in Sec.2.

105 Objective

The objective of this section is to provide a design standard for safe and reliable towing and anchor handling operation. The rules enable partially the user to specify the capacities of the equipment. Safety is maintained by enhanced focus on the actual performance and limitations.

106 Application

Vessels with class notation Offshore Service Vessel intended for anchor handling operations built in compliance with the requirements in this section may be given the class notation Anchor Handling.

Vessels with class notation Offshore Service Vessel intended for towing operations built in compliance with relevant requirements in this section may be given the class notation Towing.

A 200 Definitions

201 Anchor handling winch means winch used for towing and anchor handling as described in A102. The towing and anchor handling functions may be covered/fulfilled by dedicated drums on the winch(es).

202 Towing winch means winch used for towing as described in A103.

203 Towline means rope used for towing. When used in the context anchor handling it means work rope or any wire rope, rope, or chain.

204 Shark jaw means equipment for temporary securing the inboard end of towline

205 Towing pins means equipment for leading and restraining the towline to the intended path.

206 Stern roller means rollers, fairleads or other equipment at the towline exit on the vessel (irrespective of location onboard), supporting the towline during lifting to avoid chafing and excessive bending, and arranged to facilitate the launch and recovery of rig anchors etc.

207 Bollard pull (BP) is the maximum continuous pull obtained at static pull test on sea trial. Reference is made to test procedure in Sec.12 A 500.

208 Reference load (RL) is defined as the value obtained from Table A1:

<table>
<thead>
<tr>
<th>Table A1 Reference load</th>
<th>Bollard pull (tonnes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.0 BP</td>
<td>BP &lt; 40</td>
</tr>
<tr>
<td>(3.80 – BP/50) BP</td>
<td>40 ≤ BP ≤ 90</td>
</tr>
<tr>
<td>2.0 BP</td>
<td>BP &gt; 90</td>
</tr>
</tbody>
</table>
## A 300 Documentation requirements

### 301 The following plans and particulars shall be submitted:

<table>
<thead>
<tr>
<th>Table A2 Documentation Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Object</strong></td>
</tr>
<tr>
<td>--------------------------</td>
</tr>
<tr>
<td>Anchor handling/towing arrangement</td>
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<tr>
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<tr>
<td></td>
</tr>
<tr>
<td>Bollard pull</td>
</tr>
<tr>
<td>Winch and other equipment</td>
</tr>
<tr>
<td>Anchor Handling/ Towing winch</td>
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<td></td>
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<tr>
<td>Shark Jaw</td>
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</tbody>
</table>
A 400 Certification requirements

401 DNV product certificates will be required for the following items:
— anchor handling/towing winch
— towing hook
— shark jaw
— towing pins.

402 DNV material certificates will be required for the following items:
— shark jaw and towing pins with attachment
— winch drum and flanges
— shafts for drum
— brake components.

403 Works material certificates is required for the following items:
— coupling
— winch framework
— gear shaft and wheels.

A 500 Testing requirements

501 The winch and other equipment made mandatory in this Section shall be function tested according to approved procedure in order to verify;
— the ability for the arrangement and equipment to operate within the specified limitations, towline paths, towline sectors etc specified by the arrangement drawing
— the correct function of the normal operation modes
— the correct function of the emergency operation modes, including emergency release and dead ship operations.

502 The winch shall be load tested during hoisting, braking, and pay out. Design loads to be applied. However, a maximum load equal to BP may be accepted if the winch is not of novel design or complex structure.

503 The BP testing shall comply with applicable requirements in Sec.12 A500.

B. Hull Strength

B 100 Deck structure

101 Scantlings of foundations and supports of towing pins shall be based on 2 times the specified maximum static working load.
102 Scantlings of foundations and supports of winches intended for towing functions shall be based on minimum 2.2 times the maximum BP of the vessel.

103 Scantlings of foundations and supports of winches intended for anchor handling functions shall be based on 1.5 times the specified maximum hoisting capacity or the maximum braking capacity of the winch whichever is the greater.

104 Scantlings of foundations and supports of stern roller shall be based on 2 times the maximum static working load as specified by the designer or 2 times the specified maximum hoisting capacity of the anchor handling winch whichever is the greater.

105 Scantlings of foundations and supports of shark jaws shall be based on 2 times the maximum static working load as specified by the designer.

106 Acceptable stress levels for the scantlings of the supporting structure resulting from bending moments and shearing forces calculated for the load given above are:

\[ \sigma_b = 210 \, f_1 \, [N/mm^2] \]
\[ \tau = 120 \, f_1 \, [N/mm^2] \]
\[ \sigma_c = \left( \sigma_b^2 + 3 \, \tau^2 \right)^{1/2} \]
\[ = 235 \, f_1 \, [N/mm^2]. \]

B 200 Ship’s sides and stern

201 Where subjected to heavy loads when handling anchors, the stern shall be adequately strengthened. The plate thickness shall not be less than twice the basic requirement stated in Sec.2 B102. The deck adjacent to the stern shall be strengthened accordingly. If a substantial sheathing is fitted on the deck, the requirement may be modified.

C. Anchor Handling and Towing Arrangement

C 100 General

101 The equipment shall meet the requirements in this Section. Alternatively, equipment complying with a recognized standard may be accepted upon special considerations provided such standard gives a reasonable equivalence to the requirements of this section and fulfils the intention.

102 Arrangement drawing for anchor handling and towing with the content listed under Documentation Requirement in this Section shall be posted on the bridge.

103 Structural elements (e.g. cargo rails, bulwarks, etc) that may support the towline during normal operation, are to have a radius of bend sufficient to avoid damage to the towline.

104 The arrangement shall be such that the heeling moment arising when the towline is running in the athwart ships direction, will be as small as possible.

105 Vessel with notation Anchor Handling shall be fitted with the following items:

— anchor handling winch
— shark jaw
— towing pins
— stern roller.

106 Vessel with notation Towing shall be fitted with the following items:

— towing winch or towing hook.

107 The arrangement shall be such that the towline is led to the winch drum in a controlled manner under all foreseeable conditions (directions of the towline) and provide proper spooling on drum.

C 200 Materials for equipment

201 Shark jaw and towing pins with attachment shall be made of rolled, forged or cast steel in accordance with Pt.2 Ch.2 Sec.1, Sec.5 or Sec.7.

202 For anchor handling and towing winch materials shall comply with relevant specifications given in Pt.2.

203 For forged and cast steel with minimum specified tensile strength above 650 N/mm², specifications of chemical composition and mechanical properties shall be submitted for approval for the equipment in question.

204 Plate material in welded parts shall be of the grades as given in Pt.3 Ch.3 Sec.3 F200 Table F3.

205 When minimum specified yield is above 0.8 times the minimum specified tensile strength, 0.8 times
minimum tensile strength shall be used as minimum specified yield in calculations for structural strength as given in C300.

206 Fabrication of items in A401 is generally to be in accordance with DNV Standard for Certification 2.22 – Lifting Appliances, Ch2. Sec.2. J. Crane Manufacturing and Construction.

C 300 Anchor handling/Towing winch

301 Control system
The control stands shall provide a safe and logical interface to the operator with operating levers returning to stop position when released and in addition provide a clear view to the drums.
The anchor handling winch shall be capable of controlled operation during lowering and hoisting of anchors etc. both submerged and over the Stern Roller.

302 Monitoring system
Device for measuring tension in towrope should be fitted.

303 Emergency release
The winch shall be designed to allow drum release in an emergency, and in all operational modes.
The release capabilities shall be as specified on arrangement drawing as required in C102.
The action to release the drum shall be possible locally at the winch and from a position at the bridge with full view and control of the operation. Identical means of equipment for the release operation to be used on all release stations.
After an emergency release the winch brake shall be in normal function without delay.
It shall always be possible to carry out the emergency release sequence (emergency release and/or application of brake), even during a black-out.
Control handles, buttons etc. for emergency release shall be protected against unintentional operation.

304 Structural strength of winch for anchor handling function
Winch for anchor handling function shall be capable of withstanding the maximum forces from hoisting, rendering and braking, including dynamic effects, without exceeding the following stress levels:
— hoisting including dynamic effect at relevant layer: $0.67 \times \text{minimum specified yield}$
— braking at relevant layer as specified in C310: $0.67 \times \text{minimum specified yield}$
— rendering load/load in towline when drum starts to rotate in the opposite direction of the applied driving torque: $0.85 \times \text{minimum specified yield}$.

Buckling and fatigue to be considered according to recognized standard or code of practice.

305 Structural strength for winch for towing function
The design and scantlings shall be capable of withstanding the RL without permanent deformations at relevant layer.
Buckling and fatigue to be considered according to recognized standard or code of practice.

306 Winch intended for both functions shall meet requirements both in C304 and C305

307 Drums
The drum design shall be carried out with due consideration to the relevant operations.
The drum diameter for steel wire rope should not be less than 14 times the maximum intended diameter of the rope. However, for all rope types, the rope bending specified by the rope manufacturer should not be exceeded.

308 Towline attachment
The end attachment of the towline to the winch barrel shall be of limited strength making a weak link in case the towline has to be run out.
At least 3 dead turns of rope are assumed on the drum under normal operation to provide proper attachment.

309 Brake on drum intended for towing:
The brake is normally to act directly on drum and should be capable of holding the RL at inner layer. It shall be arranged for manual operation or other means for activation during failure of the power supply.

310 Brake on drum intended for anchor handling:
The brake is normally to act directly on drum. It shall be capable of holding at least 1.25 times the maximum torque created from towline pull including dynamic effect. In addition, the brake shall be capable of stopping the rotation of the drum from its maximum speed.
The holding load of the winch shall not be affected by failure in the power supply and the brake shall be
actuated at power failure if the load is not controlled by the winch motors or similar. Means shall however be provided for overriding such systems at any time.

311 Brake on drums intended for both functions shall meet requirements both in C309 and C310.

C 400 Other equipment

401 The shark jaw shall be capable of sustaining the load defined on the arrangement drawing given in C102 without exceeding a stress level of $0.67 \times$ minimum specified yield. Dynamic effect to be included.

402 The Towing Pins shall withstand forces and towline sectors defined on the arrangement drawing given in C102 without exceeding a stress level of $0.67 \times$minimum specified yield. Dynamic effect to be included.

403 If emergency release on shark jaw and towing pins is arranged, shall the capabilities be as specified on the arrangement drawing given in C102.

404 When towing hook is fitted, applicable requirements in Sec.12 shall be complied with.

C 500 Marking

Equipment shall be marked to enable them to be readily related to their specifications and manufacturer. When a DNV product certificate is required, the equipment shall be clearly marked by the society for identification.

D. Stability and Watertight Integrity

D 100 General requirements

101 For towing operations, stability to comply with applicable requirements in Sec.12 E.
SECTION 4
PLATFORM SUPPLY

A. General

A 100 Introduction

101 The requirements in this section apply to vessels designed specially for platform supply services.

102 Scope

The section contains additional requirements to cargo handling arrangement and certification. Basis requirements for platform supply vessels are given in Sec.2.

103 Objectives

This section’s objective is to provide a vessel design standard ensuring a safe and reliable platform supply to offshore installations.

104 Application

Vessels with class notation Offshore Service Vessel built in compliance with the relevant requirements in this section may be given the class notation Supply.

A 200 Documentation requirements

201 The following plans and particulars shall be submitted:

<table>
<thead>
<tr>
<th>Table A1 Documentation Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Object</strong></td>
</tr>
<tr>
<td>Cement and dry mud systems</td>
</tr>
<tr>
<td>Liquid mud systems</td>
</tr>
</tbody>
</table>

A 300 Certification requirements

301 Cargo pumps for flammable liquids shall be certified by the Society. This include typically pumps for transfer of liquid mud, fuel oil and base oil.

**Guidance note:**

Other pumps in the cargo systems, including hydraulic power systems, need not to be delivered with the Society's certificate.

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

302 Cargo system valves shall be certified. A manufacturer’s certificate can be accepted.

B. Cargo Handling Arrangement

B 100 General

101 Systems and arrangements shall in general comply with the relevant requirements for main class given in Pt.4 Ch.6.

Redundancy requirements for cargo pumps as specified in Ch.3 Sec.4 C102 and Ch.4 Sec.6 B201 are not applicable.

102 Cargo pumps shall be provided with remote shut down devices capable of being activated from a dedicated cargo control location which is manned at the time of cargo transfer. Remote shut down shall also to be capable of being activated from at least one other location outside the cargo area and at a safe distance from it.

103 Segregation between cargo piping systems where cross-contamination causes safety hazards or marine pollution hazards shall be by means of spectacle flanges, spool pieces or equivalent. Valve segregation is not considered equivalent.

104 Vessels intended for transportation of liquids with flashpoint below 60°C shall comply with Sec.8. Vessels that occasionally handle, store and transport recovered oil from a spill shall comply with Sec.10.

B 200 Cement and dry mud systems

201 Cement and dry mud tanks and piping systems are as far as practicable to be separated from the engine room.
Where cement and dry mud tanks are situated in way of engine room, at least the upper parts of the tanks with hatches, pipe connections and other fittings, shall be segregated from the engine room by steel deck and bulkhead.

202 Where cement and dry cargo piping is led through the engine room, the wall thicknesses of the pipes shall not be less than given in Table B1. Pipe connections located in the engine room shall be welded as far as practicable. Necessary detachable connections shall be of such design that blow-out is prevented. The arrangement will be specially considered in each particular case.

203 Access doors between the engine room and spaces in which cement and dry mud systems are located, shall be provided with signboard stating that the doors shall be kept closed while the system is under pressure.

204 Cement and dry mud tanks shall be certified in accordance with the requirements for pressure vessels given in Pt.4 Ch.7.

<table>
<thead>
<tr>
<th>Table B1 Pipes for cement and dry mud. Minimum nominal wall thickness for steel pipes in engine room</th>
</tr>
</thead>
<tbody>
<tr>
<td>External diameter (mm)</td>
</tr>
<tr>
<td>------------------------</td>
</tr>
<tr>
<td>38 to 82.5</td>
</tr>
<tr>
<td>88.9 to 108</td>
</tr>
<tr>
<td>114.3 to 139.7</td>
</tr>
<tr>
<td>152.4 to 273</td>
</tr>
</tbody>
</table>

B 300 Liquid mud systems

301 Liquid mud carried onboard supply vessels shall have a flash point not lower than 60°C.

302 Means for relief of overflow shall be provided, e.g. through a non-return valve fitted in a branch connection to the air pipe.

The sectional area of the overflow pipe shall be at least twice that of the filling pipe.
SECTION 5
DAMAGE STABILITY FOR OFFSHORE SERVICE VESSELS

A. General

A 100 Classification

101 Vessels with a length $L_F$ of 24 m and above complying with the requirements for intact stability given in Sec.2 D and damage stability given in this section may be given the additional class notation SF, provided the Society upon consideration in each case finds these requirements to be appropriate for the vessel.

102 Examination and approval of stability documents carried out by National Authorities having equivalent intact and damage stability requirements (i.e. Guidelines for the Design and Construction of Offshore Supply Vessels, 2006, IMO Res.MSC.235(82)) may be accepted as a basis for assigning the additional class notation SF.

103 In such cases the stability manual approved by the National Authorities shall be submitted as documentation of compliance with the rule requirements.

104 Cargo ships not complying with the definition of “Offshore supply vessel” as set out in paragraph 1.2.1 of the IMO guidelines may not use compliance with additional class notation SF for exclusion of compliance with application of SOLAS Ch. II-1 as amended, Part B-1.

A 200 Documentation

201 Plans and particulars for the following shall be submitted. See Table A1.

<table>
<thead>
<tr>
<th>Table A1 Documentation Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Object</strong></td>
</tr>
<tr>
<td>-----------------</td>
</tr>
<tr>
<td>Damage stability</td>
</tr>
<tr>
<td>Damage stability</td>
</tr>
<tr>
<td>Internal watertight integrity</td>
</tr>
</tbody>
</table>

202 Detailed description of stability documentation is given in Classification Note No. 20.1.

B. Damage Stability

B 100 Damage stability manual

101 The damage stability manual shall contain the following information:

— curves for limiting VCG (centre of gravity above keel) or GM values for both intact and damage conditions and the resultant curve showing the permissible area of operation.

B 200 Damage stability

201 The vessel shall comply with the damage stability requirements of IMO Res. MSC.235(82) (Guidelines for the Design and Construction of Offshore Supply Vessels, 2006)
SECTION 6
STANDBY VESSELS

A. General

A 100 Classification

101 The requirements in this section apply to vessels especially designed to carry out rescue and standby services to offshore installations.

102 Vessels built in compliance with the requirements in A, B, C, D and E may be given the class notation Standby Vessel.

Guidance note:
The flag administration may have requirements for the same items found in these rules. The stricter one is expected to prevail.

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

103 If in addition the vessel complies with requirements on strengthening of the superstructure and deckhouses given in F, the notation may be extended to Standby Vessel (S).

Guidance note:
The notation Standby Vessel (S) is recommended for vessels primarily to operate in harsh weather conditions, e.g. the North Sea.

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

A 200 Documentation

201 Plans and particulars for the following shall be submitted for approval. See Table A1.

<table>
<thead>
<tr>
<th>Object</th>
<th>Document type</th>
<th>Additional description</th>
<th>For info. (FI) or approval (AP)</th>
<th>Rule Ref.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rescue areas</td>
<td>Z030 Arrangement plan</td>
<td></td>
<td>AP</td>
<td>C</td>
</tr>
<tr>
<td>Rescue and safety equipment</td>
<td>G050 Safety Plan</td>
<td>Including rescue equipment</td>
<td>AP</td>
<td>C &amp; D</td>
</tr>
<tr>
<td>Towing arrangement</td>
<td>Z030 Arrangement plan</td>
<td></td>
<td>FI</td>
<td>A</td>
</tr>
<tr>
<td>Towing hook and towing winch supporting structures</td>
<td>H050 Structural drawing</td>
<td>Maximum braking force of winch and breaking strength of the towline shall be stated (if applicable)</td>
<td>AP</td>
<td>B</td>
</tr>
<tr>
<td>Towing hook and its release system</td>
<td>C030 Detailed drawing</td>
<td></td>
<td>AP</td>
<td>B</td>
</tr>
<tr>
<td>Windows</td>
<td>Z030 Arrangement plan</td>
<td>With information on type of glass, frames, including references to standards, and deadlights where applicable (for notation Standby Vessel (S) only)</td>
<td>AP</td>
<td>F</td>
</tr>
<tr>
<td>Spaces for survivors</td>
<td>Z030 Arrangement plan</td>
<td></td>
<td>AP</td>
<td>C</td>
</tr>
<tr>
<td>Spaces for survivors</td>
<td>Z240 Calculation report</td>
<td>Capacity</td>
<td>AP</td>
<td>C</td>
</tr>
</tbody>
</table>

A 300 Towing arrangement

301 When the vessel is fitted with means for emergency towing, the towing winch and or towing hook shall satisfy the requirements given in Sec.12 D202, D402 and D502.

302 For ships which are not built according to the Rules for Tug, Towing, Anchor Handling or AHTS notation, the towing wire and all connected parts shall have a minimum breaking load of 0.04 \( P_s \) tonnes, where \( P_s \) is the total power of the propulsion engines in kW.

303 All loose gear of the towing equipment, like shackles, rings, wire and ropes shall be delivered with a work’s test certificate.
A 400  Safety precaution

401 Exhaust outlets from diesel engines shall have spark arrestors.

A 500  Propulsion

501 The vessel shall be fitted with 2 propulsion systems or similar capable of moving the vessel in the forward/aft direction.

B. Hull arrangement and strength

B 100  General

101 The section modulus of the main and ‘tween deck frames shall not be less than:

\[ Z_1 = 1.25 Z \text{ (cm}^3\text{)} \]

\[ Z = \text{general requirement as given in Pt.3 Ch.2 Sec.6.} \]

All frames up to second deck above freeboard deck, and forward of 0.2 L from F.P. up to forecastle deck, shall have end connections with brackets.

102 Longitudinal fenders are normally to be fitted on the ship’s sides at freeboard cargo deck and second deck above. The fenders shall extend not less than 0.02 L forward of the section where the deck has its full breadth.

The breadth of the sheer strake at freeboard cargo deck shall not be less than:

\[ b = 800 + 5 L \text{ (mm).} \]

In way of fenders, the sheer strake thickness shall not be taken less than:

\[ t = (6 + 0.05 L) s/s_s \text{ (mm).} \]

The ratio \( s/s_s \) shall not be taken as less than 1.0. If fenders are omitted, as for instance within the rescue zone, the above minimum thickness shall be increased by 50\%, for a breadth not less than 0.01 L, along the level of the freeboard cargo deck and the second deck above.

If the vessel is not assigned with class notation **Offshore Service Vessel**, the side plating above the bilge, in way of the rescue zone, shall not be less than:

\[ t = (6 + 0.04 L) s/s_s \text{ (mm), minimum 8.0 mm} \]

103 The plating thickness of the exposed weather deck at the rescue zone, within at least 1.0 m from the ship side, is not to be less than:

\[ t = 6 + 0.02 L + t_k \text{ (mm)} \]

104 Bulwark plating thickness shall not be less than 7 mm. On the main weather deck the bulwark stays shall have a depth not less than 350 mm at deck and positioned at every second frame. Open rails shall have ample scantlings and efficient supports.

105 Scantlings of foundations and supports of towing winch and towing hook shall withstand a load 0.04 \( P_s \) tonnes, where \( P_s \) is the total power of the propulsion engines in kW. Acceptable stress levels in the supporting structure resulting from bending moments and shearing forces calculated for the load given above are:

\[ \sigma_b = 210 f_1 \text{ (N/mm}^2\text{)} \]

\[ \tau = 120 f_1 \text{ (N/mm}^2\text{)} \]

\[ \sigma_c = (\sigma_b^2 + 3 \tau^2)^{1/2} = 235 f_1 \text{ (N/mm}^2\text{).} \]

B 200  Freeing ports and scuppers

201 The area of the freeing ports in the side bulwarks on the cargo deck are at least to meet the requirements of Pt.3 Ch.3 Sec.6 M. The arrangement of the freeing ports shall be carefully considered to ensure the most effective drainage of water trapped on the weather deck.

C. Rescue Arrangement, Survivors' Accommodation and Safety Equipment

C 100  Rescue zone arrangement, equipment and facilities

101 The vessel shall be arranged on each side with a rescue zone with minimum 8 m length. The area shall be clearly marked on the ship's side. Its location shall be sufficiently far away from the propellers and clear of any ship side discharges up to 2 m below the loaded waterline.

102 Access routes from the rescue zones to survivors' accommodation and to helicopter winch zone if provided shall have slip-resistant deck coating or wooden lining with surface treatment giving equivalent properties.
The ship's side in way of the rescue zone shall be free of any obstruction, like for example, fenders. Satisfactory lighting shall be available along the rescue zone capable of providing minimum illumination level of 150 lux at the rescue zone and 50 lux at 20 m from the vessel. Deck area in way of the rescue zone should preferably be free from air pipes, valves, smaller hatches etc. However, when this becomes impractical, proper arrangement shall be provided as protection against personnel injury. Bulwarks or railings in way of the rescue zone shall be of a type easy to open or remove, to enable direct boarding on the deck. A searchlight shall be available on each side and operated from the navigation bridge. The searchlights should be able to provide an illumination level of 50 lux in clear air, within an area not less than 10 m diameter, to a distance of 250 m. Each rescue zone shall be provided with a scrambling net made of corrosion resistant and non-slip material. The vessel shall be provided with power assisted means capable of ensuring careful recovery of disabled persons from the sea. A decontamination area equipped with a shower system shall be arranged for cleaning survivors and crew before entering the superstructure.

The vessel shall have a treatment room for casualties, a recovery room with berths, and enclosed space to accommodate survivors. These spaces shall be provided with lighting and means to control temperature and humidity suitable for the area of operation. The survivors may be accommodated in crew spaces, excluding sanitary rooms, treatment rooms, galley, wheelhouse, radio room, cabins for captain and two crew members. The designed capacity of survivors shall be determined considering 0.75 m² per person. This includes free floor space and floor space with loose furniture, fixed seating and/or fixed beds. Other fixed furniture, toilets and bathrooms shall be excluded. Corridors and doors giving access to the treatment room for casualties and recovery room shall be dimensioned to allow adequate transport of survivors by stretchers. Sanitary facilities shall be available exclusively for the survivors. At least one installation comprising a toilet, a wash basin and shower shall be provided for each group of 50 survivors.

The vessel shall be equipped with at least one fast rescue boat of type complying with IMO MSC/Circ.809, arranged and maintained to be permanently ready for use under severe weather conditions. The launching arrangement shall be a SOLAS approved type. The following minimum safety equipment shall be provided when the vessel has a gross tonnage less than 500:

- one line-throwing appliance with not less than four projectiles and four lines
- one daylight signalling lamp
- six lifebuoys, 4 being with a self-igniting light and buoyant line (SOLAS approved type)
- one SOLAS type approved immersion suit for each crew member
- one SOLAS type approved lifejacket for each crew member plus 25% of the number of survivors for which the vessel is intended to carry.

The treatment room shall have adequate equipment and medical supplies. Treatment room equipment and medical stores should be arranged as required by local regulations or based on recognised standards.

Guidance note:
The vessel shall be provided with blankets in sufficient quantity for the number of survivors for which the vessel is intended to carry.
E. Intact and Damage Stability

E 100 General

101 The vessel shall comply with intact stability requirements as given in Sec.2 D and damage stability requirements as given in Sec.5.

Guidance note:
A detailed description of stability documentation is given in Classification Note No. 20.1.

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F. Steel Deckhouses and Superstructures (Class Notation Standby Vessel (S))

F 100 Scantling for superstructures and deckhouses

101 The section modulus of stiffeners and beams shall not be less than:
\[ Z = 0.7 \frac{l^2}{s} p \text{ (cm}^3\text{)} \]

\[ p = \text{design pressure in kN/m}^2 \]
\[ = a p_2 \text{ for exposed decks and bulkheads} \]
\[ = \text{minimum 10 kN/m}^2 \text{ for weather decks} \]
\[ = \text{minimum 5 kN/m}^2 \text{ for top of the wheelhouse} \]
\[ = 8 \text{ kN/m}^2 \text{ for accommodation decks, aft of 0.2 L from A.P and forward of 0.2 L from F.P.} \]
\[ = 6.5 \text{ kN/m}^2 \text{ elsewhere} \]

\[ a = 2 \text{ for front bulkheads} \]
\[ = 1.2 \text{ for sides, aft end bulkheads and weather decks.} \]

\[ p_2 = \text{design sea pressure as given in Pt.3 Ch.2 Sec.7 B100 and Pt.3 Ch.2 Sec.10 C100 as applicable} \]

\[ l = \text{span [m]} \]

\[ s = \text{spacing [m]}. \]

102 Stiffeners shall have effective end connections. Beams and stiffeners shall be connected by brackets. Stiffeners on lower front bulkhead on weather deck forward shall have brackets at lower end.

103 The plate thickness in deckhouses and end bulkheads of superstructures shall not be less than:
\[ t = \left[ t_0 + 0.02L \right] \frac{c}{\sqrt{t_1}} \text{ [mm]} \]

\[ t_0 = 6 \text{ for front bulkheads and weather deck forward of the lowest tier of the front bulkhead} \]
\[ = 5 \text{ for sides and aft end bulkheads and weather decks elsewhere} \]
\[ = 4.5 \text{ for deckhouse decks (in way of accommodation).} \]

\[ c = \frac{s}{0.65}, \text{ minimum 1.0} \]

F 200 Weathertight doors

201 The arrangement and sill heights of weathertight doors are in general to comply with Pt.3 Ch.3 Sec.6 B. Doors in exposed positions on the lowest weather deck and in lowest unprotected fronts and sides shall be of steel.

202 For doors located in exposed positions in sides and front bulkheads, the requirements to sill heights apply one deck higher than given by Pt.3 Ch.3 Sec.6 B.

203 Doorways to the engine room and other compartments below the weather deck are, as far as is practicable, to be located at a deck above the weather deck. Alternatively, two weathertight doors in series may be accepted.

F 300 Windows and side scuttles

301 Arrangement of windows and scuttles shall comply with the requirements given in Sec.2 E600.
SECTION 7
FIRE FIGHTERS

A. General

A 100 Classification

101 Vessels built in compliance with the relevant requirements specified in this section may be given the class notation Fire Fighter with one or more of the following qualifiers I, I+, II or III.

102 Vessels not fully in compliance with this section or not specifically built for the services intended to be covered by this section but which have special fire fighting capabilities in addition to their regular service, may be specially considered and reviewed under the intent of this section as they relate to fire fighting. Such vessels, complying as a minimum Part I of this section, may be given the class notation Fire Fighter Capability. The standard applied, with relevant data on the extent of this special fire fighting capability will be entered into the “Appendix to the Class Certificate” and such special fire fighting systems will be subject to annual surveys.

A 200 Objectives

201 The requirements in this section apply to vessels intended for fighting fires onboard ships and on offshore and onshore structures. It is intended that these types of vessel shall act as additional fire-fighting stations, by providing water to combat fire and in support of ongoing rescue operations.

202 The qualifiers I and I+ imply that the vessel has been built for early stage fire fighting and for support of rescue operations onboard or close to structures or ships on fire.

203 To meet its objectives, a Fire Fighter I vessel shall be designed with active protection, giving it the capability to withstand higher heat radiation loads from external fires. In addition, the vessel includes a sufficient set of fire fighting equipment.

204 Qualifier I+ differentiates itself from I with a higher reliability and capability. In addition to active protection as named in 202, the vessel shall have passive protection, giving it the capability to withstand the higher heat radiation loads also when the active protection fails. In addition, the vessel incorporates a longer throw length.

205 The qualifiers II and III imply that the vessel has been built for continuous fighting of large fires from a safe distance and for the cooling of structures on fire.

206 Qualifier III requires a larger water pumping capacity and more comprehensive fire fighting equipment when compared to the II.

207 If a vessel has been fitted with a fire fighting systems and equipment in accordance with the qualifiers II or III and has also been designed with passive and/or active heat radiation protection in accordance with the class notation I+ or I, then a combination of the two notations may be given.

A 300 Scope

301 The fire fighter class notations encompass the following:

— the vessel's fire fighting capability
— the vessel's stability and its ability to keep its position when the fire fighting water monitors are in operation
— the vessel's passive and active heat radiation protection against external fires.

302 Arrangements for survivor rescue and recovery is not part of the Fire Fighter notations.

303 A detailed scope for the different qualifiers follows from the content of this chapter by an indication or a statement in wording to which qualifier the requirements applies to. Without such an indication or statement, the requirement is applicable for any qualifier.

Guidance note:
C100 ‘Active fire protection (Qualifiers I and I+)’ indicates that the applicable paragraph is applicable for qualifiers I and I+ only.

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A 400 Assumptions

401 Granting of fire fighter class notations will be based on the assumption that the following has been complied with when operating the vessel as a fire fighter:

— the instructions laid down in the Operation Manual for fire fighting are being followed
— the vessel will carry a sufficient quantity of fuel oil for continuous fire fighting operations, with all fixed
water monitors in use for a period of not less than: 24 hours for qualifiers I and I+, and 96 hours for qualifiers II and III
— foam-forming liquid for at least 30 minutes continuous foam production for the fixed foam monitors is stored onboard vessels with qualifier III
— foam-forming liquid for at least 30 minutes continuous foam production by the mobile generator is stored in suitable containers onboard vessels with qualifiers II or III
— the crew operating the fire fighting systems and equipment has been trained in such operations, including the use of air breathing apparatus.
— the skill of the crew is maintained by exercises (drills).

A 500  Documentation requirements

501  Documentation shall be submitted for approval as required by Table A1.

502  For general requirements to documentation, see Pt.0 Ch.3 Sec.1.

503  For a full definition of the documentation types, see Pt.0 Ch.3 Sec.2.

Table A1 Documentation Requirements

<table>
<thead>
<tr>
<th>Function</th>
<th>Documentation type</th>
<th>Additional description</th>
<th>Relevance for qualifier</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sea chest</td>
<td>I100 - System diagram</td>
<td>For fire fighting monitors.</td>
<td>All</td>
</tr>
<tr>
<td>Structural fire protection arrangements</td>
<td>G060 - Structural fire protection drawing</td>
<td>Outer boundaries, including external doors and windows.</td>
<td>I+</td>
</tr>
<tr>
<td>Fire fighting arrangements</td>
<td>Z160 - Operation manual</td>
<td>FIFI operation.</td>
<td>All</td>
</tr>
<tr>
<td>Fire fighting arrangements</td>
<td>Z180 - Maintenance manual</td>
<td>FIFI operation.</td>
<td>All</td>
</tr>
<tr>
<td>Fire water supply and distribution arrangement</td>
<td>S010 - Piping diagram</td>
<td>All</td>
<td>All</td>
</tr>
<tr>
<td>Fire fighting vessel fire extinguishing system</td>
<td>G200 - Fixed fire extinguishing system documentation</td>
<td>Supporting structure for pumps, pump drivers and monitors.</td>
<td>All</td>
</tr>
<tr>
<td>Fire fighting vessel water spraying fire extinguishing system</td>
<td>H050 - Structural drawing</td>
<td>All</td>
<td>All</td>
</tr>
<tr>
<td>Fire-fighter's outfit</td>
<td>Z030 - Arrangement plan</td>
<td>All</td>
<td>All</td>
</tr>
<tr>
<td>Breathing air compressor unit</td>
<td>Z030 - Arrangement plan</td>
<td>All</td>
<td>All</td>
</tr>
<tr>
<td>Flood light</td>
<td>Z030 - Arrangement plan</td>
<td>All</td>
<td>All</td>
</tr>
<tr>
<td>Stability</td>
<td>B120 - Final stability manual</td>
<td>For details, see Classification Note No. 20.1.</td>
<td>All</td>
</tr>
</tbody>
</table>

A 600  Certification

601  Certificates shall be required for the components shown in Table A2:

Table A2 Required certificates

<table>
<thead>
<tr>
<th>Components</th>
<th>DNV product certificate</th>
<th>Works certificate</th>
<th>Test report</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fire fighting pumps and their prime movers</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compressors for filling the cylinders of air-breathing apparatus</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pipes and valves</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Foam liquid suitable for its intended use</td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>
A 700  Testing

701  Testing shall be carried out to verify that the vessel, fitted with fire fighting systems and equipment, is able to operate as intended and has the required capacities. The height and length of throw of the water monitors shall be demonstrated. The angle of list, with water monitors in operation in the most unfavourable position, shall also be measured.

702  For qualifiers I and I+, fire main capacities shall be tested as follows:

   — The static pressure measured at the fire hydrant manifold shall be not less than 0.25 N/mm² with four (4) jets of water from hoses simultaneously engaged to one of the fire hydrant manifolds required in G100.
   — In a separate test, both water monitors shall be tested in operations simultaneously with the active heat radiation protection system in operation for not less than one (1) hour or until the temperature of the dedicated fire fighter pumps' prim-movers are stabilised.

703  For qualifier II, the number of hoses simultaneously engaged shall be not less than six (6) and for qualifier III not less than eight (8) for the test specified in 602.

B. Basic Requirements

B 100  Operation manual

101  The following information shall be included in an approved operation manual kept onboard:

   — line of responsibility and delegation of tasks
   — description of each fire fighting system and the equipment covered by the classification
   — safety precautions and start-up procedures
   — instructions for use, testing and maintenance of the fire fighting installations and the equipment (or may be only referred to)
   — instructions for operation of the vessel during fire fighting
   — plan and records for periodically testing and drills.

B 200  Manoeuvrability

201  The vessel shall have side thrusters and propulsion machinery of sufficient power for adequate manoeuvrability during fire fighting operations.

202  Side thruster(s) and main propeller(s) shall be able to keep the vessel at a standstill in calm waters at all combinations of capacity and direction of throw of the water monitors, and the most unfavourable combination shall not require more than 80% of the available propulsion force in any direction.

203  If the system design is such that, in any operating combination, it will be possible to overload the power supply, a power management system shall be arranged. This system shall include alarm at 80% of available power and automatic action at 100% available power.

204  The operation of the side thruster(s) and the main propeller(s) shall be simple and limited to the adjustment of:

   — resultant thrust vector for the vessel
   — possible adjustment of the turning moment
   — possible adjustment of heading (gyro stabilised).

Operation shall be arranged at the workstation where the monitors are controlled.

205  It shall be visually indicated when this workstation has control. Failure in the control system shall initiate an alarm.

B 300  Floodlights

301  As an aid for operations in darkness, at least two adjustable floodlights shall be fitted onboard, capable of providing an illumination level of 50 lux in clear air, within an area not less than 10 m diameter, to a distance of 250 m. The floodlights shall be of high pressure sodium vapour type or equivalent.
C. Protection of the Vessel against External Heat Radiation

C 100 Active fire protection (Qualifiers I and I+)

101 The vessel shall be protected by a permanently installed water-spraying system. Water shall be applied by means of sprinkler nozzles, monitor nozzles and water shield nozzles or a combination thereof. Vertical sides of superstructures shall be protected by spray nozzles.

102 The fixed water-spraying system shall provide protection for all outside vertical areas of hull, superstructures and deckhouses including foundations for water monitors, essential external equipment for fire fighting operations and external life rafts and lifeboats and rescue boats. Water spray may be omitted for bulwark and rails.

103 The arrangement for the water-spraying system shall be such that necessary visibility from the wheelhouse and the control station for remote control of the fire fighting water monitors can be maintained during the water spraying.

104 The pipelines and nozzles shall be so arranged and protected that they will not be exposed to damage during the operations for which the vessel is intended.

105 The fixed water-spraying system shall have a capacity not less than 10 litres per minute per m² of the areas to be protected. For areas internally insulated to class A-60, however, a capacity of 5 litres per minute per m² may be accepted.

106 The pumping capacity for the fixed water-spraying system shall be sufficient to deliver water at the required pressure for simultaneous operation of all nozzles in the total system.

107 The pumps for the fire fighting water monitors may also serve the water-spraying system, provided the pump capacity is increased by the capacity required for the water spraying system. A connection with shut-off valve is then to be fitted between the fire main for the monitors and the main pipeline for the water spraying system. Such arrangements shall allow for separate as well as simultaneous operation of both the fire fighting water monitors and the water spray system.

108 All pipes for the fixed water-spraying systems shall be protected against corrosion both externally and internally, by hot galvanizing or equivalent. Drainage plugs shall be fitted to avoid damages by freezing water.

109 The spray nozzles shall provide an effective and even distribution of water spray over the areas to be protected. The spray nozzles are subject to the Society's approval for their purpose.

C 200 Passive fire protection (Qualifier I+ only)

201 Hull and superstructure shall be constructed of steel. External doors and hatches shall be of steel. Windows in boundary of superstructure/deckhouse, including bridge shall comply with A-0 class. External platforms and exposed piping systems shall be of steel.

D. Water Monitor System

D 100 Capacities

101 The requirements for the various class notations are given in Table D1.

<table>
<thead>
<tr>
<th>Class notation</th>
<th>Fire Fighter I and I+</th>
<th>Fire Fighter II</th>
<th>Fire Fighter III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of monitors</td>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Capacity of each monitor (m³/h)</td>
<td>1200</td>
<td>3600</td>
<td>2400</td>
</tr>
<tr>
<td>Total pump capacity (m³/h)</td>
<td>2400</td>
<td>7200</td>
<td>9600</td>
</tr>
<tr>
<td>Length of throw (m) 1)</td>
<td>120</td>
<td>180</td>
<td>150</td>
</tr>
<tr>
<td>Height of throw (m) 2)</td>
<td>50</td>
<td>110</td>
<td>80</td>
</tr>
<tr>
<td>Fuel oil capacity in hours 3)</td>
<td>24</td>
<td>96</td>
<td>96</td>
</tr>
</tbody>
</table>

1) For qualifier I, measured horizontally from the monitor outlet to the mean impact area. For I+, II and III, measured horizontally from the mean impact area to the nearest part of the vessel when all monitors are in satisfactory operation simultaneously.
2) Measured vertically from sea level to mean impact area at a horizontal distance of at least 70 m from the nearest part of the vessel.
3) Capacity for continuous operation of all monitors, to be included in the total capacity of the vessel's fuel oil tanks.
D 200 Arrangement

201 The monitors shall play either forward or aft. The horizontal angular movement of each monitor shall be at least 90°, with minimum play across the vessels centre line of 30°. The necessary angular movement in the vertical direction is determined by the required height of throw of the water jet.

The monitors shall be so positioned that they will have a free line for the water jet over the horizontal area covered.

202 At least two of the water monitors shall have a fixed arrangement making dispersion of the water jet possible.

203 The monitors shall be so arranged that the required length and height of throw can be achieved with all monitors operating simultaneously along the centre line of the vessel.

D 300 Monitor control

301 The activating and the manoeuvring of the monitors shall be remotely controllable. The remote control station shall be arranged in a protected control room with a good general view.

The valve control shall be designed to avoid water hammer.

302 As a minimum, there shall be arranged two independent control systems such that a single failure will not disable more than 50% of the monitors installed. Failure in any remote control system shall initiate an alarm at the workstation from where the monitors are controlled.

303 Open and closed indication of remotely controlled valves, if fitted, shall be indicated at the remote control station.

304 Where an electrical control system is applied, each control unit shall be provided with overload and short-circuit protection, giving selective disconnection of the circuit in case of failure.

Where a hydraulic or pneumatic control system is applied, the control power units shall be duplicated.

305 In addition to the remote control, local and manual control of each monitor shall be arranged.

**Guidance note:**

It is advised that the local and manual control devices are automatically disconnected when remote operation is applied.

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

306 All shut-off and control equipment shall be clearly marked.

D 400 Design and support of monitors

401 The monitors and their foundations shall be capable of withstanding the loads to which they may be subjected on the open deck, dynamic loads resulting from the vessel's movement at sea, as well as the reaction forces from the water jet.

402 The monitors shall be able to give a solid water jet, so that the impact area will be concentrated and limited. The materials applied shall be selected with due regard to the corrosive properties of seawater and saline air. The monitors shall be of a design approved by the Society.

E. Foam Monitor System (Qualifier III)

E 100 Capacities

101 In addition to the water monitors, the vessel shall be equipped with 2 foam monitors, each of a capacity not less than 5000 litres/minute with a foam expansion ratio of maximum 15 to 1.

102 The foam system, together with the arrangement and location of the monitors, shall give a height of throw at least 50 m above sea level when both monitors are used simultaneously with maximum foam generation.

103 The foam concentrate tank shall have capacity for at least 30 minutes of maximum foam generation from both foam monitors. When determining the necessary quantity of foam concentrate, the admixture is assumed to be 5%.

E 200 Arrangement

201 The arrangement shall comply with the same principles as given under D201.

202 The foam generating system shall be of a fixed type with separate foam concentrate tank, foam-mixing unit and pipelines to the monitors. The water supply to the system may be taken from the main pumps for the water monitors. In such cases it may be necessary to reduce the main pump pressure to ensure correct water pressure for maximum foam generation.
**E 300 Monitor control**

301 The foam monitors shall be remotely controllable. This also concerns the operation of the valves necessary for control of water and foam concentrate. The remote control of the foam monitors shall be arranged from the same control room as the control of the water monitors and the control system shall comply with the same principles as given in D302 to D304. Local/manual control of each monitor is also to be arranged.

302 All shut-off and remote control equipment shall be clearly marked.

**E 400 Monitor design**

401 The foam monitors shall be of a design approved by the Society.

**F. Pumps and Piping**

**F 100 General**

101 The arrangement shall be such that the water monitors will be able to deliver an even jet of water without pulsations of significance.

102 The requirements for pumping and piping systems given for systems covered by the main class, as well as the requirements for standard water extinguishing appliances and appliances for fire extinguishing on open decks given for main class, shall be complied with as far as applicable to systems fighting fires outside the vessel.

**F 200 Pumps**

201 The pumps for the fire fighting system and the machinery driving the pumps shall be adequately protected, and shall be so located that they will be easily accessible during operation and maintenance.

**F 300 Seawater inlets and sea chests**

301 Seawater suctions for fire fighting pumps shall not be arranged for other purposes. The seawater suction valve, the pressure valve and the pump motor shall be operable from the same position. Valves with nominal diameter exceeding 450 mm shall be power actuated as well as manually operable.

302 An interlock shall prevent start or engagement of the gear for the fire fighting pumps when the water inlet valve is closed and the pressure valve is open. Alternatively, warning by means of audible and visual alarm shall be given if starting of the fire fighting pumps or engaging gears for the pumps is carried out with the inlet valve closed and the pressure valve open. This alarm shall be given at all control positions for the start or engagement of the gear for the fire fighting pumps.

303 Suitable means for filling the water monitors' supply piping downstream of the pressure valves and up through the monitors whilst the pressure valves are in the closed position, shall be arranged.

304 Seawater inlets and sea chests shall be of a design ensuring an even and sufficient supply of water to the pumps. The location of the seawater inlets and sea chests shall be such that the water supply is not impeded by the ship's motions or by the water flow to and from bow thrusters, side thrusters, azimuth thrusters or main propellers.

305 Strums shall be fitted to the sea chest openings in the shell platting. The design maximum water velocity through the strum holes is not to exceed 2 m/s.

**F 400 Piping systems**

401 The piping system from the pumps to the water monitors shall be separate from the piping system to the hose connections required for the mobile fire fighting equipment.

402 The piping systems shall have arrangements to avoid overheating of the pumps at low delivery rates.

403 Suctions lines shall be designed to avoid cavitations in the water flow. The lines are to be as short and as straight as practicable. Pump shall preferably be located below the water line.

In any case shall the net positive suction head (NPSH) for the pump system be designed according to the following formula:

\[ \text{NPSH available} - 1 \text{ meter water column} > \text{NPSH required} \]

For pumps located above water line an approved self priming system shall be provided.

**Guidance note:**

NPSH available is the ship specific available net suction head (expressed in meter water column - mwc) as function of the elevation of the pump in relation to the waterline deduced for the pressure losses in the sea chest and supply piping up to the inlet flange of the pump.
NPSH required is the net suction head (expressed in mwc) required by the pump in question in order to prevent cavitation.

---end-of-Guide---Note---

404 All piping from seawater inlets to water monitors shall be internally protected against corrosion to a degree at least corresponding to hot galvanizing. Paint is accepted as external corrosion protection of piping exposed to weather.

The part of pipes passing through fuel oil tanks shall have thickness as for ballast pipes passing through fuel oil tanks in accordance with Pt.4 Ch.6 Sec.6 Table A2. The corrosion protection of the pipes within the tank shall be to the same level as the internal tank structure, while internal corrosion protection may be excluded for this part. A system for drainage the pipes within the fuel tank shall be arranged. Instruction shall be included in the operation manual for draining of these pipes upon completion of a fire fighting operation.

405 The piping layout shall be in accordance with good marine practice with large radius bends, and shall be satisfactorily protected against damage.

G Mobile Fire Fighting Equipment

G 100 Fire hydrants manifolds and hoses for external use

101 In addition to the fire hydrants required for onboard use, fire hydrant manifolds shall be provided on the port and starboard sides of the weather deck. The hose connections shall therefore point outwards.

102 Vessels with qualifiers I and I+ shall have one fire hydrant manifold arranged on the port side and one on the starboard side, each with at least 4 hose connections.

103 For vessels with qualifier II the number of additional hose connections at each of the fire hydrant manifolds positioned on the port and starboard sides shall be not less than six (6). For vessels with qualifier III the number is not less than eight (8).

104 In addition to the required number of hoses for onboard use, at least 8 × 15 m fire hoses of 50 mm diameter and 4 combined 16 mm jet and water spray nozzles shall be kept onboard in a readily available positions for vessels with qualifiers I and I+. For those with qualifier II, the number shall be increased to 12 hoses and 6 nozzles and for qualifier III to 16 hoses and 8 nozzles.

105 The pressure in the fire hydrant manifold shall be not less than 2.5 bar and maximum 5 bar when tested as described in A700 with one length of hose fitted with a standard 16 mm nozzle fully open on each hose connection on one fire hydrant manifold.

106 The pumps for monitors and or water spray system may be used for supply of water to the fire hydrant manifolds required by 101 providing the capacity is increased so that all connected consumers can be simultaneously served. In such case connections with shut-off valves shall be fitted between the fire main for the monitors and or water spray system in order to allow for separate as well as simultaneously operation of fire fighting water monitors and/or the water spray system as well as hoses connected the fire hydrant manifolds.

Further, valves to be arranged for independent supply to the fire hydrant manifolds without having the monitor and or the water spray in use.

107 Hoses and nozzles shall be of a design approved by the Society.

G 200 Foam generator

201 Vessels with qualifier II and III shall have a mobile high expansion foam generator with a capacity of not less than 100 m³/minute for fighting of external fires.
202 Foam-forming liquid shall be stored in containers, each of about 20 litres, suitable for mobile use. The total storing capacity of foam-forming liquid shall be sufficient for 30 minutes continuous foam production.

H. Firefighter’s Outfit

H 100 Number and extent of the outfits

101 Vessels with qualifiers I and I+ shall have at least 4 sets of firefighter's outfits.

102 Vessels with qualifier II shall have six (6) fire-fighter's outfits, and vessels with qualifier III shall have eight (8) fire-fighter's outfits.

103 The extent of the fire fighter’s outfits shall be as specified for main class. Each breathing apparatus shall have a total air capacity of at least 3600 litres including the spare cylinders.

H 200 Location of the firefighter’s outfits

201 The firefighter's outfits shall be placed in at least two separate fire stations of which one shall have access from the open deck. The entrance to the fire station shall be clearly marked. The room shall be arranged for ventilation and heating.

202 The arrangement of the fire station shall be such that all equipment will be easily accessible and ready for immediate use.

H 300 Compressed air supply

301 A high pressure compressor with accessories suitable for filling the cylinders of the breathing apparatuses, shall be installed onboard in the safest possible location. The capacity of the compressor shall be at least 75 litres/minute. The air intake for the compressor shall be equipped with a filter.

I. Stability and Watertight Integrity

I 100 General requirements

101 For vessels with a length Lₚ of 24 m and above, the stability shall be assessed when the water monitors are in operation at full capacity in the most unfavourable direction with respect to stability. A calculation showing the point of balance between the reaction forces from the water monitors and the forces from the vessel's propulsion machinery and its side thrusters shall be presented.

The monitor heeling moment shall be calculated based on the assumption in 102. The criterion in 103 shall be complied with.

102 Monitor heeling moment

The heeling force 'F' from the water monitor(s) shall be assumed in the transverse direction, based on full capacity as given in Table D1.

The monitor heeling arm 'a' shall be taken as the vertical distance between the centre of side thruster(s) and the centre line of the monitor(s).

103 Criterion

The monitor heeling lever, calculated as F·a/displacement, shall not exceed 0.5 times the maximum GZ corresponding to maximum allowable VCG.

If the maximum GZ occurs after 30°, the GZ at 30° shall be used instead of the maximum GZ.

Additional information on the monitor capacity, position, heeling force and moment as well as plotting the monitors' heeling lever on the GZ diagram of the most unfavourable loading conditions shall be included in the stability manual.
SECTION 8
OFFSHORE SERVICE VESSELS FOR TRANSPORTATION
OF LOW FLASHPOINT LIQUIDS

A. General

A 100 Classification

101 Objective
The object of this section is to define minimum requirements to vessels intended for transportation of liquids with flashpoint below 60°C in bulk to and from offshore installations.

102 Scope
This rule chapter includes requirements for arrangement and location of low flashpoint liquid tanks and spaces with low flashpoint liquid piping and installations, including requirements to entrances to such spaces. Requirements to piping systems in cargo area, gas freeing, inerting and venting of cargo tanks, ventilation system within the cargo area, fire protection and extinction, electrical installations in hazardous areas, area classification, instrumentation and control system are included. Operational instructions are required for approval.

103 Application
Compliance with the rules in this section is mandatory for vessels intended for transportation of liquids with flashpoint not lower than 43°C and which are not assigned the class notations Tanker for Oil or Tanker for Chemicals.

Vessels built and equipped in compliance with the requirements of this section for carriage of liquids with flashpoint not lower than 43°C will be given the class notation LFL (Low Flashpoint Liquids).

If the requirements for carriage of liquids with flashpoint not lower than 43°C are complied with, the notation LFL* will be given.

104 Cargoes intended to be carried in vessels to be built for class notation LFL or LFL* shall be specified for approval by the Society. The cargoes which may be carried will be stated in the “Appendix to the classification certificate”.

105 Vessels built for class notation LFL or LFL* are also to comply with the requirements in Sec.2 D and Sec.5.

A 200 Assumptions

201 The classification of the vessel is based on the assumption that cargo handling operations are carried out in accordance with the approved instruction manual, see I.

202 It is assumed that dry cargo and low flashpoint liquid cargo are not carried simultaneously unless one of the following conditions is satisfied:

— the cargo has a flashpoint of not less than 43°C and is only carried within areas where it is known for certain that the ambient air temperature cannot rise to within 10°C below the flashpoint of the cargo
— dry cargo is carried aft and low flashpoint liquid cargo forward of the superstructure, or vice versa
— the cargo tanks are kept filled with inert gas and the gas-concentration in the cofferdams is kept monitored by an automatic gas detection arrangement while the vessel is on dry cargo service
— the cargo tanks are kept filled with inert gas and the cofferdams are filled with water while the vessel is on dry cargo service
— the cargo tanks are kept filled with inert gas and the cofferdams are kept filled with inert gas and monitored by a leakage detection system while the vessel is on dry cargo service.

Operational assumptions corresponding to the above will be stated in the “Appendix to the classification certificate”.

A 300 Definitions

301 A hazardous area is an area in which an explosive gas atmosphere is or may be expected to be present, in quantities such as to require special precautions for the construction, installation and use of electrical apparatus. Hazardous areas shall be defined in compliance with H.

302 The term cargo refers generally to liquids having flashpoint below 60°C.

303 Cargo area is that part of the offshore support vessel where cargo and cargo vapours are likely to be present as defined in H.
**A 400 Documentation**

401 Details related to the additional class regarding design, arrangement and strength are in general to be included in the plans specified for the main class.

402 Documentation shall be submitted as required by Table A1.

<table>
<thead>
<tr>
<th>Table A1 Documentation requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Object</strong></td>
</tr>
<tr>
<td>Cargo piping system</td>
</tr>
<tr>
<td>Inert gas system</td>
</tr>
<tr>
<td>Cargo heating system</td>
</tr>
<tr>
<td>Hazardous areas</td>
</tr>
<tr>
<td>Ventilation systems in cargo area</td>
</tr>
<tr>
<td>Cargo tanks pressure-vacuum valves</td>
</tr>
<tr>
<td>Electrical installation in hazardous areas</td>
</tr>
<tr>
<td>Cargo tanks level monitoring system</td>
</tr>
<tr>
<td>Cargo tanks overflow protection system</td>
</tr>
<tr>
<td>Cargo valves and pumps control and monitoring system</td>
</tr>
<tr>
<td>Hydrocarbon gas detection and alarm system, fixed</td>
</tr>
<tr>
<td>Cargo area leakage detection system</td>
</tr>
<tr>
<td>Cargo tank deck fire extinguishing system</td>
</tr>
<tr>
<td>Exhaust systems</td>
</tr>
<tr>
<td>Internal access</td>
</tr>
</tbody>
</table>

403 For general requirements to documentation, including definition of the info codes, see Pt.0 Ch.3 Sec.1.

404 For a full definition of the documentation types, see Pt.0 Ch.3 Sec.2.

405 When national authorities survey the vessel in accordance with the current requirements of the International Convention on Safety of Life at Sea (SOLAS), copies of the Cargo Ship Safety Construction Certificate and the Cargo Ship Safety Equipment Certificate shall be submitted by the ship-owner or building yard. This documentation will be considered as equivalent to a survey carried out by the Society.
A 500  Materials

501 Structural materials used for tank construction, together with associated piping, valves, vents and their
jointing materials, shall be suitable at the carriage temperature and pressure for the cargo to be carried, to the
satisfaction of the Society.

A 600  Surveys and testing

601 Before assignment of class all systems covered by this section are to be function tested. This shall also
include testing of the nitrogen system capacity to verify that it is in accordance with D204.

A 700  Certification of control and monitoring system

701 Components shall be certified as required by Table A2.

<table>
<thead>
<tr>
<th>Table A2 Certification requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Object</td>
</tr>
<tr>
<td>Inert gas control and monitoring system</td>
</tr>
<tr>
<td>Hydrocarbon gas detection and alarm system, fixed</td>
</tr>
<tr>
<td>Cargo tanks level monitoring system</td>
</tr>
<tr>
<td>Cargo tanks overflow protection system</td>
</tr>
<tr>
<td>Cargo valves and pumps control and monitoring system</td>
</tr>
</tbody>
</table>

B. Vessel Arrangement

B 100  Tank arrangement

101 Cargo tanks shall not be located within the accommodation or engine room area. Engine room and
accommodation shall not be located above tanks or cofferdams.

102 Where not bounded by bottom shell plating or pump room, the cargo tanks shall be surrounded by
cofferdams.

For safe access to and within tanks for low flashpoint liquids and adjacent cofferdams, horizontal hatches or
openings to or within cargo tanks or cofferdams surrounding tanks for low flashpoint liquids are to have a
minimum clear opening of 600 × 600 mm that also facilitates the hoisting of an injured person from the bottom
of the tank/cofferdam. For access through vertical openings providing main passage through the length and
breadth within cargo tanks and cofferdams surrounding tanks for low flashpoint liquids, the minimum clear
opening shall not be less than 600 × 800 mm at a height of not more than 600 mm from bottom plating unless
gratings or footholds are provided. Smaller openings may be accepted provided evacuation of an injured person
from the bottom of the tank/cofferdam can be demonstrated.

Minimum horizontal distance between the tank side or pipes leading from the tank and the ship's shell shall be
760 mm.

103 Cargo tanks situated forward of the superstructure may extend to the deck plating, provided dry cargo is
not handled in this area.

104 Cargo tanks for liquids with a flashpoint of not less than 43°C may extend to the ship's shell and the deck
plating.

Tanks for other purposes (except freshwater and lubricating oil tanks) will be accepted as cofferdams for these
tanks.

105 The spaces forward of the collision bulkhead (forepeak) and aft of the aftermost bulkhead (afterpeak)
shall not be arranged as cargo tanks nor as cofferdams.

106 Cofferdams shall be arranged for water filling. The filling system shall not be permanently connected to
the cofferdams.

107 Tanks on open deck may be approved after special considerations in each particular case.

108 Cargoes, which react in a hazardous manner with other cargoes or fuel oils, shall be segregated from such
other cargoes or oil fuel by means of a cofferdam, pump room or tank containing a mutually compatible cargo.

B 200  Access and openings general

201 No accommodation, service spaces, control stations or machinery spaces shall be located within the
cargo area.
B 300 Access and openings to accommodation

301 Entrances, air inlets and openings to accommodation, service and machinery spaces and control stations are, in general, not to face the cargo area.

For vessels with cargo tanks aft of the superstructure, entrances, air inlets and openings facing the cargo area may be accepted provided they are situated at least 10 m from the nearest hazardous area.

The following provisions apply for such boundaries:

a) Doors shall be kept closed during loading/discharge operations. Signboards shall be fitted.

b) Port lights or windows shall be of a non-opening type. Inside covers of steel or equivalent material shall be fitted in the first tier on main deck.

c) Ventilation inlets shall be fitted as far as practicable from the nearest hazardous area (in no case less than 10 m).

B 400 Access and openings to pump room and cargo tanks

401 Cargo tanks and cofferdams surrounding cargo tanks shall have suitable access from open deck for cleaning and gas-freeing. Where cofferdams are provided over cargo tanks, small trunks are to be arranged to penetrate the cofferdam. The trunks shall be arranged for water filling.

402 Access openings are not to be arranged from cargo tanks or cofferdams to other spaces.

404 Access entrances and passages shall have a clear opening of at least 600 by 600 mm.

B 500 Chain locker and windlass

501 The chain locker shall be arranged as a non-hazardous space.

502 Windlass cable lifters and chain pipes shall be situated outside hazardous areas.

B 600 Miscellaneous

601 Exhaust outlets from combustion equipment shall have spark arrestors.

602 Surface temperatures of equipment and piping in hazardous areas shall not exceed 220°C.

C. Piping System in Cargo Area

C 100 General

101 Cargo piping systems shall comply with the requirements in Ch.4.

102 There shall be no permanent connection between piping systems in the cargo area and piping systems in the remainder of the vessel. For exemption see 300.

103 Where non-permanent connections between piping systems in the cargo area and piping systems in the remainder of the vessel are accepted, this separation may be achieved by the use of one of the following arrangements:

— removing spool pieces or valves and blanking the pipe ends
— blind flange valves.

Such arrangements shall not be located within a cargo tank or cofferdam.

For filling and drainage of cofferdams surrounding cargo tanks, non-permanent hose connections will be accepted.

104 The cofferdam boundaries shall not be penetrated at a level below the top of the cargo tanks.

Guidance note:

Typically hydraulics for pumps and valves, cables for instrumentation.

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

105 Bulkhead penetrations shall not utilise flanges bolted through the bulkhead.

106 Deck spills shall be kept away from accommodation and service areas through suitable precautionary means, such as a permanent coaming of suitable height extending from side to side or around loading and discharge stations.

107 Cargo pump room, pipe tunnels and cofferdams shall have a separate drainage system connected to
pumps or bilge ejectors situated entirely within the cargo area.

108 Bilge ejectors serving hazardous areas shall not be permanently connected to the drive water system.

109 Cofferdams shall be provided with sounding pipes and with air pipes led to the atmosphere. The air pipes shall be fitted with flame screens at their outlets.

C 200 Cargo piping system

201 The complete cargo piping system shall be located within the cargo area and shall be entirely separate from all other piping systems on board.

202 Cargoes, which react in a hazardous manner with other cargoes, shall have separate pumping and piping systems, which shall not pass through other cargo tanks containing such cargoes unless encased in a tunnel.

203 Cargo piping shall not penetrate cargo tank boundaries below the top of the tank. However, penetrations below the top of the tank may be accepted provided that a remotely operated stop valve is fitted within the cargo tank served. Where a cargo tank is adjacent to a pump room, the remotely operated stop valve may be fitted on the cargo tank bulkhead on the pump room side.

204 Filling lines to cargo tanks shall be so arranged that the generation of static electricity is reduced, e.g. by reducing the free fall into the tank to a minimum.

205 Hydraulically powered pumps, submerged in cargo tanks (e.g. deep well pumps), shall be arranged with double barriers, preventing the hydraulic system serving the pumps from being directly exposed to the cargo. The double barrier shall be arranged for detection and drainage of possible cargo leakages.

206 Displacement pumps shall have relief valves with discharge to the suction line.

207 Means shall be provided for stopping the pumps from the bridge or a similar position facing the cargo area.

208 The connecting coupling for the transfer hose shall be of a type which automatically closes at disconnection (self-sealing type).

Means of quick-release of the transfer hose shall be provided, e.g. by installation of a weak link assembly or by installation of a remotely controlled coupling.

Quick-release shall be capable of being effectuated from the bridge.

C 300 Cargo heating system

301 The heating medium shall be compatible with the cargo and the temperature of the heating medium shall not exceed 220°C.

302 The cargo heating system shall be arranged as a secondary system independent of other ship's services and not enter the engine room.

303 Heating or cooling systems shall be provided with valves to isolate the system for each tank.

304 For any heating system, means shall be provided to ensure that, when in any other but the empty condition, a higher pressure is maintained within the system than the maximum pressure head exerted by the cargo tank content on the system.

The heating circuit expansion tank shall be fitted with a gas detector or low level alarm and be vented to open air.

305 Cargo heating pipes shall not penetrate the cargo tank boundaries other than on the top of the tank.

Guidance note:
If low flashpoint liquid tanks are used as tanks for recovered oil, see also Sec.10 D603.

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

D. Gas-freeing, Inerting and Venting of Cargo Tanks

D 100 Gas-freeing of cargo tanks

101 Gas freeing operations shall be carried out such that vapour is initially discharged in one of the following ways:

1) through outlets at least 2 m above the cargo tank deck level with a vertical efflux velocity of at least 30 m/s maintained during the gas freeing operation; or

2) through outlets at least 2 m above the cargo tank deck level with a vertical efflux velocity of at least 20 m/s which are protected by suitable devices to prevent the passage of flame.
Guidance note 1:
When the flammable vapour concentration at the outlets has been reduced to 30% of the lower flammable limit, gas freeing may thereafter be continued at cargo tank deck level.

Guidance note 2:
Procedures to be included in the operation manual in I.

D 200 Inerting of cargo tanks

201 Inerting of cargo tanks is required as per A202.

202 To prevent the return of cargo vapour to any gas safe spaces, the inert gas supply line shall be fitted with two shut-off valves in series with a venting valve in between (double block and bleed valves). In addition a closable non-return valve shall be installed between the double block and bleed arrangement and the cargo tank. These valves shall be located outside non-hazardous spaces and must function under all normal conditions of trim, list and motion of the ship.

The following conditions apply:

a) The operation of the valves shall be automatically executed. Signals for opening and closing shall be taken from the process directly, e.g. inert gas flow or differential pressure.

b) An alarm for faulty operation of the valves shall be provided.

203 Where the connections to the hold spaces or to the cargo piping are non-permanent, two non-return valves may substitute the non-return devices required in D202.

Guidance note:
Cargo tank connections for inert gas padding are considered as permanent for the purpose of this requirement.

204 If the cofferdams are arranged for inert gas filling, the supply lines shall be protected from the return of cargo vapour via the tank padding supply lines with a double block and bleed arrangement.

205 The cargo discharge rate from tanks being protected shall be restricted to 80% of the inert gas capacity.

206 Low-pressure alarm shall be provided in the nitrogen supply line on the cargo tank side of any double block and bleed valves and pressure reduction units.

If pressure/vacuum alarms are fitted in each cargo tank as means to comply with redundant venting requirements, a separate low-pressure alarm is not required.

207 A high oxygen content alarm shall be provided at the location from where the cargo operation is controlled. The alarm is to be activated when the oxygen content in the inert gas supply exceeds 8%.

208 Where a nitrogen generator or nitrogen storage facilities are installed in a separate compartment, outside of the engine room, the separate compartment shall be fitted with an independent mechanical extraction ventilation system, providing 6 air changes per hour. A low oxygen alarm shall be fitted.

Such separate compartments shall be treated as one of other machinery spaces, with respect to fire protection.

D 300 Cargo tank venting system

301 The cargo tanks shall have a breathing system for relief of pressure and vacuum. Such breathing shall be through P/V-valves (pressure/vacuum relief valves). The system shall comply with the requirements given in Ch.4 Sec.9 B300 except that the height specified in B308 may be reduced to 2 m.

302 Cargoes, which react in a hazardous manner with other cargoes, shall have separate tank venting systems.

E. Ventilation System within the Cargo Area

E 100 General

101 The ventilation system shall comply with the requirements given in Ch.4 Sec.10. The following requirements in Ch.4. Sec.10 B303 may be relaxed after special consideration in each case:

— the height of the exhaust outlets from cargo handling spaces
— the horizontal distance between exhaust outlets from cargo handling spaces and the ventilation inlets to non-hazardous spaces other than accommodation.
F. Fire Protection and Extinction

F 100 Fire protection

101 The vessel is in general to comply with the current requirements of the International Convention for the Safety of Life at Sea (SOLAS) for tankers. For vessels with cargo tanks aft of the superstructure and where the superstructure is situated at least 10 m from nearest hazardous area compliance with the provisions of SOLAS for cargo ships will be acceptable.

F 200 Fire extinction

201 The vessel shall have a fixed foam fire extinguishing system for protection of the cargo deck area. Deck area to be simultaneously protected:

— within 3 m radius from tank openings, cargo pipe flanges and cargo valves
— within 5 m radius from cargo breathing valves
— within 10 m radius from cargo load/unload connection(s).

The deck area defined above shall be protected by either foam monitor(s) or nozzles or a combination of both. In case of monitors, nominal length of throw for coverage of the farthest extremity of the area protected by monitors shall be used.

Application rate shall be not less than:

a) 5 litres/minute/m² with sufficient supply for at least 20 minutes, applicable for return mud or oil products for which class notation LFL will apply.

b) 10 litres/minute/m² with sufficient supply for at least 20 minutes, applicable for products covered by the IBC Code or methanol or oil products for which class notation LFL* will apply.

Water supply to the fixed foam fire extinguishing system shall be in addition to the water supply required for the vessels fire main.

The foam concentrates shall be compatible with the cargo carried.

202 In addition, the vessel should carry in a readily available position, at cargo deck level, four portable foam applicator units with at least 8 portable 20 litre containers with foam concentrate, for use with water supplied by the vessels fire main.

203 Two fire fighter's outfits shall be provided in addition to those required by SOLAS Reg. II-2/10.10.

204 Cargo pump rooms shall be protected by an approved fire extinguishing system. Fixed pressure water-spraying system and high expansion foam system may also be considered.

205 The deck foam system shall be capable of simple and rapid operation. The main control station for the system shall be suitably located outside of the cargo area, adjacent to the accommodation spaces and readily accessible and operable in the event of fires in the areas protected. Start of the system should be supported by automatic sequential start of the system by activation of one single button. Foam monitors requiring manual operation shall be positioned outside of the protected area and be readily available in case of fire in the protected area. For pumps that also support other services such as ballast water; valves and pumps shall normally be in fire mode during transport of LFL* and in addition have remote control for switch-over to fire mode from the same position as the deck foam system operation controls in accommodation.

G. Electrical Installations in Hazardous Areas

G 100 General

101 Electrical installations in hazardous areas shall comply with the requirements given in Ch.4 Sec.12.

102 In hazardous areas only electrical equipment suitable for the relevant zone shall be installed. Electrical equipment not suitable for the relevant zone with arrangements for disconnection will not be accepted.

H. Area Classification

H 100 General

101 In order to facilitate the selection of appropriate electrical apparatus and the design of suitable electrical installations, hazardous areas are divided into zones 0, 1 and 2.
H 200 Definitions

201 Hazardous areas zone 0
The interiors of cargo tanks, slop tanks, any pipework of pressure-relief or other venting systems for cargo and slop tanks, pipes and equipment containing the cargo or developing flammable gases or vapours.

202 Hazardous area zone 1
1) cofferdams adjacent to cargo tanks
2) hold spaces containing independent cargo tanks
3) cargo pump rooms
4) enclosed spaces above or adjacent to cargo tanks
5) areas on open deck, or semi-enclosed spaces on deck, within 3 m of any cargo tank outlet, gas or vapour outlet, cargo manifold valve, cargo valve, cargo pipe flange, cargo pump-room ventilation outlets and cargo tank openings for pressure release provided to permit the flow of small volumes of gas or vapour mixtures caused by thermal variation.
6) areas on open deck, or semi-enclosed spaces on open deck above and in the vicinity of any cargo gas outlet intended for the passage of large volumes of gas or vapour mixture during cargo loading, within a vertical cylinder of unlimited height and 6 m radius centered upon the centre of the outlet, and within a hemisphere of 6 m radius below the outlet.
7) areas on open deck, or semi-enclosed spaces on deck, within 1.5 m of cargo pump room entrances, cargo pump room ventilation inlet, openings into cofferdams or other zone 1 spaces
8) areas on the open deck within spillage coamings surrounding cargo manifold valves and 3 m beyond these, up to a height of 2.4 m above the deck
9) compartments for cargo hoses
10) enclosed or semi-enclosed spaces in which pipes containing cargoes are located.

Guidance note:
Areas on open deck within 3 m of cargo tank access openings for ships with cofferdams towards deck are not defined as hazardous zones. Safety precautions related to the use of such access openings in connection with gas freeing are to be covered in the operation manual.

203 Hazardous areas zone 2
1) Areas within 1.5 m surrounding open or semi-enclosed spaces of zone 1 as specified in 202, if not otherwise specified.
2) Spaces 4 m beyond the cylinder and 4 m beyond the sphere defined in 202 6).
3) The spaces forming an air-lock as defined in Ch.4 Sec.1 B102.
4) Areas on open deck over all cargo tanks and to the full breadth of the ship plus 3 m fore and aft of the forward-most and aft-most cargo tank bulkhead, up to a height of 2.4 m above the deck (the open deck over the cargo area will normally not be defined as a hazardous area when cofferdams are fitted above the cargo tanks).

204 Spaces with access or opening located in hazardous area shall have the same zone classification as the hazardous area.

I. Instrumentation and Control System

I 100 General

101 Control systems for cargo valves and pumps shall comply with the requirements given in Ch.3 Sec.9 B.

I 200 Level gauging and level alarm

201 Each cargo tank shall be fitted with at least one level gauging device.
Where only one gauging device is fitted, it shall be arranged so that any necessary maintenance can be carried out while the cargo tank is in service. If this is not possible, means for manual sounding shall be provided.

202 In addition each cargo tank shall be fitted with a high level alarm giving alarm at 95% filling by volume. The alarm shall be activated by a level sensing device independent of the gauging device.

203 Cofferdams surrounding cargo tanks shall be fitted with leakage detection unless they are water filled when carrying low flashpoint liquids or fitted with gas detection. Alarms shall be provided at a manned control station.
I 300 Gas detection

301 The vessel shall have portable gas measuring equipment consisting of at least two apparatus each measuring:

— oxygen
— hydrocarbon content in the range 1 to 100% hydrocarbon gas by volume
— low hydrocarbon gas contents (0 to 100% LEL).

302 Cofferdams surrounding cargo tanks shall be fitted with gas detection unless they are water filled when carrying low flashpoint liquids or fitted with leakage detection. Alarm shall be provided at a manned control station.

303 Arrangements shall be made to facilitate measurement of the gas concentration in all tanks and other compartments within the cargo area.

Easily accessible sampling points shall be provided for closed gas detection of cargo tanks and inerted cofferdams from open deck. Where the atmosphere in the bottom part of cofferdams cannot be reliably measured using flexible gas sampling hoses, such spaces shall be fitted with permanent gas sampling lines.

304 The cargo pump room shall be provided with a system for continuous monitoring of the concentration of hydrocarbon gases in accordance with SOLAS II-2 Reg.4.5.10.1.3.

305 Sequential sampling is acceptable as long as it is dedicated for the pump room only, including exhaust ducts, and the sampling time is reasonably short.

J. Signboards

J 100 General

101 Doors to accommodation and service spaces facing the cargo area shall be provided with signboards with the following text:

TO BE KEPT CLOSED DURING HANDLING OF FLAMMABLE CARGO

102 Signboards regarding electrical installations, see Ch.3 Sec.8.

K. Operational Instructions

K 100 General

101 An operation manual describing all essential procedures for handling of flammable cargoes shall be prepared. The manual is subject to approval and shall be kept on board.

102 The operation manual is in general to include the following items:

1) ship particulars
2) cargo system particulars
   — tank capacities
   — cargo handling system
   — inert gas N2
   — cargo tank venting
   — cargo tank heating
   — pump room safety if applicable
   — cargo tank instrumentation
   — fire safety
   — gas detection.
3) Operations
   — assumptions
   — loading
   — voyage
   — discharging
   — cleaning and gas freeing (tank entry)
   — cofferdam safety
   — cargo area access plan
   — gas detection
4) Reference documents
   — general arrangement
   — capacity plan
   — methanol/special product cargo system
   — pressure/vacuum valves flow curves
   — nitrogen system
   — cargo venting
   — mechanical ventilation cargo area
   — hazardous zones
   — fire extinguishing
   — P&A manual (if applicable)
   — bilge cargo area.

103 The following instructions shall be included in the operation manual as applicable:
   — hydrocarbon gas measurements shall be carried out regularly
   — doors to accommodation and service spaces facing the cargo area shall be kept closed during cargo handling
   — dry cargo shall not be handled in cargo area forward of the superstructure.

For vessels not satisfying the conditions in A202, in addition:
   — dry cargo and low flashpoint liquid cargoes shall not be carried simultaneously
   — before the vessel enters dry cargo service, all cargo piping, tanks and compartments in the cargo area shall be cleaned and ventilated to the extent that the hydrocarbon gas content is less than 4% of LEL.

For vessels satisfying the requirements in D201 and H302, in addition:
During carriage of dry cargo the following items shall be complied with:
   — the cargo tanks and piping shall be filled with inert gas and the O2-content in the tanks shall not exceed 8% by volume
   — the gas detection system in cofferdams surrounding the cargo tanks shall be function tested, or alternatively
   — the cofferdams surrounding the cargo tanks shall be filled with inert gas and the O2-content shall not exceed 8% by volume and the leakage detection system shall be function tested, or alternatively
   — the cofferdams surrounding the cargo tanks shall be filled with water.
SECTION 9
WELL STIMULATION VESSELS

A. Classification

A 100 Application

101 The rules in this section apply to vessels arranged and equipped for stimulation of wells for production of oil and or gas.
The requirements are supplementary to those given for assignment of main class.

A 200 Class notation

201 Vessels built and equipped according to the rules in this section may be given the additional class notation Well Stimulation Vessel or Well Stimulation Barge, whichever is relevant.

A 300 Scope

301 The following matters will be covered by the additional class:
— tanks, pumping and piping arrangement, equipment and instrumentation related to the storage and handling of well stimulation fluids
— personnel protective equipment
— intact and damage stability of the vessel.

Guidance note:
Arrangements involving return of fluids from the well are not covered by the present rules.

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A 400 Documentation

401 In 403 to 407 plans and particulars and operation manual to be submitted for approval are specified. Other plans, specifications or information may be required depending on the arrangement and the equipment provided in each case.

402 For general requirements for documentation of instrumentation and automation, including computer based control and monitoring, see Pt.4 Ch.9 Sec.1.

403 Plans and particulars for arrangements and equipment:
— arrangement of tanks
— pumping arrangements
— arrangement of ventilation pipes from acid tanks
— mechanical ventilation arrangement of closed and semi-enclosed spaces containing acid tanks, pipes, pumps and mixing units
— drawings showing location of all electrical equipment in areas with installations for uninhibited acid
— single line diagram for intrinsically safe circuits
— list of explosion protected equipment, with reference to drawings, together with certificates.

404 Plans with the following particulars for tanks:
— drawing of acid tanks including information of non-destructive testing of welds, strength and tightness testing of tanks and specification of lining
— drawing of support and staying of independent tanks
— documentation for liquid nitrogen tanks as required by Ch.5 for liquefied gas carriers.

405 Plans and particulars of pumping and piping:
— diagrams of piping for acid, nitrogen and liquid additives including details such as flange connections and securing of pipes
— drawings of pumps and mixers
— specification and information on high pressure flexible hoses with end connections
— stress analysis of piping for liquid nitrogen
— drawings and particulars for nitrogen vaporiser
— stress analysis of high pressure piping
— drawings and particulars including stress analysis of nitrogen heat exchangers.

406 Operation manual for well stimulation procedures shall be submitted for approval, see I.
407 Documentation for the control and monitoring system for the following shall be submitted for approval:

— cargo tank level measurement system
— cargo tank overflow protection system
— emergency shut-down system
— hydrogen indication equipment
— hydrogen chloride indication equipment
— oxygen indication equipment.

For requirements to documentation types, see Pt.4 Ch.9.

A 500 Certification of control and monitoring system

501 The following control and monitoring system shall be certified according to Pt.4 Ch.9:

— cargo tank level measurement system
— cargo tank overflow protection system
— emergency shut-down system.

B. Arrangement

B 100 Tanks and pumping arrangement

101 Tanks for acid and liquefied nitrogen shall be located at a minimum distance of 760 mm from the vessel's side and bottom.

102 Tanks and pumping arrangements shall not be located within accommodation areas or machinery spaces.

103 Tanks and piping systems for the well stimulation plant shall be separated from the machinery and ship piping systems.

104 Remote control of the well stimulation processing plant shall be arranged from a position outside the area where the well stimulation systems are located.

105 Tanks and pumping arrangements for liquid additives having flashpoint below 60°C shall comply with relevant requirements of Sec.8.

Arrangement of pump room for LFL (low flashpoint liquids) substances adjacent to the LFL tanks and without separating cofferdams may be considered in each case.

106 Requirements for tanks and pumping arrangements for chemicals other than acids dealt with under F will be considered in each case with due regard to the properties of the chemicals and applicable requirements of Ch.4.

B 200 Tank venting

201 Outlets from safety valves of nitrogen tanks shall be lead to open deck. Outlet pipes shall be arranged and supported in order to allow thermal expansion during release of cold gas. Penetrations of decks or bulkheads shall be such that the structures are thermally isolated from the cold pipes.

202 Vent outlets from acid tanks shall be lead to open deck. The outlets shall have a minimum height of 4 m above the deck and located at a minimum horizontal distance of 5 m from openings to accommodation and service spaces.

203 Vent outlets from acid tanks shall have pressure/vacuum valves. The outlets shall be provided with flame screens.

B 300 Access openings

301 Enclosed spaces containing tanks, piping, pumps and blenders for uninhibited acid shall have entrances direct from open deck or through air locks from other spaces. The air lock shall have independent mechanical ventilation.

B 400 Acid spill protection

401 Floors or decks under acid storage tanks and pumps and piping for uninhibited acid shall have a lining of corrosion resistant material extending up to a minimum height of 500 mm on the bounding bulkheads or coamings. Hatches or other openings in such floors or decks shall be raised to a minimum height of 500 mm above.

402 Flanges or other detachable pipe connections shall be covered by spray shields.

403 Portable shield covers for connecting flanges of loading manifold shall be provided. Drip trays of corrosion resistant material shall be provided under loading manifold for acid.
B 500 Drainage

501 Spaces housing tanks and pumping and piping for acids or additives shall have a separate drainage system not connected to the drainage system for other areas.

502 Drainage arrangement for acids shall be of corrosion resistant materials.

C. Ventilation

C 100 Ventilation of spaces containing installations for storage or handling of acid

101 The spaces shall have an independent mechanical ventilation with a capacity of minimum 30 air changes per hour.

C 200 Ventilation of other spaces containing equipment for well stimulation

201 Spaces containing installations for liquid nitrogen and liquids containing inhibited acid shall have a mechanical ventilation system with a minimum capacity of 20 air changes per hour. The ventilation system shall be independent of the ventilation system for the accommodation.

202 Ventilation of spaces for storage and handling of dry and liquid additives will be considered in each case depending on the flammability, toxicity and reactivity properties of the additives to be used.

D. Electrical Equipment, Instrumentation and Emergency Shutdown System

D 100 Electrical equipment or other ignition sources in enclosed spaces containing acid tanks and acid pumping arrangements

101 Only equipment certified as safe for operation in hydrogen/air atmosphere shall be used.

D 200 Vapour detection

201 Vapour detection and alarm systems for hydrogen or hydrogen chloride gas shall be provided in enclosed or semi-enclosed spaces containing installations for uninhibited acid.

202 Spaces containing tanks and piping for liquid nitrogen shall be equipped with oxygen deficiency monitoring.

D 300 Gauging and level detection

301 Tanks for liquefied nitrogen shall have gauging and level detection arrangements in accordance with Ch.5 Sec.13.

302 Tanks for hydrochloric acid shall have a closed gauging system. A high level alarm shall be provided. The alarm shall be activated by a level sensing device independent of the gauging system.

303 Spaces containing equipment and storage tanks for the well stimulation system shall be provided with detection and alarm system for liquid leakages.

D 400 Emergency shutdown system

401 Emergency stop of all pumps in the oil well stimulation system shall be arranged from one or more positions located outside the area accommodating the system.

402 Emergency shut-off valves shall be provided in liquid nitrogen outlet lines from each nitrogen tank. The shut off valves shall be remotely controlled from one or more positions outside the area accommodating the oil well stimulation system.

403 Emergency depressurising and disconnection of the transfer hose shall be arranged from the central control position and from the bridge.

E. Liquid Nitrogen System

E 100 Materials

101 The materials shall be in accordance with Ch.5 Sec.2.

E 200 Storage tanks

201 The design and testing of the tanks for liquid nitrogen shall be in accordance with Ch.5 Sec.5 as required for independent tanks type C.
E 300  Pumping and piping
301  The requirements of Ch.5 Sec.6 apply.

F. Acid System

F 100  Materials
101  In general Ch.4 Sec.2 applies.
102  Storage tanks, pumping and piping for uninhibited acid shall be of corrosion resistant material or shall have internal lining of corrosion resistant material.

F 200  Storage tanks
201  The rules in Ch.4 Sec.5 apply.

F 300  Pumping and piping
301  The rules in Pt.4 Ch.6 apply.
302  The flexible hose with end connectors shall be in accordance with a recognised standard.

G. Personnel Protection

G 100  Decontamination showers and eye washes
101  Decontamination showers and eye washes shall be fitted in convenient locations.
102  The showers and eye washers shall be operable also under freezing conditions. Temperature control of the water shall be provided in order to avoid excessive temperatures.

G 200  Personnel protective equipment
201  Protective equipment shall be kept onboard in suitable locations as required by the IMO “International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk” (IBC Code) Res. MSC.4(48) as amended, for carriage of hydrochloric acid.

H. Intact and Damage Stability

H 100  General
101  The vessel shall comply with the requirements for intact and damage stability given in Sec.2 D and Sec.5.

I. Operation Manual

I 100  General
101  The vessel shall have an approved operation manual readily available on board. The manual shall give instructions and information on safety aspects related to well stimulation processing.
102  The operation manual shall give particulars on:
— protective equipment
— storage and handling of fluids and dry additives
— transfer operations
— emergency shut-down and disconnection.
SECTION 10
RECOVERED OIL RECEPTION AND TRANSPORTATION

A. General

A 100 Objective
101 The requirements in this section are intended to ensure a vessel’s ability to safely perform occasional handling, storage and transportation of oil with flash point below 60°C, recovered from a spill of oil, in emergency situations.

102 Vessels built and equipped in compliance with the requirements given in this section may be given the class notation OILREC.

103 The following safety issues are covered by the class notation:
— safety against fire and explosion during handling, storage and transportation of oil recovered from a spill on sea
— supporting structures for equipment applied during oil recovery operations
— stability and floatability
— available power for supply to equipment used during oil recovery operations.

104 The oil recovery system covered by the class notation includes the system for transfer and pumping of recovered oil, from the oil skimmer connection flange up to and including the discharge delivery flange.

A 200 Assumption
201 The classification of the vessel is based on the assumption that the operation of the vessel during oil recovery operation will be in accordance with the approved operation manual, see E100.

A 300 Documentation
301 Documentation shall be submitted as required by Table A1.

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302 For general requirements to documentation, including definition of the info codes, see Pt.0 Ch.3 Sec.1.

303 For a full definition of the documentation types, see Pt.0 Ch.3 Sec.2.

304 In the case that fire extinguishing equipment and structural fire protection and/or stability and floatability have been approved by a National administration applying requirements which may be considered equivalent to those of the class, such approval, satisfactorily documented, may be accepted as evidence of compliance with the class requirements.

A 400 Testing

401 Upon completion, the procedure for transfer to oil recovery operation of the vessel shall be demonstrated and such operation shall be simulated to verify that the vessel will be able to operate as intended and described in the operation manual.

The test need not include oil recovery equipment that will be put on board during mobilization.

B. Basic Requirements

B 100 General

101 The vessel shall be provided with:
— a suitable working deck for use in oil recovery operation
— storage tanks for recovered oil
— permanently installed pumping and piping arrangement for transfer and discharge of recovered oil.

102 The vessel shall have adequate stability and floatability in all relevant operational conditions. The stability and floatability properties will be considered in each particular case.

103 The visibility from the manoeuvring station shall be such that the Master can easily monitor oil recovery operations both on deck and in the water.

104 The oil tanks and the deck area, from where the operation is performed, shall be as far away from the accommodation as possible.

105 Deck spills shall be kept away from accommodation and service areas through suitable precautionary means, such as a permanent coaming of suitable height extending from side to side or around loading and discharge stations.

106 Exhaust outlets from machinery shall be located as high as practicable above the deck and shall be fitted with spark arresters.

B 200 Fire protection and extinction

201 For vessels with cargo tanks forward of the superstructure, exterior boundaries of superstructures and deckhouses enclosing accommodation and including any overhanging decks which support such accommodation shall be constructed of steel and insulated to A60 fire integrity for the whole of the portions which face the cargo area (up to bridge windows) and on the outward sides for a distance of 3 m from the end boundary facing the cargo area. The distance of 3 m shall be measured horizontally and parallel to the middle line of the ship from the boundary which faces the cargo area at each deck level. In the case of the sides of those superstructures and deckhouses, such A-60 insulation shall be carried up to the underside of the deck of the navigation bridge.

In lieu of A-60 fire integrity, construction to A-0 fire integrity with a permanently installed water-spraying system in compliance with 204 may be accepted.

Guidance note:
The external boundaries of service spaces used as deck stores need not be insulated provided they do not give access directly or indirectly to any other spaces and are insulated to A-60 standard towards adjacent spaces.

---c-o-n-t-i-n-u-o-u-s---
202 The requirement in 201 is also applicable for vessels with cargo tanks aft of the superstructure, provided exterior boundaries of superstructures and deckhouses enclosing accommodation and including any overhanging decks which support such accommodation, are situated within 10 m of the nearest hazardous area seen from profile view (see Fig. 1).

![Image](image_url)

**Fig. 1**

Distance from hazardous area

203 The requirement in 201 is also applicable for access doors, windows and portholes fitted in such boundaries.

Windows and portholes fitted with permanently hinged inside deadlights of steel having a thickness not less than 3 mm will be accepted in lieu A-0 standard provided the ORO manual specifies that these deadlights are to be closed during oil recovery operations.

Water-/weathertight doors constructed of steel will be accepted in lieu of A-0 standard. Provided they are fitted with windows/portholes, deadlights as mentioned above shall be fitted also for doors.

204 The water-spraying system referred to in 201 shall have a capacity of at least 10 litres/minute/m². The system shall be fully activated from bridge.

205 For protection of the working deck area two semi-portable 25 kg dry powder fire extinguishers shall be provided, stored in readily available spaces adjacent to the working deck.

In addition, the vessel should carry two portable foam applicator units with at least 4 portable 20 litre containers with foam concentrate, for use with water supplied by the vessels fire main.

### B 300 Tank arrangement

301 Tanks within the accommodation and/or machinery spaces of category A are not to be used for storage of recovered oil.

302 Tanks intended for storage of recovered oil are normally to be separated from machinery spaces of category A and accommodation by means of cofferdams, tanks for other purposes (fuel oil, ballast etc.) or dry compartments other than accommodation.

For easy access to all parts, the cofferdams shall have a minimum width of 600 mm.

303 Where cofferdams are impractical to arrange, tanks adjacent to the engine room may be accepted for storage of recovered oil provided the tank bulkhead is:

- accessible for inspection
- carried continuously through abutting plate panels, except that full penetration welding may be used at the top of the tank
- pressure tested at every complete periodical survey.

304 All openings to the tanks for recovered oil shall be located on open deck.

305 Tanks for recovered oil shall have suitable access hatches with minimum clear opening of 600 × 600 mm from open deck for cleaning and gas-freeing. Long tanks shall have access in both ends.

306 Tanks exceeding a breadth of 0.56 B or a length of 0.1 L or 12 m whichever is the greater are normally to be provided with wash bulkheads or similar arrangement to reduce liquid sloshing in partially filled tanks.

307 The height of tanks for recovered oil shall not be less than 1.5 m. Internal obstructions in tanks for recovered oil shall be provided with adequate openings to allow a full flow of oil. The area of one single opening is for that purpose not to be less than twice the sectional area of the discharge pipe.
The openings shall be so arranged that the tanks can be effectively drained.

308 Any coating in tanks for recovered oil shall be of an oil and dispersion resistant type.

B 400 Support of heavy components

401 The strength of the supporting structures for equipment applied during oil recovery operations can be based on the assumption that the oil recovery operations will take place in moderate sea conditions.

402 For cranes intended for use during oil recovery operations, dynamic loads due to the vessel's motions shall be taken into account. In general the cranes and their supporting structures shall have scantlings based on at least twice the working load of the crane.

C. Hazardous and Non-Hazardous Areas

C 100 Area Classification

101 In order to facilitate the selection of appropriate electrical apparatus and the design of suitable electrical installations, hazardous areas are divided into zones 0, 1 and 2.

102 Hazardous areas zone 0:
The interiors of cargo tanks, any pipe work of pressure-relief or other venting systems for cargo tanks, pipes and equipment containing the cargo or developing flammable gases or vapours.

103 Hazardous areas zone 1:
1) Cargo pump room.
2) Enclosed or semi-enclosed spaces in which recovered oil pipe flanges and or valves are located.
3) Enclosed or semi-enclosed spaces in which oil contaminated equipment for handling of recovered oil are located.
4) Areas on the open deck or semi-enclosed spaces on the deck within a distance of 3 m from oil skimmer equipment, hoses and valves used for recovered oil handling, openings and air pipes from tanks for recovered oil and openings and ventilation outlets from hazardous areas.

104 Hazardous areas zone 2:
1) Cofferdams and spaces adjacent to tanks intended for storage of recovered oil, not containing pipe flanges or valves.
2) Open deck over tanks intended for storage of recovered oil and 3 m forward and aft of this area, to the full width of the ship, on the open deck up to a height of 2.4 m above the deck.

105 A space with access doors or other openings into a hazardous area will normally be considered to have the same hazardous zone classification as the adjacent hazardous area. See however C201.

106 Non-hazardous areas are areas which are not defined as hazardous in the above.

C 200 Access openings between non-hazardous spaces and hazardous area

201 A non-hazardous space with access doors to hazardous area may be accepted as non-hazardous on the following conditions:
1) The non-hazardous room shall have overpressure ventilation with 20 air changes per hour in relation to the hazardous area.
2) The doors shall be gastight.
3) The doors are to be self-closing and preferably arranged to swing into the non-hazardous space so that they are kept closed by the overpressure.
4) If a door cannot be made self-closing, a second self-closing door in accordance with 2) and 3) above shall be arranged. The doors shall be arranged with sufficient spacing to allow for safe passage.
5) Self-closing doors may be used for passage, but shall not remain open during oil recovery operations. Signboards shall be fitted to this effect.
6) Emergency escape hatches to open deck that cannot be made self-closing need not be arranged with an air lock, but during oil recovery operations they can only be used for emergency escape purpose. Signboards shall be fitted to this effect.

Guidance note:
A watertight sliding door is not accepted as a self-closing door as the self-closing mode is considered too hazardous. Hence, a second self-closing door in accordance with 2) and 3) above shall be arranged. The doors shall be arranged...
with sufficient spacing to allow for safe passage.

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202 Access doors to non-hazardous spaces not normally entered may be accepted without the arrangements in C201 3) and 4) provided it is locked closed during oil recovery operations and fitted with signboards to that effect.

D. Arrangement and Equipment

D 100 General

101 The vessel shall be arranged and equipped so as to minimize the time needed to make it operational. This implies that systems and safety arrangements for handling of recovered oil shall be permanently installed.

102 Systems and arrangements shall be such that procedures for and practical execution of filling, venting, discharge, sounding, etc. will be simple to perform.

103 All electrical and mechanical equipment for use in hazardous areas during oil recovery operations shall be certified for operation in gas contaminated atmosphere.

D 200 Ventilation system

201 There shall be independent ventilation for hazardous and non-hazardous spaces.

202 Non-hazardous spaces adjacent to hazardous areas are normally to have mechanical ventilation with overpressure relative to hazardous areas. The inlet air shall be taken from a non-hazardous area at least 1.5 m from the boundaries of any hazardous area. Also the outlet air shall be led to a non-hazardous area on open deck.

203 Hazardous spaces shall have mechanical ventilation of extraction type, with 8 air changes per hour. The inlet air for hazardous enclosed spaces shall be taken from non-hazardous areas. The outlet air shall be led to an open area, which, in the absence of the considered outlet, would be of the same or lesser hazard than the ventilated space.

204 Small hazardous spaces located on or above cargo deck level (e.g. deck stores) may be accepted with natural ventilation only.

205 Spaces which normally would be regarded as Zone 2 according to C104 1) above may be accepted as non-hazardous on the condition that the following special requirements to ventilation in addition to those given in 202 above are complied with:

— the ventilation capacity shall be at least 20 changes of air per hour
— the arrangement of ventilation inlet and outlet openings in the room shall be such that the entire room is efficiently ventilated, taking special consideration to locations where gas may be released or accumulated.

206 Fans serving hazardous spaces shall be in compliance with Pt.5 Ch.3 Sec.6A 200.

207 For hazardous spaces or when the space is dependent on ventilation for its area classification, the following requirements apply:

1) Operation of the ventilation shall be monitored.
2) In the event of failure of ventilation, the following requirements apply;

— an audible and visual alarm shall be given at a manned location
— immediate action shall be taken to restore ventilation.

D 300 Tank venting system

301 Ventilation outlets from the tanks shall be led to open deck.

The outlets shall have a minimum height of 2.4 m above deck and be located at a minimum horizontal distance of 5 m away from openings to accommodation and other non-hazardous spaces, ventilation intakes for accommodation and engine room and non-certified safe electrical equipment.

302 Portable ventilation outlet pipes intended for use during oil spill recovery operations only, may be accepted.

303 The venting arrangement is in general to comply with the requirements given for the main class.

D 400 Arrangement of piping systems

401 There shall be no permanent connection between hazardous piping systems and other piping systems in
the ship, unless specified in this section.

402 The system for pumping and transfer of recovered oil is to be permanently installed and shall be located outside machinery spaces, accommodation and other non-hazardous areas. Flexible hoses shall not be used in the system for pumping and transfer of recovered oil.

403 Oil recovery piping systems are pertaining to pipe class II, irrespective of design pressure and temperature.

404 The transfer system shall be arranged such that simultaneous filling and discharge will be possible.

405 For coupling of portable skimming equipment one filling connection with branch pipes to all tanks for recovered oil shall be arranged on deck close to the skimming equipment.

406 The filling line shall be provided with means for injection of emulsion-breaking chemicals. For tanks provided with heating the requirements may be dispensed with.

407 Piping systems for recovered oil is to be segregated from all other piping systems with blind flange valves. Any part of a piping system not segregated from the oil recovery tanks or piping systems by blind flange valves are considered to be part of the oil recovery system. Such systems shall also be covered by the cleaning procedures in the operation manual required in E101.

408 Correct positions (open or closed) of blind flange valves shall be identified by colour marking or signboards.

409 Parts of existing cargo piping may be used for pumping and transfer of recovered oil. However, for such systems the design pressure shall be taken as the highest design pressure of any interconnected system.

Guidance note:
Temporary manipulation of displacement pump safety valves is not accepted as a means for reducing the design pressure.

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

410 The internal diameter of sounding pipes from tanks for recovered oil shall not be less than 50 mm. The sounding pipes shall be located on open deck.

411 Bilge drainage of the pump room and other hazardous spaces is to be independent of the bilge system in the remainder of the ship.

D 500 Tank heating - General

501 For closed heating systems, refer to Pt.5 Ch.7 Sec.8 C300.

502 To prevent the return of oil or vapour to any part of the system located in non-hazardous spaces, the steam supply line shall be fitted with two shut-off valves in series with a venting valve in between (double block and bleed valves).

These valves shall be located outside non-hazardous spaces and must function under all normal conditions of trim, list and motion of the ship. The bleed pipe for the automatic double block and bleed system shall be led to open air and in an area away from where personnel may be located. It is recommended that the outlet is located or protected to prevent water ingress.

The following conditions apply:

a) The operation of the valves shall be automatically executed. Signals for opening and closing shall be taken from the process directly, e.g. pressure sensor on steam delivery side of the double block and bleed.

b) An alarm for faulty operation of the valves shall be provided.

Manual drain valves or air blowing connections may be accepted into enclosed spaces provided these are defined as hazardous zone 1.

503 Threaded connections will not be accepted for attaching the nozzles to the cargo tanks, nor as method of pipe/valve joining. I.e. flange connections are required.

D 600 Steam nozzle arrangement - Penetrations below top of tank

601 It is not acceptable to incorporate flexible hoses in the steam system if steam nozzle penetrations are fitted below the top of the tank. Non-permanent pipe connections to steam nozzles are to be made of steel piping.

Blind covers are to be fitted when steam nozzles are not permanently installed.

602 Each tank penetration below top of tank shall be fitted with a closable non-return valve or a non-return
valve and a closable valve in series. Non-return valves integrated in nozzles will be specially considered.

**603** If steam nozzles penetrate below top of tank in tanks otherwise used for low flashpoint liquids (LFL/LFL*) the following apply:

- **602** applies
- the steam piping, non-return valves and isolation valves are to be located in cofferdams
- the steam piping is led from top of cofferdam with spool piece or blind flange valve in open air at deck level
- the arrangement is not to require access in the cofferdam for installation or operation of the system, i.e. isolation valves need to be remote operated.

**D 700 Steam nozzle arrangement - penetrations from top of tank**

**701** Load Line requirements prohibit flush hatch type design of the steam lances fitted on deck. I.e. current configuration with hatch raised 760 mm above deck is required.

**702** Steam nozzles shall be fixed to the tank during oil recovery operation. This implies that at least one nozzle is required per tank.

The penetration is to be gastight and compatible with steam, oil and seawater. An arrangement bolting the sealing to the hatch and the nozzle is required.

**703** The steam supply system shall be permanently installed. However flexible hoses of short and rigid type may be accepted for connecting nozzles to the steam supply system. Flexible hoses and couplings are to be type approved for the relevant steam temperature.

**D 800 Power supply and electrical equipment**

**801** Electrical installations in hazardous areas shall comply with the requirements given in Ch.3 Sec.8.

**802** Means for disconnection of electrical supply to non-certified electrical equipment in hazardous spaces shall be arranged. Signboards shall be fitted at the respective switches and such equipment shall be listed in the operation manual referred to in E100.

Electrical cables led through these spaces and electrical equipment in the machinery spaces are exempted.

Systems or components supporting main functions or safety systems will not be accepted disconnected in oil recovery operations.

**803** Non-certified safe electrical equipment located in hazardous areas on open deck shall be disconnected during oil recovery operation.

**804** The arrangement of power supply to non-permanent oil skimming and pumping equipment is as far as practicable to be permanently installed.

For circuits with higher rating, the outlet shall be arranged from a connection box, provided with a door which is interlocked with a switch.

The supply from the main switchboard to the connection box or socket-outlet shall be permanently installed, and provided with separate switchgear with short-circuit and over current protection in each insulated phase.

**805** Non-permanent oil skimming and pumping equipment and independent power-packages shall be certified as safe for operation in gas-contaminated atmosphere.

**806** The socket-outlet and connection boxes mentioned in 804 shall be located at easily accessible places and in such a way that flexible cables are not carried through doors or port lights leading from working deck to machinery or accommodation spaces.

**D 900 Miscellaneous requirements**

**901** A portable hydrocarbon gas-measuring instrument of approved type shall be provided on board.

**902** The deck area where handling of hoses and equipment for recovered oil takes place shall be provided with adequate lighting.

**903** If sea water cooling is provided for machinery, low sea suction shall be arranged.

**904** Exhaust pipes or any other pipes with surface temperature exceeding 220°C shall not pass through hazardous areas.

**905** Signboards shall be fixed by screws, rivets or equal.
E. Operational Instructions

E 100  General

101 The vessel shall have an approved operation manual onboard. The manual shall give information regarding the safe use of the vessel during oil recovery operations and shall have references to enclosed drawings.

102 The operation manual is in general to give information regarding the following:

1) Arrangement and equipment
   — tank arrangement
   — transfer system
   — gas measuring instrument
   — various equipment

2) Mobilisation
   — checking of all equipment taken onboard to ascertain that it is certified for use in gas-contaminated atmospheres
   — mounting and fastening of non-permanent equipment
   — blanking-off of pipes
   — assembling of air pipes
   — disconnection of electrical power supply
   — closing of openings between non-hazardous and hazardous areas
   — start of additional ventilation equipment
   — change-over to low suction for cooling water pumps
   — fitting of signboards regarding the use of open flame, non-certified electrical equipment etc.

3) Operation
   — guidelines regarding safe distance from an oil spill source. If gases are traced on open deck, the vessel shall be withdrawn immediately
   — gas measurements during operation (on open deck and in spaces where gas might accumulate)
   — actions to be taken if gases are traced in enclosed spaces (cleaning, ventilation, emptying of adjacent tanks, etc.)
   — precautions against overfilling of tanks
   — discharging.

4) Cleaning and gas-freeing of tanks and pipes.

5) Reference drawings.

The operations manual shall as a minimum refer to the valid stability documentation.

Guidance note:
Relevant additional loading conditions and/or stability instructions to be included in the stability manual.

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SECTION 11
SPECIAL PURPOSE SHIPS

A. Classification

A 100 Scope and application

101 The requirements in this section are intended for ships that by virtue of the specialized nature of the service undertaken, are carrying special personnel who are neither crew members nor passengers as defined in the 1974 SOLAS Convention.

102 The requirements of this section refer to the Code of Safety for Special Purpose Ships (SPS Code), as defined in A200.

103 A ship that has been found to be in compliance with the requirements of this section may be assigned the class notations SPS, denoting Special Purpose Ship.

   Guidance note:
   A Memo to owners will be issued stating number of persons for which the vessels complies with the SPS code. (13 to 60, 61 to 240, 241 plus)

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104 The provisions of this section may be applied to ships of lesser tonnage than 500 upon separate consideration by the Society.

105 A passenger or cargo ship, whenever built, which is converted to a special purpose ship will be treated as a special purpose ship constructed on the date on which the contract for conversion is signed.

106 For flags that have not accepted the use of the SPS Code, flag requirements will prevail whilst under that flag, i.e. SOLAS Ch.III for cargo ships to be applied.

A 200 Definitions

201 For the purpose of this section, the definitions given hereunder and in the SPS Code apply.

202 Crew means all persons carried on board the ship to provide navigation and maintenance of the ship, its machinery, systems, and arrangements essential for propulsion and safe navigation or to provide services for other persons on board.

   Guidance note:
   These rules are not intended for ships used to accommodate industrial personnel that are not working onboard.

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IMDG Code means the International Maritime Dangerous Goods Code, adopted by the Maritime Safety Committee of the International Maritime Organization IMO as resolution MSC.122(75), as amended.

Length means the length as defined in the International Convention of Load Lines, 1966.

LSA Code means the International Life-Saving Appliance Code, adopted by the Maritime Safety Committee by resolution MSC.48(66), as amended.

Passenger means every person other than:
— the master and the members of the crew or other persons employed or engaged in any capacity on board a ship on the business of that ship; and
— a child under one year of age.

SOLAS means the International Convention on Safety of Lives at Sea currently in force.

Special personnel mean all persons who are not passengers or members of the crew or children of less than one year of age and who are carried on board in connection with the special purpose of that ship or because of special work being carried out aboard that ship. Wherever in this section the number of special personnel appears as a parameter it shall include the number of passengers carried on board.

SPS Code means to the Code of Safety for Special Purpose Ships (SPS Code), as adopted by the Maritime Safety Committee as resolution MSC.266(84) on 13 May 2008.

A 300 Documentation

301 Except as specified in 302, 303 and 304 documentation shall be submitted according to table A1 as though the ship is a dry cargo ship.
302 Stability and subdivision
The documentation requirements of Pt.3 Ch.3 Sec.9 A300 shall be complied with as though the ship is a passenger ship.

303 Fire protection
Ships operating as defined under B700 shall comply with requirements for passenger ships (when relevant) with respect to fire safety and escape.

304 Life-saving appliances
For ships carrying more than 60 persons muster list and emergency instructions shall be submitted.

Table A1 Documentation to be submitted

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<th>Hull &amp; Structure or Applicable system, Junction or component</th>
<th>Document type</th>
<th>Detailed description given in Pt.0 Ch.3 under item</th>
<th>Documentation submitted for information (FI) or approval (AP)</th>
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<td>Muster list and emergency instructions</td>
<td>G140</td>
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B. Requirements

B 100 General
101 The ship shall comply with the SPS Code.

102 Relevant requirements for general cargo ships given in Ch.2 Sec.4 and which are not covered by the requirements of this section shall also be complied with.

B 200 Stability and subdivision
201 The intact stability requirements of Pt.3 Ch.3 Sec.9 shall be complied with.

202 The stability documentation shall include calculations of the most unfavourable loading conditions anticipated for each intended service mode.

203 For ships carrying 240 persons or more, the supplementary intact stability requirements of Ch.2 Sec.2 F300 shall be complied with as though the ship is a passenger ship and the special personnel are considered passengers.

Guidance note:
Unless required by the Flag State a SPS ship need not be considered a passenger ship for application of SOLAS regulation II-1/5.5 on periodical lightweight surveys.

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204 The subdivision and damage stability shall in general be in accordance with SOLAS II-1 as amended where the ship is considered a passenger ship and special personnel are considered passengers, with an R-value calculated in accordance with SOLAS regulation II-1/6.2.3 as follows:

— for ships carrying 240 persons or more, the R-value is assigned as 1.0 R
— for ships carrying not more than 60 persons, the R-value is assigned as 0.8 R; and
— for ships carrying more than 60 persons, but less than 240 persons, the R-value shall be determined by linear interpolation between the R-values given above.

205 For ships carrying 240 persons or more, the requirements of SOLAS regulations II-1/8 and II-1/8-1 and of SOLAS chapter II-1, parts B-2, B-3 and B-4 shall be applied as though the ship is a passenger ship and the special personnel are passengers. However, SOLAS regulations II-1/14 and II-1/18 are not applicable.

206 Except as provided in B207 for ships carrying less than 240 persons the provisions of SOLAS chapter II-1, parts B-2, B-3 and B-4 shall be applied as though the ship is a cargo ship and the special personnel are
crew. SOLAS regulations II-1/8, II-1/8-1, II-1/14 and II-1/18 are not applicable.

207 All ships shall comply with SOLAS regulations II-1/9, II-1/13, II-1/19, II-1/20 and II-1/21 as though the ship is a passenger ship.

Guidance note:
In general the interpretations in the Explanatory Notes to SOLAS chapter II-1 subdivision and damage stability regulations, adopted by IMO as Resolution MSC.281(85) shall be used for the application of SOLAS chapter II-1. The recommendations in resolution MSC.245(83) should be applied if cross-flooding systems are utilised.

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B 300 Machinery installations

301 All ships shall comply with Ch.2 Sec.2 C101 as though the ship is a passenger ship

302 All steering gear installations in special purpose ships carrying more than 240 persons shall comply with Pt.4 Ch.14 Sec.1 B602 as though the ship is a passenger ship.

B 400 Electrical installations

401 Electrical distribution systems in ships carrying more than 60 persons shall comply with Ch.2 Sec.2 C102.

B 500 Emergency source of power

501 The emergency source of electrical power in special purpose ships carrying not more than 60 persons and which are more than 50 m in length shall be capable, having regard to starting currents and the transitory nature of certain loads, of supplying simultaneously at least the following services for a period of half an hour if they depend upon an electrical source for their operation:

1) any watertight doors required by SOLAS Reg. II-1/13 to be power operated together with their indicators and warning signals

2) the emergency arrangements to bring the lift cars to deck level for the escape of persons.

502 Installations in special purpose ships carrying more than 60 persons shall comply with Ch.2 Sec.2 D as though the ship is a passenger ship.

B 600 Periodically unattended machinery spaces

601 All ships shall comply with the requirements in Pt.6 Ch.3 for additional class notation E0

B 700 Fire protection

701 For ships carrying more than 240 persons on board, the requirements of chapter II-2 of SOLAS for passenger ships carrying more than 36 passengers shall be applied.

702 For ships carrying more than 60, but not more than 240 persons on board, the requirements of chapter II-2 of SOLAS for passenger ships carrying not more than 36 passengers shall be applied.

703 For ships carrying not more than 60 persons on board, the requirements of chapter II-2 of SOLAS for cargo ships shall be applied.

Guidance note:
For further details and clarification of the basic SOLAS requirements implemented in this section please see “DNV Statutory Interpretations SOLAS Interpretations Ch.II-2”.

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B 800 Dangerous goods

801 Dangerous goods that are carried on board for shipment as cargo and are not used on board are subject to the provisions of the IMDG Code.

802 Spaces used for the carriage of any significant amount of dangerous goods as ships’ stores and intended for use on board shall comply with the provisions of the IMDG Code as far as reasonable and practicable.

B 900 Life-saving appliances

901 The requirements of chapter III of SOLAS shall be applied with the specifications given in B902 through B906.

902 Ships carrying more than 60 persons shall comply with the requirements contained in chapter III of SOLAS for passenger ships engaged in international voyages that are not short international voyages.

903 Notwithstanding the provisions of B902, a ship carrying more than 60 persons but not more than 200
persons may in lieu of meeting the requirements of regulations 21.1.1 of chapter III of SOLAS comply with the requirements of regulation 21.1.5 of chapter III of SOLAS, including the provision of at least two rescue boat(s) in accordance with regulation 21.2.1 of chapter III.

Guidance note:
DNV considers item 903 to apply only for ships with a gross tonnage of less than 500 and with a total number of persons on board less than 200.

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904 Ships carrying not more than 60 persons shall comply with the requirements contained in Chapter III of SOLAS for cargo ships other than tankers. Such ships may, however, carry life-saving appliances in accordance with the passenger ship requirements in B902 if they comply with the subdivision requirements in B204 as though the ship is carrying 60 persons.

905 Regulations 2, 19.2.3, 21.1.2, 21.1.3, 31.1.6 and 31.1.7 of Chapter III of SOLAS and the requirements of paragraphs 4.8 and 4.9 of the LSA Code are not applicable to special purpose ships.

906 Where in Chapter III of SOLAS the term “passenger” is used; it should be read to mean “special personnel”.

B 1000 Radio communications

1001 All special purpose ships shall carry a valid Cargo Ship Safety Radio Certificate in compliance with Chapter IV of SOLAS

B 1100 Safety of navigation

1101 All special purpose ships shall comply with the requirements of Chapter V of SOLAS.
A. General

101 The requirements in this section apply to vessels intended for towing services in harbour and open waters and pushing of floating structures.

102 Scope
The following subjects are covered in this section:
— design and testing requirements to towing equipment
— hull arrangement and supporting structure
— stability and watertight integrity.

103 Objective
The objective of this section is to provide a design standard for safe and reliable towing operation.

A 200 Definitions

201 Towline means rope used for towing.

202 Bollard pull (BP) is the maximum continuous pull obtained at static pull test on sea trial. Reference is made to test procedure in A 500 in this section.

203 Reference load (RL) is defined as value obtained from table A1:

<table>
<thead>
<tr>
<th>Table A1 Reference load</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reference load</td>
</tr>
<tr>
<td>----------------</td>
</tr>
<tr>
<td>3.0 BP</td>
</tr>
<tr>
<td>(3.80 – BP/50) BP</td>
</tr>
<tr>
<td>2.0 BP</td>
</tr>
</tbody>
</table>

A 300 Documentation Requirements

301 The following plans and particulars shall be submitted. See Table A2.

<table>
<thead>
<tr>
<th>Table A2 Documentation Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Object</td>
</tr>
<tr>
<td>------------</td>
</tr>
</tbody>
</table>
| Towing arrangement | Z030 Arrangement plan | Including:
|              |              | — towline paths showing extreme sectors and wrap on towing equipment towline points of attack
|              |              | — maximum expected BP
|              |              | — maximum design load for each component
|              |              | — emergency release capabilities | FI | D |
| Bollard pull | Z140 Test procedure for quay and sea trial | | | AP | A |
| Winch and other equipment | Z140 Test procedure for quay and sea trial | | | AP | A |
A 400 Certification requirements

401 DNV product certificates will be required for the following items:
— towing winch
— towing hook.

402 DNV material certificates will be required for the following items:
— towing hook with attachment
— winch drum and flanges
— shafts for drum
— brake components.

403 Works material certificates is required for the following items:
— coupling
— winch framework
— gear shaft and wheels.

A 500 Testing requirements

501 The winch and other equipment made mandatory in this Section shall be function tested according to approved procedure in order to verify:

Table A2 Documentation Requirements (Continued)

<table>
<thead>
<tr>
<th>Object</th>
<th>Document type</th>
<th>Additional description</th>
<th>For info.(FI) or approval (AP)</th>
<th>Rule Ref. Sec.12</th>
</tr>
</thead>
</table>
| Towing winch | C010 Design criteria | Including:
— RL and the expected maximum BP
— hoisting capacity, rendering and braking force of the winch
— release capabilities (response time and intended remaining holding force after release) | FI | D |
| | C020 Assembly or arrangement drawing | | FI | D |
| | C030 Detailed drawing | | AP | D |
| | C040 Design analysis | Strength calculation of the drum with flanges, shafts with couplings, framework and brakes. | FI | D |
| | C050 Non-destructive testing (NDT) plan | | AP | A |
| Towing hook | C010 Design criteria | The expected maximum BP to be stated | FI | D |
| | C020 Assembly or arrangement drawing | | FI | D |
| | C030 Detailed drawing | Including emergency release mechanism | AP | D |
| | C040 Design analysis | | FI | D |
| | C050 Non-destructive testing (NDT) plan | | AP | A |
| Foundation and support of towing winch, hook, etc. | H050 Structural drawing | The RL and the expected maximum BP shall be stated
Including footprint. Applicable for equipment with static force > 50 kN or bending moment > 100 kNm | AP | Sec.3 B & Sec.12 D |
— the ability for the arrangement and equipment to operate within the specified limitations, towline paths, towline sectors etc specified by the arrangement drawing
— the correct function of the normal operation modes
— the correct function of the emergency operation modes, including emergency release and dead ship operations.

502 The winch shall be load tested during hoisting, braking, and pay out. Design loads to be applied. However, a maximum load equal to BP may be accepted if the winch is not of novel design or complex structure.

503 Towing hook to be load tested with a load equal to BP.

504 Bollard pull
The BP of the vessel shall be verified by a special test approved by the Society. Based upon the results of the test a Bollard Pull Certificate will be issued.

The BP testing procedure shall be as given in A505.
Measured BP will be entered into the “Register of vessels classed with DNV”, as information.
The expected BP may be preliminarily applied for design approval purposes prior to sea trial. If sea trial reveals that the expected pull is significantly exceeded, such design approvals may have to be re-considered.

505 The following test procedure should be adhered to and possible deviations shall be recorded in the Bollard Pull Certificate:

1) A proposed test programme shall be submitted prior to the testing.
2) During testing of continuous static BP the main engine(s) shall be run at the manufacturer’s recommended maximum continuous rating (MCR).
3) During testing of overload pull, the main engines shall be run at the manufacturer’s recommended maximum rating that can be maintained for a minimum of 1 hour. The overload test may be omitted.
4) The propeller(s) fitted when performing the test shall be the propeller(s) used when the vessel is in normal operation.
5) All auxiliary equipment such as pumps, generators and other equipment, which are driven from the main engine(s) or propeller shaft(s) in normal operation of the vessel shall be connected during the test.
6) The vessel shall be trimmed at even keel or at a trim by stern not exceeding 2% of the vessel’s length.
7) The vessel shall be able to maintain a fixed course for not less than 10 minutes while pulling as specified in items 2 or 3 above.
8) The test shall be performed with a fair wind speed not exceeding 5 m/s.
9) The co-current at the test location shall not exceed 1 knot.
10) The load cell used for the test shall be approved by Det Norske Veritas and be calibrated at least once a year. The accuracy of the load cell shall be ± 2% within a temperature range and a load range relevant for the test.
11) An instrument giving a continuous read-out and also a recording instrument recording the bollard pull graphically as a function of the time shall both be connected to the load cell.
12) The arrangement of bollard, towline and load cell shall ensure a force reading in horizontal direction by means of minimizing the influence from friction and force components in vertical direction.
13) The figure certified as the vessel’s continuous static BP shall be the towing force recorded as being maintained without any tendency to decline for a duration of not less than 10 minutes.
14) Certification of BP figures recorded when running the engine(s) at overload, reduced r.p.m. or with a reduced or an increased number of engines or propellers operating can be given and noted on the certificate. The angular position of turn able propulsion devices shall be recorded.
15) Both the load cell reading, engine power, and other essential parameters shall be continuously available to the DNV surveyor.
16) The recorded load cell readings shall be made available to the DNV surveyor immediately upon completion of the test.

B. Hull Arrangement and Strength

B 100 Draught for scantlings

101 For determining the scantlings of strength members based on the ship’s draught, the latter shall not be taken less than 0.85 D.
B 200  Fore peak structures

201  For tugs designed to use the bow for pushing floating structures additional strength in the fore peak shall be in accordance with B202, B203 and B204.

202  Forward of the collision bulkhead stringers shall be arranged on the ship's side not more than 2 m apart. The stringers shall be connected to the collision bulkhead by brackets forming gradual transition to the bulkhead.

203  The dimensions of the stringers shall not be less than:

— mean depth = 250 + 2.5 L [mm]
— thickness = 6.5 + 0.03 L [mm]
— flange area = 0.15 L [cm²].

204  The frames shall be connected to the stringers by lugs or brackets at every frame.

205  For ships with large flare in the forebody and only intended for towing, the general requirements given in Pt.3 Ch.2 Sec.6 + 25% may be applied.

B 300  Fenders

301  A substantial fender for the protection of the vessel's ship sides shall be fitted at deck level, extending the whole length of the vessel. Alternatively, an arrangement with loose fenders may be approved, if the upper part of the vessel's sides is additionally stiffened.

B 400  Machinery casing and emergency exit

401  For exposed casings the scantlings of plating and stiffeners shall be at least 20% in excess of the requirements for main class.

402  Skylights on uppermost continuous deck shall be arranged on a coaming not less than 900 mm in height. The scantlings shall be as for exposed casings.

403  Emergency exit shall be arranged from engine room to weather deck. The emergency exit shall be capable of being used at extreme angles of heel. The escape hatch on deck shall have a coaming height not less than 600 mm. The hatch cover shall have hinges arranged athwart ships, and shall be capable of being opened and closed (weathertight) from either side.

B 500  Companionways

501  Companionways to spaces below deck shall have sill heights not less than 600 mm, and shall have weathertight steel doors which can be opened and closed (weathertight) from either side.

B 600  Side scuttles

601  Side scuttles are not allowed in the vessel's sides unless the distance from the lower edge of side scuttles to the design waterline is at least 750 mm. Side scuttles in the vessel's sides and in sides of any superstructures on freeboard deck shall be provided with internally fitted, hinged deadlights and shall satisfy the requirements to Type A (heavy) according to ISO Recommendation 1751. Fixed lights in skylights etc. shall have glasses of thickness appropriate to their position as required for side scuttles, and fitted with hinged deadlights which may be arranged on the weather side.

B 700  Deck structure

701  Scantlings of foundations and supports of towing pins shall be based on 2 times the specified maximum static working load.

702  Scantlings of foundations and supports of towing winches shall be based on minimum 2.2 times the BP of the vessel.

703  Scantlings of foundations and supports of towing hook shall be based on minimum 2.5 times the BP of the vessel.

704  Acceptable stress levels for the scantlings of the supporting structure resulting from bending moments and shearing forces calculated for the load given above are:

\[ \sigma_b = 210 f_1 [N/mm^2] \]

\[ \tau = 120 f_1 [N/mm^2] \]

\[ \sigma_c = (\sigma_b^2 + 3 \tau^2)^{1/2} \]

\[ = 235 f_1 [N/mm^2]. \]
C. Systems and Equipment

C 100 Rudder force

101 The design rudder force on which scantlings shall be based, shall be calculated as indicated for the main class. The speed of the ship, however, shall not be taken less than \( V = 10 \text{ knots} \).

C 200 Steering gear

201 The steering gear shall be capable of bringing the rudder from 35° on one side to 30° on the other side in 20 s, when the vessel is running ahead at maximum service speed.

C 300 Anchoring and mooring equipment

301 Tugs shall have anchoring and mooring equipment corresponding to its equipment number, see Pt.3 Ch.3 Sec.3 C100. The term \( 2B_H \) in the formula may, however, be substituted by:

\[
2 \left( a_B + \sum h_i b_i \right)
\]

where:

\( b_i = \text{breadth [m] of the widest superstructure or deckhouse of each tier having a breadth greater than } B/4. \)

D. Towing Arrangement

D 100 Design standard

The equipment shall meet the requirements in this section. Alternatively equipment complying with recognized standard may be accepted upon special considerations provided such specifications give reasonable equivalence to the requirements of this section and is fulfilling the intension.

101 Towing arrangement drawing with the content listed under Documentation Requirement in this Section shall be posted on bridge.

D 200 General

201 Structural elements (e.g. cargo rails, bulwarks, etc) that may support the towline during normal operation, are to have a radius of bend sufficient to avoid damage to the towline.

202 The vessel shall be fitted with towing hook or towing winch suitable for its purpose. The towline point of attack is recommended to be located near the mid length of the vessel or other position suitable for the manoeuvrability. The arrangement shall be such that the heeling moment arising when the towline is running in the athwart ships direction, will be as small as possible.

203 The arrangement shall be such that the towline is led to the winch drum in a controlled manner under all foreseeable conditions (directions of the towline) and provide proper spooling on drum.

D 300 Materials for equipment

301 Towing hook with attachment shall be made of rolled, forged or cast steel in accordance with Pt.2 Ch.2 Sec.1, Sec.5 or Sec.7.

302 Towing winch materials shall comply with relevant specifications given in Pt.2.

303 For forged and cast steel with minimum specified tensile strength above 650 N/mm², specifications of chemical composition and mechanical properties shall be submitted for approval for the equipment in question.

304 Plate material in welded parts shall be of the grades as given in Pt.3 Ch.3 Sec.3 F200 Table F3.

305 When minimum specified yield is above 0.8 times the minimum specified tensile strength, 0.8 times minimum tensile strength shall be used as minimum specified yield in calculations for structural strength as given in D500.

306 Fabrication of items in A401 is generally to be in accordance with DNV Standard for Certification 2.22 – Lifting Appliances, Ch2. Sec2. J. Crane Manufacturing and Construction.

D 400 Towing hook

401 Design and scantlings of the towing hook with attachment shall be capable of withstanding a load of minimum 2.5 times the BP without permanent deformations.

402 Towing hooks shall be provided with reliable release arrangement, so that in case of a critical situation, the towline can be immediately released regardless of angle of heel and of direction of towline. The releasing device shall be operable from the bridge.
D 500  Winch  

501  Control system
The control stands for winches shall provide a safe and logical interface to the operator with operating levers returning to stop position when released and in addition provide a clear view to the drums.

502  Emergency release
The winch shall be designed to allow drum release in an emergency, and in all operational modes.
The release capabilities shall be as specified on towing arrangement drawing.
The action to release the drum shall be possible locally at the winch and from a position at the bridge with full view and control of the operation. Identical means of equipment for the release operation to be used on all release stations.
After an emergency release the winch brakes shall be in normal function without delay. It shall always be possible to carry out the emergency release sequence (emergency release and/or application of brake), even during a black-out.
Control handles, buttons etc. for emergency release shall be protected against unintentional operation.

503  Structural strength
The design and scantlings of the towing winch shall be capable of withstanding the RL without permanent deformations at relevant layer.
Buckling and fatigue to be considered according to recognized standard or code of practice.

504  Drum
The drum design shall be carried out with due consideration to the relevant operations.
The drum diameter for steel wire rope should not be less than 14 times the maximum intended diameter of the rope. However, for all rope types, the rope bending specified by the rope manufacturer should not be exceeded.

505  Towline attachment
The end attachment of the towline to the winch barrel shall be of limited strength making a weak link in case the towline has to be run out.
At least 3 dead turns of rope are assumed on the drum under normal operation to provide proper attachment.

506  Drum brake
The brake is normally to act directly on drum and should be capable of holding the RL at inner layer. It shall be arranged for manual operation or other means for activation during failure of the power supply or control system.

D 600  Marking
Equipment shall be marked to enable them to be readily related to their specifications and manufacturer. When a DNV product certificate is required, the equipment shall be clearly marked by the society for identification.

E. Stability

E 100  General requirements

101  The requirements in this section apply to vessels with length L_F of 24 metres and above.

102  Vessels with a length L_F less than 24 meters should as far as practicable comply with the requirements in this section. Other stability requirements may however be applied provided the Society upon consideration in each case finds these requirements to be appropriate for the vessel.

103  The vessel's stability shall be assessed when the towing line is not in line with the vessel's longitudinal centre line. The towing heeling moment shall be calculated based on the assumption in 104. The criterion in 105 shall be complied with.

Guidance note:
It is acceptable that compliance is demonstrated for actual loading conditions only. The approval will then be limited to the present loading conditions. These initial conditions shall also comply with the relevant intact and damage stability criteria before applying the heeling moment.

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

104  Towing heeling moment
A transverse heeling moment generated by the rudder and propulsion system with maximum thrust and rudder(s) hard over is assumed to act horizontally on the towline as a static transverse force derived from the maximum bollard pull. No vertical force is assumed.
A heeling lever curve as a function of the heeling angle shall be calculated as

\[ HL_\theta = \frac{F_{\text{thr}} \cdot h \cdot \cos \theta}{g \cdot \Delta} \]

where:

- \( F_{\text{thr}} \) is taken as \( BP \cdot C_T \) in kN
- \( BP \) is the maximum continuous bollard pull measured in accordance with Sec.12 A500
- \( C_T \) is a transverse thrust and rudder force reduction factor depending on the propulsion arrangement:
  - \( C_T \) shall be taken as not less than 0.6 for conventional single or twin propeller propulsion systems with rudders and fixed or no propeller nozzles. This value is increased to 0.7 for ships fitted with moveable nozzles.
  - For single azimuth thrusters (‘Z-drives’) acting normal to the centreline and for cycloidal drives a value of 1.0 is to be applied.
  - For two azimuth thrusters \( C_T \) is taken as \( \frac{1 + \cos \gamma}{2} \), where \( \gamma \) is the offset angle that occurs between the thruster jets when one unit is directed at a right angle to the ship’s centreline and the other is directed so that its thrust jet tangentially intersects the nozzle of the first.
  - Other values for \( C_T \) may be accepted if substantiated by calculations

- \( h \) is the towing heeling arm taken as the vertical distance between the centre of propeller(s) and the fastening point of the towline
- \( g = 9.81 \text{ m/s}^2 \)
- \( \Delta \) is the displacement of the loading condition in tonnes. The displacement, LCG and VCG for the initial loading condition is assumed to remain unchanged.

[If the vessel is intended to operate with additional transverse thrusters the heeling lever generated by the propulsion system shall be increased in proportion to the heeling moment generated by such thrusters.]

105 **Stability criterion for tugs**

The residual area between the righting lever curve and the heeling lever curve calculated in accordance with 104 shall not be less than 0.09 metre-radians. The area is determined from the first interception of the two curves to the angle of the second interception or the angle of down flooding, whichever is less.

Alternatively, the area under the righting lever curve shall not be less than 1.4 times the area under the heeling lever curve calculated in accordance with 104. The areas are determined between 0° and the angle of the second interception or the angle of down flooding, whichever is less.

106 **Stability criteria for ocean towing**

For ships intended only for towing operations where the towline is secured against transverse movement near the aft perpendicular the following criteria may be applied in lieu of D103:

The residual area between the righting lever curve and the heeling lever curve calculated in accordance with 104 shall not be less than 0.055 metre-radians. The area is determined from the first interception of the two curves to the angle of the second interception or the angle of down flooding, whichever is less.

The static angle at the first interception shall not be more than 15°.

107 **Additional information**

The vessel’s stability manual shall contain additional information in on the maximum bollard pull, the assumed location of the fastening point of the towline, heeling force and moment and identification of critical flooding points. The heeling lever curve shall be plotted on the GZ curve for all intended towing conditions.
SECTION 13
ESCORT VESSELS

A. General

A 100 Classification

101 The requirements in this section apply to vessels specially intended for escort service.

102 Vessels built in compliance with the requirements in this section may be given the class notation Escort.

103 The escort rating number \( (F_{St}, t, v) \) shall be determined by approved full scale trials, performed within acceptable limits set by stability and winch criteria specified in these Rules, and further described in the separate Classification Note no. 57.2 “Escort Full Scale Testing”. A test certificate indicating the escort rating number may be issued on completion of successful full scale trials. If trials take place at both 8 and 10 knots, the escort rating number will consist of 6 parts.

104 The requirements for Tug notation given in Sec.12 shall be complied with. The winch, crucifix etc. and their supporting structures shall comply with the requirements for Tug notation based on towline force \( F_W \) (see Fig.1) instead of BP.

A 200 Definitions

201 The term Escort service includes steering, braking and otherwise controlling the assisted vessel. The steering force is provided by the hydrodynamic forces acting on the tug’s hull.

The term Escort test speed is the speed at which the full scale measurements are to be carried out, normally 8 knots and/or 10 knots.

202 The term Escort tug is the tug performing the escort service, while Assisted vessel is the vessel being escorted.

203 \( F_S \) indicates maximum transverse steering pull in metric tonnes exerted by the escort tug on the stern of the assisted vessel with the intention of controlling it, \( t \) is the time required for the change of the tug’s position from one side to the corresponding opposite side, and \( v \) is the speed at which this pull may be attained (see Fig.1).

Fig. 1
Typical Escort configuration
A 300 Documentation

301 Documentation shall be submitted as required by Table A1.

<table>
<thead>
<tr>
<th>Table A1 - Documentation requirements for Escort (FS, T, V)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Object</strong></td>
</tr>
<tr>
<td>Vessel</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Stability</td>
</tr>
<tr>
<td>Towing arrangement</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Tow line</td>
</tr>
</tbody>
</table>

302 For general requirements to documentation, including definition of the Info codes, see Pt.0 Ch.3 Sec.1.

303 For a full definition of the documentation types, see Pt.0 Ch.3 Sec.2.

B. Design and Arrangement

B 100 Design

101 The hull of the tug shall be designed to provide adequate hydrodynamic lift and drag forces when in indirect towing mode. Due attention shall be paid to the balance between hydrodynamic forces, towline pull and propulsion forces, as well as sudden loss of thrust.

102 The vessel shall be designed so that forces are in equilibrium with a minimum use of propulsive force except for providing forward thrust and balancing transverse forces during escorting service.

103 The propulsion system shall be able to provide ample thrust for manoeuvring at higher speeds for the tug being in any oblique angular position.

104 In case of loss of propulsion, the remaining forces shall be so balanced that the resulting turning moment will turn the escort tug to a safer position with reduced heel.

B 200 Arrangement

201 Freeboard shall be arranged so as to avoid excessive trim at higher heeling angles. Bulwark shall be fitted all around exposed weather deck.

202 The towing winch shall have a hydraulic load reducing system in order to prevent overload caused by dynamic oscillation in the towing line. Normal escort operation shall not be based on use of brakes on the towing winch, but the hold function shall be provided by the gearbox and the hydraulic system instead. The towing winch shall pay out towing line before the pull reaches 110% of the rated towline force FW.

C. Stability

C 100 Stability

101 The general stability criteria in Sec.12 E are to be complied with, in addition to stability criteria given below.

C 200 Stability criteria

201 The area under the righting arm curve and heeling arm curve shall satisfy the following ratio:

\[ R_{ABS} \geq 1.25 \]

\( R_{ABS} \) = Ratio between righting and heeling areas between equilibrium and 20° heeling angle. Equilibrium is obtained when maximum steering force is applied from tug.

202 Heeling arm shall be derived from the test. The heeling arm shall be kept constant from equilibrium to 20°, see Fig.2.
Guidance note:
The heeling arm shall be taken as escort heeling moment divided by the displacement. For preliminary calculations the heeling arm may be taken as the maximum value that ensures compliance with the criteria given in 201 and 203.

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

203 The following requirement shall be satisfied:

\[ A + B \geq 1.4 (B + C) \]

A + B = area under the GZ curve
B + C = area under the heeling moment curve.

The areas are taken from 0° heel to the angle of down flooding or 40°, whichever is less. See Fig.3.
D. Full Scale Testing

D 100 Procedures

101 The following tests shall be undertaken:

— Measurement of $F_S$: The escort tug will connect its towing line wire to the assisted vessel's stern and follow it with the wire slack, both ships travelling at the same speed. The tug will then position itself at an agreed angle of attack relative to the flow of water and the resulting towline tension $F_W$ shall be recorded. These readings combined with the respective $\theta$-$\beta$ angles combinations shall be then used to establish $F_S$.

— Manoeuvre test: The escort tug will shift its position from a steering position minimum 30° from one side of the assisted vessel (i.e. $\theta$ is 60°) to the mirror position in the opposite side and $t$ will be the time required.

The escort test speed is 8 knots and/or 10 knots. A DNV surveyor will attend the test for the purpose of witnessing compliance with the agreed test program.

102 Approved escort departure and escort arrival loading conditions from the stability booklet shall define the way the tug will be loaded for the trial.

D 200 Recordings during full scale trials

201 At least the following data shall be recorded continuously in real time mode during trials for later analysis:

— towline tension
— towline length
— towline angle $\theta$
— oblique angle $\beta$
— heeling angle on tug
— speed of assisted vessel, relative to the sea
— time for the manoeuvre test
— weather condition and sea state.

202 Sea trials exceeding critical heeling angle from approved stability calculations shall not be accepted.
SECTION 14
BARGES

A. General

A 100 Introduction

101 Objective
The objective of this section is to define a minimum technical standard for barges.

102 Scope
Scope includes arrangement, hull strength, hatches and deck openings, steering arrangement, equipment, machinery and electrical installations, drainage, and stability.

103 For barges intended to carry personnel, the scope also covers basic safety requirements. This includes fire safety, life saving appliances, power supply, and radio communication.

104 Application
Vessels constructed and equipped, surveyed and tested in accordance with the rules of this section, will be assigned the class notation Barge.

105 DNV Rules for Ships Pt.2 and Pt.4 applies unless otherwise specified. Pt.3 is replaced by the requirements of this section.

106 A barge may be towed or pushed. For barge to be pushed, see Sec.15.

107 Vessels built in compliance with the requirements as specified in Table A1 will be assigned the additional notations, as follows:

### Table A1 – Additional notations - Barge

<table>
<thead>
<tr>
<th>Class notation</th>
<th>Qualifier</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barge</td>
<td>&lt;none&gt;</td>
<td>Hull constructed from steel Sec.14 C</td>
</tr>
<tr>
<td></td>
<td>Concrete 2</td>
<td>Hull constructed from concrete Sec.14 D</td>
</tr>
<tr>
<td></td>
<td>for “C” 3</td>
<td>Barge specifically intended for carriage of chemicals Pt.5 Ch.4</td>
</tr>
<tr>
<td></td>
<td>for Deck Cargo4</td>
<td>Barge specifically intended for carriage of cargo on deck only NA5</td>
</tr>
<tr>
<td></td>
<td>for Liquefied Gas</td>
<td>Barge specifically intended for carriage of liquefied gas Pt.5 Ch.5</td>
</tr>
<tr>
<td></td>
<td>for Oil</td>
<td>Barge specifically intended for carriage of oil Pt.5 Ch.3</td>
</tr>
</tbody>
</table>

1) Guidance note: For vessels with limited means of self-propulsion an upper limit for barges/pontoons may normally be taken as machinery output giving a maximum speed less than V = 3 + L/50 knots, L not to be taken greater than 200 m.

2) Barge made of concrete will be assigned the class notation: Concrete Barge. The survey related class notation BIS is mandatory and requirements given in Pt.3 Ch.1 Sec.1 D shall be complied with.

3) “C” denotes the type of cargo for which the barge is classified, referring to specific type of liquid chemical. Example: Barge for Methanol.

4) Deck Cargo is an optional qualifier.

5) If built for loading or unloading cargo by submerging the cargo deck, relevant requirements given in Sec. 21 shall be complied with.

### Table A2 – Documentation requirements - Class notation Barge

<table>
<thead>
<tr>
<th>Object</th>
<th>Documentation type</th>
<th>Additional description</th>
<th>Info</th>
</tr>
</thead>
<tbody>
<tr>
<td>Towing arrangement</td>
<td>Z030 – Arrangement plan</td>
<td>Arrangement of towing line Fastening arrangement and details</td>
<td>FI</td>
</tr>
<tr>
<td>Towing equipment</td>
<td>H050 - Structural drawing</td>
<td>Including towing force design loads and winch load footprint.</td>
<td>AP</td>
</tr>
</tbody>
</table>

A 200 Documentation requirements

201 For class notation Barge, documentation shall be submitted as required by Pt.3 Ch.1 Sec.1 or Pt.3 Ch.2 Sec.1. In addition, documentation shall be submitted as required by Table A2.
For Barges carrying 36 persons or more the following additional following documentation shall be submitted as required in Table A3:

<table>
<thead>
<tr>
<th>Object</th>
<th>Documentation type</th>
<th>Additional description</th>
<th>Info</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety general</td>
<td>G040 – Fire control plan</td>
<td></td>
<td>AP</td>
</tr>
<tr>
<td></td>
<td>G050 – Safety control plan</td>
<td></td>
<td>AP</td>
</tr>
<tr>
<td>Structural fire protection arrangements</td>
<td>G060 – Structural fire protection drawing</td>
<td></td>
<td>AP</td>
</tr>
<tr>
<td></td>
<td>G061 – Penetration drawings</td>
<td></td>
<td>AP</td>
</tr>
<tr>
<td>Fire detection and alarm system</td>
<td>I200 – Control and monitoring system documentation</td>
<td></td>
<td>AP</td>
</tr>
<tr>
<td></td>
<td>Z030 – Arrangement plan</td>
<td></td>
<td>AP</td>
</tr>
<tr>
<td>Fire water system</td>
<td>S010 – Piping diagram</td>
<td></td>
<td>AP</td>
</tr>
<tr>
<td></td>
<td>S030 – Capacity analysis</td>
<td></td>
<td>AP</td>
</tr>
<tr>
<td></td>
<td>Z030 – Arrangement plan</td>
<td></td>
<td>AP</td>
</tr>
<tr>
<td>Fixed fire-extinguishing systems</td>
<td>G200 – Fixed fire extinguishing system documentation</td>
<td></td>
<td>AP</td>
</tr>
<tr>
<td>Escape routes</td>
<td>G120 – Escape route drawing</td>
<td></td>
<td>AP</td>
</tr>
<tr>
<td>Ventilation systems</td>
<td>S013 - Ducting and instrumentation diagram (D&amp;ID)</td>
<td></td>
<td>AP</td>
</tr>
<tr>
<td></td>
<td>S014 - Duct routing sketch</td>
<td></td>
<td>AP</td>
</tr>
<tr>
<td>Life-saving appliances</td>
<td>G160 – Life-saving arrangement plan</td>
<td></td>
<td>AP</td>
</tr>
</tbody>
</table>

For qualifier Concrete, additional documentation shall be submitted as required by Table A4.
### Table A4 – Documentation requirements – qualifier Concrete

<table>
<thead>
<tr>
<th>Object</th>
<th>Documentation type</th>
<th>Additional description</th>
<th>Info</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hull structure</td>
<td>H010 – Structural design brief</td>
<td>Including:</td>
<td>FI</td>
</tr>
<tr>
<td></td>
<td></td>
<td>— Overall design safety</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>— Functional requirements</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>— Material data</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>— Design phases</td>
<td></td>
</tr>
<tr>
<td></td>
<td>H020 – Design load plan</td>
<td>Including:</td>
<td>FI</td>
</tr>
<tr>
<td></td>
<td></td>
<td>— Self-weight distribution</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>— Accidental loads</td>
<td></td>
</tr>
<tr>
<td></td>
<td>H050 – Structural drawing</td>
<td>Including:</td>
<td>AP</td>
</tr>
<tr>
<td></td>
<td></td>
<td>— Reinforcement in structural members</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>— Reinforcement details</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>— Position and density of pre-stressing arrangement</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>— Pre-stressing anchorage details</td>
<td></td>
</tr>
<tr>
<td></td>
<td>H080 – Strength analysis</td>
<td>Including:</td>
<td>FI</td>
</tr>
<tr>
<td></td>
<td></td>
<td>— Combination of local and global loads for different limit states</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>— Calculate the utilisation of the structural elements in the different limit state</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Z250 - Procedure</td>
<td>Plan for in-service inspection based on design and construction considerations, including identification of areas to be inspected.</td>
<td>AP</td>
</tr>
<tr>
<td></td>
<td>Q010 – Quality manual</td>
<td>Documenting valid EN ISO 9001 certificate or equivalent.</td>
<td>FI</td>
</tr>
<tr>
<td></td>
<td>Z041 – Ship construction file</td>
<td>Deviation reports and their closure documentation</td>
<td>AP</td>
</tr>
<tr>
<td>Structural fabrication</td>
<td>H130 – Fabrication specification</td>
<td>Including:</td>
<td>FI</td>
</tr>
<tr>
<td></td>
<td></td>
<td>— Qualification testing of the concrete</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>— Construction procedures</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>— Formwork</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>— Concreting</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>— Procedure for taking control specimens and testing of these</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>— Procedure for curing of the concrete</td>
<td></td>
</tr>
</tbody>
</table>

**204** For general requirements to documentation, including definition of the Info codes, see Pt.0 Ch.3 Sec.1.

**205** For a full definition of the documentation types, see Pt.0 Ch.3 Sec.2.

### A 300 Certification requirements

**301** For qualifier Concrete, materials shall be certified as required by Table A5.

### Table A5 – Certification requirements – qualifier Concrete

<table>
<thead>
<tr>
<th>Object</th>
<th>Certificate type</th>
<th>Additional description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete materials</td>
<td>NV-M</td>
<td>DNV material certificate</td>
</tr>
</tbody>
</table>
B. Arrangement

**B 100 Transverse bulkheads**

101 Barges shall have a collision bulkhead and an after end bulkhead.

**B 200 Bow height**

201 The requirement for minimum bow height given in Pt.3 Ch.1 Sec.3 A900 or Pt.3 Ch.2 Sec.3 A900 may be dispensed with.

  **Guidance note:**
  For manned barges the requirements to bow height should be clarified with the respective Administration.

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

C. Hull Strength - Steel

**C 100 Longitudinal strength**

101 The midship section modulus requirements within 0.4 L amidships about the horizontal neutral axis based on cargo or ballast condition is given by:

\[
Z = \frac{M_s + M_W}{\sigma_f} \times 10^3 \text{ (cm}^3\text{)}
\]

\[
\sigma_f = \begin{cases} 
184 \ f_1 & \text{for seagoing condition with } M_W \text{ as below} \\
140 \ f_1 & \text{for special conditions as mentioned in 102}
\end{cases}
\]

\[
M_s = \begin{cases} 
-0.11 \ C_W L^2 B (C_B + 0.7) & \text{(kNm) sagging} \\
0.19 \ C_W L^2 B C_B & \text{(kNm) hogging}
\end{cases}
\]

\[
C_W = \text{as given in Fig. 1}
\]

\[
C_W \text{ need not be taken greater than } D/1.4
\]

\[
f_1 = \text{material factor as given in Pt.3 Ch.1 Sec.2}
\]

\[
f_1 = 1.0 \text{ for NV-NS.}
\]

102 For special harbour conditions (e.g. transient states when moving heavy structures on board from end of barge) or when the wave heights are considered to be negligible, the wave bending moment may be taken zero when calculating Z in 101. Correspondingly the most unfavourable M_s should be used in 101. If M_s should occur outside 0.4 L amidships the actual section shall be considered.

103 The midship section modulus shall not be less than:

\[
Z = 0.95 \ \frac{C_{WO}}{f_1} L^2 B (C_B + 0.7) \text{ (cm}^3\text{)}
\]

C_{WO} as given in Fig. 1.

104 For ordinary barge construction the section modulus outside 0.4 L amidship will normally be satisfactory. In other cases it may be necessary to consider the section modulus in more detail along the ship length. In such cases the distribution of bending moments may be taken as outlined in Pt.3 Ch.1 Sec.5. Acceptable bending stresses at ends may be 85 f_1 N/mm^2 and 65 f_1 N/mm^2 for ordinary seagoing and special conditions, respectively.
For barges with restricted service \( C_W \) and \( C_{WO} \) may be reduced as given in Table C1.

<table>
<thead>
<tr>
<th>Class notation</th>
<th>Reduction</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( C_W )</td>
<td>( C_{WO} )</td>
<td></td>
</tr>
<tr>
<td>R0</td>
<td>none</td>
<td>none</td>
<td></td>
</tr>
<tr>
<td>R1</td>
<td>none</td>
<td>none</td>
<td></td>
</tr>
<tr>
<td>R2</td>
<td>10%</td>
<td>5%</td>
<td></td>
</tr>
<tr>
<td>R3</td>
<td>25%</td>
<td>13%</td>
<td></td>
</tr>
<tr>
<td>R4</td>
<td>40%</td>
<td>20%</td>
<td></td>
</tr>
</tbody>
</table>

\( \Sigma A \geq 0.1 \left( Q_S + Q_W \right) \) (cm\(^2\))

\( \Sigma A \) = sum of effective shear areas of ship sides and bulkheads
\( Q_S \) = still water shear force in kN
\( Q_W \) = wave shear forces in kN. Values and distribution of \( Q_W \) may be found in Pt.3 Ch.1 Sec.5 B200.

For special harbour conditions as outlined in 102 it may be accepted to use \( Q_W = 0 \).

Within 0.6 \( L \) amidships or in special areas due to conditions as referred to in 102 the value of \( \Sigma A_S \) shall
The thickness requirement for bottom, side and deck plating due to lateral pressure is given by:

\[ t = k_s \frac{\sqrt{p}}{f_1} + t_k \text{ (mm)} \]

- \( k = 1.5 \) for bottom and deck plating within 0.4 \( L \) when transverse stiffening and for longitudinally stiffened deck plating in way of cargo area of vessels with class notation ESP.
- \( t_k = \) corrosion addition, see Pt.3 Ch.1 Sec.2
- \( p = \) as given in Table C2.

The thickness of bottom, side and deck plating shall not be less than:

\[ t = 5 + \frac{0.04L}{f_1} + t_k \]

The thickness of stiffeners and web plates shall not be less than:

\[ t = 5 + \frac{0.02L}{f_1} + t_k \]

For buckling control of plating, see Pt.3 Ch.1 Sec.13 or Pt.3 Ch.2 Sec.12.

The section modulus requirement to local stiffeners and girders is given by:

\[ Z = \frac{83 l^2 s p}{\sigma} k \text{ (cm}^3\text{)} \]

- \( l = \) stiffener or girder span (m)
- \( s = \) stiffener or girder spacing (m)
- \( k = 1 + 0.08 t_k \)
- \( p = \) as given in Table C2.
- \( \sigma = \) may be taken from relevant sections in Pt.3 Ch.1 or Pt.3 Ch.2.

The web area of girder ends is given by:

\[ A = 0.06 l s p + 10 h t_k \text{ (cm}^2\text{)} \]

The web area at the middle of the span shall not be less than 0.5 \( A \). Alternatively the web area can be determined with basis on direct strength calculations. Ref. Pt.3 Ch.1 Sec.12.

Corrosion addition for internal members inside ballast tanks using fresh water from rivers and lakes:

- \( t_k = 2.0 \text{ mm within 1.5 m below weather deck tank or cargo hold top} \)
- \( t_k = 1.0 \text{ mm otherwise.} \)
Guidance note:
If liquid cargo or ballast shall be carried, the structure should also be considered as tank structure.

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

C 400 Bottom structure

401 The bottom structure may be built as single or double bottom. In case the barge is arranged with a double bottom refer to requirements given in Pt.3 Ch.1 Sec.6 or Pt.3 Ch.2 Sec.5.

402 The height of a double bottom shall give good access to all internal parts. The height shall not be less than 650 mm.

403 The bottom structure shall be considered as a grillage system being supported by ship sides and/or bulkheads.

The structure is generally to be calculated for a net loading corresponding to p (bottom) given in Table C2. Acceptable stress levels may be as given for stiffeners in Pt.3 Ch.1 Sec.13 C.

404 If the arrangement of the barge is such that the net loading specified in 403 is considered to be unrealistic, reduced net loadings (i.e. sea pressure-cargo) according to specified loading conditions may be accepted. The reduced net loading should not be less than 50% of the full net loading given in 403.

405 The bottom in barges with L > 100 m shall be strengthened against slamming, see Pt.3 Ch.1 Sec.6 H. In the formula for C2 the ballast draught TBF may be substituted by full draught T.

C 500 Deck structure

501 If the deck girders constitute a grillage system, direct strength calculations shall be made to verify that for the loading specified in Table C2 or other specified design loadings, the stresses comply with the levels given in Pt.3 Ch.1 Sec.8 or Pt.3 Ch.2 Sec.7.

502 If the deck will be subject to heavy point loads, plans shall be submitted showing the arrangement and position of loads as well as their magnitude.

It shall be specified if all loading points will be subject to loads simultaneously, or if there will be some alternative groupings of the loads. For reduction of dynamic loads, see notes to Table C2, factor k.

503 Heavy point loads should preferably be supported directly by bulkheads.

504 Decks subject to wheel loads shall have scantlings complying with requirements given in Pt.5 Ch.2 Sec.4 C in the Rules.

505 Dry cargo barges where the cargo holds and the main deck are supported by cantilevers are to comply with requirements given in Pt.5 Ch.2 Sec.4.

C 600 Towing arrangement

601 Towing hooks, winches, or brackets with their supporting structure shall be capable of withstanding the breaking load $P_b$ of the towline.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---
The breaking load shall not be taken less than the towline minimum breaking strength given in Equipment Table, i.e. Pt.3 Ch.3 Sec.3 Table C1.

Acceptable stress levels in the supporting structure resulting from bending moments and shearing forces calculated for the load \( P_b \) given in 601 or 602 are:

\[
\sigma_b = 210 f_1 \text{ (N/mm}^2\text{)} \\
\tau = 130 f_1 \text{ (N/mm}^2\text{)} \\
\sigma_{comb} = \sqrt{\sigma_b^2 + 3 \tau^2} = 235 f_1 \text{ (N/mm}^2\text{)}
\]

Scantlings of deckhouses shall comply with Pt.3 Ch.1 Sec.10 or Pt.3 Ch.2 Sec.10.

---

**D. Tentative Rules for Hull Strength - Concrete**

**D 100 Materials**

101 A barge may be constructed using the following materials: steel reinforcement, FRP reinforcing rods, LWA concrete, NW concrete, structural grout, or fibre reinforced grout.

102 Concrete is in this standard used as a common reference to NW concrete, LWA concrete, structural grout, fibre reinforced structural grout and fibre reinforced structural concrete if the above specified materials are not included specifically.

103 Definitions (for further definitions, see DNV-OS-C502 Sec.4)

<p>| |</p>
<table>
<thead>
<tr>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>NW denotes normal weight concrete</td>
</tr>
<tr>
<td>LWA concrete denotes lightweight aggregate concrete</td>
</tr>
<tr>
<td>fibre reinforced concrete is concrete mixed with either steel or FRP fibres</td>
</tr>
<tr>
<td>fibre reinforced structural grout is grout mixed with either steel or FRP fibre</td>
</tr>
<tr>
<td>FRP fibres are fibres cut from fibre reinforced polymers</td>
</tr>
</tbody>
</table>

104 The material to be used in a concrete barge shall be in accordance with the requirements specified in DNV-OS-C502 Sec.4.

105 Testing of concrete, grout, steel, FRP, additions, admixtures and constituent materials shall all be in accordance with the requirements of DNV-OS-C502 Sec.4 M.

106 The material properties of concrete (with and without fibres) shall be in accordance with the requirement DNV-OS-C502 Sec.4 C and D.

107 The material properties of grout (with and without fibres) shall be in accordance with the requirement DNV-OS-C502 Sec.4 C, E and F.

108 For concrete, fibre reinforced concrete, structural grout and fibre and reinforced structural grout; the 28 days characteristic compressive strength, \( f_{ck} \), is defined as the lower 5th percentile found from statistical analysis of tests on cylindrical specimens with diameter 150 mm and height 300 mm.

109 For NW concrete, LWA concrete and fibre reinforced concrete; normalized compressive and tensile strength are required in detailed design of structural members. Normalized values are given in DNV-OS-C502 Sec.4.

110 For LWA concrete, grout, fibre reinforced concrete and fibre reinforce grout; NV material certificates are required, documenting specific product properties. For further details, see DNV-OS-C502 Sec.4.

111 For FRP reinforcement NV material certificates are required, documenting specific product properties. For further details, see DNV-OS-C502 Sec.4.

112 NV material certificates for NW Concrete, reinforcement and tendons as required by DNV-OS-C502 Sec.4 shall be submitted.

113 For fatigue properties of concrete, LWA concrete, fibre reinforced concrete, grout and fibre reinforced grout; references are made to DNV-OS-C502 Sec.6 M200. Parameters defining the fatigue parameters shall be defined in the material certificates.

114 For fatigue properties of reinforcement, FRP reinforcement and tendons; see DNV-OS-C502 Sec.6 M200. Parameters defining the fatigue parameters are to be defined in the material certificates.

115 Anchorage devices and mechanical splices shall be documented by material certificates, see DNV-OS-C502 Sec.4 G200.
Friction welded end anchorages on rebars (T-heads) shall be qualified tested in advance with the actual type of rebar and be routinely tested during production. The test program shall include a tension test and a bend test to document strength and ductility of the connection. The friction weld shall not fail before the rebar.

Welding procedures, together with the extent of testing for weld connections relevant to reinforced concrete and concrete structures, shall be specified and approved in each case.

The concrete material and steel material shall be documented in accordance with DNV-OS-C502 Sec.4 A100.

D 200 Design principles

The design shall be performed according to the load and resistance factor design format (LRFD method) as detailed in DNV-OS-C502 Sec.6. The design shall be carried out for the limit states of strength (ULS), accident (ALS), fatigue (FLS) and serviceability (SLS).

Detailed design for structural capacity, water tightness (SLS), Fatigue life and Progressive collapse shall be carried out in accordance with DNV-OS-C502 Sec.6.

The concrete material and steel material shall be documented in accordance with DNV-OS-C502 Sec.4 A100.

D 300 Hull girder loads

The design stillwater bending moments, \( M_S \), and design stillwater shear forces, \( Q_S \), are to be based on the envelope curves representing all relevant loading conditions specified in the Trim & Stability booklet, and are to be combined with partial load factors for permanent loads as given in DNV-OS-C502 Sec.5 D.

The vertical wave bending moments at arbitrary positions along the length of the barge are normally not to be taken less than:

\[
M_{\text{Wave}} = K_{\text{global}} M_W \gamma f, E \text{ (kNm)}
\]

\( K_{\text{global}} = \) factor depending on limit state

\( = 0.59 \) for SLS

\( = 1.0 \) for ULS

\( \gamma f, E = \) partial load factor for environmental loads as given in DNV-OS-C502 Sec.5 D

\( M_W = \) Rule-defined vertical wave bending moments as given in Pt.3 Ch.1 Sec.5 B202
The vertical wave shear forces at arbitrary positions along the length of the barge are normally not to be taken less than:

\[ Q_{\text{Wave}} = k_{\text{global}} Q_{\text{WP(WN)}} \gamma_{f,E} \ (\text{kNm}) \]

\( k_{\text{global}} \gamma_{f,E} \) as given in 302

\( Q_{\text{WP(WN)}} \) as Rule-defined vertical wave shear forces as given in Pt.3 Ch.1 Sec.5 B203

### D 400 Local loads

**401** The design sea pressure acting on side, bottom and weather deck shall be taken as the sum of the static and the dynamic pressure as:

- For load point below summer load waterline:

\[ p_{\text{sea}} = 10 \ h_0 \ \gamma_{f,G,Q} + k_{p_2} \ p_{dp} \ \gamma_{f,E} \ (\text{kN/m}^2) \]

- For load point above summer load waterline:

\[ p_{\text{sea}} = k_{p_2} \ p_{2} \ \gamma_{f,E} \ (\text{kN/m}^2) \]

\( k_{p_2} = \) factor depending on limit state

- 1.0 for SLS
- 2.0 for ULS

\( \gamma_{f,G,Q} = \) partial load factor for permanent and functional loads as given in DNV-OS-C502 Sec.5 D

\( \gamma_{f,E} = \) partial load factor for environmental loads as given in DNV-OS-C502 Sec.5 D

\( p_{dp}, p_2 = \) dynamic sea pressure as given in Pt.3 Ch.1 Sec.4 C201

**402** All tanks shall be designed for the following internal design pressure:

\[ p_{AV} = \rho \ g_0 \ h_s \ \gamma_{f,G,Q} + k_{AV} \rho \ a_V \ \gamma_{f,E} \ (\text{kN/m}^2) \]

\( k_{AV} = \) factor depending on limit state

- 0.5 for SLS
- 1.0 for ULS

\( \gamma_{f,G,Q} = \) as given in 401

\( \gamma_{f,E} = \) as given in 401

\( h_s = \) vertical distance in m from the load point to the top of tank, excluding smaller hatchways

\( a_V = \) combined vertical acceleration as given in Pt.3 Ch.1 Sec.4 B600, taken in centre of gravity of tank

**403** For tanks where the air pipe may be filled during filling operations, the following additional internal design pressure conditions shall be considered:

\[ p_{d} = (\rho \ g_0 \ h_s + \Delta p_{\text{dyn}}) \ \gamma_{f,G,Q} \ (\text{kN/m}^2) \]

\( \Delta p_{\text{dyn}} = \) calculated pressure drop as further described in Pt.3 Ch.1 Sec.4 C302

\( \gamma_{f,G,Q} = \) as given in 401

**Guidance note:**

This internal pressure needs not to be combined with extreme environmental loads. Normally only static global response need to be considered.

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

**404** The weather deck shall be designed for the following design pressure:

\[ p_{dk} = q(\rho_0 \ \gamma_{f,G,Q} + k_{AV} \ a_V \ \gamma_{f,E}) \ (\text{kN/m}^2) \]

\( q = \) deck loading in t/m². q is not to be taken less than 0.7 T.

\( k_{AV} \) as given in 401

**405** For concrete barges with L>100 m, the bottom forward shall be strengthened against slamming, applying the following impact pressure:

\[ p_{\text{slam}} = p_{d} \ c_3 \ \gamma_{f,E} \ (\text{kN/m}^2) \]

\( p_{d} = \) design slamming pressure as given in Pt.3 Ch.1 Sec.6 H203. In the formula for \( C_2 \) the ballast draught \( T_{BF} \) may be substituted by full draught \( T \).
\[ C_3 = \text{load intensity factor as given in Pt.3 Ch.1 Sec.6 H211} \]
\[ \gamma_{f, E} = \text{as given in 401} \]

**Guidance note:**
This impact pressure is only to be considered for the ULS case and needs not to be combined with extreme environmental loads. Normally only static global response need to be considered.

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

406 The forces from cargo, equipment or other components acting on supporting structures should be taken as:

\[
P_{Vd} = (g_0 \gamma_{f, G, Q} + k_{aT} a_T \gamma_{f, E}) M \quad \text{(kN)}
\]
\[
P_{Hd} = (g_0 \gamma_{f, G, Q} + k_{aV} a_V \gamma_{f, E}) M \quad \text{(kN)}
\]

- \( k_{aT} \) = factor depending on limit state
  - 0.67 for SLS
  - 1.0 for ULS
- \( k_{aV} \) = as given in 402
- \( a_T \) = combined transverse acceleration as given in Pt.3 Ch.1 Sec.4 B700
- \( a_V \) = combined vertical acceleration as given in Pt.3 Ch.1 Sec.4 B600
- \( \gamma_{f, G, Q}, \gamma_{f, E} \) = as given in 401

\( M \) = mass of cargo, equipment or other components (t)

\( P_{Vd} \) = vertical design force
\( P_{Hd} \) = horizontal design force

**D 500 Design resistance**

501 The characteristic resistance of a cross-section or a structural member shall be derived from characteristic values of material properties and nominal geometrical dimensions. The design resistance shall be determined in accordance with the approach outlined in DNV-OS-C502 Sec.6.

502 The design shall document adequate strength and tightness in all design situations. The necessary limitation in concrete stresses, reinforcement stress and crack width to ensure water tightness is provided in DNV-OS-C502 Sec.6 O600.

503 DNV-OS-C502 Sec.6 B contains detailed information on the different limit states, characteristic values for material strength to be used in design, partial safety factors for material, and design by testing as a special case.

504 DNV-OS-C502 Sec.6 C specifies design material strength, material coefficients, stress-strain curves, temperature effects and creep.

505 Calculation approach for prediction of bending moment capacity is provided in DNV-OS-C502 Sec.6 D.

506 Provisions for design of slender members are given in DNV-OS-C502 Sec.6 E.

507 Provisions for predicting the shear capacity of hull and plates are provided in DNV-OS-C502 Sec.6 F.

508 Provisions for predicting the combined bending, shear and torsion capacity are provided in DNV-OS-C502 Sec.6 G.

509 DNV-OS-C502 Sec.6 H provides a general method for predicting the shear strength of structural members subjected to in-plane shear forces.

510 DNV-OS-C502 Sec.6 J provides requirements to shear strength of construction joints.

511 DNV-OS-C502 Sec.6 K provides requirement for design of bond strength and anchorage strength of reinforcement bars.

512 DNV-OS-C502 Sec.6 L provides requirements to design of partly loaded areas in ULS.

513 The fatigue strength shall be designed and evaluated in accordance with the provisions of DNV-OS-C502 Sec.6 M.

514 The strength in accidental limit state shall be predicted based on DNV-OS-C502 Sec.6 N.

515 Durability, cracking, tightness and deflections are controlled by SLS. The SLS requirements are provided in DNV-OS-C502 Sec.6 O.

516 Requirements for design by testing are provided in DNV-OS-C502 Sect.6 P.
517 Placing and detailing of the reinforcement are both important for the hull durability. Provisions for detailing including requirements to minimum amount of reinforcement in the concrete section are provided in DNV-OS-C502 Sec.6 Q. For concrete barges, the minimum concrete cover to reinforcement may be reduced to 25 mm, provided the concrete is covered with an elastic epoxy-based coating.

518 Provisions for designing concrete members with fibre reinforcement are provided in DNV-OS-C502 Sec.6 S.

519 Provisions for the design of structural members in which concrete is replaced by structural grout are given in DNV-OS-C502 Sec.6 T.

520 Provisions for the design of structural members in which concrete is replaced by fibre reinforced structural grout are given in DNV-OS-C502 Sec.6 U.

521 For design of a composite steel-concrete hull, provisions are given in DNV-OS-C502 Sect.6 A500. When designing for composite action between concrete and steel plating, then sufficient number of studs shall be provided.

D 600 Construction

601 The construction of the concrete barge shall be planned and executed in accordance with the provisions of DNV-OS-C502 Sec.7.

602 A quality management system based on the requirement of EN ISO 9001 or equivalent shall be applied during construction of the barge.

603 The requirements given in DNV-OS-C502 Sec.7 with respect to construction documentation, quality control, construction planning, materials, material certificates, material testing, formwork, tolerances, precast concrete elements, reinforcement, production of concrete and grout, transport, compaction and curing of concrete, repairs, corrosion protection, site records and As Built documentation are to be complied with, as found relevant.

604 DNV will as part of classification, review site records and review on-going activities to ensure that the construction is in accordance with design intent.

D 700 Surveillance and Maintenance

701 For hull and equipment, concrete barges are in general to follow the survey intervals and extent as given in Pt.7 Ch.1 Sec.2 B for annual surveys, Sec.3 B for intermediate surveys, and Sec.4 B for renewal surveys.

702 The requirements to dry-docking as given in Pt.7 Ch.1 Sec.5 A103 may be dispensed from, provided the bottom survey is carried out afloat according to the requirements for the Class notation BIS. This will then be stated in the Appendix to the Classification Certificate.

703 In addition to the survey extent given in 701, the concrete barge is subject to an In-service Inspection scheme. This scheme is to be further specified in an In-service Inspection manual as part of As Built documentation, and is to be harmonized with the periodic survey intervals given in 701 as far as possible.

704 The objective of the In-service Inspection is described in DNV-OS-C502 Sec.8. The overall objective for the inspection program is to ensure that the barge is suitable for its intended purpose throughout its lifetime.

705 The scope of the In-service Inspection is described in DNV-OS-C502 Sec.8. An In-service Inspection programme shall be prepared as part of the design process considering safety, environmental consequences and total life cycle costs.

706 In preparing the inspection programme, special attention shall be paid on observing deterioration mechanisms for the relevant materials and structural components.

707 The inspection and monitoring types relevant for the concrete hull is defined in DNV-OS-C502 Sec.8 A1000.

708 If protective coating is applied in accordance with 517, the coating shall be intact throughout the working life of the barge.

E. Hatches and Deck Openings

E 100 General

101 Deck openings in barges shall normally have hatch coamings and covers as given in Pt.3 Ch.3 Sec.6. Minimum design pressure for hatch covers in dry cargo barges is 3.5 kN/m².

102 The closing arrangement of deck openings for barges with restricted service and high freeboard will be specially considered.
F. Steering Arrangement

F 100 General

101 If rudder is installed, the steering arrangement shall comply with the requirements given in Pt.3 Ch.3 Sec.2 as far as these rules are found to be relevant for barges.

When calculating the rudder force, the speed shall not be taken less than 8 knots.

G. Equipment

G 100 General

101 Unmanned barges are not required to carry equipment according to Pt.3 Ch.3 Sec.3 Table C1.

102 Manned barges are required to carry equipment according to Pt.3 Ch.3 Sec.3 Table C1. However, the required total length of anchor chain cable may be reduced by 50%, based upon a special consideration of the intended service area of the vessel. In such cases a B will be given in brackets after the equipment letter for the vessel. e.g. F(B).

H. Machinery and Electrical Installations

H 100 General

101 If the barge is arranged with machinery and electrical installations, relevant requirements given in Pt.4 shall be complied with.

I. Drainage

I 100 General

101 Barges are normally to be provided with means for drainage of cargo holds, engine rooms and watertight compartments and tanks which give major contribution to the vessel's buoyancy and floatability.

102 As far as applicable and with the exemptions specified in the following, the rules and principles for drainage of ship with propulsion machinery shall be complied with.

103 Manned barges shall be provided with a permanently installed bilge system with power bilge pumps. The bilge system shall have suctions in rooms mentioned in 101.

An additional emergency bilge suction shall be provided in engine rooms.

Dry compartments in fore- and after peaks may be drained by effective hand pumps. Rooms situated on deck may be drained directly overboard.

104 Manned barges for unlimited service shall be equipped with two permanently installed bilge pumps. Manned barges with restricted service may have one bilge pump.

Ballast pumps may be used as bilge pumps. Where only one permanently installed bilge pump is installed, this pump shall not serve as fire pump.

105 Ballast systems shall comply with the requirements for ballast systems in ships. However, one ballast pump may be accepted.

Alternative methods for emptying ballast tanks, e.g. by means of compressed air and bottom valves, may be accepted upon consideration in each case.

106 Unmanned barges shall be provided with drainage facilities for compartments rooms mentioned in 101.

For cargo holds the facilities shall be so arranged that drainage can be performed in loaded conditions, for instance by arranging ducts for portable pumps to bilge wells or pipping from the connection point of the bilge pump to the bilge wells.

Other compartments which shall be drained by portable equipment shall be provided with suitable access openings for such equipment.

Any engine room or pump room shall have bilge suctions to available pumps.

107 Unmanned barges may have portable bilge pumping equipment only, arranged with their own power supply.

For barges for unlimited service such equipment shall be permanently installed.
For barges for restricted service the rules are based on the assumption that suitable bilge pumping equipment is available on board the barge or on board the towing / pushing vessel. This assumption will be included in the Appendix to the Classification Certificate to be issued for the barge.

**J. Stability**

**J 100 Stability requirements**

101 Barges with a length of 24 m and above shall comply with the intact stability requirements according to Pt.3 Ch.3 Sec.9.

102 The alternative stability criteria as given in 2008 IS Code Part B Ch.2.2 may be applied for barges with class notation *Barge for Deck Cargo* or *Concrete Barge for Deck Cargo*.

103 Barges with class notations *Concrete Barge* shall be capable of surviving a minor hull damage that results in flooding of any one compartment bounded by the shell. The minor damage should be assumed to occur anywhere in the length of the barge, but not on a watertight bulkhead or deck. The barge's survival capabilities after the specified damage should be in accordance with the damage stability criteria of IMO resolution MSC.235(82) chapter 3.3.

Other recognized international damage stability standards may however be accepted as an alternative to IMO resolution MSC.235(82) subject to agreement with the Society.

**K. Safety**

**K 100 General requirements**

101 For barges designed to carry 36 persons or more the topics in this sub-section are to be taken into consideration.

102 The yard or builder shall submit evidence of these topics being accepted by the respective Administration, in which the same will be also be acceptable to the Society.

103 For manned barges with less than 36 persons, the requirements herein will be reviewed on a case by case basis.

**K 200 Fire safety**

201 The barge is to comply with the cargo ship fire safety requirements of Ch.II-2 of SOLAS 1974 as amended.

**K 300 Life saving appliances**

301 The barge is to comply with the requirements given in Part A and Section I of Part B of Ch.III of SOLAS 1974, as amended, and with the applicable provisions of the International Life-Saving Appliance (LSA) Code.

302 The barge shall carry one or more lifeboats complying with the requirement of section 4.6, 4.7, 4.8 and 4.9 of the LSA Code of such aggregate capacity on each side of the ship as will accommodate the at least 50% of all persons onboard.

303 In addition, inflatable or rigid liferafts complying with the requirement of section 4.2 and 4.3 of the LSA Code, of such aggregate so that there will be survival craft on each side of the barge to accommodate all persons onboard.

304 In lieu of the requirement in 302 and 303, barges of less than 85 m in length or barges with appropriate damage stability as per SOLAS SPS Code, may carry on each side of the barge one or more liferafts complying with the requirement of section 4.2 and 4.3 of the LSA Code of such aggregate as will accommodate all persons onboard.

305 The barge shall carry at least one rescue boat complying with the requirement of section 5 of the LSA Code.

306 Personal life-saving appliances are to comply with requirements given in SOLAS Reg.III/32

307 Survival craft embarkation and launching arrangement is to comply with requirements given in SOLAS Reg.III/33.

**K 400 Power supply**

401 At least two main generator sets are to be provided. The capacity shall be sufficient to maintain the barge in normal operational conditions with any one main generator out of operation.
402 A self contain emergency source of power shall be provided. The emergency source of power and its associated equipment shall be located on or above the freeboard deck, and independent of the main electrical power required by 401.

403 The requirements for a separate emergency source of power may be omitted for installations with two independent engine rooms when compliant with Pt.4 Ch.8 Sec.2 C 104

404 In case of failure in the main source of electrical power, the emergency source of power shall be automatically connected to the emergency switchboard unless a transitional source of power is provided. The emergency source of power shall be capable of supplying simultaneously the services listed for at least 18 hours

— Emergency lighting for machinery spaces, control stations, alleyways, stairways, exits and elevators
— Emergency lighting for embarkation stations on decks and over sides
— Emergency lighting for stowage position(s) for firemen’s outfits
— Emergency lighting for helicopter landing decks
— Navigation and special purpose lights and warning systems including helicopter landing lights
— General alarm and communications systems
— Fire detection and alarm systems
— Fire extinguishing systems.

405 The transitional source of power, if required, shall be capable of supplying the services listed for at least 30 minutes:

— Emergency lighting
— General alarm and communications systems
— Fire detection and alarm systems.

406 The electrical installation shall in general comply with relevant requirements given in Pt.4 Ch.8.

K 500 Radio communication

501 Each barge is to be provided with a radiotelephone station complying with the provision of Chapter IV of SOLAS 1974 as amended and at least one emergency position-indicating radio beacon (EPIRB).

502 The radio station is to be subject to survey by the administration which issue the licence or its authorised representative before the radio station is put into service

503 The radio station shall be surveyed once every 12 months, carried out by an officer of the Administration or its authorised representative, or by a qualified radio service engineer from a DNV approved local radio firm.
SECTION 15
PUSHERS

A. General

A 100  Classification

101 The requirements in this section apply to vessels specially intended for pushing.

102 Vessels built in compliance with the relevant requirements to main class and the additional requirements in this section may be given the class notation Pusher.

When a pusher vessel is intended for operation in combination with a number of barges specially designed to accommodate the pusher and built also in compliance with Sec.16, the class notation Pusher and Pusher/Barge Unit may be given.

103 For a pusher/barge combination the identification numbers of the barges associated with the pusher will be given in the class certificate.

A 200  Documentation

201 The following additional plans shall be submitted for approval:

— forebody plans showing reinforcements.

If the pusher is designed for firm connection to barges, details regarding connection points and supporting structures shall be shown.

If the pusher is designed for flexible connection, details regarding the connection equipment and contact structures shall be shown.

202 An arrangement drawing showing the pushing arrangement shall be submitted for information.

203 The drawings shall state all relevant reaction forces in the connection points which may occur during the pushing operation.

If the connection between the pusher and the pushed vessel is fixed, i.e. the connection shall be able to transmit shearing forces and or bending moments, calculations of these forces shall be submitted. See also Sec.16.

If the connection is flexible, calculations of forces in the connection equipment and on contact areas shall be submitted.

B. Hull Strength

B 100  Draught for scantlings

101 For determining the scantlings of strength members based on the vessel's draught, the latter shall not be taken less than 0.85 D.

B 200  General requirements

201 The pusher shall be regarded as a separate unit and when relevant also as an integrated part of a combination of pusher and barge, see Sec.16.

202 When regarded as a separate unit, the pusher is subject to all main class requirements.

203 When the pusher is connected as an integrated part of a combined system, the hull scantlings of exposed parts of the pusher shall satisfy the main class rules for aft structures as calculated for the combined unit.

204 Regarding strengthening for ice, see Pt.5 Ch.1.

205 Pushers being part of a flexible system Type II (see Sec.16) shall be equipped also for towing the barge.

B 300  Structure in the forebody

301 The structure in the forebody shall be satisfactorily reinforced to sustain the reaction forces occurring during the pushing operation. For complex structures stress analysis shall be carried out to show that the stress level will be within acceptable limits.

302 In combined pusher/barge systems the connection forces and allowable stresses shall comply with the requirements given in Sec.16.

303 In combined pusher/barge systems the deflections of the structure during operation shall be limited to
avoid hammering when pusher/barge units are heeled.

C. Rudder and Steering Gear

C 100  Rudder force

101 The design rudder force on which scantlings shall be based, shall be calculated as indicated for the main class. The speed of the vessel is however not to be taken less than \( V = 10 \) knots.

C 200  Steering gear

201 The steering gear shall be capable of bringing the rudder from 35° on one side to 30° on the other side in 20 sec., when the vessel is running ahead at maximum service speed. For the combined pusher/barge unit, the requirement is 28 sec.

D. Equipment

D 100  General

101 Pushers shall have anchoring and mooring equipment corresponding to their equipment number, see Pt.3 Ch.3 Sec.3 C100. The term 2 BH in the formula may, however, be substituted by:

\[
2 \left( a B + \sum h_i b_i \right)
\]

\( b_i = \) breadth (m) of the widest superstructure or deckhouse of each tier having a breadth greater than B/4.
SECTION 16
PUSHER/BARGE UNITS

A. General

A 100 Definitions

101 A combined pusher barge unit may be of the following types:

Type I. The connection between the pusher and the barge is assumed to be rigid, i.e. it should be designed to transmit the static and dynamic shearing forces and bending moments in such a manner that the combination behaves like one integrated structure.

Type II. The connection between the pusher is free to heave and/or pitch relatively to the barge. This type of connection will normally not be applicable under severe sea conditions or in ice-infested waters.

A 200 Classification

201 The requirements in the section apply to the combined pusher/barge unit.

202 Combined units built in compliance with relevant requirements for main class and the additional requirements in this section may be given the combination class notation specified in Sec.12 A102. In addition each barge may be given the class notations Barge, Barge for Deck Cargo, or Barge for Oil, Barge for Liquified gas or Barge for C on the separate class certificate.

A 300 Documentation

301 The following additional plans shall be submitted for approval:

— 0 of barge and forward part of pusher showing details of connecting points with supporting structures
— details of connecting system.

302 An arrangement drawing of the pusher/barge unit with information about the connecting system and the reaction forces and/or bending moments in the connection shall be submitted, see also Sec.12 A200.

A 400 Certificates

401 Det Norske Veritas' certificates will be required for:

— locking devices in Type I connection system
— steel wires or other means of flexible connections (works' certificate from approved manufacturer will normally be accepted).

B. Arrangement

B 100 Number and position of watertight transverse bulkheads

101 The barge is at least to have a collision bulkhead between 0.05 L and 0.08 L from F.P. and an after peak bulkhead at a suitable distance forward of the connection area. The pusher shall have a number of transverse bulkheads corresponding to its own length, as given in Pt.3 Ch.1 Sec.3 Table A1.

C. Hull Strength

C 100 Longitudinal strength

101 The longitudinal strength shall comply with the requirements given in Pt.3 Ch.1 Sec.5. For the combined pusher/barge unit of Type I the longitudinal strength of the barge shall be based on a length L as given in Pt.3 Ch.1 Sec.1 measured between the bow of the barge and the stern of the pusher.

C 200 Connection pusher/barge

201 The pusher and the aft part of the barge shall be so designed as to allow the pusher to interact with the stern area of the barge. The mutual forces between the two structures shall be transferred by a system of contact surfaces. The connection of Type I shall be secured by at least one mechanical locking device. For Type II a flexible connection shall be provided.

202 The connection forces shall be based on the most severe load conditions to be expected in service. Wave-induced loads shall be determined according to accepted theories, model tests or full scale measurements.
The loads shall be referred to extreme wave conditions, which should be based upon wave statistics for the expected route or service area, in case of restricted service. For unlimited world wide service North Atlantic wave statistics shall be used. The resulting loads shall be given as long term values corresponding to $10^8$ wave encounters (most probable largest loads at a probability of exceedence equal to $10^{-8}$).

Realistic conditions with respect to speed and navigation in heavy weather shall be considered, also taking into account the general assumption of competent handling.

203 Direct calculations shall be made in order to evaluate the stresses in all relevant strength members of the connection between barge and pusher. Shearing forces and or longitudinal bending moments in the sections in question are found from direct calculations for barge and pusher in still water and in waves. Preloading from locking devices is also to be taken into account.

Permissible stresses in the connection are:

- **Normal stresses:** $225 \, \sigma_1 \, \text{N/mm}^2$
- **Shearing stresses:** $120 \, \sigma_1 \, \text{N/mm}^2$

\[
f_1 = \left(\frac{\sigma_1}{240}\right)^{0.75}
\]

for forged and cast steel parts.

204 All relevant strength members shall have effective continuity, and details which may cause stress concentration shall have gradual transitions.

205 Deflections of the structural parts in the connection structure and the necessary preloading shall be considered in order to avoid hammering when the most unfavourable reaction forces occur. Calculations of these deflections shall be submitted.

206 Locking devices and or other connection equipment are subject to approval. If based on hydraulic operation the connecting system shall be mechanically lockable in closed position with remote indication on the bridge.

C 300 Local strength

301 Structural members are in general to comply with the rule requirements for hull structures Pt.3 Ch.1 based on the rule length of the combined unit.

302 Scantlings of the after body of the barge are in no case to be less than required for the barge in unconnected condition.

C 400 Ice strengthening

401 Pusher/barge units with Type I connection system may be given an ice class notation provided relevant requirements given in Ch.1 regarding machinery and hull strengthening are complied with.

402 The requirements to machinery (in the pusher) and hull strengthening shall be based on a displacement which is the sum of the displacements of barge and pusher.

403 The hull strengthening of the exposed part of the pusher shall comply with the requirements for the aft end of the combined pusher/barge unit.

D. Equipment

D 100 General

101 The pusher/barge unit shall have equipment corresponding to an equipment number which shall be calculated for the combined pusher/barge unit according to Pt.3 Ch.3 Sec.3.

E. Machinery, Bilge System, Fire Extinguishing Plant

E 100 General

101 Machinery, pumps, piping systems, fitting, materials, bilge system and fire extinguishing plant shall comply with Pt.4, as relevant for barges.
SECTION 17
CRANE VESSELS

A. General

A 100 Classification

101 The requirements in this section apply to vessels specially intended for lifting operations, and which for that purpose are equipped with crane(s) or similar lifting appliance(s).

102 Vessels built in compliance with the requirements in this section may be given the class notation Crane Vessel.

103 Vessels complying with the requirements for the class notation Barge (see Sec.14) and which comply with the requirements of this section, may be given the class notation Crane Barge.

A 200 Scope

201 The following matters are covered by the classification:

— hull structural details related to the lifting operations
— supporting structures for the crane
— devices for locking the crane in parked position (vessel at sea)
— the crane itself with respect to structural strength, safety equipment and functioning
— stability and floatability.

A 300 Documentation

301 The following plans and particulars shall be submitted for approval:

— plans showing location of the crane during operation and in parked position, with information of forces which will be transferred to the hull
— plans showing supporting structures and strengthening of hull (deck) in way of supports
— arrangement plan of rack bar (toothed bar) with details of supports
— plans showing devices for locking the parked crane to the hull (vessel at sea)
— plans of electrical installations for the crane
— dynamic load charts for the crane.

For documentation related to stability requirements for heavy lift operations, see D200.

302 The following plans and particulars shall be submitted for information:

— assembly plan showing principal dimensions of the crane and limiting positions of its movable parts.

303 Documentation of control and monitoring systems shall be submitted for design assessment.

Pt.4 Ch.9 Sec.1 of these rules indicates the extent of required documentation.

B. Hull Arrangement and Strength

B 100 General

101 The hull structural strength is in general to be as required for the main class taking into account necessary strengthening for supporting the crane during operation and in parked position at sea.

C. Crane with Substructure

C 100 General

101 The crane shall be delivered with Det Norske Veritas' certificate in compliance with the DNV Standard for Certification No. 2.22 “Lifting Appliances”. In agreement with the society the crane may be certified based on other internationally recognised standards. Cranes certified by other societies may be accepted based on special consideration.

102 Devices for locking the crane in parked position at sea will be specially considered taking into account environmental load conditions as indicated for the main class of the vessel.

103 After completed installation on board, functional testing of the crane shall be carried out as specified in the DNV Standard for Certification No. 2.22 “Lifting Appliances”.
D. Stability and Watertight Integrity

D 100 General

101 The requirements in this section apply to vessels with length $L_F$ of 24 metres and above.

102 The intact and damage stability criteria applicable to the ship shall be complied with at all times including when the crane is in use, except for the conditions with operational and or environmental limitations as described in D300 and D400.

This includes the main class requirements in Pt.3 Ch.3 Sec.9, statutory damage stability requirements and voluntary class notations when applicable.

The accidental load drop criterion in D200 shall be investigated in all cases when counter ballasting is utilised. For lifting conditions carried out within clearly defined limitations as set forth by D302 and D303, the alternative intact and damage stability criteria as set forth in D304 and D400 may be applied, subject to prior consent by the Society.

Guidance note:
Operational limitations may include environmental operation criteria, operation reference period (i.e. planned operation time plus contingency time), traffic control etc.

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

103 The following additional documentation is to be included in the stability manual:

— Maximum crane heeling moment as a function of crane boom direction as well as the corresponding counter ballast moment, if used, at each draught as a function of the vertical centre of gravity.

— Loading conditions at maximum, minimum and intermediate draught(s) with maximum permissible crane load. The righting lever (GZ) curves before and after the load drop are to be presented for each loading condition where applicable.

— Limitations on crane operation, including permissible heeling angles, if provided.

— Instructions related to normal crane operation, including those for use of counter ballast.

— Instructions such as ballasting/de-ballasting procedures to righting the vessel following an accidental load drop.

D 200 Accidental load drop

201 The effect of accidental drop of crane load shall be investigated and shall meet the following criteria:

— The restoring energy represented by area $A_2$ in Fig.1 is to be at least 40% in excess of the potential energy represented by area $A_1$.

— The angle of static equilibrium $\Theta_c$ after loss of crane load shall not be more than 15° from the upright.
RL1 = Net righting lever (GZ) curve for the condition before loss of crane load, corrected for crane heeling moment and for the righting moment provided by the counter ballast if applicable.

RL2 = Net righting lever (GZ) curve for the condition after loss of crane load, corrected for the transverse moment provided by the counter ballast if applicable.

\( \Theta_L \) = Static angle of equilibrium before loss of crane load.

\( \Theta_L \) may alternatively be determined by the equation:

\[
\Theta_L = \arctan \left( \frac{TCG}{GMt} \right)
\]

if this results in a small angle of heel.

TCG is then to be taken as the vessel’s transverse centre of gravity before loss of crane load, and GMt is the corrected transverse metacentric height in the same condition.

\( \Theta_f \) = Static angle of equilibrium after loss of crane load

\( \Theta_f \) = Angle of down flooding as defined in Pt.3 Ch.3 Sec.9.

**Guidance note:**

Net righting lever implies that the calculation of the GZ curve includes the vessel’s true transverse centre of gravity as function of the angle of heel.

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**D 300 Alternative intact stability criteria during heavy crane lift**

301 The criteria given in 304 may be applied in lieu of the intact stability criteria according to Pt.3 Ch.3 Sec.9 for the crane loading conditions when operational and environmental limitations are imposed.

302 The environmental limitation shall at least be specified as follows:

- maximum wind speed (1 minute sustained at 10 m above sea level)
- maximum significant wave height.

303 The operational limitations shall at least be specified as follows:
— maximum duration of the lift (operation reference period)
— limitations in vessel speed
— limitations in traffic/traffic control.

304 The following criteria shall be met when the crane load is at the most unfavourable position:

— the deck edge shall not be submerged
— with the wind superimposed from the most unfavourable direction the area \((A+B) \geq 1.4(B+C)\) in accordance with Fig. 2
— the area under the GZ curve measured from the equilibrium position \(\Theta_L\) and to the down flooding angle \(\Theta_f\) or 20°, whichever is less shall be at least 0.03 mrad.

\[\text{Fig. 2} \]

**Alternative intact criteria**

\[\begin{align*}
W_A &= \text{The heeling arm due to wind forces (for wind speed see 302).} \\
RL_1 &= \text{Net righting lever (GZ) curve for the condition, corrected for crane heeling moment and for the righting moment provided by the counter ballast if applicable.} \\
\Theta_L &= \text{Static angle of equilibrium.} \\
\Theta_f &= \text{Angle of down flooding as defined in Pt.3 Ch.3 Sec.9.} \\
\end{align*}\]

**Guidance note:**

Net righting lever implies that the calculation of the GZ curve includes the vessel’s true transverse centre of gravity as function of the angle of heel.

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

D 400 Alternative damage stability criteria during heavy crane lift

401 The flooding scenario given in 402 and survival criteria given in 403 may be applied in lieu of the damage stability criteria according to Pt.3 Ch.3 Sec.9 and additional class notations for the crane loading conditions when operational and environmental limitations as listed in D302 and D303 are imposed.

402 Accidental flooding of any one compartment bounded by the shell or which contains pipe systems leading to the sea shall be investigated for the relevant loading conditions.

403 In the flooded condition the following criteria shall be complied with:

— the maximum angle of heel shall be less than 15°
— no immersion of openings through which progressive flooding may occur
— the area under the GZ-curve shall be greater than 0.015 mrad.
SECTION 18
DREDGERS

A. General

A 100   Classification

101 The requirements in this section apply to vessels specially intended for dredging.

102 Vessels built in compliance with the requirements in this section may be given the class notation Dredger.

A 200   Scope

201 The following matters are covered by the classification:

— hull structural details related to the dredging operations
— supporting structures for the dredging equipment.

Guidance note:
The Society may on request supervise the construction and testing of the following items not covered by the classification:
- equipment for anchoring and mooring during dredging
- equipment and installations for dredging.

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

A 300   Documentation

301 The following plans and particulars shall be submitted for information or approval:

<table>
<thead>
<tr>
<th>Table A1 Documentation Requirements</th>
</tr>
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<tbody>
<tr>
<td><strong>Object</strong></td>
</tr>
<tr>
<td>Foundation and support for dredging equipment</td>
</tr>
<tr>
<td>Dredging arrangement plan</td>
</tr>
</tbody>
</table>

B. Hull Arrangement and Strength

B 100   General

101 The hull structural strength shall be as required for the main class taking into account necessary strengthening of supporting structures for equipment applied in the dredging operations.
SECTION 19
CABLE LAYING VESSELS

A. General

A 100 Classification
101 The requirements in this section apply to vessels specially intended for laying cables on the sea bottom.
102 Vessels built in compliance with the requirements in this section may be given the class notation Cable Laying Vessel.
103 Vessels complying with the requirements for the class notation Barge (see Sec.14) and which comply with the requirements of this section, may be given the class notation Cable Laying Barge.

A 200 Scope
201 The following matters are covered by the classification:
— hull structural details related to the cable laying operation
— equipment and installations for cable laying
— supporting structures for equipment applied in the cable laying operations
— equipment for anchoring and mooring related to the cable laying operations
— equipment for positioning during cable laying.

A 300 Documentation
301 The following plans and particulars are in general to be submitted for approval:
— plans showing location and supports of equipment related to cable laying. Reaction forces to be stated
— plans showing the structure of load bearing parts of the equipment as well as calculations documenting satisfactory structural strength
— plans showing supporting structures for stowed cables. Maximum weight of stored cables shall be stated.
302 Plans to be submitted for approval if anchoring system is installed for positioning during cable laying:
— general arrangement of anchoring system. Anchor line forces and limiting anchor line angles shall be stated
— plan of supporting structures for winches
— plan of force-transmitting structures at points where the anchor lines change direction.
303 The following plans and particulars are in general to be submitted for information:
— arrangement drawings of the cable laying equipment
— estimated load on components of cable laying equipment
— description of operational features.

B. Hull Arrangements and Strength

B 100 General
101 The hull structural strength is in general to be as required for the main class taking into account necessary strengthening of supporting structures for equipment applied in the cable laying operations.
102 For catamarans, semisubmersibles and other special hull configurations, the hull structural strength will be specially considered.

C. Anchoring and Mooring Equipment

C 100 General
101 The equipment for mooring and anchoring, i.e. anchors, chain cables windlass, mooring ropes, etc., are in general to be as required for the main class.
102 For catamarans, semisubmersibles and other special hull configurations, the equipment will be specially considered.
103 Equipment for positioning during cable laying will be specially considered.
D. Cable Laying Equipment and Installations

D 100 General

101 Equipment - to be specified in each case - taking part in the cable laying operation is subject to approval with respect to mechanical and structural strength and material quality.

102 For documentation to be submitted, see A300.

D 200 Requirements

201 Structural and mechanical elements shall comply with DNV Standard for Certification No. 2.22 “Lifting Appliances”, as far as relevant.

202 Transmission gears shall comply with Pt.4 Ch.4 Sec.2, as required for auxiliary gears.
SECTION 20
PIPE LAYING VESSELS

A. General

A 100 Classification

101 The requirements in this section apply to vessels specially intended for laying pipelines on the sea bottom.

102 Vessels built in compliance with the requirements in this section may be given the class notation Pipe Laying Vessel.

103 Vessels complying with the requirements for the class notation Barge (see Sec.14) and which comply with the requirements of this section, may be given the class notation Pipe Laying Barge.

A 200 Scope

201 The following matters are covered by the classification:

— hull structural details related to the pipe laying operations
— supporting structures for equipment applied in the pipe laying operations
— equipment for anchoring and mooring
— equipment and installations for pipe laying
— equipment for positioning during pipe laying

A 300 Documentation

301 The following plans and particulars are in general to be submitted for approval:

— fender arrangement or other protection of side plating
— pipe support arrangement on the pipe ramp. Maximum forces to be stated
— tensioner arrangement and supporting structures. Tensioner capacities to be stated
— plans showing fastening of stinger to hull. Maximum forces to be stated
— plans showing location and supports of cranes and davits. Reaction forces to be stated
— plans showing supporting structures for stowed pipes. Maximum weight of stored pipes to be stated
— plans showing supporting structures for the reel(s) when piping is stored on reel(s). Information on maximum weight of reel with pipe, including water if the pipe shall be hydraulically tested on board
— information on the vessel's stability and floatability in all operating modes
— stability and floatability calculations.

302 Plans to be submitted for approval if anchoring system is installed for positioning during pipe laying:

— general arrangement of anchoring system. Cable forces and limiting cable angles to be stated
— plan of supporting structures for winches
— plan of force transmitting structures at points where the cables change direction.

303 Plans to be submitted for approval for barge intended for being pulled by tugs during pipe laying:

— general arrangement of pulling system. Cable forces and limiting cable directions to be stated
— plan of structures transmitting the pulling forces to the hull.

B. Hull Arrangement and Strength

B 100 General

101 The hull structural strength shall be as required for the main class taking into account necessary strengthening of supporting structures for equipment applied in the pipe laying operations.

102 For catamarans, semi-submersibles and other special hull configurations, the hull structural strength will be specially considered.

C. Anchoring and Mooring Equipment

C 100 General

101 The equipment for mooring and anchoring, i.e. anchors, chain cables, windlass, mooring ropes etc., are in general to be as required for the main class.
For catamarans, semi-submersibles and other special hull configurations, the equipment will be specially considered.

Equipment for positioning during pipe laying will be specially considered.

**D. Pipe Laying Equipment and Installations**

**D 100 General**

The equipment and installations will be specially considered.
SECTION 21
SEMI-SUBMERSIBLE HEAVY TRANSPORT VESSELS

A. General

A 100 Classification

101 The requirements in this section apply to vessels intended for loading or unloading of deck cargo by submerging the cargo deck through ballast operations.

102 Ships intended for loading or unloading of deck cargo by submerging the cargo deck shall be built in accordance with the requirements in this section, and will be assigned the mandatory ship type notation Semi-Submersible Heavy Transport Vessel.

103 The additional notation DK+ is mandatory for vessels assigned the notation Semi-Submersible Heavy Transport Vessel.

A 200 Scope

201 The following is covered by the classification:

— hull structure
— reserve freeboard and reserve buoyancy
— stability and floatability in transit and submerged conditions
— fire safety
— lifesaving appliances
— navigation and nautical safety.

A 300 Definitions

301 The following definitions are used:

Semi-Submersible Heavy Transport Vessel: A vessel designed to load and unload deck cargo by temporarily submerging its cargo deck through ballast operations.

Temporarily Submerged Condition: Any ballasting or de-ballasting with the load line mark submerged.

Transit Condition: The condition from when the vessel has completed loading, with the cargo properly secured, to when the vessel has reached its intended destination and preparation for unloading can commence.

Cargo Deck: The deck being submerged for carrying the cargo, as well as its horizontal extension.

Maximum Submerged Draught: The maximum draught to which the vessel is allowed to be submerged.

Exposed Surfaces: Superstructures, casings and other buoyant volumes above the cargo deck, or its horizontal extension, that may become damaged if coming in contact with the cargo at any stage during loading or unloading operations. The cargo deck is also to be considered as an “exposed surface.”


A 400 Documentation

401 Documentation shall be submitted as required by Table A1.

<table>
<thead>
<tr>
<th>Object</th>
<th>Documentation type</th>
<th>Additional description</th>
<th>Info</th>
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<tr>
<td>Vessel arrangement</td>
<td>Z010 – General arrangement plan</td>
<td>Including maximum submerged draught, maximum transit draught and minimum transit draught with cargo.</td>
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<td>Ship hull structure</td>
<td>H020 – Design load plan</td>
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Table A1 – Documentation requirements
Table A1 – Documentation requirements (Continued)

<table>
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<tr>
<th>Object</th>
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<tr>
<td>Stability</td>
<td>B030 - Internal watertight integrity plan</td>
<td>F1</td>
<td></td>
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<tr>
<td></td>
<td>B050 – Preliminary stability manual</td>
<td>Including the following: - intact and damage stability calculations for typical transit conditions, sufficient to demonstrate stability of the vessel with the cargoes it is intended to carry, including the most onerous combination of weight, VCG and wind moment. - intact and damage stability calculations for typical temporarily submerged conditions, sufficient to demonstrate stability of the vessel during ballasting and de-ballasting with and without the cargoes it is intended to load/unload; cargo without buoyancy is also to be checked; maximum trim for the maximum submerged draught is to be shown, if relevant. - limit curves based on intact and damage stability according to IACS UI LL65 (i.e. SOLAS Ch.II-1) shall be developed for general use in transit conditions; such limit curves shall not take into account the buoyancy of the deck cargo, but shall include a maximum windage moment representative of the intended cargoes.</td>
<td>AP</td>
</tr>
<tr>
<td></td>
<td>B120 – Final stability manual</td>
<td>AP</td>
<td></td>
</tr>
<tr>
<td></td>
<td>B130 – Final damage stability calculation</td>
<td>AP</td>
<td></td>
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<tr>
<td>External watertight and weathertight integrity</td>
<td>B200 – Freeboard plan</td>
<td>AP</td>
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<td>Z240 – Calculation report</td>
<td>Reserve buoyancy calculations.</td>
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<td>Emergency escape</td>
<td>G120 – Escape route drawing</td>
<td>AP</td>
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<tr>
<td>Fire water system</td>
<td>S010 – Piping diagram</td>
<td>Number and position of hydrants and hoses.</td>
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</tr>
<tr>
<td></td>
<td>S030 – Capacity analysis</td>
<td></td>
<td>AP</td>
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<td></td>
<td>Z030 – Arrangement plan</td>
<td></td>
<td>AP</td>
</tr>
<tr>
<td>Fire extinguishing system, fixed extinguishing system, fixed fire extinguishing system documentation</td>
<td>G200 – Fixed fire extinguishing system documentation</td>
<td>AP</td>
<td></td>
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<tr>
<td>Navigation systems</td>
<td>Z090 - Equipment list</td>
<td></td>
<td>AP</td>
</tr>
<tr>
<td>Navigation bridge</td>
<td>N010 – Bridge design drawing</td>
<td></td>
<td>AP</td>
</tr>
<tr>
<td></td>
<td>N020 – Vertical field of vision drawing</td>
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<td>AP</td>
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<tr>
<td></td>
<td>N030 – Horizontal field of vision drawing</td>
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<td></td>
<td>Z090 – Equipment list</td>
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<tr>
<td>Internal communication systems</td>
<td>Z030 – Arrangement plan</td>
<td></td>
<td>AP</td>
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<tr>
<td>Operation</td>
<td>Z250 – Procedure</td>
<td>Submersion operation, including generic ballasting sequence during submersion and re-emersion.</td>
<td>F1</td>
</tr>
</tbody>
</table>

For general requirements to documentation, including definition of the Info codes, see Pt.0 Ch.3 Sec.1.

For a full definition of the documentation types, see Pt.0 Ch.3 Sec.2.

B. Hull Arrangement and Strength

B 100  Global strength

101 During cargo handling operations, the global wave loads given in Pt.3 Ch.1 Sec.5 B200 may be reduced in accordance with a) to c).

a) Temporarily submerged conditions may be treated as harbour conditions, i.e., a and b may be taken equal.
to 0.5.

b) During non-submerged loading and unloading with the vessel moored to the quay, a and b may be taken equal to 0.25, provided that the operation is carried out in conditions with a significant wave height equal to or less than 0.5 m. This condition will be stated in the Appendix to Classification Certificate.

c) If the conditions in b) are fulfilled, further reduction of a and b may be accepted provided that the hull girder loads are closely monitored throughout the loading/unloading sequence. In such cases the method used for monitoring the loads will be subject to special consideration.

102 Due to the low depth of the hull girder, special attention should be paid to the requirement to moment of inertia given in Pt.3 Ch.1 Sec.5 C400. This requirement shall be satisfied over a minimum of 0.25 L in the midship area.

B 200 Local strength

201 External hull boundaries and sea chest boundaries shall be able to withstand the sea pressure at maximum submerged draught. In temporarily submerged conditions, the dynamic part of the sea pressure may be reduced by 50%.

202 The design pressure for internal watertight bulkheads, including doors, hatches, pipe penetrations and other piercings, shall be based on the deepest equilibrium waterline in damaged transit or damaged submerged condition, as applicable, depending on relevant damage scenario. Damage stability requirements in transit and submerged conditions are given in D100 and D300, respectively. Flooding scenarios related to access openings in submerged conditions, refer C405, shall also be taken into account.

203 Bolted connections between buoyancy towers and hull are subject to special consideration.

C. Load Line

C 100 Freeboard assignment transit draught

101 Freeboard will be calculated and assigned according to ICLL 1966 and standard procedures. Compliance with requirements to weathertight and watertight closing appliances shall be documented with a freeboard plan.

C 200 Temporarily submerged conditions

201 Requirements to reserve buoyancy and water- and weathertight integrity given in C300 and C400 shall be complied with in the maximum submerged draught condition.

Guidance note:

International load line exemption certificate

Independent of class approval, an exemption from ICLL 1966, Article 12 “Submersion” will have to be applied for as the load line mark will be submerged during cargo operations. This exemption may only be granted by the Flag Administration and is to be based on an application from the owner. The Flag Administration will normally require the classification society to give their comments to the application. Normally DNV will recommend to the Flag that an exemption be granted, provided that the requirements in this section are fulfilled.

C 300 Reserve buoyancy

301 The ratio of reserve buoyancy shall not be less than:

— 4.5% for the vessel
— 1.5% for the forward and aft end buoyancy structures considered separately.

302 The reserve buoyancy requirements in 301 shall be documented by a calculation according to the principles given in a) to d).

a) Ratio of reserve buoyancy is the reserve buoyancy divided by the volume displacement of the vessel at maximum submerged draught with no trim.

b) Reserve buoyancy is defined as the volume providing buoyancy, positioned above the waterline with no trim at maximum submerged draught. In the calculation of the total reserve buoyancy for the vessel, no buoyancy shall be assumed above the lowest of the zero trim waterlines corresponding to:

— the position of the lowest opening which can not be closed and secured to prevent water from entering the buoyant volume
— the uppermost point of the deck limiting the buoyancy structure forward
— the uppermost point of the deck limiting the buoyancy structure aft.

c) Calculations for end structures considered separately need only take account of openings and decks in the
end under consideration. Trim shall be taken into account if it is consistent with practice to operate the vessel with trim and the maximum draught at the perpendicular is larger than the mean maximum submerged draught. Reserve buoyancy is then defined as the volume providing buoyancy for the end under consideration, above the waterline with no trim at maximum perpendicular draught.

d) Openings which can not be closed and secured to prevent water from entering the buoyant volume are to be considered as down flooding points in the reserve buoyancy calculation. These openings shall include all air pipes, but need not include weathertight doors, hatches, ventilators, side scuttles and small windows with deadlights. This is provided that the relevant opening will be closed and secured during submerged stages, and that the closing appliance has been found to be adequate and of at least the same strength as the bulkhead or deck where it is fitted.

The calculation shall be submitted as a separate document and not be part of the stability documentation.

303 As an alternative to the requirements in 301, the reserve buoyancy may be evaluated based on real intact and flooded scenarios with the intact vessel at maximum submerged draught, including trim when relevant. In intact scenarios, ship movements shall be evaluated to determine the risk of submergence of decks limiting buoyancy structures. In flooded scenarios, the freeboard to a deck limiting a buoyancy structure shall not be less than 1 m.

Guidance note:
Intact scenarios should consider ship movements in defined worst operating sea condition(s) and as the result of forces transferred from cargo.

Flooded scenarios should at least cover the effect of filling additional tank space by mistake and the effect of tanks and dry spaces being flooded due to valve failure. The possibility of spaces being flooded progressively should be taken into account where necessary. Partial flooding stages should be considered where this may give a more severe waterline.

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C 400 Requirements to water- and weathertight integrity

401 All openings below the first deck above the maximum submerged draught shall be arranged with watertight closing appliances.

402 Access openings which are submerged at the maximum submerged draught are to be protected by two watertight doors or hatches in series. A leakage detection device shall be provided in the compartment between the two doors or hatches. Drainage of this compartment to bilges controlled by a readily accessible screw-down valve shall be arranged.

403 A watertight closing appliance shall be provided for any internal opening leading to the compartment required by 402.

404 The effect of flooding the watertight compartment required by 402 shall be investigated in the stability calculations for all stages where the outer door or hatch is submerged.

405Bulkheads bounding the compartment required by 402 shall be of sufficient strength to withstand the water pressure that could occur after flooding. Doors and hatches shall be approved and pressure tested.

406 All openings between the first and second deck above the maximum submerged draught shall comply with ICLL 1966 position 2 requirements to weathertight closing.

407 Scuppers are to be of substantial thickness below the first deck above the maximum submerged draught.

C 500 Miscellaneous requirements

501 On-board instruction manuals and checklists containing operating procedures for submerging shall list the closing appliances which have to be closed before operation commences. Examples are watertight doors and hatches, closing appliances as given in 402 and 403, and closing valves in sanitary discharges. Signboards shall be fitted at the relevant closing appliance.

502 Guard rails must be arranged so that they do not interfere with cargo operations. Removable guard rails with steel wire rope may be acceptable, provided that the arrangement is according to ICLL 1966 and scantlings are found sufficient. Wires should have steel cores of not less than 10 mm in diameter and be plastic coated.

503 In order to provide access to the ends of the vessel when deck cargo covers the whole breadth of the vessel, an under-deck passage way in compliance with Pt.3 Ch.3 Sec.8 A202 a) shall be provided.
D. Stability

D 100 Stability requirements in transit condition

101 The intact stability requirements of The International Code on Intact Stability (2008 IS Code) Part A, Ch. 2.2 and 2.3 apply. The windage area in loading conditions shall include deck cargo.

102 If the vessel's characteristics render compliance with The International Code on Intact Stability (2008 IS Code) Part A, Ch. 2.2 impracticable, then the criteria of Part B, Ch.2.4.5 may be used.

103 For intact stability the buoyancy provided by a part of large deck cargo such as semi-submersible units, jack-up units, barges or ships may be taken into account, provided that the securing arrangement is separately approved. The watertight integrity of the cargo is to be defined and taken into account in the calculations.

104 The damage stability standard shall be in accordance with SOLAS Ch.II-1 or ICLL 1966 Reg.27, including IACS UI LL65, as applicable.

105 Ships with B-60 or B-100 freeboard:

B-60 freeboard requires one-compartment damage, while B-100 requires two-compartment damage in accordance with Reg.27 of the ICLL 1966. The calculations are to be carried out assuming the damaged tanks empty and for representative loads, such as a semi-submersible unit and a jack-up unit, as far as applicable. Damage extent is to be taken according to ICLL Reg. 27. The buoyancy of watertight volumes of the deck cargo not located within the damage extent for each damage case may be taken into account. In all cases, transverse penetration shall be taken from the ship’s side.

Ships with ordinary B freeboard:

If, in addition to the SOLAS limit curves, it is desired to take the buoyancy of the deck cargo into account, calculations as for ICLL Reg. 27 corresponding to B-60 damage may be considered equivalent (same approach as the case of ships with reduced freeboard).

Guidance note:

As there are no international rules or interpretations regarding whether the buoyancy of deck cargo may be taken into account in order to make these operations feasible, the Flag state must be approached for acceptance of the application of the requirements given in D103 and D105 for statutory purposes.

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D 200 Intact stability criteria in temporarily submerged conditions

201 The owner must ensure that the loading and unloading sequences be so planned that the stability is sufficient during all phases of the sequence. The buoyancy provided by a part of large deck cargo such as semi-submersible units, jack-up units, barges or ships may be taken into account, provided that proper environmental limitations have been separately defined.

202 The GM at equilibrium shall not be less than 0.3 m. The positive range of the GZ curve shall be minimum 15° in conjunction with a height of not less than 0.1 m within this range. The maximum righting arm shall occur at an angle of heel not less than 7°. Unprotected openings shall not be immersed within this range. It may be required to calculate the stability about additional axis to determine the most onerous result.

203 Whenever free liquid surface exists in a tank, the effect shall be considered. The calculations shall account for the real filling of the tanks, i.e., in particular the location of air pipes needs to be carefully considered. If the complete filling of the tanks is dependent on certain trim or heel during the submerging sequence this needs to be clearly stated in the stability manual.

D 300 Damage stability in temporarily submerged conditions

301 The risks of accidental flooding of any one compartment on the ship shall be considered. Damage to be considered is that which might occur following an uncontrolled movement of the deck cargo during loading or offloading leading to puncture of exposed surfaces. This study shall cover all relevant phases of the loading/offloading sequence as required by D201.

302 Accidental flooding of watertight compartment described in C404 shall be considered in addition if this would result in a more severe condition.

303 The permeability $\mu$ of a damaged compartment shall be assumed to be 0.95 except for full ballast tanks, where $\mu = 0$. For machinery spaces, $\mu = 0.85$.

304 In the final stage of flooding after damage, the positive range of the GZ curve shall be minimum 7° in conjunction with a height of not less than 0.05 m within this range. Unprotected openings shall not be immersed within this range unless the space concerned is assumed to be flooded. The angle of heel after flooding shall not exceed 15°. The final waterline after flooding is to be below the lower edge of any weathertight opening through which progressive flooding may take place unless the space concerned is assumed to be flooded. It may be required to calculate the stability about additional axis to determine the most onerous result.
The stability at intermediate stages of flooding after damage shall not be significantly less than in the final stage.

The flooding of any damaged compartment shall not render vital safety functions inoperative.

For the purpose of damage stability calculations, a damage extent of 5 m horizontally along the surface shall be assumed for all exposed surfaces except the cargo deck. Watertight bulkheads may be considered to remain intact provided that the distance between adjacent bulkheads exceeds 5 m. The damage penetration into the structure shall be assumed to be equal to 0.76 m and the vertical extent of damage is assumed to be from the cargo deck or its horizontal extension upwards without limit. For the cargo deck a damage extent of 5 m shall be assumed. Watertight bulkheads may be considered to remain intact provided that the distance between adjacent bulkheads exceeds 5 m. The damage penetration into the cargo deck shall be assumed to be equal to 0.76 m.

**E. Fire Safety**

**E 100 Fire extinguishing equipment**

The cargo deck shall be protected by fixed fire-fighting equipment consisting of water monitors or fire hydrants with hoses, or a combination thereof.

If water monitors are selected in lieu of fire hydrants, then the monitors shall be capable of covering the cargo deck area and may be positioned fore and/or aft of the cargo area, as applicable. The fire monitors shall also comply with 103-106.

The main control station for the system shall be suitably located outside the cargo deck area, adjacent to the accommodation spaces and readily accessible and operable in the event of fire in the areas protected. For monitors arranged at the end of the cargo area opposite to the accommodation spaces, remote control of the monitor(s) from the bridge will be required. Alternatively, these monitors shall be of oscillating type capable of sweeping the protected area.

The protected area shall be within 75% of the water monitor throw in still air conditions taking into account the distance from the monitor to the farthest extremity of the protected area forward of that monitor.

The capacity of each monitor shall not be less than 1250 litres/minute. The additional water supply to the monitors shall be based on one monitor operated at a time, and shall be in addition to the requirements given in SOLAS Reg. II-2/10.2.2.4.

Fixed arrangement for possible dispersion of the monitor water jet shall be delivered as part of each monitor.

Fire hydrants arranged with two hydrants at both port and starboard side just aft and forward of the cargo area, with sufficient number of hoses to reach the entire cargo area with two hoses from these hydrants, will be accepted as equivalent to the position of hydrants required by SOLAS Reg. II-2/10.2.1.5. For SOLAS convention ships, this equivalent arrangement is subject to acceptance by the flag state. These will ensure flexibility during fire-fighting operations, and will cover areas screened from the monitors.

**E 200 Escape ways**

The under-deck passage way required by C503 shall not be used as an escape way in submerged conditions.

If buoyancy towers are manned during cargo handling operations, then these shall be provided with escape ways (to the Life Saving Appliances), which will be subject to special consideration, depending on the vessel design.

**F. Life Saving Appliances**

**F 100 Location of survival craft**

If buoyancy towers are manned during cargo handling operations, then these shall be fitted with life saving appliances, such as life buoys or rafts. The type and arrangement of such appliances will be subject to special consideration, depending on the vessel design.

**Guidance note:**

Survival craft forward of wide deck cargo should be specially considered by the body approving the life saving arrangement, to ensure that they are positioned in a way such as to avoid damage from the cargo.
G. Nautical Safety and Communication

G 100  Navigation

101  In cases where the cargo is partially blocking the view from the bridge, a secondary look-out point (crows nest) shall be arranged.

  Guidance note:
  Unless the secondary look-out point is fully duplicated, manning of both wheel house and look-out point will normally be required by the Flag State during transport.

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Equipment in the secondary look-out point shall at least include:

— conning position with un-obscured view to the sea surface looking forward over an arc of 225° (Ref. SOLAS Reg. V/22)
— a gyro bearing repeater
— rudder, propeller, thrust, pitch and operational mode indicators
— external communication system – one VHF
— internal communication system for communication with main bridge.

  Guidance note:
  Acceptance of alternative solutions may be granted by the Flag Administration.

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H. Miscellaneous Requirements

H 100  Watertight seals for propeller axle and rudder stock

101  Watertight seal on propeller axle and rudder stock shall be approved for the maximum submerged draught.

H 200  Integrated high-pressure tanks

201  Ballast tanks emptied by means of overpressure are subject to special consideration.

  Guidance note:
  In designs where overpressure is applied for emptying integrated ballast tanks, exemptions from the rules for pressure vessels in Pt.4 Ch.7 may be granted on a case-by-case basis, provided that satisfactory alternative safety measures are presented. Examples of such safety measures are increased safety margin by lowering the allowable stress levels, installation of cofferdams, pressure monitoring systems, increased NDT during construction, and more thorough inspections in the operation phase.

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H 300  Additional anchors

301  Anchors and associated equipment in excess of that required in Pt.3 Ch.3 Sec.3 Table C1 need not be certified.

H 400  Sea trial

401  A sea trial including submersion to maximum submerged draft and function testing of all equipment related to submersion shall be performed before final certificates are issued.
SECTION 22
WIND TURBINE INSTALLATION VESSELS

A. General

A 100 Introduction

101 This section provides principles, technical requirements and guidance for the design and construction of vessels built to satisfy subject service notation.

A 200 Scope

201 This service notation defines requirements in addition to Pt.2 through Pt.4 relevant to meet the objective. In case of conflicting requirements, the specific details in this section apply.

202 Coastal State and/or statutory regulations may include requirements in excess of the provisions of this standard depending on the size, type, location and intended service of the unit/installation. These requirements are excluded from this section.

A 300 Objectives

301 The objective of this section is to define the standard as relevant for wind turbine installation - from a vessel or barge.

A 400 Application

401 Vessels built in compliance with this section may be given the class notation, including one mandatory qualifier, as defined in Table A1

A 500 References

501 For wind turbine installation vessels other than barges and ships, refer to the offshore standard DNV-OS-J301.

A 600 Documentation

601 For further document requirement in additional to those for main class, refer to the specific sections and certification standards specified under B.

B. Technical requirements

B 100 Hull arrangement and strength

101 The hull structural strength shall be as required for the main class taking into account necessary strengthening of supporting structures for equipment applied in the installation operations.

102 For catamarans and other special hull configurations, the hull structural strength will be specially considered.

103 All load effects caused by deck cargo and heavy equipment shall be accounted for in the design calculations for all operational phases.

B 200 Dynamic Positioning (DP) System

201 If a dynamic positioning system is installed, class notation DYNPOS or DPS is mandatory.

B 300 Crane Arrangements

301 If a crane is used for heavy lift purposes, the requirements of the service notation Crane Vessel shall apply.

302 The crane shall be delivered with Det Norske Veritas' certificate in compliance with the DNV Standard
for Certification No. 2.22 “Lifting Appliances”. In agreement with the Society the crane may be certified based on other internationally recognised standards. Cranes certified by other Societies may be accepted based on special considerations.

303 After completed installation on board, functional testing of the cranes to be used for installation of wind turbines shall be carried out as specified in the DNV Standard for Certification No. 2.22 “Lifting Appliances”.
SECTION 23
WINDFARM MAINTENANCE

A. General

A 100 Introduction

101 The requirements in this section apply to vessels intended for maintenance of offshore wind farms.

102 Wind farm maintenance may include:

— being a mother craft for smaller craft transferring technicians to and from offshore wind turbines
— transferring technicians directly to the wind turbine
— transferring supplies to the wind turbine
— perform smaller lifting operations onto the wind turbine.

A 200 Scope

201 This section contains requirements to hull arrangement, strength, and equipment.

202 Coastal State and/or statutory regulations may include requirements in excess of the provisions of these rules depending on the size, type, location and intended service of the unit/installation. These requirements are excluded from this section.

A 300 Objectives

301 The objective of this section is to define a standard supporting safe and reliable operations for offshore service vessels performing maintenance of offshore wind farms.

A 400 Application

401 Vessels with class notation Offshore Service Vessel intended for maintenance of offshore wind farms built in compliance with the requirements in this section may be given the class notation Windfarm Maintenance.

A 500 Documentation Requirements

501 Plans and particulars for the following shall be submitted:

<table>
<thead>
<tr>
<th>Object</th>
<th>Document type</th>
<th>Additional description</th>
<th>For info.(FI) or approval (AP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dynamic positioning system</td>
<td>C040 – Design analysis</td>
<td>Capability plot</td>
<td>AP</td>
</tr>
<tr>
<td>Work Boat Davit and Winch</td>
<td>C010 – Design criteria</td>
<td>Safe Working Load, heel/trim if applicable, dynamic factor if above 1.5</td>
<td>FI</td>
</tr>
<tr>
<td>for Work Boat Davit</td>
<td>C020 – Assembly or arrangement drawing</td>
<td></td>
<td>FI</td>
</tr>
<tr>
<td></td>
<td>C030 – Detailed drawing</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>C040 – Design analysis</td>
<td></td>
<td>AP</td>
</tr>
<tr>
<td></td>
<td>Z160 – Operation manual</td>
<td></td>
<td>FI</td>
</tr>
<tr>
<td></td>
<td>Z170 – Installation manual</td>
<td></td>
<td>FI</td>
</tr>
<tr>
<td></td>
<td>Z180 – Maintenance manual</td>
<td></td>
<td>FI</td>
</tr>
<tr>
<td>Foundations and supporting structures</td>
<td>H050 Structural drawing</td>
<td>Design loads, footprint loads, fastening details (welding details etc.)</td>
<td>AP</td>
</tr>
</tbody>
</table>

A 600 Certification Requirements

601 DNV Product Certificates (NV) will be required for the following items:

— Work Boat Davit
— Winch for Work Boat Davit.

602 3.1 material certificates (EN 10204) will be required for the following items:

— Work Boat Davit
— Winch for Work Boat Davit.
B. Technical Requirements

B 100 Hull arrangement and strength

101 The hull structural strength shall be as required for the main class taking into account necessary strengthening of supporting structures for equipment applied during the maintenance and service of offshore wind farms.

102 All load effects caused by deck cargo and heavy equipment shall be accounted for in the design calculations for all operational phases.

B 200 Dynamic Positioning and Capability Plots

201 The vessel shall be built, as a minimum, according to class notation DYNPOS-AUTR, DPS 2 or DYNPOS-ER with the additional requirement explained in sub section B500.

202 The position keeping ability of the vessel shall be calculated and presented in form of capability plots as outlined in these rules. The capability plots shall be kept onboard.

Guidance note:
The International Marine Contractors Association (IMCA) document M 140 “Specification for DP Capability Plots” may be used as a guideline for making capability plots.

203 The capability plots shall be produced in polar form, as a static analysis with coincident forces of wind, waves, and current. In the analysis the vessel shall maintain fixed position and heading, and shall be exposed to forces from a fixed current speed corresponding to the intended location of operation but in any case not less than 1.5 m/s with correlating wind and waves. The fixed current speed applied shall be specified in the Appendix to Classification Certificate.

204 Thus there shall at the same time be a balance of forces and a balance of moments, i.e. including all moments generated by the thrusters, and those caused by environmental forces.

205 The limiting wind speed where the current, wind and wave forces equals the maximum available thruster forces shall be plotted at least every 15° around the vessel. Linear interpolation between points is acceptable.

206 The environmental forces caused by wind, waves, and current shall be calculated by recognised methods. Alternatively, environmental forces established by model testing can be used. The correlation between wind and waves used for ERN is given in Pt.6 Ch.7 Sec.6 Table A1 or Pt.6 Ch.26 Sec.7 Table B1.

207 The capability plots shall be based upon available power and the thrust output that is under control, in the most efficient control mode.

208 A minimum of four plots is required:
— Case 1 shall represent optimal use of all thrusters
— Case 2 shall represent minimum effect of single-thruster failure
— Case 3 shall represent the maximum effect single-thruster failure
— Case 4 shall represent the worst case failure modes. There shall be one plot for failure of each redundancy group.

All plots shall be produced on the same scale.

Guidance note:
It is recommended that the wind speed scale is 15 mm = 10 m/s and with range 0 to 50 m/s.

B 300 Cranes

301 For wind farm maintenance vessels equipped with cranes, the class notation CRANE shall be complied with.

302 The crane shall be delivered with DNV product certificate to confirm compliance with the DNV Standard for Certification No. 2.22 “Lifting Appliances”.

303 After completed installation on board, load- and functional testing of the crane shall be carried out as specified in the DNV Standard for Certification No. 2.22 “Lifting Appliances”.

B 400 Offshore Transfer Systems

401 If the vessel is equipped with an offshore transfer system to transfer technicians from the ship to the wind turbine, the following requirements shall be complied with.

402 The offshore transfer system shall be delivered with a DNV product certificate.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---
The offshore transfer system shall be designed and manufactured in accordance with relevant parts of the following standards:

— DNV’s Standard for Certification No. 2.22 “Lifting Appliances”
— ISO 7061 “Shipbuilding - Aluminium shore gangways for seagoing vessels”
— ISO 5488 “Shipbuilding - Accommodation ladders”.
— IMO MSC.1/Circ.1331 “Guidelines for construction, installation, maintenance and inspection/survey of means of embarkation and disembarkation”.

B 500 Work Boat Davits

501 Where fitted, work boat davits and winches are to comply with SOLAS 1974 and the LSA Code with the exceptions given in 202-205.

502 Functional and operational requirements:

— No requirements to heel or trim unless specified by operator
— Stored mechanical power not required, however lowering in dead ship condition shall be possible
— No requirements to hoisting or lowering speed unless specified by flag administration
— If estimated dynamic factor exceed 1.5, shock damper arrangement is required.

503 In addition to strength requirements given in above regulations, fatigue according to a recognised standard to be considered.

504 Testing at factory and after installation on board shall be performed in line with IMO MSC. 81(70) part 2.

B 600 Work Boats

601 All work boats fitted onboard are to be certified by DNV according to DNV Certification standard 2.21 “Craft”.

602 The ship side in way of the work boats shall be equipped with fenders to reduce the impact during launch and recovery of the craft.
SECTION 24
SEISMOGRAPHIC RESEARCH VESSELS

A. General

A 100 Introduction

101 The requirements in this section apply to vessels designed especially for seismographic research operations.

A 200 Objective

201 The objective of this section is to provide a design standard enabling safe and reliable operation of seismographic research vessels with particular focus on the robust design of the seismic equipment hangar; the ability to maintain propulsion power and vessel manoeuvrability through adapted bridge design and navigation systems.

A 300 Scope

301 This section contains requirements to hull arrangement and hull strength, systems and equipment applicable to seismographic research vessels.

A 400 Application

401 Vessels built in compliance with the requirements as specified in Table A1 will be assigned the class notations as follows:

<table>
<thead>
<tr>
<th>Class notation</th>
<th>Qualifier</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seismic Vessel</td>
<td>&lt;none&gt;</td>
<td>Hull arrangement and strength A and B</td>
</tr>
<tr>
<td></td>
<td>(A)</td>
<td>Systems and equipment C</td>
</tr>
</tbody>
</table>

402 Qualifier (A) is optional.

403 Vessels with qualifier (A) shall hold the following additional class notations:

— RP(+), see Pt.6 Ch.2; or DYNPOS-AUTR or DYNPOS-AUTRO, see Pt.6 Ch.7; or DYNPOS-ER, see Pt.6 Ch.26
— E0 or ECO, see Pt.6 Ch.3
— NAUT-OSV(A), see Pt.6 Ch.20

A 500 Documentation Requirements

501 Documentation shall be submitted as required by Table A2.

<table>
<thead>
<tr>
<th>Object</th>
<th>Documentation type</th>
<th>Additional description</th>
<th>Info</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seismic handling equipment</td>
<td>C010 – Design criteria</td>
<td>Design loads (safe working load, fleet angles, brake rendering load and wire breaking load as relevant). Self weights of equipment in operational and in transit modes.</td>
<td>FI</td>
</tr>
<tr>
<td>Z030 Arrangement plan</td>
<td></td>
<td>Heavy machinery in hangar and on deck and equipment for handling and storage and mooring at sea.</td>
<td>FI</td>
</tr>
<tr>
<td>Z030 Calculation report</td>
<td></td>
<td>Hangar: Design loads and racking calculations covering operational and transit modes.</td>
<td>FI</td>
</tr>
</tbody>
</table>

Seismic equipment supporting structures

<table>
<thead>
<tr>
<th>Object</th>
<th>Documentation type</th>
<th>Additional description</th>
<th>Info</th>
</tr>
</thead>
<tbody>
<tr>
<td>H050 Structural drawing</td>
<td></td>
<td>Including foundations. Design loads, footprint loads and fastening details.</td>
<td>AP</td>
</tr>
</tbody>
</table>

Work boat davits

<table>
<thead>
<tr>
<th>Object</th>
<th>Documentation type</th>
<th>Additional description</th>
<th>Info</th>
</tr>
</thead>
<tbody>
<tr>
<td>Z160 – Operation manual</td>
<td></td>
<td></td>
<td>FI</td>
</tr>
<tr>
<td>Z170 – Installation manual</td>
<td></td>
<td></td>
<td>FI</td>
</tr>
<tr>
<td>Z180 – Maintenance manual</td>
<td></td>
<td></td>
<td>FI</td>
</tr>
</tbody>
</table>
B. Hull Arrangement and Strength

B 101 Design Loads for Seismic Equipment Hangar

101 Loading conditions and load combinations are to be as specified in the Table B1 for transit vessel mode (fully loaded deck equipment in stowed condition) and operational mode (seismographic equipment is deployed).

Table B1 Loading conditions and load combinations on the seismic equipment hangar

<table>
<thead>
<tr>
<th>Load combination</th>
<th>Transit Vertical</th>
<th>Transit Transverse</th>
<th>Transit Longitudinal</th>
<th>Seismic operation Vertical</th>
<th>Seismic operation Transverse</th>
</tr>
</thead>
<tbody>
<tr>
<td>((g_0+0.5a_v)M)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(g_0M)</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>(0.67a_vM)</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(0.67a_vM)</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Equipment load</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sea pressure</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Guidance note: Accelerations are to be according to Pt.3 Ch.1 Sec.4. In no case transverse accelerations \((0.67a_v)\) are to be less than \(0.5g_0\).

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

102 The total weight \(M\) is to include steel weight of the hangar, weight of the deck cargo and fully loaded equipment. For the operational conditions the weight of the equipment can be reduced by the weight of deployed cables.

103 Combinations of equipment loads are to include maximum operational loads on seismographic handling equipment (winches, towing points, etc.) which are assumed to be at least one line with breaking load and remaining lines with safe working load times the dynamic factor.

In case of maximum transverse loading, safe working load on towing points times dynamic factor is to be combined with maximum breaking strength on at least one line in the most unfavourable position (normally the outermost line). Similar for maximum vertical loading the breaking load is normally to be applied to the mid-span line and combined with SWL times dynamic factor for the remaining lines.

If the design specification should include combinations with more than one piece of equipment with breaking load then this is to be included in the load specification of the seismic equipment hangar.

104 Breaking load need not to be taken greater than the force causing the winch to render.

105 A design dynamic factor of not less than 1.3 shall be applied to the static SWL of the seismic handling equipment.

106 For the lowermost deck on semi-enclosed hangars, the design load shall be taken as the greater value of the Rule sea pressure and specified deck load (when below \(2t/m^2\)) in combination with sea pressure. The sea pressure does not need to exceed \(30\, kN/m^2\), when it is used in combination with the deck load. For the remaining decks on semi-enclosed hangars, the design load shall be taken as the greater value of the Rule sea pressure and deck load. For open weather deck located over \(1.7Cw\) (ref. Pt.3 Ch.1 Sec.4) above the Summer Load Waterline, the design load shall be taken as the greater value of the Rule sea pressure and deck load.
Allowable stresses:
— Normal stresses: 160 f_y N/mm²
— Shear stresses: 90 f_y N/mm²

B 200 Supporting Structures for Seismic Handling Equipment

201 Local structural strength in way of the equipment foundation is to be in compliance with Pt.3 Ch.3 Sec.5.

202 In case the winch is supported by two deck levels, then local support at one deck level shall be capable of bearing all vertical loads from the winch.

203 When part of the equipment is acting as structural hull support (i.e. winch frame providing pillar support for the decks) it is to comply with the strength requirements as for the main structure with respect to the design loads and Rule acceptance criteria.

204 In cases when equipment is being used as hull structural support this is to be stated in Memo to Owner (MO) and Appendix to Class Certificate.

B 300 Strengthening for Side-By-Side Mooring

301 The SWL for the mooring bollard shall be at least 3 times the minimum breaking load of the mooring lines according to the vessel’s equipment letter, or based upon the designer’s specification for the minimum breaking load to be used for side-by-side mooring lines.

302 The mooring line specification and restrictions on operation of the mooring bollards are to be stated in the Appendix to Class Certificate and in a Memo to Owner.

303 The strength of supporting deck structure is to be based on the mooring bollard’s SWL times 1.5.

304 Allowable stresses:
— Normal stresses: 160 f_y N/mm²
— Shear stresses: 90 f_y N/mm²

C. Systems and Equipment

C 100 Certification Requirements

101 Components shall be certified as required by Table A3.

<table>
<thead>
<tr>
<th>Object</th>
<th>Certificate type</th>
<th>Additional description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work boats</td>
<td>NV-P</td>
<td>DNV product certificate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DNV Standard for Certification 2.21 – Craft</td>
</tr>
<tr>
<td>Wide tow equipment</td>
<td>NV-P</td>
<td>DNV product certificate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DNV Standard for Certification 2.22 – Lifting Appliances, normally as ‘Industrial crane’</td>
</tr>
<tr>
<td>Handling and towing booms</td>
<td>NV-P</td>
<td>DNV product certificate</td>
</tr>
<tr>
<td>Work boat davits</td>
<td>NV-P</td>
<td>DNV product certificate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DNV material certificate</td>
</tr>
<tr>
<td></td>
<td>NV-M</td>
<td>EN 10204</td>
</tr>
<tr>
<td>Work boat winches</td>
<td>NV-P</td>
<td>DNV product certificate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DNV material certificate</td>
</tr>
<tr>
<td></td>
<td>NV-M</td>
<td>EN 10204</td>
</tr>
</tbody>
</table>

102 For a definition of the certificate types, see Pt.1 Ch.1 Sec.4 B.

C 200 Work Boat Davits and winches

201 Where fitted, work boat davits and winches, unless otherwise required by national authorities are to comply with SOLAS 1974 and the LSA Code, with the following exceptions:
— No requirements to heel or trim unless specified by operator.
— Stored mechanical power not required, however lowering in dead ship condition shall be possible.
— No requirements to hoisting or lowering speed.
— If estimated dynamic factor exceeds 1.5, shock damper arrangement is required.

202 In addition to strength requirements given in above regulations, fatigue according to a recognised standard to be considered.

203 Testing at factory and after installation on board shall be performed in line with IMO MSC. 81(70) part 2.

C 300 High pressure air system

301 The piping system shall comply with the requirements in Pt.4 Ch.6. In addition, the requirements
specified in 302 to 311 are to be fulfilled.

302 High pressure pipes shall not be installed in the vicinity of gangways or other spaces which are in normal use by personnel. If this cannot be avoided, shielding or equivalent arrangement shall be applied.

Any manifold and pressure relief valve shall be shielded to safeguard any operator. The pressure relief valves shall be arranged for venting to exhaust or overboard.

**Guidance note:**
Example of appropriate shielding may be punched steel shields. The shielding may also be removable in order for accessing de-pressurized equipment.

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

303 Pipes should be inclined relative to the horizontal. Water pockets in the pipeline shall be avoided as far as practicable. If this cannot be avoided, means of drainage shall be arranged.

304 All manifolds and other locations where liquid may accumulate shall be arranged with possibilities for efficient drainage. Automated drains shall be arranged for air receivers, with additional possibility for manual operation.

305 Lubricating oil points for the air guns shall not be located in the vicinity of manifolds. If this cannot be avoided, there shall be arranged automatic shutdown of lubrication pumps when the high pressure air system is not pressurized.

306 All valves shall be automatically operated in order to prevent adiabatic compression or water hammer in the system. Alternatively, the system shall always be de-pressurized before operating any valves.

**Guidance note 1:**
Opening time of a valve shall be at least 10 seconds.

Controlled pressure adjustment before opening a high pressure valve may, in some cases serve as an equivalent to automatically operated valves. By adjusting the system pressure to 1.8 of design pressure, the risk of generating high temperatures through adiabatic compression is negligible.

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

307 Air intakes for the compressors shall be so located as to minimize the intake of oil or water contaminated air.

308 Pipes from air compressors with automatic start shall be fitted with a separator or similar device to prevent condensate and HP piping must be done in a way to prevent condensate from draining back into compressors.

309 Cylinder banks shall be located in areas which are not in normal use by personnel. The area shall be arranged for high pressure air to expand in case of an explosion.

**Guidance note:**
Proper shielding of connected piping and valves may be considered as an equivalent solution if designated areas cannot be arranged.

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

310 There shall be at least one burst disc installed at the manifold, and one at the cylinder bank. The discs shall be directed away from working areas.

311 The piping shall be hydrostatically tested for at least 30 minutes in the presence of a DNV surveyor after installation on board with the following test pressure:

\[ \text{PH} = 1.5 \ p \]

PH = test pressure in bar

\[ p = \text{design pressure in bar as defined in Pt.4 Ch.6 Sec.7 A303.} \]

The test pressure need not exceed the design pressure by more than 70 bar.