RULES
FOR THE
CLASSIFICATION
OF INLAND
NAVIGATION VESSELS

PART 4
ADDITIONAL
REQUIREMENTS FOR
NOTATIONS

Croatian
Register of
Shipping

June
2018
RULES
FOR THE CLASSIFICATION OF
INLAND NAVIGATION VESSELS

Part 4 – ADDITIONAL REQUIREMENTS FOR NOTATIONS

June 2018

CROATIAN REGISTER OF SHIPPING
Hrvatska (Croatia) • 10000 Zagreb • Rudeška cesta 89-91
Tel.: (...) 385 (0)1 38 72 444
Fax.: (...) 385 (0)1 38 72 357
E-mail: crs-inland@crs.hr
web site: www.crs.hr
By the decision of the General Committee of Croatian Register of Shipping,

RULES FOR THE CLASSIFICATION OF INLAND NAVIGATION VESSELS
PART 4 – ADDITIONAL REQUIREMENTS FOR NOTATIONS

have been adopted on 29th May 2018 and shall enter into force on 5th June 2018
1. HISTORICAL RECORD

- The Croatian Register of Shipping (hereinafter referred to as CRS) is a heritor of ship classification activities at the eastern Adriatic coast.
- The Austrian Veritas was founded in this area, already in 1858, as the third classification society in the world.
- In 1918 the Austrian Veritas changed its name into the Adriatic Veritas and was acting as such till year 1921.
- CRS, acting till 1992 as JR (Yugoslav Register of Shipping), was founded in 1949.
- CRS Head Office is situated in Split, Republic of Croatia.
- CRS is the classification society, member of International Association of Classification Societies (IACS), starting from May 2011.

From April 1973 till January 2005, when IACS generally discontinued associate status, CRS was an associate IACS member.

- CRS is certified by British Standards Institution (BSI) confirming that CRS operates the Quality Management System which complies with the requirements of BS EN 9001:2015 for the scope of classification and statutory certification of ships, statutory certification of marine equipment and recreational crafts, and BSI Annual Statement of Compliance confirming that CRS Quality Management System complies with IACS Quality System Certification Scheme.

2. STATUS

- CRS is an independent, not for profit but common welfare oriented, public foundation performing:
  - classification of ships;
  - statutory certification of ships on behalf of the national Maritime Administrations;
  - statutory certification of recreational crafts;
  - certification of materials and products;
  - conformity assessment of recreational crafts;
  - conformity assessment of marine equipment;
  - conformity assessment of pressure vessels;
  - certification / registration of quality management systems.
  
- The present status of CRS is defined by the Law on Croatian Register of Shipping (OFFICIAL GAZETTE No. 1996/81, as amended with No. 2013/76) and Charter of CRS.

3. MISSION

- CRS mission in the field of classification and statutory certification is to promote the highest internationally adopted standards in the safety of life and property at sea and inland waterways, as well as in the protection of the sea and inland waterways environment.

4. LIABILITY

1. CRS is neither, nor may be considered as, an Underwriter, Consulting Engineer, Naval Architect, Shipbuilder, Shipowner or Operator, and cannot assume or be exposed to the obligations and responsibilities incumbent on such functions, even though experience of CRS enables it to answer enquiries concerning matters not covered by its Rules, Recommendations, Guidance notes, Instructions, Documents or other evidence.

2. Practices and procedures of CRS are selected by CRS in its sole and absolute discretion based on its experience and knowledge, and in conformity with generally accepted professional standards in the relevant field of the classification Societies.

3. Nothing contained herein, or in any information, report, certificate or like document issued in connection with or pursuant to the performance by CRS of its services, shall be deemed to relieve any designer, naval architect or engineer, shipbuilder or manufacturer, shipyard, seller, supplier, contractor or subcontractor, repairer, or owner, operator, manager or any other person or entity from any warranty or other contractual obligations or responsibilities, expressed or implied or from any negligent act, error or omission whatsoever, nor may create any right, claim or benefit to any third party.

4. CRS shall exercise due diligence in selection or appointment of its surveyors and all other personnel whose attendance and work is employed or engaged for the purpose of performing its services.

5. Nevertheless, if any person or entity uses services of CRS and suffers loss, damage or expenses thereby, which is attributable or proved to have been caused by any negligent act, omission or error of the surveyors, servants, agents, appointees, officers, managers or directors of CRS or purporting to act in the name of and on behalf of CRS, or any negligent inaccuracy, advice, report or evidence is given by or in the name or/and on behalf of CRS, then the liability of CRS is limited in respect of any direct or indirect claim whatsoever to an amount not exceeding five times the amount of the fee charged or chargeable by CRS for the relevant service.

6. Where the fees are related to a number of services, the amount of fees shall be apportioned for the purpose of the calculation of the maximum compensation of the limited liability, as established by the preceding paragraph, in accordance with the estimated time involved in the performance of each service.

7. Any liability for consequential damages is expressly excluded.

8. These rules (General Conditions) are construed and interpreted in accordance with the English Law.

9. Any dispute arising out of the services rendered by CRS shall be referred to the Permanent Arbitration Court with the Croatian Chamber of Commerce in Zagreb, Republic of Croatia.
Table of contents

I TYPE NOTATIONS .................................................................................................................................................. 1
  1 SYMBOLS ...................................................................................................................................................... 1
  2 CARGO VESSELS ............................................................................................................................................... 2
    2.1 General .................................................................................................................................................... 2
    2.2 Single side cargo vessels ......................................................................................................................... 2
    2.3 Double hull cargo vessels ....................................................................................................................... 6
  3 TANKERS ......................................................................................................................................................... 10
    3.1 General .................................................................................................................................................. 10
    3.2 Vessel arrangement ................................................................................................................................. 11
    3.3 Structural arrangement ........................................................................................................................... 12
  4 PASSENGER VESSELS ...................................................................................................................................... 19
    4.1 General .................................................................................................................................................. 19
    4.2 Vessel arrangement ................................................................................................................................. 20
    4.3 Buoyancy and stability ............................................................................................................................ 28
    4.4 Structural arrangement ........................................................................................................................... 32
  5 TUGS AND PUSHERS ...................................................................................................................................... 36
    5.1 General .................................................................................................................................................. 36
    5.2 Vessel arrangement ................................................................................................................................. 37
    5.3 Structural arrangement ........................................................................................................................... 37
  6 PONTOONS ......................................................................................................................................................... 39
    6.1 General .................................................................................................................................................. 39
    6.2 Vessel arrangement ................................................................................................................................. 40
    6.3 Structural arrangement ........................................................................................................................... 40
  7 VESSELS FOR DREDGING ............................................................................................................................ 41
    7.1 General .................................................................................................................................................. 41
    7.2 Vessel arrangement ................................................................................................................................. 42
    7.3 Structural arrangement ........................................................................................................................... 42

II TRANSPORT OF DANGEROUS GOODS ......................................................................................................... 44
  1 GENERAL REQUIREMENTS .......................................................................................................................... 44
    1.1 General .................................................................................................................................................. 44
    1.2 Classification of dangerous goods ......................................................................................................... 44
    1.3 Substances approved for carriage in tank vessels ................................................................................ 44
    1.4 Carriage of dangerous substances not listed in Table C of Chapter 3.2, Part 3 of ADN ...................... 44
    1.5 Definitions and explanations .................................................................................................................. 45
    1.6 Dry cargoes .......................................................................................................................................... 51
    1.7 Liquid cargoes ...................................................................................................................................... 51
  2 DRY CARGO VESSELS - DDG .......................................................................................................................... 55
    2.1 General .................................................................................................................................................. 55
    2.2 Documentation to be submitted ............................................................................................................ 55
    2.3 Vessel arrangement ................................................................................................................................. 55
    2.4 Electrical installation .............................................................................................................................. 56
    2.5 Fire protection and fire-extinguishing ................................................................................................. 57
    2.6 Additional requirements applicable to double hull vessels ............................................................... 57
    2.7 Notice boards ....................................................................................................................................... 59
  3 TANKERS TYPE G .......................................................................................................................................... 60
    3.1 General .................................................................................................................................................. 60
    3.2 Documentation to be submitted ............................................................................................................ 60
    3.3 Vessel arrangement ................................................................................................................................. 61
    3.4 Cargo containment ................................................................................................................................. 64
    3.5 Cargo piping system ............................................................................................................................... 65
    3.6 Cargo pressure and temperature control .............................................................................................. 66
    3.7 Pressure cargo tank venting system ....................................................................................................... 67
    3.8 Inverting facility ................................................................................................................................... 68
    3.9 Electrical installations ............................................................................................................................ 68
    3.10 Fire protection and fire-extinguishing ................................................................................................. 69
    3.11 Safety and control installations ........................................................................................................... 70
    3.12 Buoyancy and stability .......................................................................................................................... 71
    3.13 Notice boards ...................................................................................................................................... 72
<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>TANKERS TYPE C..................................................................................</td>
<td>73</td>
</tr>
<tr>
<td>4.1</td>
<td>General</td>
<td>73</td>
</tr>
<tr>
<td>4.2</td>
<td>Documentation to be submitted</td>
<td>73</td>
</tr>
<tr>
<td>4.3</td>
<td>Vessel arrangement</td>
<td>73</td>
</tr>
<tr>
<td>4.4</td>
<td>Cargo containment</td>
<td>76</td>
</tr>
<tr>
<td>4.5</td>
<td>Cargo piping system</td>
<td>79</td>
</tr>
<tr>
<td>4.6</td>
<td>Cargo pressure and temperature control</td>
<td>80</td>
</tr>
<tr>
<td>4.7</td>
<td>Tanks and receptacles for residual products and receptacles for slops</td>
<td>80</td>
</tr>
<tr>
<td>4.8</td>
<td>Inerting facility</td>
<td>81</td>
</tr>
<tr>
<td>4.9</td>
<td>Electrical installations</td>
<td>81</td>
</tr>
<tr>
<td>4.10</td>
<td>Fire protection and fire-extinguishing</td>
<td>83</td>
</tr>
<tr>
<td>4.11</td>
<td>Safety and control installations</td>
<td>83</td>
</tr>
<tr>
<td>4.12</td>
<td>Buoyancy and stability</td>
<td>84</td>
</tr>
<tr>
<td>4.13</td>
<td>Notice boards</td>
<td>85</td>
</tr>
<tr>
<td>5</td>
<td>TANKERS TYPE N..................................................................................</td>
<td>86</td>
</tr>
<tr>
<td>5.1</td>
<td>General</td>
<td>86</td>
</tr>
<tr>
<td>5.2</td>
<td>Documentation to be submitted</td>
<td>86</td>
</tr>
<tr>
<td>5.3</td>
<td>Vessel arrangement</td>
<td>86</td>
</tr>
<tr>
<td>5.4</td>
<td>Cargo containment</td>
<td>89</td>
</tr>
<tr>
<td>5.5</td>
<td>Cargo piping system</td>
<td>91</td>
</tr>
<tr>
<td>5.6</td>
<td>Cargo pressure and temperature control</td>
<td>92</td>
</tr>
<tr>
<td>5.7</td>
<td>Tanks and receptacles for residual products and receptacles for slops</td>
<td>93</td>
</tr>
<tr>
<td>5.8</td>
<td>Inerting facility</td>
<td>94</td>
</tr>
<tr>
<td>5.9</td>
<td>Electrical installations</td>
<td>94</td>
</tr>
<tr>
<td>5.10</td>
<td>Fire protection and fire-extinguishing</td>
<td>95</td>
</tr>
<tr>
<td>5.11</td>
<td>Safety and control installations</td>
<td>96</td>
</tr>
<tr>
<td>5.12</td>
<td>Buoyancy and stability</td>
<td>97</td>
</tr>
<tr>
<td>5.13</td>
<td>Notice boards</td>
<td>98</td>
</tr>
<tr>
<td>6</td>
<td>OIL SEPARATOR VESSEL........................................................................</td>
<td>98</td>
</tr>
<tr>
<td>6.1</td>
<td>General</td>
<td>98</td>
</tr>
<tr>
<td>6.2</td>
<td>Documentation to be submitted</td>
<td>98</td>
</tr>
<tr>
<td>6.3</td>
<td>Vessel arrangement</td>
<td>99</td>
</tr>
<tr>
<td>6.4</td>
<td>Cargo containment</td>
<td>100</td>
</tr>
<tr>
<td>6.5</td>
<td>Cargo piping system</td>
<td>101</td>
</tr>
<tr>
<td>6.6</td>
<td>Cargo pressure and temperature control</td>
<td>101</td>
</tr>
<tr>
<td>6.7</td>
<td>Tanks and receptacles for residual products and receptacles for slops</td>
<td>102</td>
</tr>
<tr>
<td>6.8</td>
<td>Electrical installations</td>
<td>102</td>
</tr>
<tr>
<td>6.9</td>
<td>Fire protection and fire-extinguishing</td>
<td>103</td>
</tr>
<tr>
<td>6.10</td>
<td>Safety and control installations</td>
<td>103</td>
</tr>
<tr>
<td>6.11</td>
<td>Buoyancy and stability</td>
<td>104</td>
</tr>
<tr>
<td>6.12</td>
<td>Notice boards</td>
<td>105</td>
</tr>
<tr>
<td>7</td>
<td>SUPPLY VESSEL..................................................................................</td>
<td>105</td>
</tr>
<tr>
<td>7.1</td>
<td>General</td>
<td>105</td>
</tr>
<tr>
<td>7.2</td>
<td>Documentation to be submitted</td>
<td>105</td>
</tr>
<tr>
<td>7.3</td>
<td>Vessel arrangement</td>
<td>106</td>
</tr>
<tr>
<td>7.4</td>
<td>Cargo containment</td>
<td>107</td>
</tr>
<tr>
<td>7.5</td>
<td>Cargo piping system</td>
<td>108</td>
</tr>
<tr>
<td>7.6</td>
<td>Cargo pressure and temperature control</td>
<td>109</td>
</tr>
<tr>
<td>7.7</td>
<td>Tanks and receptacles for residual products and receptacles for slops</td>
<td>109</td>
</tr>
<tr>
<td>7.8</td>
<td>Electrical installations</td>
<td>109</td>
</tr>
<tr>
<td>7.9</td>
<td>Fire protection and fire-extinguishing</td>
<td>110</td>
</tr>
<tr>
<td>7.10</td>
<td>Safety and control installations</td>
<td>111</td>
</tr>
<tr>
<td>7.11</td>
<td>Buoyancy and stability</td>
<td>111</td>
</tr>
<tr>
<td>7.12</td>
<td>Notice boards</td>
<td>112</td>
</tr>
<tr>
<td>8</td>
<td>VESSELS USED FOR PROPULSION OF A PUSHED CONVOY...............................</td>
<td>113</td>
</tr>
<tr>
<td>8.1</td>
<td>General</td>
<td>113</td>
</tr>
<tr>
<td>8.2</td>
<td>Vessel arrangement</td>
<td>113</td>
</tr>
<tr>
<td>8.3</td>
<td>Electrical installations</td>
<td>114</td>
</tr>
<tr>
<td>8.4</td>
<td>Fire protection and fire-extinguishing</td>
<td>114</td>
</tr>
<tr>
<td>8.5</td>
<td>Notice boards</td>
<td>115</td>
</tr>
<tr>
<td>9</td>
<td>VESSELS BEING THE PART OF A PUSHED CONVOY......................................</td>
<td>116</td>
</tr>
<tr>
<td>9.1</td>
<td>General</td>
<td>116</td>
</tr>
<tr>
<td>9.2</td>
<td>Vessel arrangement</td>
<td>116</td>
</tr>
</tbody>
</table>
## Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.3 Electrical installations</td>
<td>116</td>
</tr>
<tr>
<td>9.4 Fire protection and fire-extinguishing</td>
<td>116</td>
</tr>
<tr>
<td>9.5 Notice boards</td>
<td>117</td>
</tr>
<tr>
<td><strong>III</strong> ADDITIONAL CHARACTERS OF CLASS</td>
<td>118</td>
</tr>
<tr>
<td>1 SYMBOLS</td>
<td>118</td>
</tr>
<tr>
<td>2 STRENGTHENED CONSTRUCTION</td>
<td>118</td>
</tr>
<tr>
<td>2.1 General</td>
<td>118</td>
</tr>
<tr>
<td>2.2 Navigation in ice</td>
<td>118</td>
</tr>
<tr>
<td>2.3 Grab loading</td>
<td>122</td>
</tr>
<tr>
<td>3 HEAVY CARGO TRANSPORT</td>
<td>122</td>
</tr>
<tr>
<td>3.1 General</td>
<td>122</td>
</tr>
<tr>
<td>3.2 Vessels intended to carry heavy unit cargoes</td>
<td>123</td>
</tr>
<tr>
<td>3.3 Vessels intended to carry heavy dry bulk cargoes</td>
<td>123</td>
</tr>
<tr>
<td>4 STABILITY</td>
<td>124</td>
</tr>
<tr>
<td>4.1 General</td>
<td>124</td>
</tr>
<tr>
<td>4.2 Cargo vessels</td>
<td>124</td>
</tr>
<tr>
<td>4.3 Tankers</td>
<td>127</td>
</tr>
<tr>
<td>4.4 Tugs and pushers</td>
<td>127</td>
</tr>
<tr>
<td>4.5 Pontoons and dredgers</td>
<td>127</td>
</tr>
<tr>
<td>4.6 Floating installations without confirmation of stability</td>
<td>128</td>
</tr>
</tbody>
</table>
Chapter 1 - TYPE NOTATIONS

1 SYMBOLS

- A = structural member’s net sectional area, [cm²];
- \( a_x \) = vessel’s longitudinal acceleration, [m/s²];
- \( a_y \) = vessel’s transverse acceleration, defined in 4.4.6.3.2, [m/s²];
- B = breadth, defined in the Rules, Part 2 – Hull and Hull Equipment, Chapter I, 3.2.2, [m];
- \( B_{WL} \) = breadth of waterline: breadth of the hull in [m], measured from the outside of the side plating at the plane of maximum draught line, [m];
- \( b_i, h_i \) = width and height of i-th tier of superstructure, respectively, (see Figure 4.4.6-1), [m];
- \( C_b \) = block coefficient, defined in the Rules, Part 2 – Hull and Hull Equipment, Chapter I, 3.5.1;
- D = depth, defined in the Rules, Part 2 – Hull and Hull Equipment, Chapter I, 3.2.3, [m];
- \( d_m \) = inside diameters of the main line of bilge piping, [mm];
- \( d_s \) = inside diameters of the branch line of bilge piping, [mm];
- E = Young’s modulus of elasticity, [N/mm²];
- \( f_s \) = safety factor;
- GM = metacentric height, [m];
- GZ = lever arm, [m];
- \( g \) = acceleration of gravity = 9.81 m/s²;
- H = significant wave height, defined in the Rules, Part 2 – Hull and Hull Equipment, Chapter I, 3.7.2, [m];
- \( h_{WB}, t_{WB} \) = structural member’s web height and thickness respectively, [mm];
- \( KG \) = vertical centre of gravity (VCG) corresponding to the loading condition considered and the base line, [m];
- k = material factor defined in the Rules, Part 2 – Hull and Hull Equipment, Chapter II, Section 2;
- \( L \) = Rule length, defined in the Rules, Part 2 – Hull and Hull Equipment, Chapter I, 3.2.1, [m];
- \( L_{WL} \) = length of waterline defined in the Rules, Part 2 – Hull and Hull Equipment, Chapter I, 3.2.6, [m];
- \( l_{CS} \) = total length of cargo space, including cofferdams, [m];
- \( l_{WC} \) = length of the watertight compartment considered, [m];
- \( M_G \) = bending moment, [N/mm²];
- \( M_{CF} \) = moment due to centrifugal force, [kNm];
- \( M_P \) = heeling moment due to crowding of passengers, [kNm];
- \( M_{WD} \) = heeling moment due to wind, [kNm];
- \( m_i \) = total mass of persons on board, [t];
- \( m_s \) = total mass of persons on board, [t];
- \( P_s, P_i \) = static and inertial concentrated loads respectively, [kN];

\[ P_{Di} \] = design lateral loads acting on i-th tier of a deck, defined in the Rules, Part 2 – Hull and Hull Equipment, Chapter V, 9.3, [kN/m²];

\[ P_E \] = external load on sides, defined in the Rules, Part 2 – Hull and Hull Equipment, Chapter V, 9.3, [kN/m²];

\[ P_{WD} \] = wind pressure defined in the Rules, Part 2 – Hull and Hull Equipment, Chapter III, 4.1.2, [kN/m²];

\[ Q \] = shear force, [N/mm²];

\[ R_{eff} \] = yield strength for hull structural steel, [N/mm²];

\( s, S \) = spacing of ordinary stiffeners and primary supporting members, respectively, defined in the Rules, Part 2 – Hull and Hull Equipment, Chapter II, 5.3.2, [m].

\( S_B \) = spacing between adjacent transverse bulkheads or efficient supports, [m];

\( T \) = draught, defined in the Rules, Part 2 – Hull and Hull Equipment, Chapter I, 3.2.4, [m];

\( T_{LC} \) = draught associated with each cargo and ballast distribution defined in the Rules, Part 2 – Hull and Hull Equipment, Chapter III – Design load principles, [m];

\( t \) = net thickness, [mm];

\( v \) = vessel speed, [km/h];

\( x, y, z \) = x, y and z coordinates of the calculation point with respect to the reference coordinate system, defined in the Rules, Part 2 – Hull and Hull Equipment, Chapter I, 3.5.2, [t];

\( \Delta \) = displacement, defined in the Rules, Part 2 – Hull and Hull Equipment, Chapter I, 3.5.2, [t];

\( \varphi \) = the heeling angle, [°];

\( \varphi_E \) = the heeling angle in the final stage of flooding, [°];

\( \varphi_m \) = the angle of vanishing stability, [°];

\( \varphi_f \) = the downflooding angle, [°];

\( \varphi_{max} \) = the heeling angle at which the maximum righting lever arm occurs, [°];

\( \varphi_{mom} \) = the maximum heeling angle, [°];

\( \tau \) = shear stress determined in compliance with the Rules, Part 2 – Hull and Hull Equipment, Chapter IV, Section 4, [kN/mm²].
2 CARGO VESSELS

2.1 General

2.1.1 Design loads

The loads shall be calculated independently for each vessel’s condition (as given in the Rules, Part 2 – Hull and Hull Equipment, Chapter III, 2.3), by applying the associated loading conditions (as defined in the Rules, Part 2 – Hull and Hull Equipment, Chapter III, 2.2), to determine the most severe loading of the structural members analysed.

Where loading conditions other than standard design loading conditions are also expected, calculations for such conditions shall be submitted in addition to the standard conditions.

Structural members of compartments subjected to testing conditions, shall be checked for testing loads, calculated according to the Rules, Part 2 – Hull and Hull Equipment, Chapter III, 5.8.

Structural members of watertight boundaries of compartments not intended to carry liquids, shall be checked for flooding loads, calculated according to the Rules, Part 2 – Hull and Hull Equipment, Chapter III, 4.4.

2.1.2 Materials other than normal strength hull structural steel

When steels with a minimum yield strength $R_{y,01}$ other than 235.0 N/mm² are used on a vessel, the scantlings shall be determined by taking into account the corresponding material factor, $k$, Young’s modulus of elasticity, $E$, yield strength, $R_{y,01}$, for hull structural steels etc.

2.1.3 Safety factor

If not otherwise specified, safety factors, $f_s$, covering uncertainties regarding material and resistance, of vessels covered by the present Rules are defined in the Rules, Part 2 – Hull and Hull Equipment, Chapter V, 1.7.

2.1.4 Stability

Proof of sufficient intact stability shall be provided in accordance with the present Rules, Chapter III, 4.2.2.

The Register may waive this requirement, depending on the vessel design and characteristics, loading conditions and intended operating conditions.

For damage stability criteria see the present Rules, Chapter III, 4.2.3.

2.2 Single side cargo vessels

2.2.1 General

2.2.1.1 Application

.1 vessels complying with the requirements of this Section are eligible for the assignment of the type notation Cargo vessel, as defined in the Rules, Part 1 – Classification and Surveys, Chapter I, 3.5.4;

.2 vessels considered in 2.2 shall comply with the applicable requirements of the Rules, Part 1 – Classification and Surveys, Part 2 – Hull and Hull Equipment and Part 3 – Machinery, Systems and Electricity, as well as with the requirements of 2.2 which are specific to single side cargo vessels.

2.2.1.2 Direct calculation

Direct calculation may be adopted for the yielding and buckling checks of hull structural members instead of the Rules scantling formulae as well as for the analysis of structural members not covered by the Rules or for type of loading not covered by the Rules (e.g. heavy concentrated loads, unevenly distributed loads etc.), in accordance with the Rules, Part 2 – Hull and Hull Equipment, Chapter V, 1.8.

The following strength checks shall be carried out, as applicable:

.1 level of normal stresses and shear stresses in way of transition of single bottom into double bottom;

.2 level of normal stresses and shear stresses in way of significant structural discontinuities: considerable changes in structural arrangement and scantlings or change from the longitudinal to transverse framing system;

.3 level of normal stresses and shear stresses of primary supporting members in way of holes and cut-outs for passage of ordinary stiffeners;

.4 level of normal stresses and shear stresses in welds in way of highly stressed areas;

.5 buckling strength of unstiffened webs or face plates of primary supporting members, corrugated bulkheads etc.

All calculation documents shall be submitted to the Register.

2.2.2 Vessel arrangement

2.2.2.1 General

The requirements of 2.2 apply to open deck vessels with single side structure, with or without double bottom, intended primarily to carry uniform or dry bulk cargoes.

The loading/unloading may be performed in one or two runs.

2.2.2.2 Welding

.1 General

Welding shall comply with the requirements of the Rules, Part 2 – Hull and Hull Equipment, Chapter VII, Section 1.

.2 Shell plating and inner bottom plating

The longitudinal and transverse joints shall, as a rule, be butt welded.

Joints of inner bottom plating may be welded in way of floor flange which then acts as a support.

.3 Topside plating

The longitudinal and transverse joints of the topside plating shall, as a rule, be butt welded.

.4 Double bottom supporting members

In the case of a double bottom, where its height does not make it possible to connect floors and bottom girders to the inner bottom by fillet welding, slot welding may be used. In that case, the floors and girders shall be fitted with a flange (see also the Rules, Part 2 – Hull and Hull Equipment, Chapter V, 2.6.4).
2.2.2.3 Protection of hull compartments

2.2.2.3.1 Coating

All metallic structures shall be protected against corrosion by suitable protection measures, in accordance with to the Rules, Part 2 – Hull and Hull Equipment, Chapter VII, Section 2.

Coatings shall be chosen and surfaces to be protected shall be prepared in accordance with the manufacturer’s requirements, taking care of the compartment considered and cargoes intended to be carried. Special attention shall be paid to the compatibility of the coating with the cargo.

Where double bottom is not accessible for inspection and maintenance, it shall be well protected against corrosion, by filling it with an efficient protective product in accordance with the manufacturer’s requirements.

2.2.2.3.2 Protection of cargo hold by ceiling

The cargo hold bottom shall, as a rule, be sheathed to the upper part of the bilge by wooden or metallic ceiling of thickness depending on the cargo nature.

Where a side ceiling is provided, it shall be secured to the side frames by an appropriate system, in general every 4 frame spacings.

The ceiling shall be so fitted as to allow its ready removal to enable access for inspection and maintenance of cargo hold structures.

2.2.2.4 Access arrangement

2.2.2.4.1 General

Convenient access to vessel compartments shall be provided, complying with the applicable requirements of the Rules, Part 2 – Hull and Hull Equipment, Chapter II, Section 4.

2.2.2.4.2 Access to double bottom

To enable access to all double bottom compartments, where required, inner bottom manholes shall be provided.

Watertight plate covers shall close the inner bottom manholes. Where no ceiling is fitted, covers shall be adequately protected from damage by the cargo.

Floors and side girders shall be provided with adequate number and disposition of manholes to enable access to all parts of double bottom.

The manholes shall be as small as possible to provide the convenient access and shall be well-rounded with smooth edges. The manholes shall not, in general, exceed 50% of local height of double bottom. If greater sizes of manholes are deemed necessary, an appropriate means of reinforcement may be required, covered by calculations and considered by the Register on a case by case basis (see also the Rules, Part 2 – Hull and Hull Equipment, Chapter II, 6.4).

Manholes in the floors shall be located at half the floor height and in a region extending on 0,2 - 0,4 from the centreline of the vessel, on each side. Where the central girders are provided, its distance to the nearest side of manhole shall not be less than the double bottom height. Manholes in the side girders shall be located at half the girders' height and midway between two successive web frames. Where side girders are fitted in extension of inner sides, the distance of the nearest side of manhole in the side girder to the to the transverse bulkheads of side compartments shall, in general, not be less than 1,5 m or two times the double bottom height, whichever is greater.

Centre girders or floors and side girders below pillars shall not be provided with manholes unless permitted by the Register on a case by case basis.

2.2.2.4.3 Access to cargo hold

As far as practicable, permanent or movable means of access stored on board shall be provided to ensure proper survey and maintenance of cargo holds.

2.2.3 Structural arrangement

2.2.3.1 General

Adequate continuity of structure shall be maintained throughout the length of the vessel. Where significant changes in structural arrangement or change from the longitudinal to transverse framing system occur, adequate transitional structure shall be provided.

Special attention shall be paid:

– at the connection of midship region with the fore part, the machinery space and/or the aft part and in way of ends of those structures;
– in way of ends of double bottom;
– in way of ends of superstructures;
– in way of ends and at the connections of ordinary stiffeners and primary supporting members.

The transition shall be made gradually, with adequate tapering and sufficient scarfing, in accordance with requirements from the Rules, Part 2 – Hull and Hull Equipment, Chapter II, Section 6.

In addition, general provisions given in the Rules, Part 2 – Hull and Hull Equipment, Chapter V, 1.5 shall be complied with, as applicable.

2.2.3.2 Bottom structure arrangement

2.2.3.2.1 General

General provisions given in the Rules, Part 2 – Hull and Hull Equipment, Chapter V, Section 2 shall be complied with, as applicable.

To ensure continuity of structure, at their ends, supporting members shall, as a rule, be connected by means of brackets.

As an alternative, if brackets are not suitable, single bottom supporting members may be connected to vertical primary supporting members of single side by means of bracketless end connections, in compliance with the Rules, Part 2 – Hull and Hull Equipment, Chapter II, 5.4.3.

Where brackets are fitted, their net scantlings shall not be less than the values obtained from the formulae given in the Rules, Part 2 – Hull and Hull Equipment, Chapter II, 5.4.2.

A curved bracket shall be considered as the largest bracket contained in the curved bracket as defined in the Rules, Part 2 – Hull and Hull Equipment, Chapter II, 5.4 and Figure 5.2.2-1.
2.2.3.2 Scantlings

The net thicknesses of bottom and inner bottom plating and the net scantlings of bottom and inner bottom supporting members shall comply with the Rules, Part 2 – Hull and Hull Equipment, Chapter V, 2.4 and 2.5 respectively.

2.2.3.2.3 Single bottom structure

1. Single bottom arrangement

General provisions given in the Rules, Part 2 – Hull and Hull Equipment, Chapter V, 2.6.2 and 2.6.3 shall be complied with, as applicable.

All single bottom vessels shall have a centre girder. The Register may waive this requirement for vessels with breadth measured on the top of floors less than 6 m, where the floor is a rolled section or where the floor stability is covered otherwise.

Depending on the vessel breadth measured on the top of floors/bottom transverses, side girders shall be fitted, complying with the above mentioned requirements. The bottom centre and side girders shall extend fore and aft as far as possible.

These girders shall be formed by intercostal web plates, fitted vertically, in alignment, and connected to the floors or bottom transverses and the bottom plating. Flanges of floors/bottom transverses and centre/side girders shall be joined with a butt weld.

2 Transversely framed single bottom

Transversely framed single bottom shall be fitted with floors at every frame.

3 Longitudinally framed single bottom

The spacing of bottom transverses shall not be greater than 8 frame spacings or 4.0 m, whichever is less.

Bottom longitudinals shall, in general, be continuous through the bottom transverses and transverse bulkheads.

In case the longitudinals are interrupted in way of a transverse, brackets on both sides of the transverse shall be fitted in alignment. The details of connection shall be considered by the Register on a case by case basis.

The section modulus of longitudinals located in way of the web frames of transverse bulkheads shall be increased by 20 %.

2.2.3.2.4 Double bottom structure

1. Double bottom arrangement

General provisions given in the Rules, Part 2 – Hull and Hull Equipment, Chapter V, 2.6.4 and 2.6.5 shall be complied with, as applicable.

Where the height of the double bottom varies, the variation shall, in general, be made gradually and over an adequate length, by means of inclined inner bottom plating, to ensure continuity of structure. The knuckles at the ends of the sloped part of inner bottom plating shall be located in way of solid floors or bottom girders.

Where this is not possible, suitable structures such as partial girders, brackets etc., fitted across the knuckle, shall be arranged.

In way of ends of inner bottom the transition shall be made gradually, with adequate tapering and sufficient scarfing. The stress concentration shall be reduced by the use of smoothly shaped brackets coplanar with the plane of inner bottom plating.

A centre girder shall be fitted on all vessels exceeding 6.0 m in breadth.

Depending on the vessel design and range of navigation, side girders shall be fitted, as applicable, complying with the requirements in the Rules, Part 2 – Hull and Hull Equipment, Chapter V, 2.6.4 and 2.6.5.

The bottom centre and side girders shall extend fore and aft as far as possible.

These girders shall be formed by intercostal web plates, fitted vertically, in alignment, and connected to the floors or bottom transverses and the bottom plating. Flanges of floors/bottom transverses and centre/side girders shall be joined with a butt weld.

2 Transversely framed double bottom

General provisions given in the Rules, Part 2 – Hull and Hull Equipment, Chapter V, 2.6.4 shall be complied with, as applicable.

Transversely framed double bottom shall be fitted with floors at every frame.

Watertight floors shall be fitted in way of transverse bulkheads, between the double bottom tanks and in way of double bottom steps. In general, watertight floors shall be continuous.

3 Longitudinally framed double bottom

General provisions given in the Rules, Part 2 – Hull and Hull Equipment, Chapter V, 2.6.5 shall be complied with, as applicable.

The spacing of double bottom transverses shall not be greater than 8 frame spacings or 4.0 m, whichever is less.

Additional transverses shall be fitted in way of transverse watertight bulkheads.

In general, transverses shall be continuous.

Bottom and inner bottom longitudinals shall, in general, be continuous through the transverses and transverse bulkheads.

In case the longitudinals are interrupted in way of a transverse or in case of stepped double bottom structure, brackets on both sides of the transverse shall be fitted in alignment. The details of connection shall be considered by the Register on a case by case basis.

Bottom longitudinals may be connected to the inner bottom longitudinals by means of struts having a cross sectional area not less than those of the connected longitudinals.

Where struts are fitted between bottom and inner bottom longitudinals in the area of mid-span of the longitudinals, the section modulus of bottom longitudinals and inner bottom longitudinals may be reduced by 25 %.

In general, intermediate brackets shall be fitted connecting the centre girder to the nearest bottom and inner bottom longitudinals.

2.2.3.3 Side structure arrangement

2.2.3.3.1 General

General provisions given in the Rules, Part 2 – Hull and Hull Equipment, Chapter V, Section 3 shall be complied with, as applicable.
To ensure continuity of structure, at their ends, supporting members shall, as a rule, be connected by means of brackets.

As an alternative, if brackets are not suitable, vertical primary supporting members of single side may be connected to single bottom and deck supporting members by means of bracketless end connections, in compliance with the Rules, Part 2 – Hull and Hull Equipment, Chapter II, 5.4.3. Where brackets are fitted, their net scantlings shall not be less than the values obtained from the formulae given in the Rules, Part 2 – Hull and Hull Equipment, Chapter II, 5.4.2.

A curved bracket shall be considered as the largest bracket contained in the curved bracket as defined in the Rules, Part 2 – Hull and Hull Equipment, Chapter II, 5.4.2 and Figure 5.2.2-1.

### 2.2.3.3.2 Scantlings

The net thicknesses of side plating and the net scantlings of side supporting members shall comply with the Rules, Part 2 – Hull and Hull Equipment, Chapter V, 3.4 and 3.5 respectively.

### 2.2.3.3.3 Transversely framed side

#### 1. Side frames

Transversely framed side shall be fitted with side frames at every frame.

General provisions given in the Rules, Part 2 – Hull and Hull Equipment, Chapter V, 3.6.2 shall be complied with.

The side frames shall be connected to the floors by means of brackets or bracketless end connections, in compliance with the Rules, Part 2 – Hull and Hull Equipment, Chapter V, Figure 3.6.2.1-1. In case of a longitudinally framed single bottom, side frames shall be connected to the outermost bottom longitudinal, either directly or by means of a bracket, in accordance with the Rules, Part 2 – Hull and Hull Equipment, Chapter V, Figure 3.6.2.1-2.

The side frames shall be connected to topside structure by means of brackets. Those brackets shall, as a rule, extend to the hatch coaming, in accordance with the Rules, Part 2 – Hull and Hull Equipment, Chapter V, Figure 4.1.1. As an alternative, in case of a longitudinally framed deck, if brackets extending to the hatch coaming are not suitable, the side frames shall be connected by means of brackets to deck longitudinal stiffeners most aside, in compliance with the Rules, Part 2 – Hull and Hull Equipment, Chapter V, Figure 3.6.2.1-4. In any case, the strength continuity of the open deck structure shall be ensured. The details of connection shall be considered by the Register on a case by case basis.

#### 2. Web frames

Web frames spacing shall, in general, be between 8 frame spacings or 4.0 m, whichever is less.

General provisions given in the Rules, Part 2 – Hull and Hull Equipment, Chapter V, 3.6.2 shall be complied with.

In case of a double bottom, at their lower end, web frames shall be connected to floors or bottom transverses by means of brackets.

In all other cases, web frames shall be connected to the floors/bottom transverses and the deck reinforced beams/deck transverses by means of brackets or, as alternative, by bracketless end connections, in compliance with the Rules, Part 2 – Hull and Hull Equipment, Chapter II, 5.4.3.

#### 2.2.3.4 Longitudinally framed side

##### 1. Side transverses

The side transverses spacing shall, in general, not be greater than 8 frame spacings or 4.0 m, whichever is less.

General provisions given in the Rules, Part 2 – Hull and Hull Equipment, Chapter V, 3.6.3 shall be complied with.

In case of a double bottom, at their lower end, the side transverses shall be connected to the bottom transverses by means of brackets.

In all other cases, side transverses shall be connected to the bottom transverses and the deck transverses or beams of reinforced scantlings by means of brackets or, as alternative, by bracketless end connections, in accordance with the Rules, Part 2 – Hull and Hull Equipment, Chapter II, 5.4.3.

##### 2. Side longitudinals

General provisions given in the Rules, Part 2 – Hull and Hull Equipment, Chapter V, 3.6.3 shall be complied with.

Side longitudinals shall, in general, be continuous through the transverses. In case the longitudinals are interrupted in way of a transverse, brackets on both sides of the transverse shall be fitted in alignment. The details of connection shall be considered by the Register on a case by case basis.

### 2.2.3.4 Topsides structure arrangement

#### 2.2.3.4.1 General

General provisions given the Rules, Part 2 – Hull and Hull Equipment, Chapter V, Section 4 shall be complied with, as applicable.

#### 2.2.3.4.2 Scantlings

The net thicknesses of deck plating and the net scantlings of deck supporting members shall, in general, comply the Rules, Part 2 – Hull and Hull Equipment, Chapter V, 4.4 and 4.5 respectively.

In addition, the net scantlings of topside structure in cargo hold area shall comply with the Rules, Part 2 – Hull and Hull Equipment, Chapter V, Table 4.5-2.

Continuity of deck structure shall be maintained throughout the length of the vessel, especially at the ends of the cargo hold space. All longitudinal members shall be continuous or adequately connected to adjacent structures by means of adequate transitional joints.

Hatch side girders and hatch end beams of reinforced scantlings shall be fitted in the hatchway area to ensure strength continuity of deck structure and hatch coaming boundaries.

As far as practicable, it is recommended to extend the part of the hatch coaming which is located above deck and to effectively connect it to the side bulkheads of the superstructures or deckhouses or other adjacent structures.
2.2.3.5 Cargo hold transverse bulkheads

2.2.3.5.1 General

The minimum number and disposition of transverse bulkheads are defined in the Rules, Part 2 – Hull and Hull Equipment, Chapter II, 3.1.1.

Additional bulkheads shall be fitted, if necessary, at steady intervals to provide sufficient transverse strength of the vessel, in accordance with the Rules, Part 2 – Hull and Hull Equipment, Chapter II, 3.1.2.

In cargo space of single hull open deck vessels, additional transverse bulkheads may be needed in order to ensure an efficient support to the topside structure.

As alternative, if ensuring the spacing of bulkheads at steady intervals is not possible, and the length of cargo space is unusually great, the transverse strength of the vessel shall be maintained by increased framing, fitting of transverse reinforced rings etc. Details shall be considered by the Register on a case by case basis.

2.2.3.5.2 Scantlings

The net thicknesses of bulkhead platting and the net scantlings of bulkhead supporting members shall comply with the Rules, Part 2 – Hull and Hull Equipment, Chapter V, 5.4 and 5.5 respectively.

2.2.3.5.3 Cargo hold plane bulkheads

.1 General

The upper end of the vertical of vertically framed bulkheads stiffeners shall be connected either to a strong deck beam (designed, in general, as rectangular hollow section) or to the bulkhead end stringer positioned at the stringer plate level or above.

The details of connection of upper part of horizontally framed bulkheads to adjacent structure shall be considered by the Register on a case by case basis.

General provisions given in the Rules, Part 2 – Hull and Hull Equipment, Chapter V, 5.6.4 shall be complied with.

.2 Plane bulkhead end stringer

The net scantlings of the plane bulkhead end stringer shall be obtained from the Rules, Part 2 – Hull and Hull Equipment, Chapter V, Table 5.5-1.

2.2.3.6 Transverse reinforced rings

.1 General

Transverse reinforced rings shall be fitted, where necessary, to provide additional supports of topside structure and to maintain the transverse strength of the vessel.

Transverse reinforced ring consists of the following supporting members: floor or bottom transverse, side web frame or side transverse and strong deck beam.

.2 Scantlings

The net scantlings of reinforced ring supporting members shall be obtained as follows:

- floors and bottom transverses, the Rules, Part 2 – Hull and Hull Equipment, Chapter V, Table 2.5-1.
- side web frames and side transverses, the Rules, Part 2 – Hull and Hull Equipment, Chapter V, Table 3.5-1.

2.2.3.7 Strengthening of cargo hold structures for grab loading/unloading

In the case of loading and unloading cargoes by means of grabs or buckets, the scantlings of structural elements within the cargo hold, where no continuous wooden ceiling is fitted, shall be increased according to the present Rules, Chapter III, 2.3.

2.3 Double hull cargo vessels

2.3.1 General

2.3.1.1 Application

.1 vessels complying with the requirements of 2.3 may be assigned the type notation Cargo vessel, as defined in in the Rules, Part 1 – Classification and Surveys, Chapter I, 3.5.4;

.2 vessels considered in 2.3 shall comply with the applicable requirements of the Rules, Part 1 – Classification and Surveys, Part 2 – Hull and Hull Equipment and Part 3 – Machinery, Systems and Electricity, as well as with the requirements of 2.3 which are specific to double hull cargo vessels.

2.3.1.2 Direct calculation

Direct calculation may be adopted for the yielding and buckling checks of hull structural members instead of the Rules scantling formulae as well as for the analysis of structural members not covered by the Rules or for type of loading not covered by the Rules (e.g. heavy concentrated loads, unevenly distributed loads etc.), in accordance with the Rules, Part 2 – Hull and Hull Equipment, Chapter V, 1.8.

The following strength checks shall be carried out, as applicable:

.1 level of normal stresses and shear stresses in way of transition of the double hull into the single hull;

.2 level of normal stresses and shear stresses in way of significant structural discontinuities: considerable changes in structural arrangement and scantlings or change from the longitudinal to transverse framing system;

.3 level of normal stresses and shear stresses of primary supporting members in way of holes and cut-outs for passage of ordinary stiffeners;

.4 level of normal stresses and shear stresses in welds in way of highly stressed areas;

.5 buckling strength of unstiffened webs or face plates of primary supporting members, corrugated bulkheads etc.

All calculation documents shall be submitted to the Register.

2.3.2 Vessel arrangement

2.3.2.1 General

The requirements of 2.3 apply to open deck vessels of double hull structure, intended primarily to carry uniform or dry bulk cargoes.

The loading/unloading may be performed in one or two runs.
2.3.2.2 Welding

.1 General
  Welding shall comply with the requirements of the Rules, Part 2 – Hull and Hull Equipment, Chapter VII, Section 1.

.2 Shell plating and double hull plating
  The longitudinal and transverse joints shall, as a rule, be butt welded.
  Joints of inner bottom plating may be welded in way of floor flange which then acts as a support.

.3 Topside plating
  The longitudinal and transverse joints of the topside plating shall, as a rule, be butt welded.

.4 Double bottom supporting members
  Where the double bottom height does not make it possible to connect floors and bottom girders to the inner bottom by fillet welding, slot welding may be used. In that case, the floors and girders shall be fitted with a flange (see also the Rules, Part 2 – Hull and Hull Equipment, Chapter V, 2.6.4).

2.3.2.3 Protection of hull compartments

2.3.2.3.1 Coating
  All metallic structures shall be protected against corrosion by suitable protection measures, in accordance with the Rules, Part 2 – Hull and Hull Equipment, Chapter VII, Section 2.
  Coatings shall be chosen and surfaces to be protected shall be prepared in accordance with the manufacturer’s requirements, taking care of the compartment considered and cargoes intended to be carried. Special attention shall be paid to the compatibility of the coating with the cargo.

  Where double bottom is not accessible for inspection and maintenance, it shall be well protected against corrosion, by filling it with an efficient protective product in accordance with the manufacturer’s requirements.

2.3.2.3.2 Protection of cargo hold by ceiling
  The cargo hold inner bottom, inner sides and bulkheads shall be sheathed, as necessary, by wooden or metallic ceiling of thickness depending on the cargo nature.
  The ceiling shall be so fitted as to permit its ready removal to enable access for and examination of the bottom, side, bulkheads, etc. structural members during inspection and maintenance of cargo hold structures.

2.3.2.4 Access arrangement

2.3.2.4.1 General
  Convenient access to vessel compartments shall be provided, complying with the applicable requirements of the Rules, Part 2 – Hull and Hull Equipment, Chapter II, Section 4.

2.3.2.4.2 Access to double bottom
  To enable access to all double bottom compartments, where required, inner bottom manholes shall be provided.
  Watertight plate covers shall close the inner bottom manholes. Where no ceiling is fitted, covers shall be adequately protected from damage by the cargo.

Floors and side girders shall be provided with adequate number and disposition of manholes to enable access to all parts of double bottom.

In order to avoid structural discontinuities and to maintain adequate structural strength, the manholes shall be as small as possible to provide the convenient access and shall be well-rounded with smooth edges. The manholes shall not, in general, exceed 50% of local height of double bottom. If greater sizes of manholes are deemed necessary, an appropriate means of reinforcement may be required, covered by calculations and considered by the Register on a case by case basis (see also the Rules, Part 2 – Hull and Hull Equipment, Chapter II, 6.4).

Manholes in the floors shall be located at half the floor height and in a region extending on 0.2·B from the centreline of the vessel, on each side. Where the central girder is provided, its distance to the nearest side of manhole shall not be less than the double bottom height. Manholes in the side girders shall be located at half the girder height and midway between two successive web frames. Where side girders are fitted in extension of inner sides, the distance of the nearest side of manhole in the side girder to the to the transverse bulkheads of side compartments shall, in general, not be less than 1.5 m or two times the double bottom height, whichever is greater.

Centre girder or floors and side girders below pillars shall not be provided with manholes unless permitted by the Register on a case by case basis.

2.3.2.4.3 Access to side compartments
  To enable access to all side compartments, manholes cut in the stringer plate shall, in general, be provided. These manholes shall be arranged clear of the hatch corners and shall be of even-deck design, without any obstacles above deck, strengthened by thick plates, by doubling plates or by other equivalent structure. The details of design shall be considered by the Register on a case by case basis.

Plate web frames, where fitted, shall, if needed, be provided with manholes to enable convenient access to all parts of double side. Manholes shall not, in general, exceed 50% of local width of double side. If greater sizes of manholes are deemed necessary, an appropriate means of reinforcement may be required, covered by calculations and considered by the Register on a case by case basis (see also the Rules, Part 2 – Hull and Hull Equipment, Chapter II, 6.4).

2.3.3 Structural arrangement

2.3.3.1 General
  Adequate continuity of structure shall be maintained throughout the length of the vessel. Where significant changes in structural arrangement or change from the longitudinal to transverse framing system occur, adequate transitional structure shall be provided.

  Special attention shall be paid:
  – at the connection of midship region with the fore part, the machinery space and/or the a! part and in way of ends of those structures;
  – in way of ends of double bottom and double sides;
  – in way of ends of superstructures;
Chapter I - TYPE NOTATIONS

in way of ends and at the connections of ordinary stiffeners and primary supporting members.

The transition shall be made gradually, with adequate tapering and sufficient scarfing, in accordance with requirements from the Rules, Part 2 — Hull and Hull Equipment, Chapter II, Section 6.

In addition, general provisions given in the Rules, Part 2 — Hull and Hull Equipment, Chapter V, 1.5 shall be complied with, as applicable.

Pushing transoms, if provided, shall be arranged in compliance with the Rules, Part 2 — Hull and Hull Equipment, Chapter VI, 8.2.4.

2.3.3.2 Bottom structure arrangement

2.3.3.2.1 General

General provisions given in the Rules, Part 2 — Hull and Hull Equipment, Chapter V, Section 2 shall be complied with, as applicable.

To ensure continuity of structure, at their ends, supporting members shall, as a rule, be connected by means of brackets.

Where brackets are fitted, their net scantlings shall not be less than the values obtained from the formulae given in the Rules, Part 2 — Hull and Hull Equipment, Chapter II, 5.4.2.

A curved bracket shall be considered as the largest bracket contained in the curved bracket as defined in the Rules, Part 2 — Hull and Hull Equipment, Chapter II, 5.4.2 and Figure 5.2.2-1.

2.3.3.2.2 Scantlings

The net thicknesses of bottom and inner bottom plating and the net scantlings of bottom and inner bottom supporting members shall comply with the Rules, Part 2 — Hull and Hull Equipment, Chapter V, 2.4 and 2.5 respectively.

2.3.3.2.3 Double bottom structure

1. General

General provisions given in the Rules, Part 2 — Hull and Hull Equipment, Chapter V, 2.6.4 shall be complied with, as applicable.

Where the height of the double bottom varies, the variation shall, in general, be made gradually and over an adequate length, by means of inclined inner bottom plating, to ensure continuity of structure. The knuckles at the ends of the sloped part of inner bottom plating shall be located in way of solid floors or bottom girders. Where this is not possible, suitable structures such as partial girders, brackets etc., fitted across the knuckle, shall be arranged.

In way of ends of inner bottom the transition shall be made gradually, with adequate tapering and sufficient scarfing. The stress concentration shall be reduced by the use of smoothly shaped brackets coplanar with the plane of inner bottom plating.

A centre girder shall be fitted on all vessels exceeding 6.0 m in breadth.

Depending on the vessel design and range of navigation, side girders shall be fitted, as applicable, in extension of the inner sides, complying with the requirements in the Rules, Part 2 — Hull and Hull Equipment, Chapter V, 2.6.4 and 2.6.5.

The bottom centre and side girders shall extend fore and aft as far as possible.

These girders shall be formed by intercostal web plates, fitted vertically, in alignment, and connected to the floors or bottom transverses and the bottom plating. Flanges of floors/bottom transverses and centre/side girders shall be joined with a butt weld.

Adequate strength continuity of floors and double bottom transverses in way of the side compartments shall be ensured by means of end brackets.

2. Transversely framed double bottom

General provisions given in the Rules, Part 2 — Hull and Hull Equipment, Chapter V, 2.6.4 shall be complied with, as applicable.

Transversely framed double bottom shall be fitted with floors at every frame.

Watertight floors shall be fitted in way of transverse bulkheads, between the double bottom tanks and in way of double bottom steps. In general, watertight floors shall be continuous.

Where fitted, side girders shall have a web net thickness equal to that of the inner side plating.

In addition, the floors of those vessels shall be supported at each frame, in way of the inner side plating, by means of a stiffener. Stiffeners shall, in general, be made as flat bars, having the net cross-sectional area, \( A \), height, \( h_{WS} \), and net thickness, \( t_{WS} \), not less than:

\[
A = 0.011 \cdot h_{WS} \cdot t_{WS} \quad \text{[cm}^2\text{]} \quad (2.3.3-1)
\]

\[
h_{WS} = 38.7 \cdot \sqrt{A} \quad \text{[mm]} \quad (2.3.3-2)
\]

\[
t_{WS} = \frac{h_{WS}}{15} \quad \text{[mm]} \quad (2.3.3-3)
\]

where:

\( h_{WS}, t_{WS} \) = floor web height and net thickness, respectively, [mm].

3. Longitudinally framed double bottom

General provisions given in the Rules, Part 2 — Hull and Hull Equipment, Chapter V, 2.6.5 shall be complied with, as applicable.

The spacing of double bottom transverses shall not be greater than 8 frame spacings or 4.0 m, whichever is less.

Additional transverses shall be fitted in way of transverse watertight bulkheads.

In general, transverses shall be continuous.

Bottom and inner bottom longitudinals shall, in general, be continuous through the transverses and transverse bulkheads.

In case the longitudinals are interrupted in way of a transverse or in case of stepped double bottom structure, brackets on both sides of the transverse shall be fitted in alignment. The details of connection shall be considered by the Register on a case by case basis.

Bottom longitudinals may be connected to the inner bottom longitudinals by means of struts having a cross

Rules for the Classification of Inland Navigation Vessels

June 2018
sectional area not less than those of the connected longitudinals.  
Where struts are fitted between bottom and inner bottom longitudinals in the area of mid-span of the longitudinals, 
the section modulus of bottom longitudinals and inner bottom longitudinals may be reduced by 25%.

In general, intermediate brackets shall be fitted 
connecting the centre girder to the nearest bottom and 
inner bottom ordinary stiffeners.

2.3.3.3 Side structure arrangement

2.3.3.3.1 General

General provisions given the Rules, Part 2 – Hull and Hull Equipment, Chapter V, Section 3 shall be complied with, as applicable.

Where the width of the double side varies, the variation shall, in general, be gradual and over an adequate length, to ensure continuity of structure. The knuckles of inner side plating shall be located in way of plate web frames or transverse bulkheads.

In way of ends of inner sides the transition shall be made gradually, with adequate tapering and sufficient scarfing. The stress concentration shall be reduced by the use of smoothly shaped brackets coplanar with the plane of inner side plating. In general, the double sides shall be extended by means of brackets outside the cargo hold space over a distance not less than twice the stringer plate width.

Double side structures may be additionally supported by plate web frames. Plate web frames shall be fitted with horizontal stiffeners, with the spacing not greater than 1,0 m.

To ensure continuity of structure, at their ends, supporting members shall, as a rule, be connected by means of brackets. Special attention shall be paid to ensure continuity of structure where the inner sides at their lower end do not extend down to the bottom plating (see also provisions in 2.3.3.2.3 concerning bottom side girders in a way of inner sides).

Where brackets are fitted, their net scantlings shall not be less than the values obtained from the formulae given in the Rules, Part 2 – Hull and Hull Equipment, Chapter II, 5.4.2.

A curved bracket shall be considered as the largest bracket contained in the curved bracket as defined in the Rules, Part 2 – Hull and Hull Equipment, Chapter II, 5.4.2 and Figure 5.2.2.1.

2.3.3.3.2 Scantlings

The net thicknesses of side and inner side plating and the net scantlings of side and inner side supporting members shall comply with the Rules, Part 2 – Hull and Hull Equipment, Chapter V, 3.4 and 3.5 respectively.

2.3.3.3.3 Transversely framed double side

.1 General

General provisions given in the Rules, Part 2 – Hull and Hull Equipment, Chapter V, 3.6.4 shall be complied with, as applicable.

.2 Side and inner side frames

Transversely framed side structure shall be fitted with side and inner side frames at every frame.

General provisions given in the Rules, Part 2 – Hull and Hull Equipment, Chapter V, 3.6.4 shall be complied with.

Side frames may be connected to the inner side frames by means of struts, having a cross sectional area not less than those of the connected frames.

Where struts are fitted between side and inner side frames in the area of mid-span of the frames, the section modulus of side frames and inner side frames may be reduced by 25%.

At their ends, side frames and inner side frames shall be adequately connected by means of brackets to deck and bottom supporting members.

Side frames and inner side frames may be connected directly to each other by means of brackets, in which case those brackets may be a section or a plate, possibly flanged, with a section modulus at least equal to that of the web frames.

3 Side and inner side web frames

Web frames spacing shall, in general, not be greater than 8 frame spacings, or 4,0 m, whichever is less.

General provisions given in the Rules, Part 2 – Hull and Hull Equipment, Chapter V, 3.6.4 shall be complied with.

At mid-span, the web frames shall be connected by means of struts having a cross sectional area not less than those of the connected web frames.

At the lower and upper end, double side structure in a way of the web frames shall be connected to the bottom and deck structure by means of brackets fitted in alignment with the floors/bottom transverses and the deck reinforced beams/deck transverses, respectively.

2.3.3.4 Longitudinally framed double side

The requirements in 2.3.3.3.1 and 2.3.3.3.3 apply also to longitudinally framed double sides, with transverses instead of web frames.

Side and inner side longitudinals shall, in general, be continuous through the transverses and transverse bulkheads.

In case the longitudinals are interrupted in way of a transverse or in a case of stepped double side structure, brackets on both sides of the transverse shall be fitted in alignment. The details of connection shall be considered by the Register on a case by case basis.

Side longitudinals may be connected to the inner side longitudinals by means of struts having a cross sectional area not less than those of the connected longitudinals. Where struts are fitted between side and inner side longitudinals in the area of mid-span of the longitudinals, the section modulus of side and inner side longitudinals may be reduced by 25%.

2.3.4 Topside structure arrangement

2.3.4.1 General

General provisions given in the Rules, Part 2 – Hull and Hull Equipment, Chapter V, Section 4 shall be complied with, as applicable.

2.3.4.2 Scantlings

The net thicknesses of deck plating and the net scantlings of deck supporting members shall, in general, comply with the Rules, Part 2 – Hull and Hull Equipment, Chapter V, 4.4 and 4.5 respectively.
Chapter I - TYPE NOTATIONS

In addition, the net scantlings of topside structure in cargo hold area shall comply with the Rules, Part 2 – Hull and Hull Equipment, Chapter V, Table 4.5-2.

Continuity of deck structure shall be maintained throughout the length of the vessel, especially at the ends of the cargo hold space. All longitudinal members shall be continuous or adequately connected to adjacent structures by means of adequate transitional joints.

Hatch supporting members of reinforced scantlings shall be fitted in the hatchway area to ensure strength continuity of deck structure and hatch coaming boundaries.

As far as practicable, it is recommended to extend the part of the hatch coaming which is located above deck and to effectively connect it to the side bulkheads of the superstructures or deckhouses or other adjacent structures.

2.3.3.5 Cargo hold transverse bulkhead

2.3.3.5.1 General

The minimum number and disposition of transverse bulkheads are defined in the Rules, Part 2 – Hull and Hull Equipment, Chapter II, 3.1.1.

Where the length of cargo spaces is unusually great, additional bulkheads shall be fitted, if necessary, to provide sufficient transverse strength of the vessel, in accordance with the Rules, Part 2 – Hull and Hull Equipment, Chapter II, 3.1.2.

2.3.3.5.2 Scantlings

The net thicknesses of bulkhead plating and the net scantlings of bulkhead supporting members shall comply with the Rules, Part 2 – Hull and Hull Equipment, Chapter V, 5.4 and 5.5 respectively.

2.3.3.5.3 Cargo hold plane bulkheads

.1 General

The upper end of the vertical of vertically framed bulkhead stiffeners shall be connected either to a strong deck beam (designed, in general, as rectangular hollow section) or to the bulkhead end stringer positioned at the stringer plate level or above.

The details of connection of upper part of horizontally framed bulkheads to adjacent structure shall be considered by the Register on a case by case basis.

General provisions given in the Rules, Part 2 – Hull and Hull Equipment, Chapter V, 5.6.4 shall be complied with.

.2 Plane bulkhead end stringer

The net scantlings of the plane bulkhead end stringer shall be obtained from the Rules, Part 2 – Hull and Hull Equipment, Chapter V, Table 5.5-1.

2.3.3.6 Strengthening of cargo hold structures for grab loading/unloading

In case of loading and unloading cargoes by means of grabs or buckets, the scantlings of structural elements within the cargo hold, where no continuous wooden ceiling is fitted, shall be increased according to the present Rules, Chapter III, 2.3.

3 TANKERS

3.1 General

3.1.1 Application

3.1.1.1 Vessels complying with the requirements of this Section may be assigned the type notation Tanker, as defined in the Rules, Part 1 – Classification and Surveys, Chapter I, 3.5.4.

3.1.1.2 Vessels considered in this Section shall comply with the applicable requirements of the Rules, Part 1 – Classification and Surveys, Part 2 – Hull and Hull Equipment and Part 3 – Machinery, Systems and Electricity, as well as with the requirements of this Section which are specific to tankers.

3.1.2 Design loads

The loads shall be calculated independently for each vessel’s condition (as given in the Rules, Part 2 – Hull and Hull Equipment, Chapter III, 2.3), by applying the associated loading conditions (as defined in the Rules, Part 2 – Hull and Hull Equipment, Chapter III, 2.2), to determine the most severe loading of the structural members analysed.

Where loading conditions other than standard design loading conditions are also expected, calculations for such conditions shall be submitted in addition to the standard conditions.

Structural members of compartments subjected to testing conditions, shall be checked for testing loads, calculated according to the Rules, Part 2 – Hull and Hull Equipment, Chapter III, 5.8.

Structural members of watertight boundaries of compartments not intended to carry liquids, shall be checked for flooding loads, calculated according to the Rules, Part 2 – Hull and Hull Equipment, Chapter III, 4.4.

3.1.3 Direct calculation

3.1.3.1 General

Direct calculation may be adopted for the yielding and buckling checks of hull structural members instead of the Rules scantling formulae as well as for the analysis of structural members not covered by the Rules (e.g. heavy concentrated loads, unevenly distributed loads etc.), in accordance with the Rules, Part 2 – Hull and Hull Equipment, Chapter V, 1.8.

The following strength checks shall be carried out, as applicable:

.1 level of normal stresses and shear stresses in way of transition of the double hull into the single hull;

.2 level of normal stresses and shear stresses in way of significant structural discontinuities; considerable changes in structural arrangement and scantlings or change from the longitudinal to transverse framing system;

.3 level of normal stresses and shear stresses of primary supporting members in way of holes and cut-outs for passage of ordinary stiffeners;

.4 level of normal stresses and shear stresses in way of seatings of independent cargo tanks;
3.2 Vessel arrangement

3.2.1 General

The requirements of this Section apply to tankers with single or double hull structure, intended primarily to carry liquid cargoes.

The loading/unloading shall, as a rule, be performed in two runs, unless otherwise specified.

3.2.2 Expansion tanks

3.2.2.1 General

In the area of mid-length, each tank shall be provided with an expansion tank whose height above tank top shall not be less than 0,5 m.

3.2.2.2 Scantlings

The arrangement and scantlings of expansion tank structure shall be considered by the Register on a case by case basis.

3.2.3 Welding

.1 General

Welding shall comply with the requirements of the Rules, Part 2 – Hull and Hull Equipment, Chapter VII, Section 1.

On tankers for oil or chemical cargoes, doubling plates are not permitted within the cargo tank area, i.e. from the aftermost to the foremost cofferdam bulkhead.

.2 Shell plating and inner bottom plating

The longitudinal and transverse joints shall be butt welded.

On tankers for oil or chemical cargoes, welding of joints of inner bottom plating in way of floor flange (which acts as a support) is not permitted within the cargo tank area.

.3 Topside plating

The longitudinal and transverse joints of the topside plating shall be butt welded.

.4 Double bottom supporting members

In the case of a double bottom, where its height does not make it possible to connect floors and bottom girders to the inner bottom by fillet welding, slot welding may be used. In that case, the floors and girders shall be fitted with a flange (see also the Rules, Part 2 – Hull and Hull Equipment, Chapter V, 2.6.4).

On tankers for oil or chemical cargoes, such arrangements are not permitted to be fitted within the cargo tank area.

3.2.4 Protection of hull compartments

All metallic structures shall be protected against corrosion by suitable protection measures, in accordance with the Rules, Part 2 – Hull and Hull Equipment, Chapter VII, Section 2.

Coatings shall be chosen and surfaces to be protected shall be prepared in accordance with the manufacturer’s requirements, taking care of the compartment considered and cargoes intended to be carried. Special attention shall be paid to the compatibility of the coating with the cargo.
3.2.5 Access arrangement

3.2.5.1 General

Convenient access to vessel compartments shall be provided, complying with the applicable requirements of the Rules, Part 2 – Hull and Hull Equipment, Chapter II, Section 4. All compartments in the cargo zone shall, as a rule, be well ventilated and accessible for inspection and maintenance.

3.2.5.2 Access to double bottom

To enable access to all parts of double bottom, adequate number and disposition of manholes shall be provided.

The manholes shall be as small as possible to provide the convenient access and shall be well-rounded with smooth edges. The manholes shall not, in general, exceed 50% of local height of double bottom. If greater sizes of manholes are deemed necessary, an appropriate means of reinforcement may be required, covered by calculations and considered by the Register on a case by case basis (see also the Rules, Part 2 – Hull and Hull Equipment, Chapter II, 6.4).

Manholes in the floors shall be located at half the floor height and in a region extending on 0.2 of the distance of the centreline of the vessel, on each side. Where the central girder is provided, its distance to the nearest side of manhole shall not be less than the double bottom height. Manholes in the side girders shall be located at half the girder height and midway between two successive web frames. Where side girders are fitted in extension of inner sides, the distance of the nearest side of manhole in the side girder to the to the transverse bulkheads of side compartments shall, in general, not be less than 1.5 m or two times the double bottom height, whichever is greater.

Centre girder or floors and side girders below pillars shall not be provided with manholes unless permitted by the Register on a case by case basis.

3.2.5.3 Access to side compartments

To enable access to all side compartments, manholes cut in the stringer plate shall, in general, be provided. These manholes shall be arranged clear of the hatch corners and shall be of even-deck design, without any obstacles above deck, strengthened by thick plates, by doubling plates or by other equivalent structure. The details of design shall be considered by the Register on a case by case basis.

Plate web frames, where fitted, shall, if needed, be provided with manholes to enable convenient access to all parts of double side. Manholes shall not, in general, exceed 50% of local width of double side. If greater sizes of manholes are deemed necessary, an appropriate means of reinforcement may be required, covered by calculations and considered by the Register on a case by case basis (see also the Rules, Part 2 – Hull and Hull Equipment, Chapter II, 6.4).

3.2.5.4 Access to cargo tanks

Tanks up to 35.0 m in length shall have at least one access hatchway and ladder whereas tanks having lengths 35.0 m and above shall have minimum of two access hatchways and ladders. In the latter case, the hatchways and ladders shall be positioned as far apart longitudinally from each other as practicable.

Access hatchways shall have dimensions sufficient to allow a person wearing a self-contained breathing apparatus to ascend or descend the ladder without obstruction as well as to provide a clear opening to facilitate the hoisting of an injured person from the bottom of the tank.

In any case the clear opening shall not be less than 0.36 m² and its length not less than 0.50 m.

3.2.6 Bilge system

The inside diameters of the main line and branch line of bilge piping, dw and db, respectively, shall not be taken less than 50.0 mm or than the values derived from the following formulae:

\[ d_w = 3 \cdot \sqrt{B + D} \cdot l_{CS} + 35 \text{ mm} \]  
\[ d_b = 2 \cdot \sqrt{B + D} \cdot l_{WC} + 25 \text{ mm} \]

where:

- \( l_{CS} \) = total length of cargo space, including cofferdams, [m];
- \( l_{WC} \) = length of the watertight compartment considered, [m].

3.3 Structural arrangement

3.3.1 General design

3.3.1.1 In single hull vessels with integrated cargo tanks, the bottom, the sides and the deck form the boundaries of cargo tanks, as shown in Figure 3.3-1.

3.3.1.2 In double hull vessels with integrated cargo tanks, the inner bottom, inner sides and the deck form the boundaries of cargo tanks, as shown in Figure 3.3-2. Those boundaries are integral part of the vessel's structure, contributing to the hull girder longitudinal strength, the transverse strength and the local strength of vessel.

Depending on cargoes to be carried, minimum distances between tank boundaries and the bottom or side plating shall be determined. Convenient access to double bottom and double side compartments shall, in general, be provided, in accordance with 3.2.5.2 and 3.2.5.3, respectively. The minimum width of side tanks, measured at right angles to the side shell, shall not be less than 600.0 mm.

3.3.1.3 In vessels with independent cargo tanks, those tanks are permanently installed but are independent of the vessel's structure and not forming an integral part of the hull (see Figure 3.3-3).
3.3.2 General provisions

Adequate continuity of structure shall be maintained throughout the length of the vessel. Where significant changes in structural arrangement or change from the longitudinal to transverse framing system occur, adequate transitional structure shall be provided.

Special attention shall be paid:

- at the connection of midship region with the fore part, the machinery space and/or the aft part and at the ends of those structures;
- in way of ends of double bottom and double sides;
- in way of ends of superstructures;
- in way of ends and at the connections of ordinary stiffeners and primary supporting members.

The transition shall be made gradually, with adequate tapering and sufficient scarfing, in accordance with requirements from the Rules, Part 2 – Hull and Hull Equipment, Chapter II, Section 6.

General provisions given in the Rules, Part 2 – Hull and Hull Equipment, Chapter V, 1.5 shall also be complied with, as applicable.

In addition, the inner side shall be extended inside the cofferdam. Where possible, it shall be additionally extended by means of brackets or adequate transitional structure beyond the cofferdam, in the fore part and aft part or machinery space of the vessel.

3.3.3 Vessels with integrated cargo tanks

The net thicknesses of plating and the net scantlings of supporting members shall comply with the applicable requirements of the Rules, Part 2 – Hull and Hull Equipment, Chapter V – Hull Scantlings.

The net thickness, in [mm], of plating and supporting members in cargo area, in compartments intended to carry liquids, including cofferdams, shall not be less than 4.5 mm.

3.3.3.1 Bottom structure arrangement

3.3.3.1.1 General

General provisions given in the Rules, Part 2 – Hull and Hull Equipment, Chapter V, Section 2 shall be complied with, as applicable.

To ensure continuity of structure, at their ends, supporting members shall, as a rule, be connected by means of brackets.

As an alternative, if brackets are not suitable, single bottom supporting members may be connected to vertical primary supporting members of single side by means of bracketless end connections, in compliance with the Rules, Part 2 – Hull and Hull Equipment, Chapter II, 5.4.3.

Where brackets are fitted, their net scantlings shall not be less than the values obtained from the formulae given in the Rules, Part 2 – Hull and Hull Equipment, Chapter II, 5.4.2.

A curved bracket shall be considered as the largest bracket contained in the curved bracket as defined in the Rules, Part 2 – Hull and Hull Equipment, Chapter II, 5.4.2 and Figure 5.2.2-1.

3.3.3.1.2 Scantlings

The net thicknesses of bottom and inner bottom plating and the net scantlings of bottom and inner bottom supporting members shall comply with the Rules, Part 2 – Hull and Hull Equipment, Chapter V, 2.4 and 2.5 respectively.
Chapter I - TYPE NOTATIONS

3.3.3.1.3 Single bottom structure

1 Single bottom arrangement

General provisions given in the Rules, Part 2 – Hull and Hull Equipment, Chapter V, 2.6.2 and 2.6.3 shall be complied with, as applicable.

All single bottom vessels shall have a centre girder. The Register may waive this requirement for vessels with breadth measured on the top of floors less than 6.0 m, where the floor is a rolled section or where the floor stability is covered otherwise.

Depending on the vessel breadth measured on the top of floors/bottom transverses, side girders shall be fitted, complying with the above mentioned requirements.

The bottom centre and side girders shall extend fore and aft as far as possible.

As a rule, those girders shall be formed by intercostal web plates, fitted vertically, in alignment, and connected to the floors or bottom transverses and the bottom plating. Flanges of floors/bottom transverses and centre/side girders shall be joined with a butt weld.

2 Transversely framed single bottom

Transversely framed single bottom shall be fitted with floors at every frame. Floors shall not be continuous in way of longitudinal bulkheads, but interrupted and connected to both sides of the bulkhead by means of brackets fitted in alignment. Equivalent arrangements of end connection ensuring adequate strength continuity shall be considered by the Register on a case by case basis.

Provisions shall be made for adequate draining of liquid cargo. A sufficient number of limbers shall be cut out in floors/bottom transverses, girders and longitudinals to ensure a free passage of liquid cargo from all parts of the bottom to the pump suction.

3 Longitudinally framed single bottom

The spacing of bottom transverses shall not be greater than 6 frame spacings or 3.0 m, whichever is less.

Bottom longitudinals shall, in general, be continuous through the bottom transverses and transverse bulkheads. In case the longitudinals are interrupted in way of a transverse, brackets on both sides of the transverse shall be fitted in alignment. The details of connection shall be considered by the Register on a case by case basis.

The section modulus of longitudinals located in way of the web frames of transverse bulkheads shall be increased by 20 %.

3.3.3.1.4 Double bottom structure

1 Double bottom arrangement

General provisions given in the Rules, Part 2 – Hull and Hull Equipment, Chapter V, 2.6.4 shall be complied with, as applicable.

Where the height of the double bottom varies, the variation shall, in general, be made gradually and over an adequate length, by means of inclined inner bottom plating, to ensure continuity of structure. The knuckles at the ends of the sloped part of inner bottom plating shall be located in way of solid floors or bottom girders. Where this is not possible, suitable structures such as partial girders, brackets etc., fitted across the knuckle, shall be arranged.

In way of ends of inner bottom the transition shall be made gradually, with adequate tapering and sufficient scarfing. The stress concentration shall be reduced by the use of smoothly shaped brackets coplanar with the plane of inner bottom plating.

A centre girder shall be fitted on all vessels exceeding 6.0 m in breadth.

Depending on the vessel design and range of navigation, side girders shall be fitted, as applicable, complying with the requirements in the Rules, Part 2 – Hull and Hull Equipment, Chapter V, 2.6.4 and 2.6.5.

The bottom centre and side girders shall extend fore and aft as far as possible.

Those girders shall be formed by intercostal web plates, fitted vertically, in alignment, and connected to the floors or bottom transverses and the bottom plating. Flanges of floors/bottom transverses and centre/side girders shall be joined with a butt weld.

2 Transversely framed double bottom

Transversely framed double bottom shall be fitted with floors at every frame.

Watertight floors shall be fitted in way of transverse bulkheads, between the double bottom tanks and in way of double bottom steps. In general, watertight floors shall be continuous.

On vessels assigned with ranges of navigation less than IWW-1.2, where the inner sides, at their lower end, do not extend down to the bottom plating, partial intercostal side girders shall be fitted in extension of inner sides, in way of transverse bulkheads of side compartments, extending between the adjacent floors. These girders shall be extended at each end by brackets having length equal to one frame spacing. Side girders shall have a web net thickness equal to that of the inner side plating.

In addition, the floors of those vessels shall be supported at each frame, in way of the inner side plating, by means of a stiffener. Stiffeners shall, in general, be made as flat bars, having the net cross-sectional area $A$, height $h_{WS}$, and net thickness $t_{WS}$, not less than:

$$A = 0.011 \cdot h_{WS} \cdot t_{WS}, \quad [cm^2]$$  \hspace{1cm} (3.3.3-1)

$$h_{WS} = 38.7 \cdot \sqrt[3]{A}, \quad [mm]$$  \hspace{1cm} (3.3.3-2)

$$t_{WS} = \frac{h_{WS}}{15}, \quad [mm]$$  \hspace{1cm} (3.3.3-3)

where:

$h_{WS}, t_{WS} =$ floor web height and net thickness, respectively, [mm].

3 Longitudinally framed double bottom

General provisions given in the Rules, Part 2 – Hull and Hull Equipment, Chapter V, 2.6.5 shall be complied with, as applicable.
The spacing of double bottom transverses shall not be greater than 6 frame spacings or 3,0 m, whichever is less. Additional transverses shall be fitted in way of transverse watertight bulkheads.

In general, transverses shall be continuous. Bottom and inner bottom longitudinals shall, in general, be continuous through the transverses and transverse bulkheads.

In case the longitudinals are interrupted in way of a transverse or in case of stepped double bottom structure, brackets on both sides of the transverse shall be fitted in alignment. The details of connection shall be considered by the Register on a case by case basis.

Bottom longitudinals may be connected to the inner bottom longitudinals by means of struts having a cross sectional area not less than those of the connected longitudinals.

Where struts are fitted between bottom and inner bottom longitudinals in the area of mid-span of the longitudinals, the section modulus of bottom longitudinals and inner bottom longitudinals may be reduced by 25 %.

In general, intermediate brackets shall be fitted connecting the centre girder to the nearest bottom and inner bottom longitudinals.

3.3.3.2 Side structure arrangement

3.3.3.2.1 General

General provisions given in the Rules, Part 2 – Hull and Hull Equipment, Chapter V, Section 3 shall be complied with, as applicable.

To ensure continuity of structure, at their ends, supporting members shall, as a rule, be connected by means of brackets.

As an alternative, if brackets are not suitable, vertical primary supporting members of single side may be connected to single bottom and deck supporting members by means of bracketless end connections, in compliance the Rules, Part 2 – Hull and Hull Equipment, Chapter II, 5.4.3.

Where brackets are fitted, their net scantlings shall not be less than the values obtained from the formula given in the Rules, Part 2 – Hull and Hull Equipment, Chapter II, 5.4.2.

A curved bracket shall be considered as the largest bracket contained in the curved bracket as defined in the Rules, Part 2 – Hull and Hull Equipment, Chapter II, 5.4.2 and Figure 5.2.2-1.

3.3.3.2.2 Scantlings

The net thicknesses of side plating and the net scantlings of side supporting members shall comply with the Rules, Part 2 – Hull and Hull Equipment, Chapter V, 3.4 and 3.5 respectively.

3.3.3.2.3 Transversely framed side

1 Side frames

Transversely framed side shall be fitted with side frames at every frame.

General provisions given in the Rules, Part 2 – Hull and Hull Equipment, Chapter V, 3.6.2 shall be complied with.

The side frames shall, in general, be supported by a stringer in the area of mid-span of the frame.

The side frames shall be connected to the floors by means of brackets or bracketless end connections, in compliance with the Rules, Part 2 – Hull and Hull Equipment, Chapter V, Figure 3.6.2.1-1.

In case of a longitudinally framed single bottom, side frames shall be connected to the outermost bottom longitudinal, either directly or by means of a bracket, in accordance with the Rules, Part 2 – Hull and Hull Equipment, Chapter V, Figure 3.6.2.1-2.

In the case of transversely framed deck, at the upper end of frames, connecting brackets shall be provided. Those brackets shall, in general, be connected to the deck beam, in accordance with the Rules, Part 2 – Hull and Hull Equipment, Chapter V, Figure 3.6.2.1-3.

In case of a longitudinally framed deck, at the upper end of frames, connecting brackets shall, in general, extend up to the deck longitudinal stiffener most aside, in accordance with the Rules, Part 2 – Hull and Hull Equipment, Chapter V, Figure 3.6.2.1-4.

2 Web frames

Web frames spacing shall, in general, not be greater than 6 frame spacings or 3,0 m, whichever is less.

General provisions given in the Rules, Part 2 – Hull and Hull Equipment, Chapter V, 3.6.2 shall be complied with.

In case of a double bottom, at their lower end, web frames shall be connected to floors or bottom transverses by means of brackets.

In all other cases, web frames shall be connected to the floors/bottom transverses and the deck reinforced beams/deck transverses by means of brackets or, as alternative, by bracketless end connections, in accordance with the Rules, Part 2 – Hull and Hull Equipment, Chapter II, 5.4.3.

3.3.3.2.4 Longitudinally framed side

1 Side transverses

The side transverses spacing shall, in general, not be greater than 6 frame spacings or 3,0 m, whichever is less.

General provisions given in the Rules, Part 2 – Hull and Hull Equipment, Chapter V, 3.6.3 shall be complied with.

In case of a double bottom, at their lower end, the side transverses shall be connected to the bottom transverses by means of brackets.

In all other cases, side transverses shall be connected to the bottom transverses and the deck transverses or beams of reinforced scantlings by means of brackets or, as alternative, by bracketless end connections, in accordance with the Rules, Part 2 – Hull and Hull Equipment, Chapter II, 5.4.3.

2 Side longitudinals

General provisions given in the Rules, Part 2 – Hull and Hull Equipment, Chapter V, 3.6.3 shall be complied with. Side longitudinals shall, in general, be continuous through the transverses. In case the longitudinals are interrupted in way of a transverse, brackets on both sides of the transverse shall be fitted in alignment. The details of connection shall be considered by the Register on a case by case basis.
3.3.3.3 Deck structure arrangement

3.3.3.3.1 General

General provisions given in the Rules, Part 2 – Hull and Hull Equipment, Chapter V, Section 4 shall be complied with, as applicable.

Continuity of deck structure shall be maintained throughout the length of the vessel, especially where significant changes in structural arrangement occur. All longitudinal members shall be continuous or adequately connected to adjacent structures by means of adequate transitional joints.

Decks may be supported by bulkheads, partial bulkheads, pillars or strong deck beams of transverse reinforced rings.

To ensure strength continuity, strong deck beams, forming the transverse reinforced rings, shall have, as a rule, the scantlings not less than those of side web frames to which they are connected by means of brackets or other adequate transitional structure.

3.3.3.3.2 Scantlings

The net thicknesses of deck plating and the net scantlings of deck supporting members shall, in general, comply with the Rules, Part 2 – Hull and Hull Equipment, Chapter V, 4.4 and 4.5 respectively.

3.3.3.3.3 Transversely framed deck

General provisions given in the Rules, Part 2 – Hull and Hull Equipment, Chapter V, 4.6.2 shall be complied with, as applicable.

Transversely framed deck shall be fitted with deck beams at every frame.

Beams shall not be continuous in way of longitudinal bulkheads, but interrupted and connected to both sides of the bulkhead by means of brackets fitted in alignment. Equivalent arrangements of end connection ensuring adequate strength continuity shall be considered by the Register on a case by case basis.

Deck beams shall be continuous in way of expansion tanks. Otherwise, the details of connection shall be considered by the Register on a case by case basis, provided it is equally effective.

3.3.3.3.4 Longitudinally framed deck

General provisions given in the Rules, Part 2 – Hull and Hull Equipment, Chapter V, 4.6.3 shall be complied with, as applicable.

Deck transverses shall, as a rule, be fitted in way of bottom transverses.

The deck longitudinals shall be continuous in way of expansion tanks. Otherwise, the details of connection shall be considered by the Register on a case by case basis, provided it is equally effective.

3.3.3.3.5 Pillars

.1 General

Pillars or other adequate supporting structures shall, in general, be provided in way of transverse reinforced rings, in way of brakes in deck, under heavy concentrated loads etc.

General provisions given in the Rules, Part 2 – Hull and Hull Equipment, Chapter V, 4.6.4 shall be complied with, as applicable.

Hollow pillars shall, in general, be avoided in cargo tanks. In no case hollow pillars are permitted in tanks for flammable liquids or chemicals.

Pillars shall be attached at their heads and heels by continuous welding.

Pillars subjected to compressive loads may be fitted by welds only, in case the net thickness of the attached plating forming connecting structure is at least equal to the net thickness of the pillar.

Heads and heels of pillars which may also be subjected to tension loads (such as those in tanks) shall be attached to the surrounding structure by means of brackets or insert plates so that the loads are well distributed.

Pillars shall be connected to the bottom/inner bottom structure at the intersection of floors and girders. Where pillars are not located at intersections of floors and girders, partial floors or girders or equivalent structures suitable to support the pillars shall be arranged.

Lightening holes and manholes shall be avoided in the girders and floors in way of the heads and heels of pillars.

.2 Scantlings

The net scantlings of pillars shall comply with the Rules, Part 2 – Hull and Hull Equipment, Chapter V, 4.6.4, where design lateral loads of deck structure located above the pillar considered, shall be calculated according to the Rules, Part 2 – Hull and Hull Equipment, Chapter V, Table 4.3-1.

Pillars in tanks shall be checked for tension, applying the required testing load in compliance with the Rules, Part 2 – Hull and Hull Equipment, Chapter III, 5.8.1.

3.3.3.4 Cargo tank bulkheads

3.3.3.4.1 General

The minimum number and disposition of transverse bulkheads are defined in the Rules, Part 2 – Hull and Hull Equipment, Chapter II, 3.1.1.

Additional bulkheads shall be fitted, if necessary, at steady intervals to provide sufficient transverse strength of the vessel, in accordance with the Rules, Part 2 – Hull and Hull Equipment, Chapter II, 3.1.2.

As alternative, if ensuring the spacing of bulkheads at steady intervals is not possible, and the length of cargo tank is unusually great, the transverse strength of the vessel shall be maintained by increased framing, fitting of transverse reinforced rings etc. Details shall be considered by the Register on a case by case basis.

Non-tight bulkheads shall comply with the general provisions given in the Rules, Part 2 – Hull and Hull Equipment, Chapter V, 5.6.5.

Wash bulkheads shall comply with the general provisions given in the Rules, Part 2 – Hull and Hull Equipment, Chapter V, 5.6.6.

Bulkheads acting as pillars shall be designed according to provisions given in the Rules, Part 2 – Hull and Hull Equipment, Chapter V, 4.6.4.

3.3.3.4.2 Scantlings

The net thicknesses of bulkhead plating and the net scantlings of bulkhead supporting members shall comply with the Rules, Part 2 – Hull and Hull Equipment, Chapter V, 5.4 and 5.5 respectively. In addition, the minimum net
CROATIAN REGISTER OF SHIPPING

Part 4 – Additional Requirements for Notations

Chapter I - TYPE NOTATIONS

3.3.4.3 Cargo tank plane bulkheads

General provisions given in the Rules, Part 2 – Hull and Hull Equipment, Chapter V, 5.6.2 shall be complied with.

3.3.4.4 Cargo tank corrugated bulkheads

General provisions given in the Rules, Part 2 – Hull and Hull Equipment, Chapter V, 5.6.3 shall be complied with.

3.3.5 Transverse reinforced rings

3.3.5.1 General

Transverse reinforced rings shall be fitted, where necessary, to provide additional supports of topside structure and to maintain the transverse strength of the vessel.

Transverse reinforced ring consists of the following supporting members: floor or bottom transverse, side web frame or side transverse and strong deck beam.

3.3.5.2 Scantlings

The net scantlings of reinforced ring supporting members shall be obtained as follows:

- floors and bottom transverses, the Rules, Part 2 – Hull and Hull Equipment, Chapter V, Table 2.5-1;
- side web frames and side transverses, the Rules, Part 2 – Hull and Hull Equipment, Chapter V, Table 3.5-1;
- strong deck beams, the Rules, Part 2 – Hull and Hull Equipment, Chapter V, Table 4.5-2;

3.3.4 Vessels with independent cargo tanks

3.3.4.1 General

Vessels with independent cargo tanks shall be built on the transverse framing system. When a longitudinal framing system is applied, it shall be specially considered by the Register.

The net thicknesses of plating and the net scantlings of supporting members of independent cargo tanks, independent of the vessel’s structure, shall comply with the applicable requirements of the Rules, Part 2 – Hull and Hull Equipment, Chapter V – Hull Scantlings, where the hull girder stresses shall be taken equal to zero.

The net thickness, in [mm], of plating and supporting members in cargo area, in compartments intended to carry liquids, including cofferdams, shall not be less than 4.5 mm.

To ensure proper contact between tank structure and vessel’s bottom, the bottom structure shall be adequately stiffened. To reduce stress concentrations in tank structures and adjacent hull structures, the reaction forces in way of tank supports shall, as far as practicable, be directly transmitted to the hull primary supporting members. Where the reaction forces are not in the plane of hull primary supporting members, brackets or adequate transitional structure shall be provided in order to effectively transmit those loads to hull structure. Calculation of reaction forces in way of tank supports shall be provided in accordance with provisions given in 3.3.4.5.

Special care shall be taken to ensure that the tank supports do not restrain the contraction or extension of the independent cargo tank when cooled down or heated up to the transport temperature. Where applicable, calculations of thermal stresses in tank structural members and hull structural members shall be obtained in accordance with 3.3.5.2.

In hull plating and primary supporting members in way of tank supports, openings shall be avoided.

3.3.4.2 Bottom supporting members

At least one bottom girder shall be provided on each side of the vessel in way of floors not in contact with tanks (floors located between tanks and floors at the ends of the cargo compartment). Those girders shall be fitted approximately at one-third of the breadth and shall extend at least over three frame spaces beyond tank end bulkheads. Girders shall be formed by intercostal web plates, fitted vertically, in alignment, and connected to the floors and bottom plating. Flanges of floors and side girder shall be joined with a butt weld.

To ensure continuity of structure, bottom longitudinal supporting members within the cargo compartments shall be arranged in line with those located in adjacent compartments. Where such design is not possible, strength continuity between the cargo space and the adjacent compartments shall be ensured by means of wide tapering brackets or other adequate transitional structures.

3.3.4.3 Side supporting members

The supporting members of tank side bulkheads may be inside or outside the independent cargo tank.

When tank longitudinal or transverse bulkheads are vertically framed, supporting members shall, as a rule, be arranged in a way that they form frames with tank bottom and top supporting members, in transverse or longitudinal planes respectively.

To ensure continuity of structure, at their ends, supporting members shall, as a rule, be connected by means of brackets.

Where supporting members of adjacent tank walls are fitted in the same plane, the brackets shall connect side supporting members to supporting members of adjacent structure.

Where supporting members are positioned in perpendicular planes, the brackets shall extend up to the closest supporting member of adjacent hull structure.

Typical connections of side supporting members to perpendicular walls shall be in accordance with the Rules, Part 2 – Hull and Hull Equipment, Chapter V, Figures 5.6.2-2 and 5.6.2-3.

As an alternative, if brackets are not suitable, primary supporting members fitted in the same plane may be connected by means of bracketless end connections, in compliance with the Rules, Part 2 – Hull and Hull Equipment, Chapter II, 5.4.3.

3.3.4.4 Fastening of independent cargo tanks

3.3.4.4.1 Chocking of tanks

The tank seatings shall be constructed in such a way that any movement of the tanks in relation to the vessel structure is disabled.

The tanks shall be adequately supported by floors or bottom longitudinals (see also 3.3.4.1).
When a stringer is chocked against tanks, in way of web frames or other adequate supporting member of tank bulkhead, chocking may consist in a bolted assembly. To reduce stress concentrations in hull structure, chocking assembly shall preferably be fitted at the intersection of side shell or bulkhead stringer with the side shell or bulkhead web frame/transverse.

In case of applying wedges in hard wood or synthetic material capable of transmitting the chocking stress, arrangements shall be provided to avoid any accidental shifting of wedges during navigation.

**3.3.4.2 Anti-flotation arrangements**

Anti-flotation arrangements shall be provided for independent cargo tanks. The anti-flotation arrangements shall be such that hull structure withstands an upward force caused by buoyancy of an empty tank in a cargo space flooded to the head of water corresponding to damage condition, without any plastic deformation likely to endanger the hull integrity.

**3.3.4.5 Strength check of hull structure in way of tank supports**

The arrangements and net scantlings of the tank supports and hull structures in way of tank supports shall be provided, based on the strength check carried out by direct calculation, in accordance with 3.1.3.

The reaction forces in way of the tank supports shall be calculated for vessel conditions as specified below, taking into account the most unfavourable of associated loadings. If the tank supports are not able to react in tension, the distribution of the reaction forces at the supports may not show any tensile reaction.

The design lateral loads and hull girder loads acting on hull structure in way of supports, complying with the requirements of the **Rules, Part 2 – Hull and Hull Equipment, Chapter V – Hull Scantlings**, shall also be taken into account, as applicable.

For the purpose of this calculation, safety factor, $f_S$, given in the **Rules, Part 2 – Hull and Hull Equipment, Chapter V, 1.7.1** shall be increased by 35%.

The reaction forces loads in a way of tank supports shall be determined according to the following provisions:

**.1 upright vessel conditions:**

a) loads acting in vertical direction:
- reaction forces generated by the weight of the filled tanks acting downwards;
- reaction forces generated by the buoyancy of the empty tanks acting upwards, assuming the vessel is in the damaged condition;

b) loads acting in the fore-and-aft direction:
- reaction forces generated by total longitudinal force acting on seatings equals to 0,30 times the weight of filled tank. As an alternative, the Register may accept the value of longitudinal forces derived from direct calculations, when justified on the basis of the vessel’s type and characteristics and intended operating conditions;

**.2 heeled vessel condition:**
- reaction forces generated by the weight of the filled tanks for the total heeling range up to the completely capsized condition of the vessel, acting downwards.

Inertial loads acting on tank structures, in compliance with the **Rules, Part 2 – Hull and Hull Equipment, Chapter III, 5.1**, shall also be taken into account, as applicable.
Chapter 1 - TYPE NOTATIONS

Part 4 – Additional Requirements for Notations

### 4 PASSENGER VESSELS

#### 4.1 General

##### 4.1.1 Application

Vessels complying with the requirements of this Section may be assigned the type notation **Passenger vessel**, as defined in the *Rules, Part 1 – Classification and Surveys, Chapter I, 3.5.4.*

##### 4.1.1.2 Vessels considered in this Section shall comply with the applicable requirements of the *Rules, Part 1 – Classification and Surveys, Part 2 – Hull and Hull Equipment and Part 3 – Machinery, Systems and Electricity*, as well as with the requirements of this Section which are specific to passenger vessels.

##### 4.1.1.3 Where available, statutory regulations in the operating area of the vessel (e.g. European directive) shall take precedence over these requirements.

##### 4.1.2 Design loads

The loads shall be calculated independently for each vessel’s condition (as given in the *Rules, Part 2 – Hull and Hull Equipment, Chapter III, 2.3*), by applying the associated loading conditions (as defined in the *Rules, Part 2 – Hull and Hull Equipment, Chapter III, 2.2*), to determine the most severe loading of the structural members analysed.

Where loading conditions other than standard design loading conditions are also expected, calculations for such conditions shall be submitted in addition to the standard conditions.

Structural members of compartments subjected to testing conditions, shall be checked for testing loads, calculated according to the *Rules, Part 2 – Hull and Hull Equipment, Chapter III, 5.8*.

Structural members of watertight boundaries of compartments not intended to carry liquids, shall be checked for flooding loads calculated according to the *Rules, Part 2 – Hull and Hull Equipment, Chapter III, 4.4*.

##### 4.1.3 Direct calculation

Direct calculation may be adopted for the yielding and buckling checks of hull structural members instead of the *Rules* scantling formulae as well as for the analysis of structural members not covered by the *Rules* or for type of loading not covered by the *Rules* (e.g. heavy concentrated loads, unevenly distributed loads etc.), in accordance with the *Rules, Part 2 – Hull and Hull Equipment, Chapter V, 1.8*.

The following strength checks shall be carried out, as applicable:

1. level of normal stresses and shear stresses in way of highly stressed areas;
2. level of normal stresses and shear stresses in welds in way of highly stressed areas;
3. buckling strength of unstiffened webs or face plates of primary supporting members, corrugated bulkheads etc.

All calculation documents shall be submitted to the Register.

#### 4.1.4 Materials other than normal strength hull structural steel

When steels with a minimum yield strength \( R_{y} \) other than 235,0 N/mm\(^2\) are used on a vessel, the scantlings shall be determined by taking into account the corresponding material factor, \( k \), Young’s modulus of elasticity, \( E \), yield strength, \( R_{y} \), for hull structural steels etc.

#### 4.1.5 Safety factor

If not otherwise specified, safety factors, \( f_{s} \), covering uncertainties regarding material and resistance, of vessels covered by the present *Rules* are defined in the *Rules, Part 2 – Hull and Hull Equipment, Chapter V, 1.7*.

#### 4.1.6 Stability

Proof of sufficient stability shall be required, in accordance with provisions given in 4.3.

##### 4.1.7 Definitions

**Passenger vessel**

A passenger vessel is a day trip or cabin vessel constructed and equipped to carry more than 12 passengers.

Vessels without their own power cannot be authorized for passenger transport.

A day trip vessel is a passenger vessel without overnight passenger cabins.

**Cabin vessel**

A cabin vessel is a passenger vessel with overnight passenger cabins.

**Safe area**

Safe area is the area which is externally bounded by a vertical surface running at a distance of \( B_{W}/5 \) parallel to the course of the hull in the line of maximum draught.

**Buoyancy and stability definitions**

**Margin line**

Margin line is an imaginary line drawn on the side plating not less than 10,0 cm below the bulkhead deck and not less than 10,0 cm below the lowest non-watertight point of the side plating.

If there is no bulkhead deck, a line drawn not less than 10,0 cm below the lowest line up to which the outer plating is watertight shall be used.

**Other buoyancy and stability definitions**

Other buoyancy and stability definitions (as plane of maximum draught, freeboard, residual freeboard, safety clearance, residual safety clearance etc.) are given in the *Rules, Part 2 – Hull and Hull Equipment, Chapter II, 11.1.2*.
Chapter 1 - TYPE NOTATIONS

4.1.6 Bulkhead deck
Bulkhead deck is the uppermost deck to which the required watertight bulkheads are carried and from which the freeboard is measured.

4.1.7 Main fire zones
Main fire zones are those sections into which the hull, superstructures and deckhouses are divided by “A” class divisions:
- the mean length and width of which on any deck does not, in general, exceed 40,0 m, or
- the area of which on any deck does not exceed 800,0 m².

4.1.8 Wall
Wall is a dividing surface, usually vertical.

4.1.9 Shipboard personnel
Shipboard personnel: all employees on board a passenger vessel who are not members of the crew.

4.1.10 Persons with reduced mobility
Persons with reduced mobility: persons facing particular problems when using public transport, such as the elderly and the handicapped and persons with sensory disabilities, persons in wheelchairs, pregnant women and persons accompanying young children.

4.1.8 Documentation to be submitted
In addition to the documentation required in other Parts of the Rules, the following documentation shall be submitted where applicable, for approval/review:
.1 ventilation plan;
.2 safety plan (escape routes plan);
.3 fire division/insulation plan showing designation of each space, including information on applied materials and constructions;
.4 sprinkler system;
.5 vessel arrangement plan;
.6 details of fire protection, detection and extinction;
.7 details of emergency electrical systems;
.8 details of safety devices and equipment;
.9 intact stability calculations;
.10 damage stability.

4.2 Vessel arrangement

4.2.1 General
The requirements of this Section apply to general arrangement, subdivision, stability, fire protection, scantlings, etc. of hull and superstructures of passenger vessels.

4.2.2 Protection of hull compartments
All metallic structures shall be protected against corrosion by suitable protection measures, in accordance with the Rules, Part 2 – Hull and Hull Equipment, Chapter VII, Section 2.

Coatings shall be chosen and surfaces to be protected shall be prepared in accordance with the manufacturer’s requirements, taking care of the compartment considered (see also 4.2.7.5, as applicable).

4.2.3 Access arrangement

4.2.3.1 General
Convenient access to vessel compartments shall be provided, complying with the applicable requirements of the Rules, Part 2 – Hull and Hull Equipment, Chapter II, Section 4.

4.2.3.2 Access to double bottom
In case of a double bottom structure, to enable access to all compartments, where required, inner bottom manholes shall be provided.

Watertight plate covers shall close the inner bottom manholes.

Floors and side girders shall be provided with adequate number and disposition of manholes to enable access to all parts of double bottom.

The manholes shall be as small as possible to provide the convenient access and shall be well-rounded with smooth edges. The manholes shall not, in general, exceed 50% of local height of double bottom. If greater sizes of manholes are deemed necessary, an appropriate means of reinforcement may be required, covered by calculations and considered by the Register on a case by case basis (see also the Rules, Part 2 – Hull and Hull Equipment, Chapter II, 6.4).

Manholes in the floors shall be located at half the floor height and in a region extending on 0,2⋅B from the centreline of the vessel, on each side. Where the central girder is provided, its distance to the nearest side of manhole shall not be less than the double bottom height. Manholes in the side girders shall be located at half the girder height and midway between two successive web frames. Where side girders are fitted in extension of inner sides, the distance of the nearest side of manhole in the side girder to the to the transverse bulkheads of side compartments shall, in general, not be less than 1,5 m or two times the double bottom height, whichever is greater.

Centre girder or floors and side girders below pillars shall not be provided with manholes unless permitted by the Register on a case by case basis.

4.2.4 Bulkheads

4.2.4.1 In addition to requirements of the Rules, Part 2 – Hull and Hull Equipment, Chapter II, Section 3, the number and disposition of watertight bulkheads shall be selected such that, in the event of flooding, the vessel remains buoyant according to 4.3.3. Every portion of the internal structure which affects the efficiency of the subdivision of such vessels shall be watertight, and shall be of a design which will maintain the integrity of the subdivision.

4.2.4.2 The bulkheads, which are taken into account in the damage stability calculation according to 4.3.3, shall be watertight and be installed up to the bulkhead deck. Where there is no bulkhead deck, these bulkheads shall extend to a height at least 0,2 m above the margin line.

4.2.4.3 The number of openings in watertight bulkheads shall be kept as low as is consistent with the type of construction and normal operation of the vessel.

Rules for the Classification of Inland Navigation Vessels
June 2018
4.2.4.4 A transverse watertight bulkhead may be fitted with a bulkhead recess, if all parts of this recess lie within the safe area.

4.2.4.5 The distance of the collision bulkhead from the forward perpendicular shall be between 0,04\( \cdot L_{W2} \) and (0,04\( \cdot L_{W2} +2 \)) in [m].

4.2.4.6 The first compartment aft of the collision bulkhead may be shorter than the length of damage stated in 4.3.5 if the total length of the two foremost compartments measured in the plane of maximum draught is not less than this value.

4.2.4.7 Bulkheads separating the machinery spaces (including boiler rooms) from passenger rooms or crew and shipboard personnel accommodation shall have no doors. Those bulkheads shall be gastight.

4.2.4.8 The net thicknesses of bulkhead plating and the net scantlings of bulkhead supporting members are defined in 4.4.2.2.

4.2.5 Openings and watertight doors

4.2.5.1 Openings and penetrations shall not have a detrimental effect on the watertight function of the bulkheads.

Openings on watertight bulkheads below the bulkhead deck shall be fitted with watertight doors or watertight covers having strength such as to withstand the head of water likely to occur.

4.2.5.2 Collision bulkheads shall have no openings and no doors below the bulkhead deck.

4.2.5.3 Open-ended piping and ventilation ducts shall be offset in such a way that, in any conceivable flooding, no additional spaces or tanks are flooded through them.

Where a pipework system has no open outlet in a compartment, the pipework shall be regarded as intact in the event of this compartment being damaged, if it runs within the safe area and is more than 0,5 m from the bottom of the vessel.

4.2.5.4 Manually operated doors without remote control in bulkheads according to 4.2.4.2, are permitted only in areas not accessible to passengers. They shall:

a) remain closed at all times and be opened only temporarily to allow access;

b) be fitted with suitable devices to enable them to be closed quickly and safely;

c) display the following notice on both sides of the doors: “Close door immediately after passing through”.

4.2.5.5 Doors in bulkheads according to 4.2.4.2 that are open for long periods shall comply with the following requirements:

a) they shall be capable of being closed from a remote, easily accessible location above the bulkhead deck;

b) the time taken for the remote controlled closure process shall be at least 30 seconds but not more than 60 seconds;

c) after a door has been remotely closed, it shall be possible to reopen and close it safely on the spot, from both sides of the bulkhead, by one person only. Closure shall not be impeded by carpeting, foot rails or other obstructions;

d) during the closure procedure an automatic audible alarm shall sound by the door;

e) the door drive and alarm shall also be capable of operating independently of the on-board power supply;

f) there shall be device at the location of the remote control that displays whether the door is open or closed.

4.2.5.6 Doors in bulkheads according to 4.2.4.2, and their actuators shall be located in the safe area, defined in 4.1.7.4.

4.2.5.7 There shall be a warning system in the wheelhouse to indicate which of the doors in bulkheads according to 4.2.4.2 are open.

4.2.6 Passenger rooms and areas

4.2.6.1 General

4.2.6.1.1 Passenger rooms shall:

a) on all decks, be located aft of the level of the collision bulkhead and, if they are below the bulkhead deck, forward of the level of the aft-peak bulkhead; and

b) be separated from the machinery spaces (including boiler rooms) in a gastight manner.

Deck areas which are enclosed by awnings or similar mobile installations not only above but also fully or partially to the side must satisfy the same requirements as enclosed passenger rooms.

4.2.6.1.2 Cupboards and rooms according to the Rules, Part 3 – Machinery, Systems and Electricity, Chapter III, 2.2.5 and intended for the storage of flammable liquids shall be outside the passenger area.

4.2.6.2 Means of escape

The number and width of the exits of passenger rooms shall comply with the following requirements:

a) rooms or groups of rooms designed or arranged for 30 or more passengers or including beds for 12 or more passengers shall have at least two exits. On day trip vessels one of these two exits can be replaced by two emergency exits; rooms, with the exception of cabins, and groups of rooms that have only one exit, shall have at least one emergency exit;

b) if rooms are located below the bulkhead deck, one of the exits can be a watertight bulkhead door, according to 4.2.5.5, leading into an adjacent compartment from which the upper deck can be reached directly. The other exit shall lead directly or, if permitted in accordance with a), as an emergency exit to the safe area above the bulkhead deck or exposed deck. This requirement does not apply to individual cabins;

c) exits according to a) and b) shall be suitably arranged and shall have a clear width of at least 0,8 m and also a clear height of at least 2,0 m. For doors of passenger cabins and other small rooms, the clear width may be reduced to 0,7 m;

d) in the case of rooms or groups of rooms intended for more than 80 passengers the widths of exits intended for passengers, and which shall be used by them in an emergency, shall be at least 0,01 m per passenger. If the total width of the exits is determined by the number of passengers, the width of each exit shall be at least 0,005 m per passenger. These requirements also apply to the doors within the means of escape;
c) emergency exits shall have clear dimension of a shortest side or a minimum diameter of at least 0,7 m. They shall open in the direction of escape and be marked on both sides;

f) doors shall always open in the direction of means of escape and shall be clearly marked as such.

4.2.6.3 Escape routes

Escape routes shall comply with the following requirements:

a) they shall have a clear width of at least 0,8 m. Clear width is a width between bulkheads or handrails, as applicable. If they lead to rooms used by more than 80 passengers, they shall comply with the provisions mentioned in 4.2.6.2, d) regarding the width of the exits leading to escape routes;

b) where a part of the vessel or a room intended for passengers is served by a single connecting corridor, the clear width thereof shall be at least 1,0 m;

c) stairways, exits and emergency exits shall be so disposed that, in the event of a fire in any given area, the other areas may be evacuated safely.

d) the escape routes shall lead by the shortest route to muster areas according to 4.2.6.6;

e) escape routes shall not lead through engine rooms or areas used by more than 80 passengers, they shall comply with the provisions applicable. If they lead to rooms used by more than 80 passengers, at least 0,01 m per passenger;

f) the musters and evacuation areas shall be shown as such in the safety plan and signposted on board the vessel;

g) the provisions of b) shall also apply to free decks on which muster areas are defined.

4.2.6.6 Muster areas

For all persons on board, there shall be muster areas available which satisfy the following requirements:

a) the muster areas shall be clear of furniture, whether movable or fixed;

b) if movable furniture is located in a room in which muster areas are defined, it shall be secured appropriately to avoid slipping;

c) life-saving appliances shall be easily accessible from the muster areas;

d) it shall be possible to evacuate people safely from these evacuation areas, using either side of the vessel;

e) the muster areas shall lie above the margin line;

f) the muster and evacuation areas shall be shown as such in the safety plan and signposted on board the vessel;

g) the provisions of b) shall also apply to free decks on which muster areas are defined.

4.2.6.7 Bulwark, railing and gangways

4.2.6.7.1 Parts of the deck intended for passengers, and which are not enclosed, shall be surrounded by a fixed bulwark or guard rail at least 1,0 m high. Bulwarks and railings of decks intended for use by persons with reduced mobility shall be at least 1,1 m high.

4.2.6.7.2 General provisions given in the Rules, Part 2 – Hull and Hull Equipment, Chapter VI, Section 2 shall also be complied with, as applicable.

4.2.6.7.3 Guide rail shall comprise a handrail, a rail at knee height and a footrail. The opening below the lower course shall not be greater than 230,0 mm. The other courses shall not be more than 380,0 mm apart.

The foot-guard shall rise to at least 50,0 mm above the weather deck.

4.2.6.7.4 Other standards may be accepted, in particular, bulwarks or guard rails in accordance with European Standard EN 711:2016, construction type PF, PG or PZ, may be provided.

4.2.6.7.5 Openings and equipment for embarking or disembarking and also openings for loading or unloading shall be such that they can be secured and have a clear width of at least 1,0 m.

4.2.6.7.6 If the openings and equipment for embarking or disembarking cannot be observed from the wheelhouse, appropriate auxiliary means shall be provided.

4.2.6.7.7 Gangways shall be constructed in accordance with European Standard EN 14206:2003. The boarding gangway at least 0,40 m wide and 4 m long whose side edges are defined by a brightly-coloured strip; that gangway shall be equipped with a handrail. The Register may permit shorter gangways for small vessels.
4.2.6.7.8 The parts of the vessel not intended for passengers, in particular access to the wheelhouse, to the winches and to the engine rooms, shall be such that they can be secured against unauthorized entry.

4.2.7 Fire protection and fire fighting

4.2.7.1 General

The suitability for fire protection of materials and components shall be established by an accredited test institution on the basis of appropriate test methods.

The test institution shall satisfy:
- the Code for Fire Test Procedures; or

4.2.7.2 Sounding pipes

Sounding pipes of fuel tanks may not terminate in accommodation or passenger spaces.

4.2.7.3 Fire containment

4.2.7.3.1 Sections of the hull, superstructures and deckhouses shall be divided to main fire zones, as defined in 4.1.7.7, by vertical partitions in accordance with 4.2.7.4.

The vertical partitions shall be smoke-tight under normal operating conditions and shall be continuous from deck to deck.

4.2.7.3.2 Hollows above ceilings, beneath floors and behind wall linings shall be separated at intervals of not more than 14.0 m by non-combustible draught stops which, even in the event of fire, provide an effective fireproof seal.

In the vertical direction, such hollows, including those behind linings of stairways, trunks, etc., shall be closed at each deck level.

4.2.7.4 Fire structural integrity

4.2.7.4.1 For the purpose of determining the appropriate fire integrity standard to be applied to partitions (divisions) between adjacent spaces, such spaces are classified according to their fire risk described in the Rules, Part 3 – Machinery, Systems and Electricity, Chapter III, 1.3.

4.2.7.4.2 Type A and B partitions (“A” and “B” class divisions) are bulkheads, walls, decks or ceilings which satisfy the requirements of the Rules, Part 3 – Machinery, Systems and Electricity, Chapter III, 1.2.6 and 1.2.7 respectively.

4.2.7.4.3 The minimum fire structural integrity shall be as given in Table 4.2.7-1.

4.2.7.4.4 Type A and B bulkheads/walls shall be continuous from deck to deck or shall end at continuous ceilings, which satisfy the same requirements as defined in Table 4.2.7-1.

4.2.7.4.5 Bulkheads/walls between cabins shall be of approved type B-0 and to corridors of approved type B-15.

Where a sprinkler system is fitted, the corridor bulkheads/walls may be reduced to approved type B-0.

4.2.7.4.6 All stairways shall be of steel frame or other non-combustible construction.

Stairways connecting more than two decks shall be enclosed by at least Type B bulkheads/walls.

Stairways connecting only two decks need to be protected at least at one deck level by Type B bulkheads/walls.

Table 4.2.7-1

Fire structural integrity of bulkheads and decks – partitions between adjacent spaces

<table>
<thead>
<tr>
<th>Space</th>
<th>Control centres</th>
<th>Stairwells</th>
<th>Muster areas</th>
<th>Lounges</th>
<th>Machinery spaces</th>
<th>Galleys</th>
<th>Store rooms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control centres</td>
<td>–</td>
<td>A0</td>
<td>A0 / B0 ¹)</td>
<td>B0</td>
<td>A30</td>
<td>A0</td>
<td>A0</td>
</tr>
<tr>
<td>Stairwells</td>
<td>–</td>
<td>–</td>
<td>A0</td>
<td>B0</td>
<td>A30</td>
<td>A0</td>
<td>A0</td>
</tr>
<tr>
<td>Muster areas</td>
<td>–</td>
<td>–</td>
<td>A0 / B0 ²)</td>
<td>A30</td>
<td>A0</td>
<td>A0</td>
<td>A0</td>
</tr>
<tr>
<td>Lounges</td>
<td>–</td>
<td>– / B0 ³)</td>
<td>A30 / A0 ⁴)</td>
<td>A15</td>
<td>A0</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Machinery spaces</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Galleys</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>A15</td>
<td>A0</td>
</tr>
<tr>
<td>Store rooms</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>

Notes:
1) Partitions between control centres and internal muster areas shall correspond to Type A0, but external muster areas only to Type B0.
2) Partitions between lounges and internal muster areas shall correspond to Type A0, but external muster areas only to Type B0.
3) Partitions between cabins, partitions between cabins and corridors and vertical partitions separating lounges (according to 4.2.7.3) shall comply with Type B0.
4) Partitions between machinery spaces of category A and the emergency power plant (according to 4.2.10.3) shall comply with Type A30. In other cases they shall comply with Type A0.
5) B0 is sufficient for partitions between galleys, on the one hand, and cold-storage rooms and food store rooms, on the other; in other cases partitions shall comply with Type A0.
Chapter I - TYPE NOTATIONS

4.2.7.4.7 Where Type A and B partitions are penetrated for the passage of cables, pipes, trunks, ducts etc. or for the fitting of ventilation terminals, lighting fixtures and similar devices, arrangements shall be made to ensure that the fire resistance is not impaired.

4.2.7.5 Fire protection materials

All insulation materials, bulkheads, linings, ceilings and draught stops shall be of at least approved non-combustible material.

Primary deck coverings and surface materials shall be of an approved type.

4.2.7.6 Openings in type A and B partitions

Doors in partitions according to 4.2.7.4 shall satisfy the following requirements:

a) they shall satisfy the same requirements set out in 4.2.7.4 as the partitions themselves;

b) it shall be possible to open and close the door on the spot, from both sides of the bulkhead, by one person only;

c) they shall be self-closing or shall be capable of remote release in the case of doors in partition bulkheads/walls according to 4.2.7.3;

d) there shall be device at the location of the remote control that displays whether the door is open or closed;

4.2.7.7 Ventilation systems

Ventilation systems and air supply systems shall satisfy the following requirements:

a) they shall be designed in such a way as to ensure that they themselves do not cause the spread of fire and smoke;

b) ventilation ducts shall be made from steel or an equivalent non-combustible material, except short ducts applied at the end of the ventilation device, which may be made of a material which has low-flame spread characteristics. Ventilation ducts shall be securely connected to each other and to the structure of the vessel;

c) ventilation ducts shall be subdivided by approved fire dampers analogously to the requirements of 4.2.7.3. Penetrations through stairway boundaries shall also be fitted with approved fire dampers;

d) when ventilation ducts with a cross-section of more than 0,02 m² are passed through partitions according to 4.2.7.4 of Type A or partitions according to 4.2.7.3, they shall be fitted with approved fire dampers which can be operated from a location permanently manned by shipboard personnel or crew members;

f) fire dampers shall be so designed that they can be operated locally (manually), from both sides of the partition.

4.2.7.8 Control of smoke spread

Control centres, stairwells and internal muster areas shall be fitted with natural or mechanical smoke extraction systems. Smoke extraction systems shall satisfy the following requirements:

a) they shall offer sufficient capacity and reliability;

b) they shall comply with the operating conditions for passenger vessels;

c) if smoke extraction systems also serve as general ventilators for the rooms, this shall not hinder their function as smoke extraction systems in the event of a fire;

d) smoke extraction systems shall have a manually operated triggering device;

e) mechanical smoke extraction systems shall additionally be such that they can be operated from a location permanently occupied by shipboard personnel or crew members;

f) natural smoke extraction systems shall be fitted with an opening mechanism, operated either manually or by a power source inside the extraction system;

g) manually operated triggering devices and opening mechanisms shall be accessible from inside or outside the room being protected.

4.2.7.9 Fire detection and fire alarm

4.2.7.9.1 In addition to general provisions given in the Rules, Part 3 – Machinery, Systems and Electricity, Chapter III - Fire protection, detection and extinction, passenger vessels are subject to the following requirements:

a) all day rooms normally accessible to passengers and crew as well as galleys, engine rooms and other rooms presenting a fire risk shall be monitored by a type tested, automatic fire detection and fire alarm system;

b) the existence of a fire and the area concerned shall be automatically displayed at a location permanently manned by shipboard personnel or crew members.

4.2.7.9.2 Detectors shall be grouped into separate sections, each of which shall not comprise more than one main fire zone or one watertight division and not more than two vertically adjacent decks.

If the fire detection system is designed for remote and individual identification of detectors, several decks in one main fire zone respectively one watertight division may be monitored by the same detector loop. The detector loop shall be so arranged, that in the event of a damage (wire break, short circuit, etc.) only a part of the loop becomes faulty.

Smoke detectors shall be used in passageways, stairways and escape routes. Heat detectors shall be used in cabins in the accommodation area.

Flame detectors shall only be used in addition to the other detectors.

4.2.7.9.3 Manually operated call points shall be provided, in addition to the automatic system:

– in passageways, enclosed stairways and at lifts;

– in saloons, day rooms and dining rooms;

– in machinery spaces, galleys and spaces with a similar fire hazard.

The manually operated call points shall be spaced not more than 10,0 m apart, however at least one call point shall be available in every watertight compartment.

4.2.7.9.4 The alarm set off by a manual call point shall be transmitted only to the rooms of the vessel’s officers and crew and must be capable of being cancelled by the vessel’s officers. Manual call points shall be safeguarded against unintended operation.
4.2.7.9.5 The requirements of 4.2.7.9.1, b) and 4.2.7.9.2 are deemed to be met in the case of spaces protected by an automatic pressure water spraying system designed in accordance with the Rules, Part 3 – Machinery, Systems and Electricity, Chapter III, 5.2.

4.2.7.10 Fire fighting

4.2.7.10.1 General water fire extinguishing system

.1 passenger vessels with $L_{WL}$ over 40.0 m and passenger vessels with cabins for passengers having $L_{WL}$ over 25.0 m are subject to the additional requirements in .2 to .5;

.2 passenger vessels shall be provided with a hydrant system consisting of sufficient number of hydrants with permanently connected fire extinguisher hoses fitted with a nozzle capable of producing both a mist (spray) and a jet of water and incorporating a shut-off facility;

.3 materials for firefighting equipment shall either be heat resistant or shall be suitably protected against failure to work when subjected to high temperatures;

.4 hydrant systems shall be designed and dimensioned in such a way that:

a) any point of the vessel can be reached from at least two hydrants in different places, each with a single hose length of not more than 20.0 m;

b) on all decks a water jet length of at least 12.0 m can be attained with a nozzle diameter of 12.0 mm. Hydrant valves with screw threads or cocks shall be such that they can be set so that each of the fire extinguisher hoses can be separated and removed during operation of the fire extinguishing pumps.

Pipes and hydrants shall be arranged in such a way that the risk of freezing is avoided.

Two fire hoses shall be located in hose boxes in both fore and aft part of the vessel. Further hoses may be required depending on the size and design features of the vessel;

.5 two motor-driven fire extinguishing pumps shall be provided. The minimum capacity of the fire pump shall be 20.0 m$^3$/h. The fire pumps shall be housed in separate rooms and can be operated independently of each other.

The pump drive shall be independent of the engine room, and the pump capacity shall comply with the requirements in .3 and .4.

Connections in the piping system with the engine room must be capable of being shut off from outside at the point of entry into the engine room. The fire extinguishing pumps shall be installed forward of the after peak bulkhead. The portable pump may be accepted, provided that a permanently installed pump is available in the engine room. Fire extinguishing pumps may also be used for general purposes.

4.2.7.10.2 Portable fire extinguishers

In addition to the portable extinguishers according to the Rules, Part 3 – Machinery, Systems and Electricity, Chapter III, 5.5.5, at least the following portable extinguishers shall be available on board:

a) one portable extinguisher for every 120.0 m$^2$ of gross floor area in passenger rooms;

b) one portable extinguisher per group of 10 cabins, rounded upwards;

c) one portable extinguisher in each galley and in the vicinity of any room in which flammable liquids are stored or used. In galleys the extinguishing agent shall also be suitable for fighting fat fires.

These additional fire extinguishers shall meet the requirements laid down in the Rules, Part 3 – Machinery, Systems and Electricity, Chapter III, Section 5.5.4, and be installed and distributed on the vessel so that, in the event of a fire starting at any point and at any time, a fire extinguisher can be reached immediately.

4.2.7.10.3 Automatic pressure water spraying system (pressurised sprinkler system)

Where installed, automatic pressure water spraying systems for the passenger area shall be ready for operation at all times when passengers are on board. No additional measures on the part of the crew shall be needed to actuate the system. For automatic pressure water spraying system, see the Rules, Part 3 – Machinery, Systems and Electricity, Chapter III, 5.2.

4.2.7.10.4 Fixed fire-extinguishing systems

Engine rooms containing internal combustion engines and oil fired boilers shall be fitted with a permanently fitted fire-extinguishing system according to the Rules, Part 3 – Machinery, Systems and Electricity, Chapter III, 5.3.

4.2.8 Safety devices and equipment

4.2.8.1 Passenger vessels with cabins and day trip vessels, with $L_{WL}$ over 25.0 m, shall comply with the following requirements of alarm and communication systems.

Derogations of the present Rules for ferries and day passenger vessels may be considered by the Register on a case by case basis.

4.2.8.2 Vessels shall be equipped with an alarm system enabling the vessel’s command to alert the crew and shipboard personnel. The alarm system shall also reach the recreation rooms for the crew and shipboard personnel, the cold-storage rooms and other store rooms. Alarm triggers shall be protected against unintentional use.

4.2.8.3 Passenger vessel with cabins shall also be equipped with:

a) an alarm system enabling passengers, crew members and shipboard personnel to alert the vessel’s command and crew.

This alarm shall be given only in areas assigned to the vessel’s command and to the crew; it shall only be possible for the vessel’s command to stop the alarm. The alarm shall be capable of being triggered from at least the following places:

– in each cabin;

– in the corridors, lifts and stairwells, with the distance to the nearest trigger not exceeding 10.0 m and with at least one trigger per watertight compartment;

– in lounges, dining rooms and similar recreation rooms;
Chapter I - TYPE NOTATIONS

- in toilets, intended for use by persons with reduced mobility;
- in engine rooms, galleys and similar rooms where there is a fire risk;
- in the cold-storage rooms and other store rooms.
The alarm triggers shall be installed at a height above the floor of 0,85 m to 1,1 m;

b) an alarm system enabling the vessel’s command to alert passengers.

This alarm shall be clearly and unmistakably audible in all rooms accessible to passengers. It shall be capable of being triggered from the wheelhouse and from a location that is permanently staffed.

4.2.8.4 Where no direct means of communication exist between the bridge and the:
- engine room (control platform);
- service spaces;
- crew’s day rooms;
a suitable intercommunications system shall be provided.

The general telephone system can be approved for this purpose provided it is guaranteed that the bridge/engine link always has priority and that existing calls on this line between other parties can be interrupted.

Where a telephone system is used, the engineer's alarm according to 4.2.8.3 may be dispensed with provided that two-way communication is possible between the machinery space and the engineers' accommodation.

4.2.8.5 Vessels with a length $L_{WL}$ ≥ 40,0 m and vessels intended for more than 75 passengers shall be equipped with loudspeakers capable of reaching all the passenger areas.

The public address system shall be designed in such a way as to ensure that the information transmitted can be clearly distinguished from background noise. The Register may waive this requirement if direct communication between the wheelhouse and the passenger area is possible.

4.2.8.6 Each watertight compartment shall be fitted with a bilge level alarm.

4.2.8.7 A bilge pumping system with permanently installed pipework shall be available.

The number and capacity of bilge pumps shall be in compliance with the Rules, Part 3 – Machinery, Systems and Electricity, Chapter I, 7.9.2.

Further bilge pumps may be required according to size and propulsion power.

4.2.9 Propulsion system

4.2.9.1 In addition to the main propulsion system, vessels shall be equipped with a second independent propulsion system so as to ensure that, in the event of a breakdown affecting the main propulsion system, the vessel can continue to make steerageway under its own power.

4.2.9.2 The second independent propulsion system shall be placed in a separate engine room. If both engine rooms have common partitions, these shall be built according to 4.2.7.4.

4.2.10 Electrical equipment

4.2.10.1 General

Passenger vessels with cabins and day trip vessels, with $L_{WL}$ over 25,0 m, shall comply with the following requirements in addition to the requirements stated in the Rules, Part 3 – Machinery, Systems and Electricity, Chapter II – Electrical installations.

Derogations of the present Rules for ferries and day passenger vessels may be considered by the Register on a case by case basis.

A failure of the main or emergency power equipment shall not mutually affect the operational safety of the installations.

The requirements stated in the Rules, Part 3 – Machinery, Systems and Electricity, Chapter II, 11.5.3, shall also apply additionally for passenger rooms.

4.2.10.2 Generator plant

For supply of electrical equipment, at least two power sources (main generator plants) shall be provided, according to the Rules, Part 3 – Machinery, Systems and Electricity, Chapter II, 2.1. Those power sources shall be independent of each other in a way that if one power source fails, the remaining source shall be able to supply the electrical equipment needed for the safe operation of the vessel (including prime mover system and manoeuvring).

4.2.10.3 Emergency power plant

1 There shall be an emergency power plant, consisting of an emergency electrical power source and emergency switchboard, which, in the event of a failure of the supply to the following electrical equipment and the consumers, essential to the safety of passengers and crew, can immediately take over as their replacement supply, where the equipment does not have its own electrical power source:
   a) navigation and signalling lights;
   b) audible warning devices (e.g. tyfon);
   c) emergency lighting in accordance with 4.2.10.4;
   d) radiotelephone installations;
   e) alarm, loudspeaker and on-board communications systems;
   f) searchlights that can be operated from the wheelhouse;
   g) fire detection and alarm system;
   h) other safety equipment such as automatic pressurised sprinkler systems or fire extinguishing pumps.

2 The following requirements shall be complied with:
   a) the emergency power plant shall be installed outside the machinery spaces, the machinery casings and the rooms housing the power sources according to the Rules, Part 3 – Machinery, Systems and Electricity, Chapter II, 2.1.1, and outside the room where the main switchboard is located; it shall be separated from these rooms by watertight partitions, complying also with the requirements of 4.2.7.4;
   b) cables feeding the electrical installations in the event of an emergency shall be installed and routed in such a way as to maintain the continuity of supply of these installations in the event of fire or flooding. These cables shall never be routed through the main engine
The emergency lighting system shall be cut in automatically following a failure of the main power supply. Local switches shall be provided only where it may be necessary to switch off the emergency lighting (e.g. in the wheelhouse). The power supply and the duration of the supply shall conform to 4.2.10.3;

b) for the following rooms and locations, adequate lighting and emergency lighting shall be provided:
   - locations where life-saving equipment is stored and where such equipment is normally prepared for use;
   - escape routes, access for passengers, including gangways, entrances and exits, connecting corridors, lifts and accommodation area companionways, cabin areas and accommodation areas;
   - markings (signs) on the escape routes and emergency exits (see also 4.2.6.3, h));
   - in other areas intended for use by persons with reduced mobility;
   - operation rooms, engine rooms, steering equipment rooms and their exits;
   - wheelhouse;
   - emergency electrical power source room;
   - points at which extinguishers and fire extinguishing equipment controls are located;
   - areas in which passengers, shipboard personnel and crew muster in the event of danger;

c) the light fittings for the emergency lighting shall be marked as such for ease of identification;

d) if a vessel is divided into main fire zones, at least two circuits shall be provided for the lighting of each main fire zone, and each of these shall have its own power supply line. One circuit shall be supplied from the emergency power source. The supply lines shall be so located that, in the event of a fire in one main fire zone, the lighting in the other zones is as far as practicable maintained.

3 Final sub-circuits

In the important spaces mentioned below the lighting shall be supplied by at least two different circuits:
   - passageways;
   - stairways leading to the boat deck, and public spaces and day rooms for passengers and crew;
   - large galleys.

The lamps shall be so arranged that adequate lighting is maintained even if one of the circuits fails.

4.2.11 Derogations for certain passenger vessels

4.2.11.1 The following provisions shall not apply to passenger vessels with a length $L_W$ of not more than 25.0 m:

a) 4.2.6.3, e), for the galleys, as long as a second escape route is available;

b) 4.2.9.
Chapter 1 - TYPE NOTATIONS

4.2.11.2 For passenger vessels in accordance with 4.3.7.1 the Register may permit minor derogations from the clear height required in 4.2.6.2, c). The derogation shall not be more than 5%. In the case of derogations the relevant parts shall be indicated by colour.

4.2.11.3 By way of derogation from 4.2.5.4, passenger vessels with a length \( L \) of not more than 45,0 m and authorized to carry at most a number of passengers corresponding to the length of the vessel in metres are permitted to have on board, in the passenger area, a manually controlled bulkhead door without remote control if:

a) the vessel has only one deck;
b) this door is accessible directly from the deck and is not more than 10,0 m away from the deck;
c) the lower edge of the door opening lies at least 30,0 cm above the floor of the passenger area; and
d) each of the compartments divided by the door is fitted with a bilge level alarm.

4.2.11.4 On passenger vessels in accordance with 4.2.11.3, by way of derogation from 4.2.6.3, e), one escape route may lead through a galley, as long as there is a second escape route available.

4.3 Buoyancy and stability

4.3.1 General

General provisions given in the Rules, Part 2 – Hull and Hull Equipment, Chapter II, Section 11 shall be complied with.

Stability calculation shall be carried out, based on the results from the application of criteria for intact and damage stability, to prove that both intact and damage stability of the vessel is appropriate.

All calculations shall be carried out free to trim and sinkage. The lightship data taken into account for the stability calculation shall be determined by means of an inclining test.

4.3.2 Standard load conditions

The stability shall be proven for the following standard loading conditions:

a) at the start of the voyage:
   - 100% passengers, 50% fuel and fresh water, 50% waste water;
   - during the voyage:
   - 100% passengers, 50% fuel and fresh water, 50% waste water;
   - at the end of the voyage:
   - 100% passengers, 10% fuel and fresh water, 98% waste water;
  
   d) unladen vessel:
   - no passengers, 10% fuel and fresh water, no waste water.

For all standard loading conditions, the ballast tanks shall be considered as either empty or full in accordance with normal operational conditions.

In addition, the requirement of 4.3.4, d) shall be proved for the following loading condition:

100% passengers, 50% fuel and fresh water, 50% waste water, all other liquid (including ballast) tanks are considered filled to 50%.

4.3.3 Heeling moments

4.3.3.1 Moment due to crowding of passengers

The heeling moment due to one-sided accumulation of persons, \( M_{P} \), shall be calculated according to the following formula:

\[
M_{P} = g \cdot m_{P} \cdot y_{P} = \sum m_{Pi} \cdot y_{Pi} \quad [\text{kNm}]
\]  

(4.3.3-1)

where:

\( g \) = acceleration of the gravity = 9,81 m/s²;

\( m_{P} \) = total mass of persons on board in calculated by adding up the maximum permitted number of passengers and the maximum number of shipboard personnel and crew under normal operating conditions, [t];

\( y_{P} \) = lateral distance of centre of gravity of total mass of persons, \( m_{P} \), from centre line, [m];

\( m_{Pi} \) = mass of persons accumulated on area \( A_{Pi} \), [t];

\( A_{Pi} \) = area occupied by persons, [m²];

\( n_{Pi} \) = number of persons per square meter;

\( y_{Pi} \) = lateral distance of geometrical centre of area, \( A_{Pi} \), from centre line, [m].

The calculation shall be carried out for an accumulation of persons both to starboard and then to port.

The distribution of persons shall correspond to the most unfavourable one from the point of view of stability. Cabins shall be assumed unoccupied for the calculation of the persons (crowding) moment.

For the calculation of the loading cases, the centre of gravity of a person shall be taken as 1,0 m above the floor, and the maximum number of shipboard personnel and crew under normal operating conditions, [t];

\( y_{P} \) = lateral distance of centre of gravity of total mass of persons, \( m_{P} \), from centre line, [m];

\( n_{Pi} \) = number of persons per square meter;

\( y_{Pi} \) = lateral distance of geometrical centre of area, \( A_{Pi} \), from centre line, [m].

The calculation shall be carried out for an accumulation of persons both to starboard and then to port.

The distribution of persons shall correspond to the most unfavourable one from the point of view of stability. Cabins shall be assumed unoccupied for the calculation of the persons (crowding) moment.

For the calculation of the loading cases, the centre of gravity of a person shall be taken as 1,0 m above the lowest point of the deck at 0,5 \( L_{W} \), ignoring any deck curvature and assuming a mass of 0,075 t per person.

As an alternative, a detailed calculation of deck areas which are occupied by persons may be dispensed with if \( y_{P} \) is taken equal to 0,5 \( L_{W} \) and the following values are used:

- for day trip vessels:
  
  \[
  m_{P} = 1,1 \cdot n_{max} \cdot 0,075 \quad [\text{t}]
  \]
  
  (4.3.3-2)

- for cabin vessels:
  
  \[
  m_{P} = 1,5 \cdot n_{max} \cdot 0,075 \quad [\text{t}]
  \]
  
  (4.3.3-3)

where:

\( n_{max} \) = maximum permitted number of passengers on board.
4.3.3.2 Moment due to lateral wind pressure

The heeling moment due to wind pressure, \( M_{BD} \), shall be calculated as follows:

\[
M_{BD} = p_{BD} \cdot A_{BD} \left( \delta_{BD} + \frac{T_{LC}}{2} \right), \quad [\text{kNm}]
\]

where:

\( p_{BD} \) = wind pressure defined in the *Rules, Part 2 – Hull and Hull Equipment, Chapter III, 4.1.2, [kN/m²];

\( A_{BD} \) = lateral area of the vessel above the plane of draught, \( T_{LC} \), associated with the loading condition considered, [m²];

\( \delta_{BD} \) = distance of the centre of gravity of the lateral plane, \( A_{BD} \), from the plane of draught, \( T_{LC} \), associated with the loading condition considered, [m];

\( T_{LC} \) = draught associated with each cargo and ballast distribution defined in the *Rules, Part 2 – Hull and Hull Equipment, Chapter III – Design load principles, [m].

In calculating the lateral plane, account shall be taken of the intended enclosure of the deck by awnings and similar mobile installations.

4.3.3.3 Turning circle moment

The moment due to centrifugal force, \( M_{CF} \), caused by the turning of the vessel, shall be calculated as follows:

\[
M_{CF} = c_{CF} \cdot C_{B} \cdot \nu^{2} \cdot \frac{\Delta}{L_{WL}} \left( KG - \frac{T_{LC}}{2} \right), \quad [\text{kNm}]
\]

where:

\( c_{CF} \) = a coefficient equal to 0,0347;

\( C_{B} \) = block coefficient;

\( L_{WL} \) = length of waterline, [m];

\( \nu \) = maximum speed of the vessel, [km/h];

\( \Delta \) = displacement, [t];

\( KG \) = vertical centre of gravity (VCG) corresponding to the loading condition considered and the base line, [m].

For passenger vessels with propulsion systems according to the *Rules, Part 3 – Machinery, Systems and Equipment, Chapter I, 8.5.3 (rudder propeller, water jet, cycloidal propeller and bow thruster), \( M_{CF} \) shall be derived from full-scale or model tests or else from corresponding calculations.

4.3.4 Intact stability

The proof of adequate intact stability by means of a calculation shall be produced using the following criteria for the intact stability and for the standard loading conditions given in 4.3.2:

a) the maximum righting lever arm \( GZ_{max} \) shall occur at a heeling angle of \( \varphi_{max} \geq (\varphi_{max} + 3°) \) and shall not be less than 0,2 m. However, in case \( \varphi_{r} < \varphi_{max} \), the righting lever arm at the downflooding angle, \( \varphi_{f} \), shall not be less than 0,2 m;

b) the downflooding angle, \( \varphi_{f} \), shall not be less than \( (\varphi_{max} + 3°) \);

c) the area, \( A_{CL} \), in [m-rad], under the curve of the righting lever arm in static stability diagram shall, depending on the position of \( \varphi_{r} \) and \( \varphi_{max} \), reach at least the following values given in Table 4.3.4-1;

d) the initial metacentric height, \( GM_{0} \), in [m], corrected by the free surface effect in liquid tanks, shall not be less than 0,15 m;

e) in each of the following two cases the heeling angle \( \varphi_{max} \) shall not exceed 12°:

- in application of the heeling moment due to persons crowding and wind pressure, according to 4.3.3.1 and 4.3.3.2 respectively;

- in application of the heeling moment due to persons crowding and turning of the vessel, according to 4.3.3.1 and 4.3.3.3 respectively;

f) for a heeling moment resulting from moments due to persons crowding, wind pressure and turning of the vessel, according to 4.3.3.1 to 4.3.3.3 the residual freeboard shall not be less than 0,2 m;

g) for vessels with windows or other openings in the hull located below the bulkhead decks and not closed weathertight, the residual safety clearance shall be at least 0,1 m on the application of the three heeling moments resulting from \( \varphi_{f} \).

Table 4.3.4-1

<table>
<thead>
<tr>
<th>Case</th>
<th>( A_{CL} ), [m-rad]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. ( \varphi_{max} \leq 15° ) or ( \varphi_{r} \leq 15° )</td>
<td>0,05 up to the smaller of the angles ( \varphi_{max} ) or ( \varphi_{r} )</td>
</tr>
<tr>
<td>2. ( 15° &lt; \varphi_{max} &lt; 30° ) ( \varphi_{max} \leq \varphi_{r} )</td>
<td>0,035 + 0,001 \cdot (30 - \varphi_{max}) up to the angle ( \varphi_{max} )</td>
</tr>
<tr>
<td>3. ( 15° &lt; \varphi_{r} &lt; 30° ) ( \varphi_{max} &gt; \varphi_{r} )</td>
<td>0,035 + 0,001 \cdot (30 - \varphi_{r}) up to the angle ( \varphi_{r} )</td>
</tr>
<tr>
<td>4. ( \varphi_{max} \geq 30° ) and ( \varphi_{r} \geq 30° )</td>
<td>0,035 up to the angle ( \varphi = 30° )</td>
</tr>
</tbody>
</table>

where:

\( \varphi \) = the heeling angle, [°];

\( \varphi_{r} \) = the heeling angle, at which any opening on the hull, superstructure or deck houses, which cannot be closed weathertight, submerge, [°];

\( \varphi_{max} \) = the heeling angle at which the maximum righting lever arm occurs, [°];

\( \varphi_{f} \) = the maximum heeling angle according to 4.3.4, [°];
4.3.5 Damage stability

4.3.5.1 Buoyancy of the vessel in the event of flooding shall be proven for the standard loading conditions specified in 4.3.2. Accordingly, mathematical proof of sufficient stability shall be determined for the three intermediate stages of flooding (25, 50 and 75% of flood build-up) and for the final stage of flooding.

4.3.5.2 The calculation of the final stage of flooding shall be based on the method of “lost buoyancy” and the interim stages of flooding should be calculated on the basis of the method of “added mass”.

4.3.5.3 Assumptions

Passenger vessels shall comply with the one-compartment status and the two-compartment status. The following assumptions concerning the extent of damage given in Table 4.3.5-1 shall be taken into account in the event of flooding:

a) for 1-compartment status the bulkheads may be assumed to be intact if the distance between two adjacent bulkheads is greater than the damage length. Longitudinal bulkheads at a distance of less than $B/3$, measured perpendicular to the centre line from the shell plating at the maximum draught shall not be taken into account for calculation purposes. A bulkhead recess in a transverse bulkhead that is longer than 2,5 m, is considered a longitudinal bulkhead;

b) for 2-compartment status each bulkhead within the extent of damage will be assumed to be damaged. This means that the position of the bulkheads shall be selected in such a way as to ensure that the passenger vessel remains buoyant after flooding of two or more adjacent compartments in the longitudinal direction;

c) the lowest point of each non-watertight opening (e.g. doors, windows, access hatchways) shall lie at least 0,1 m above the damaged waterline. The bulkhead deck shall not be immersed in the final stage of flooding;

d) permeability is assumed to be 95%. If it is proven by a calculation that the average permeability of any compartment is less than 95%, the calculated value may be used instead.

The values to be adopted shall not be less than those given in Table 4.3.5-2;

e) if damage of a smaller dimension than specified above produces more detrimental effects with respect to heeling or loss of metacentric height, such damage shall be taken into account for calculation purposes.

4.3.5.4 Damage stability criteria

.1 for all intermediate stages of flooding according to 4.3.5.1, the following criteria shall be met:

a) the heeling angle $\phi$ at the equilibrium position of the intermediate stage in question shall not exceed 15°;

b) non-watertight openings shall not be immersed before the heel in the equilibrium position of the intermediate stage in question has been reached;

c) beyond the heel in the equilibrium position of the intermediate stage in question, the positive part of the righting lever arm curve shall display a righting lever arm value of $GZ \geq 0,02$ m before the first unprotected (non-watertight) opening becomes immersed or a heeling angle $\phi$ of 25° is reached;

d) the calculation of the free surface effect in all intermediate stages of flooding shall be based on the gross surface area of the damaged compartments;

.2 for the final stage of flooding, the following criteria shall be met (see Figure 4.3.5-1), taking into account the heeling moment due to persons crowding in accordance with 4.3.3.1:

a) during the final stage of flooding (at the stage of equilibrium), heeling angle $\phi$ shall not exceed 10°;

b) non-watertight openings shall not be immersed before the equilibrium position has been reached. If such openings are immersed before this point, the corresponding compartments shall be considered to be flooded for damage stability calculation purposes;

c) beyond the equilibrium position the positive part of the righting lever arm curve shall display a righting lever arm value of $GZ_R \geq 0,02$ m with an area $A_{GZ} \geq 0,0025$ m.rad. These minimum values for stability shall be met until the immersion of the first unprotected (non-watertight) opening or in any case before reaching a heeling angle of 25°.

---

### Table 4.3.5-1

<table>
<thead>
<tr>
<th>Extent of damage</th>
<th>1-compartment status</th>
<th>2-compartment status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimension of the side damage</td>
<td>longitudinal $l_D$, [m]</td>
<td>0,1$L_{WL}$, however not less than 4,0 m</td>
</tr>
<tr>
<td></td>
<td>transverse $b_{DS}$, [m]</td>
<td>$B/5$</td>
</tr>
<tr>
<td></td>
<td>vertical $h_{Dv}$, [m]</td>
<td>from vessel bottom to top without delimitation</td>
</tr>
<tr>
<td>Dimension of the bottom damage</td>
<td>longitudinal $l_D$, [m]</td>
<td>0,1$L_{WL}$, however not less than 4,0 m</td>
</tr>
<tr>
<td></td>
<td>transverse $b_{DS}$, [m]</td>
<td>$B/5$</td>
</tr>
<tr>
<td></td>
<td>vertical $h_{Dv}$, [m]</td>
<td>0,59; pipework installed according to 4.2.5.3, shall be deemed intact</td>
</tr>
</tbody>
</table>
where:

$\varphi_E$ = the heeling angle in the final stage of flooding taking into account the moment in accordance with 4.3.3.1, [°];

$\varphi_m$ = the angle of vanishing stability or the angle at which the first unprotected (non-weathertight) opening immerses or $25^\circ$, whichever is less, [°];

$GZ_R$ = the remaining or residual righting lever arm in the final stage of flooding taking into account the moment in accordance with 4.3.3.1, [m];

$GZ_K$ = the heeling lever arm resulting from the moment in accordance with 4.3.3.1, [m].

#### Table 4.3.5-2

<table>
<thead>
<tr>
<th>Lounges</th>
<th>95%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine and boiler rooms</td>
<td>85%</td>
</tr>
<tr>
<td>Luggage and store rooms</td>
<td>75%</td>
</tr>
<tr>
<td>Double bottoms, fuel bunkers, ballast and other tanks, depending on whether, according to their intended purpose, they shall be assumed to be full or empty for the vessel floating at the plane of maximum draught</td>
<td>0% to 95%</td>
</tr>
</tbody>
</table>

**4.3.5.5** The shut-off devices of openings capable of being closed watertight, through which undamaged compartments may additionally become flooded, shall be marked accordingly.

**4.3.5.6** If cross-flood openings to reduce asymmetrical flooding are provided, they shall meet the following conditions:

a) for the calculation of cross-flooding, IMO Resolution A.266 (VIII) shall be applied;

b) they shall be self-activating;

c) they shall not be equipped with shut-off devices;

d) the total time permitted for compensation shall not exceed 15 minutes.

**4.3.5.7** As an alternative to the damage stability requirements given in 4.3.5.4 to 4.3.5.6, for passenger vessels authorized to carry up to a maximum of 50 passengers and with a length $L_{WL}$ of not more than 25.0 m, the stability criteria defined in 4.3.7.1 may be complied with.

**4.3.6 Safety clearance and freeboard**

**4.3.6.1 General**

The following requirements do not apply to the passenger vessels authorized to carry up to a maximum of 50 passengers and with a length, $L_{WL}$, of not more than 25.0 m.

**4.3.6.2 Safety clearance**

The safety clearance shall be at least equal to the sum of:

a) the additional lateral immersion, which, measured on the outside plating, is resulting from the permissible heeling angle according to 4.3.4, e; and

b) the residual safety clearance according to 4.3.4, g).

For vessels without a bulkhead deck, the safety clearance shall be at least 0.50 m.

**4.3.6.3 Freeboard**

The freeboard shall be at least equal to the sum of:

a) the additional lateral immersion, which, measured on the outside plating, is resulting from the heeling angle according to 4.3.4, e; and

b) the residual freeboard according to 4.3.4, f).
Chapter I - TYPE NOTATIONS

However, the freeboard shall be at least 0,3 m.

4.3.6.4 The plane of maximum draught shall be set so as to ensure compliance with the safety clearance according to 4.3.6.2 and the freeboard according to 4.3.6.3.

For safety reasons, the Register may stipulate a greater safety clearance or a greater freeboard.

4.3.7 Derogations for certain passenger vessels

4.3.7.1 Passenger vessels authorized to carry up to a maximum of 50 passengers and with a length LWL of not more than 25,0 m shall prove adequate stability after damage according to 4.3.5 or, as an alternative, prove that they comply with the following criteria after symmetrical flooding:

a) keep the positive buoyancy after flooding of each compartment. Muster area on the bulkhead area must not be submerged; and

b) the residual metacentric height GMt shall not be less than 0,1 m.

The necessary residual buoyancy shall be assured through the appropriate choice of material used for the construction of the hull or by means of highly cellular foam floats, solidly attached to the hull. In the case of vessels with a length of more than 15,0 m, residual buoyancy may be ensured by a combination of floats and subdivision complying with the 1-compartment status according to 4.3.5.

4.3.7.2 By way of derogation from 4.3.5, passenger vessels with a length of not more than 45,0 m and authorized to carry up to a maximum of 250 passengers do not need to have 2-compartment status.

4.4 Structural arrangement

4.4.1 General

Adequate continuity of structure shall be maintained throughout the length of the vessel. Where significant changes in structural arrangement or change from the longitudinal to transverse framing system occur, adequate transitional structure shall be provided.

Special attention shall be paid:
– at the connection of midship region with the fore part, the machinery space and/or the aft part and in way of ends of those structures;
– in way of ends of double hull;
– in way of ends of superstructures;
– in way of ends and at the connections of ordinary stiffeners and primary supporting members.

The transition shall be made gradually, with adequate tapering and sufficient scarfing, in accordance with requirements from the Rules, Part 2 – Hull and Hull Equipment, Chapter II, Section 6.

In addition, general provisions given in the Rules, Part 2 – Hull and Hull Equipment, Chapter V, 1.5 shall be complied with, as applicable.

4.4.2 Bottom structure arrangement

4.4.2.1 General

General provisions given in the Rules, Part 2 – Hull and Hull Equipment, Chapter V, Section 2 shall be complied with, as applicable.

Where double bottom is provided, the minimum height, measured at right angles to the bottom, shall not be less than 600,0 mm.

To ensure continuity of structure, at their ends, supporting members shall, as a rule, be connected by means of brackets.

As an alternative, if brackets are not suitable, single bottom supporting members may be connected to vertical primary supporting members of single side by means of bracketless end connections, in compliance with the Rules, Part 2 – Hull and Hull Equipment, Chapter II, 5.4.3.

Where brackets are fitted, their net scantlings shall not be less than the values obtained from the formulae given in the Rules, Part 2 – Hull and Hull Equipment, Chapter II, 5.4.2 and Figure 5.2.2-1.

4.4.2.2 Scantlings

The net thicknesses of bottom and inner bottom plating and the net scantlings of bottom and inner bottom supporting members shall comply with the Rules, Part 2 – Hull and Hull Equipment, Chapter V, 2.4 and 2.5 respectively.

Where the height of the double bottom varies, the variation shall, in general, be made gradually and over an adequate length, by means of inclined inner bottom plating, to ensure continuity of structure. The knuckles at the ends of the sloped part of inner bottom plating shall be located in way of solid floors or bottom girders. Where this is not possible, suitable structures such as partial girders, brackets etc., fitted across the knuckle, shall be arranged.

In way of ends of inner bottom the transition shall be made gradually, with adequate tapering and sufficient scarfing. The stress concentration shall be reduced by the use of smoothly shaped brackets coplanar with the plane of inner bottom plating.

4.4.3 Side structure arrangement

4.4.3.1 General

General provisions given in the Rules, Part 2 – Hull and Hull Equipment, Chapter V, Section 3 shall be complied with, as applicable.

Where side compartments are provided, the minimum width of double side, measured at right angles to the side shell, shall not be less than 600,0 mm.

To ensure continuity of structure, at their ends, supporting members shall, as a rule, be connected by means of brackets.

As an alternative, if brackets are not suitable, vertical primary supporting members of single side may be connected to single bottom and deck supporting members by
means of bracketless end connections, in compliance with the
Rules, Part 2 – Hull and Hull Equipment, Chapter II, 5.4.3.

Where bulkheads are fitted, their net scantlings shall
not be less than the values obtained from the formulae given
in the Rules, Part 2 – Hull and Hull Equipment, Chapter II, 5.4.2.

A curved bracket shall be considered as the largest
bracket contained in the curved bracket as defined in the
Rules, Part 2 – Hull and Hull Equipment, Chapter II, 5.4.2
and Figure 5.2.2-1.

4.4.3.2 Scantlings

The net thicknesses of side plating and the net
scantlings of side supporting members shall comply with the
Rules, Part 2 – Hull and Hull Equipment, Chapter V, 3.4 and
3.5 respectively.

The Register may waive requirement for increased
thickness of sheer strake plating if an efficient fender is
provided in a way of the upper deck.

4.4.4 Deck structure arrangement

4.4.4.1 General

General provisions given in the Rules, Part 2 – Hull
and Hull Equipment, Chapter V, Section 4 shall be complied
with, as applicable.

4.4.4.2 Scantlings

The net thicknesses of deck plating and the net
scantlings of deck supporting members shall, in general,
comply with the Rules, Part 2 – Hull and Hull Equipment,
Chapter V, 4.4 and 4.5 respectively.

Continuity of deck structure shall be maintained
throughout the length of the vessel, especially at the ends of
superstructures/deckhouses. All longitudinal members shall
be continuous or suitably connected to adjacent structures by
means of adequate transitional joints.

4.4.5 Bulkheads

4.4.5.1 General

The minimum number and disposition of bulkheads
are defined in 4.2.4.

Additional bulkheads shall be fitted, if necessary, at
steady intervals to provide sufficient transverse strength of
the vessel, in accordance with the Rules, Part 2 – Hull
and Hull Equipment, Chapter II, 3.1.2. Additional bulkheads may
also be needed in order to ensure an efficient support to the
superstructures/deckhouses.

As alternative, if ensuring the bulkheads at relevant
positions is not possible, the strength continuity of the vessel
shall be maintained by increased framing, fitting of
transverse reinforced rings etc. Details shall be considered by
the Register on a case by case basis.

General provisions given in the Rules, Part 2 – Hull
and Hull Equipment, Chapter V, Section 5 shall be complied
with, as applicable.

4.4.5.2 Scantlings

The net thicknesses of bulkhead plating and the net
scantlings of bulkhead supporting members shall comply with the
Rules, Part 2 – Hull and Hull Equipment, Chapter
V, 5.4 and 5.5 respectively.

4.4.6 Superstructures and deckhouses

4.4.6.1 General

General provisions given in the Rules, Part 2 – Hull
and Hull Equipment, Chapter V, Section 9 shall be complied
with, as applicable.

Adequate continuity of structure shall be
maintained as follows (see also the Rules, Part 2 – Hull
and Hull Equipment, Chapter V, 9.2):

.1 superstructure and deckhouse supporting members shall,
in general, be fitted in way of supporting members of
adjacent hull structure.

As a rule, spacing of the vertical supporting members of
sides of superstructures and deckhouses shall be the same
as that of the beams or transverses of the supporting
dek;

.2 ends of superstructures and deckhouses shall be
effectively supported by hull bulkheads, pillars,
reinforced rings, side shell or inner sides etc.;

.3 the side plating of superstructures contributing to the
longitudinal strength shall, in general, be arranged as a
continuation of the hull side shell.

Ends of superstructures shall be effectively tapered into
the bulwark or sheer strake of the supporting deck;

.4 if sides of superstructure are placed at some distance
inboard of the shell edge, then bulkheads, deep girders or
other internal vertical members for tie-in with the main
hull shall be fitted, maintaining the structural continuity;

.5 the connection details of corners of superstructures and
deckhouses and the supporting deck shall be considered
by the Register on a case by case basis. If deemed
necessary by the Register, reinforcements shall be
required.

4.4.6.2 Scantlings

The net thicknesses of plating and the net scantlings
of superstructure and deckhouse supporting members shall
comply with the Rules, Part 2 – Hull and Hull Equipment,
Chapter V, 9.4 and 9.5 respectively.

In addition, structure above the lowest deck (which
is, in general, the uppermost continuous deck supporting the
superstructure, marked as upper deck in Figure 4.4.6.1
shall be checked against structural horizontal inertial loads due
to vessel’s accelerations (determined in compliance with the
Rules, Part 2 – Hull and Hull Equipment, Chapter III, 5.3)
and external loads (determined in compliance with the Rules,
Part 2 – Hull and Hull Equipment, Chapter III, 4.3), acting
simultaneously on the structure.

Transverse inertial forces shall be distributed on
vertical structural members of reinforced scantlings (sides,
bulkheads and/or efficient supports, as applicable) effectively
connected to hull structure and efficiently contributing to
longitudinal and/or transverse strength.

Strength check of those members shall be carried
out by direct calculation, in accordance with 4.1.3.
Chapter I - TYPE NOTATIONS

4.4.3 Strength against racking

4.4.3.1 General

In addition to strength check in accordance with 4.4.6.2, the racking analysis shall be carried out for check of transverse strength of superstructure taking into account the horizontal transverse loads due to heel, vessel’s transverse accelerations and external loads, defined in 4.4.6.3.2.

4.4.6.3.2 Loads due to heeling and external loads

1 General

The loads acting simultaneously, inducing the racking in vessel structures above upper deck (see Figure 4.4.6-1) are as follows:

- external load;
- structural horizontal transverse load;
- non-structural horizontal transverse load.

2 Transverse acceleration

Transverse acceleration, \( a_y \), due to roll, is given by the following formula:

\[
a_y = \varphi_M \left( \frac{2 \pi}{T_R} \right)^2 \left( z_i - z_G \right), \quad [\text{m/s}^2]
\]

(4.4.6-1)

where:

\( \varphi_M \) = heel angle due to heeling moment, [°];

= in damage condition, due to one-sided accumulation of persons, given in 4.3.3.1;

= in intact condition, due to heeling moment resulting from moments due to persons, wind and turning according 4.3.3.1, 4.3.3.2 and 4.3.3.3, respectively;

\( T_R \) = motion period, [s];

\[
= 2,2 \cdot \frac{\delta}{\sqrt{GM}};
\]

\( \delta \) = rule radius of gyration, corresponding to the loading condition considered, [m];

= when \( \delta \) is not known, the value of 0,35\( B \) may be considered by the Register on a case by case basis;

\( z_i \) = \( z \) coordinate of \( i \)-th tier deck (see Figure 4.4.6-1), [m];

\( z_G \) = height of rolling centre above base line, [m];

= when \( z_G \) is not known, it may be considered by the Register on a case by case basis to be taken equal to the vertical centre of gravity, corresponding to the loading condition and stability condition considered.

.3 Structural horizontal load

The structural horizontal load acting on \( i \)-th tier deck, between adjacent transverse bulkheads or efficient supports, is given by the following formula:

\[
P_{Hi} = P_{si} + P_{ai} \quad [\text{kN}]
\]

(4.4.6-2)

where:

\( P_{si} \), \( P_{ai} \) = static and inertial forces, respectively, [kN].

Static force acting on structure is given by the formula:

\[
P_{si} = g \cdot m_{si} \cdot \sin \varphi, \quad [\text{kN}]
\]

(4.4.6-3)

where:

\( m_{si} \) = structural mass of \( i \)-th tier of superstructure, between adjacent bulkheads or efficient supports, [t];

= in general, where applicable and relevant, structural mass shall be taken with outfitting and equipment included;

= if not otherwise provided, the value of \((0,075 \cdot S_B \cdot b_i \cdot h_i)\) may be considered by the Register on a case by case basis;

\( S_B \) = spacing between adjacent transverse bulkheads or efficient supports, [m];

\( b_i \), \( h_i \) = width and height of \( i \)-th tier of superstructure, respectively (see Figure 4.4.6-1), [m];

\( \varphi \) = heel angle in general not less than 12°, for both intact and damage condition. Different values of heel angle may be accepted or required by the Register, based on the stability calculations, in accordance with 4.3, [°].

Inertial force acting on structure is given by the formula:

\[
P_{ai} = 0,0 \quad [\text{kN}]
\]

(4.4.6-4)

\( P_{ai} \) = 0,0 kN for \( H < 1,20 \text{ m} \).

where:

\( H \) = significant wave height, [m].

.4 Non-structural horizontal load

The non-structural horizontal load acting on \( i \)-th deck, between adjacent bulkheads or efficient supports, is given by the following formula:

\[
P_{Hi} = P_{si} + P_{ai} \quad [\text{kN}]
\]

(4.4.6-5)
where:

\[ P_{si} = P_{Di} \cdot S_{Bi} \cdot b_i \cdot \sin \phi, \quad [\text{kN}] \]  

where:

\[ P_{Di} = \text{design lateral loads acting on } i^{\text{th}} \text{ tier deck, defined in the Rules, Part 2 – Hull and Hull Equipment, Chapter V, 9.3,} \quad [\text{kN/m}^2]; \]

\[ S_{Bi} = \text{spacing between adjacent transverse bulkheads or efficient supports,} \quad [\text{m}]; \]

\[ b_i = \text{width of } i^{\text{th}} \text{ tier of superstructure,} \quad [\text{m}]; \]

\[ \phi = \text{heel angle in general not less than } 12^\circ, \text{ for both intact and damage condition. Different values of heel angle may be accepted or required by the Register, based on the stability calculations, in accordance with 4.3,} \quad [\text{°}]. \]

Inertial force on structure is given by the formula:

\[ P_{ii} = P_{Di} \cdot S_{Bi} \cdot b_i \cdot \sin \phi \cdot \frac{a_i}{g}, \quad [\text{kN}] \]  

\[ H = 0,0 \text{ kN for } H < 1,20 \text{ m.} \]

where:

\[ H = \text{significant wave height,} \quad [\text{m}]. \]

.5 External load

The external load acting on \( i^{\text{th}} \) tier deck, between adjacent bulkheads or efficient supports, is given by the following formula:

\[ P_{Ei} = 0,5 \cdot P_{Ei} \cdot S_{Bi} \cdot (h_i + h_{si}), \quad [\text{kN}] \]  

where:

\[ P_{Ei} = \text{external load on sides, defined in the Rules, Part 2 – Hull and Hull Equipment, Chapter V, 9.3,} \quad [\text{kN/m}^2]; \]

\[ S_{Bi} = \text{spacing between adjacent transverse bulkheads or efficient supports,} \quad [\text{m}]; \]

\[ h_i = \text{height of } i^{\text{th}} \text{ tier of superstructure, see Figure 4.4.6-4}, \quad [\text{m}]. \]

4.4.6.3.3 Strength check

Structure above the lowest deck (marked as upper deck in Figure 4.4.6-1) shall be checked against racking as follows.

Transverse forces calculated in accordance with 4.4.6.3.2 shall be distributed on vertical structural members of reinforced scantlings (transverse bulkheads or efficient supports) effectively connected to hull structure and efficiently acting against racking.

Check of transverse strength of those members shall be carried out by direct calculation, in accordance with 4.1.3., taking the safety factor as \( f_v=1,2 \).

4.4.6.4 Strength against collision

4.4.6.4.1 General

If deemed necessary by the Register, in case of slender and sensitive superstructures, taking into consideration vessel characteristics and intended operating conditions, strength check of superstructure against collision may be required.

4.4.6.4.2 Loads induced by collision

.1 General

The loads induced by collision in vessel structures above upper deck (see Figure 4.4.6-1) are as follows:

– structural loads;
– non-structural horizontal loads.

.2 Longitudinal and transverse acceleration

The values of the longitudinal and transverse accelerations, in \([\text{m/s}^2]\), shall not be taken less than:

– longitudinal acceleration: \( a_x = 3,0 \text{ m/s}^2 \);
– transverse acceleration: \( a_y = 1,5 \text{ m/s}^2 \).

.3 Horizontal loads induced by collision

The horizontal loads induced by collision are structural horizontal inertial loads acting on \( i^{\text{th}} \) tier deck in longitudinal or transverse direction, between adjacent bulkheads or efficient supports.

Inertial forces in longitudinal or transverse direction, respectively, acting on structure, are given by the following formulas:

\[ P_{ax} = m_{si} \cdot a_x, \quad [\text{kN}] \]  

\[ P_{ay} = m_{si} \cdot a_y, \quad [\text{kN}] \]  

where:

\[ m_{si} = \text{structural mass of } i^{\text{th}} \text{ tier of superstructure, between adjacent bulkheads or efficient supports,} \quad [\text{t}]; \]

= in general, where applicable and relevant, structural mass shall be taken with outfitting and equipment included;

= if not provided, the value of \((0,075 \cdot S_{Bi} \cdot b_i \cdot h_i)\) may be considered by the Register on a case by case basis;

\[ S_{Bi} = \text{spacing between adjacent transverse bulkheads or efficient supports,} \quad [\text{m}]; \]

\[ b_i, h_i = \text{width and height of } i^{\text{th}} \text{ tier of superstructure, respectively (see Figure 4.4.6-4)}, \quad [\text{m}]; \]

\[ a_x = \text{vessel’s longitudinal acceleration,} \quad [\text{m/s}^2]; \]

\[ a_y = \text{vessel’s transverse acceleration defined in 4.4.6.3.2}, \quad [\text{m/s}^2]. \]
It shall be considered as contributing to the longitudinal strength if superstructure or a deckhouse is comprised of longitudinal members below strength deck extending over an effective length (see the Rules, Part 2 – Hull and Hull Equipment, Chapter IV, 1.3.1), and is adequately connected to the hull structure, maintaining the structural continuity and forming a part of hull girder (see provisions given in the Rules, Part 2 – Hull and Hull Equipment, Chapter IV, 3.1).

4.4.6.5.2 Hull girder loads

Hull girder loads acting on the vessel as a whole, when considered as a girder, shall be determined according to the Rules, Part 2 – Hull and Hull Equipment, Chapter IV, Section 2).

4.4.6.5.3 Bending and shear strength check

Bending and shear strength of hull girder transverse sections shall comply with the requirements of the Rules, Part 2 – Hull and Hull Equipment, Chapter IV, Section 3 and Section 4, respectively.

4.4.6.6 Scantling of window stiles

4.4.6.6.1 General

The geometric characteristics of the hull girder shall be determined in compliance with 4.4.6.3, considering that the hull girder extends up to the deck of the uppermost superstructure/deckhouse contributing to the longitudinal strength (i.e. to the strength deck).

4.4.6.6.2 Forces in the window stile

a) Local shear force, \( Q \), shall be obtained from the following formula:

\[
Q = 0.5 \cdot \tau \cdot t \cdot l_{\text{WI}} \quad \text{[kN]}
\]  

(4.4.6-11)

where:

\( \tau \) = shear stress in way of the window (i.e. at the hull girder transverse section in a way of window, at the vertical level of the window) determined in compliance with the Rules, Part 2 – Hull and Hull Equipment, Chapter IV, Section 4, [N/mm²];

\( t \) = mean net thickness of the hull girder sides in way of the window, [mm];

\( l_{\text{WI}} \) = distance between centres of two adjacent windows, [m].

b) Maximum local bending moment, \( M_B \), shall be obtained from the following formula:

\[
M_B = 0.5 \cdot Q \cdot h_{\text{WI}} \quad \text{[kNm]}
\]  

(4.4.6-12)

where:

\( h_{\text{WI}} \) = distance between centres of two adjacent windows, [m].

4.4.6.6.3 Strength check

Strength check of window stiles shall be carried out by direct calculation in accordance with 4.1.3., taking the safety factor as \( f_s = 1.2 \).
.2 level of normal stresses and shear stresses in welds in way of highly stressed areas;
.3 column buckling and local buckling of primary supporting members, plane or corrugated bulkheads etc., subjected to significant compressive loads.

All calculation documents shall be submitted to the Register.

5.1.4 Materials other than normal strength hull structural steel

When steels with a minimum yield strength \( R_{yf} \) other than 235,0 N/mm² are used on a vessel, the scantlings shall be determined by taking into account the corresponding material factor, \( f_k \), Young’s modulus of elasticity, \( E \), yield strength, \( R_{yf} \), for hull structural steels etc.

5.1.5 Safety factor

If not otherwise specified, safety factors, \( f_k \), covering uncertainties regarding material and resistance, of vessels covered by the present Rules are defined in the Rules, Part 2 – Hull and Hull Equipment, Chapter V, 1.7.

5.1.6 Stability

Proof of sufficient intact stability shall be provided in accordance with the present Rules, Chapter III, 4.4.

The Register may waive this requirement, depending on the vessel design and characteristics, loading conditions and intended operating conditions.

5.1.7 Documentation to be submitted

In addition to the documentation required in other Parts of the Rules, the following documentation shall be submitted for approval/review:

.1 plans showing the pushing or towing arrangements and connection of pushing/towing devices to hull structure;

.2 the maximum pushing/towing force for which the arrangements shall be designed, shall be specified on the drawings.

Those plans shall also indicate the reinforced scantlings of hull structure as well as details of connections and transitional structures ensuring adequate strength continuity.

5.2 Vessel arrangement

5.2.1 General

General provisions given in the Rules, Part 2 – Hull and Hull Equipment, Chapter VI, Section 8 shall be complied with, as applicable.

The towing/pushing devices shall, in general, be fixed on deck, which shall be locally reinforced.

Adequate continuity of structure shall be ensured in way of connection of towing/pushing devices to hull in order to avoid in order to avoid the occurrence of excessive stresses in the vessel structure.

The dimensioning of towing/pushing devices and adjacent hull structural members shall be performed on the basis of towing/pushing forces obtained by the Designer.

5.2.2 Pushing devices

Pushers shall be arranged with an efficient flat transom plate or any other adequate pushing devices at the fore end of the vessel, the arrangement of which shall be in compliance with the Rules, Part 2 – Hull and Hull Equipment, Chapter VI, Section 8.2.

The structural reinforcements in way of pushing devices shall be continued in fore-and-aft direction (by means of longitudinal bulkheads, deck girders, reinforced rings etc. of adequate scantlings) in order to effectively transmit the pushing forces to the hull structure.

The details of design shall be considered by the Register on a case by case basis.

5.2.3 Towing devices

On tugs towing astern, the connection of the towing devices to the adjacent hull structure shall be strengthened, as necessary, by means of framing of reinforced scantlings and by means of plating of increased thickness.

On tugs using a broadside tow, the towing bollards shall be fixed to their foundations effectively supported by bulkheads, web frames or reinforced rings of adequate scantlings.

Those structural reinforcements shall be continued in fore-and-aft direction and, as necessary, in athwartship direction, in order to adequately transmit the pushing forces to the hull structure.

The details of design shall be considered by the Register on a case by case basis.

5.2.4 Hull protection

A strong fender for the protection of the vessel sides shall be fitted at deck level.

As alternative, arrangements with loose side fenders may be considered by the Register on a case by case basis, provided that those arrangements are equally effective.

5.3 Structural arrangement

5.3.1 General

General provisions given in 5.2 shall be complied with.

Adequate continuity of structure shall be maintained. Where significant changes in structural arrangement occur, adequate transitional structure shall be provided.

The transition shall be made gradually, with adequate tapering and sufficient scarfing, in accordance with requirements from the Rules, Part 2 – Hull and Hull Equipment, Chapter II, Section 6.

Special attention shall be paid in way of connection of the pushing/towing devices to the hull structure.

General provisions given in the Rules, Part 2 – Hull and Hull Equipment, Chapter V, 1.5 shall also be complied with, as applicable.
Chapter I - TYPE NOTATIONS

5.3.2 Design loads

5.3.2.1 General

The loads shall be calculated independently for each vessel’s condition (as given in the Rules, Part 2 – Hull and Hull Equipment, Chapter III, 2.3), by applying the associated loading conditions (as defined in the Rules, Part 2 – Hull and Hull Equipment, Chapter III, 2.2), to determine the most severe loading of the structural members analysed.

Where loading conditions other than standard design loading conditions are also expected, calculations for such conditions shall be submitted in addition to the standard conditions.

Structural members of compartments subjected to testing conditions shall be checked for testing loads, calculated according to the Rules, Part 2 – Hull and Hull Equipment, Chapter III, 5.8.

Structural members of watertight boundaries of compartments not intended to carry liquids shall be checked for flooding loads, calculated according to the Rules, Part 2 – Hull and Hull Equipment, Chapter III, 4.4.

5.3.2.2 Pushing/towing forces

The value of pushing/towing forces shall be specified by the Designer, based on intended service conditions of the vessel.

5.3.3 Hull scantlings

5.3.3.1 General

The hull scantlings shall, in general, not be less than required in the Rules, Part 2 – Hull and Hull Equipment, Chapter V – Hull scantlings, taking also into account the above mentioned provisions concerning hull structure in a way of pushing/towing devices.

5.3.3.2 Plating

The net thickness, \( t \), of plating shall not be less than the following value:

\[
t = \sqrt{k} + 0.55 \cdot s + 2.9 \text{ , [mm]}
\]

where:

- \( k \) = material factor defined in the Rules, Part 2 – Hull and Hull Equipment, Chapter II, Section 2;
- \( s \) = spacing of ordinary stiffeners defined in the Rules, Part 2 – Hull and Hull Equipment, Chapter II, 5.3.2, [m].

In addition, the minimum net thickness of deck plating shall not be less than 5.0 mm.

5.3.3.3 Supporting members

The net thickness, \( t \), of web of ordinary stiffeners and primary supporting members shall not be less than the following value:

\[
t = \sqrt{k} + 0.55 \cdot s + 2.9 \text{ , [mm]}
\]

where:

- \( k \) = material factor defined in the Rules, Part 2 – Hull and Hull Equipment, Chapter II, Section 2;
- \( s \) = spacing of ordinary stiffeners defined in the Rules, Part 2 – Hull and Hull Equipment, Chapter II, 5.3.2, [m].

5.3.4 Hull outfitting

Rudder arrangements shall be provided following provisions given in the Rules, Part 2 – Hull and Hull Equipment, Chapter VI, Section 5.

In any case, the rudder scantlings shall not be less than those determined according to the requirements applicable to range of navigation IWW-1,2.

5.3.5 Machinery

Propulsion systems positioned under the bottom level shall be protected against damage by suitable structures fitted around those systems.
6 PONTOONS

6.1 General

6.1.1 Application

6.1.1.1 Vessels complying with the requirements of this Section may be assigned the type notation Pontoons, as defined in the Rules, Part 1 – Classification and Surveys, Chapter I, 3.5.4.

6.1.1.2 Vessels considered in this Section shall comply with the applicable requirements of the Rules, Part 1 – Classification and Surveys, Part 2 – Hull and Hull Equipment and Part 3 – Machinery, Systems and Electricity, as well as with the requirements of this Section which are specific to pontoons.

6.1.2 Design loads

6.1.2.1 General

The loads shall be calculated independently for each vessel’s condition (as given in the Rules, Part 2 – Hull and Hull Equipment, Chapter III, 2.3), by applying the associated loading conditions (as defined in the Rules, Part 2 – Hull and Hull Equipment, Chapter III, 2.2), to determine the most severe loading of the structural members analysed.

Where loading conditions other than standard design loading conditions are also expected, calculations for such conditions shall be submitted in addition to the standard conditions.

Structural members of compartments subjected to testing conditions, shall be checked for testing loads, calculated according to the Rules, Part 2 – Hull and Hull Equipment, Chapter III, 3.8.

Structural members of watertight boundaries of compartments not intended to carry liquids, shall be checked for flooding loads, calculated according to the Rules, Part 2 – Hull and Hull Equipment, Chapter III, 4.4.

6.1.3 Direct calculation

Direct calculation may be adopted for the yielding and buckling checks of hull structural members instead of the Rules scantling formulae as well as for the analysis of structural members not covered by the Rules or for type of loading not covered by the Rules (e.g. heavy concentrated loads, unevenly distributed loads etc.), in accordance with the Rules, Part 2 – Hull and Hull Equipment, Chapter V, 1.8.

The following strength checks shall be carried out, as applicable:

.1 level of normal stresses and shear stresses in way of significant structural discontinuities (e.g. considerable changes in structural arrangement and scantlings);

.2 level of normal stresses and shear stresses in way of highly stressed areas;

.3 column buckling and local buckling of primary supporting members, plane or corrugated bulkheads etc., subjected to significant compressive loads.

All calculation documents shall be submitted to the Register.

6.1.4 Materials other than normal strength hull structural steel

When steels with a normal yield strength \( \sigma_{y} \) other than 235,0 N/mm² are used on a vessel, the scantlings shall be determined by taking into account the corresponding material factor, \( k \), Young’s modulus of elasticity, \( E \), yield strength, \( \sigma_{y} \), for hull structural steels etc.

6.1.5 Safety factor

If not otherwise specified, safety factors, \( f_s \), covering uncertainties regarding material and resistance, of vessels covered by the present Rules are defined in the Rules, Part 2 – Hull and Hull Equipment, Chapter V, 1.7.

6.1.6 Stability

Proof of sufficient intact stability shall be provided in accordance with the present Rules, Chapter III, 4.5.

The Register may waive this requirement, depending on the vessel design and characteristics, loading conditions and intended operating conditions.

6.1.7 Documentation to be submitted

6.1.7.1 General

Documentation required in the Rules, Part 1 – Classification and Surveys, Chapter II, Table 3.2-1, shall be submitted to the Register.

6.1.7.2 Vessels intended to carry heavy cargoes

In addition to the documentation specified in 6.1.7.1, for vessels intended to carry heavy cargoes, the following information shall be submitted to the Register:

.1 heavy cargo arrangement, indicating weight of cargoes concentrated on limited areas;

.2 transverse and longitudinal sections showing, as applicable, strengthened structural members subjected to heavy cargo loads.

That documentation shall, in general, be supported by direct calculations and shall clearly indicate the design loads of structural members subjected to load concentrations as well as relevant details of transitional structures ensuring adequate strength continuity.

6.1.7.3 Vessels equipped with a permanently fitted crane, intended for lifting heavy cargoes

In addition to the documentation specified in 6.1.7.1, for vessels equipped with a permanently fitted crane, specifically arranged and intended for lifting of heavy cargoes, the following information shall be submitted to the Register:

.1 intended crane operations, including crane load charts (indicating weight of cargoes to be lifted and associated operating radii);

.2 cargo arrangement, indicating weight of cargoes distributed on deck areas;

.3 crane pedestal arrangement, indicating connections to hull structure;

.4 transverse and longitudinal sections showing strengthened structural members subjected to crane loads.

That documentation shall be supported by direct calculations and shall clearly indicate the design loads of
Chapter I - TYPE NOTATIONS

structural members subjected to load concentrations as well as relevant details of transitional structures ensuring adequate strength continuity.

General provisions given in the Rules, Part 2 – Hull and Hull Equipment, Chapter 1, 1.2 shall be complied with.

6.1.7.4 Vessels intended to wheeled vehicles

In addition to the documentation specified in 6.1.7.1, for vessels intended to carry wheeled vehicles, the following information shall be submitted to the Register:

.1 wheeled cargo arrangement, indicating the following:
- type of vehicles;
- axle load;
- distance between axles;
- number of wheels (or group of wheels) per axle;
- configuration of wheels including distance between wheels;
- tyre print area.

.2 transverse and longitudinal sections showing, as applicable, strengthened structural members subjected to wheeled cargo loads.

That documentation shall, in general, be supported by direct calculations and shall clearly indicate the design loads of structural members subjected to load concentrations as well as relevant details of transitional structures ensuring adequate strength continuity.

6.2 Vessel arrangement

6.2.1 General

The requirements of this Section apply, in general, to flush deck single hull vessels, intended primarily to carry cargoes on deck.

The loading/unloading may be performed in one or two runs.

Hull structure shall, in general, be built in longitudinal framing system, with longitudinal stiffeners supported by transverses forming transverse rings, possibly of reinforced scantlings.

As an alternative, parts of hull structure may be built with primary supporting members as a grillage. The details of arrangement shall be considered by the Register on a case by case basis.

6.2.2 Truss arrangements

Truss arrangements may be used as supports of the deck loads, including deck and bottom primary supporting member, possibly of reinforced scantlings, in association with pillars and diagonal structural members (bracings). The diagonal structural members shall, in general, have angles of inclination with respect to the horizontal of about 45° and cross-sectional area of about 50% of that of the adjacent pillars.

6.2.3 Supports for docking

Suitable supports (bottom centre girder of adequate scantlings or equivalent structures) shall be fitted in order to carry loads acting on the structure during dry docking.

6.2.4 Lifting appliances during navigation

For vessels with the type notation Pontoon/ Crane, as a rule, it shall be possible to lower and efficiently secure the crane boom or the derrick structure during navigation.

The analysis of the behaviour of the lifting appliances during operation or navigation is, in general, outside the scope of the classification and is under the responsibility of the Designer.

6.3 Structural arrangement

6.3.1 General

General provisions given in 6.2 shall be complied with.

Adequate continuity of structure shall be maintained. Where significant changes in structural arrangement occur, adequate transitional structure shall be provided.

The transition shall be made gradually, with adequate tapering and sufficient scarfing, in accordance with requirements from the Rules, Part 2 – Hull and Hull Equipment, Chapter II, Section 6.

Special attention shall be paid in way of connection of mooring or towing equipment, crane pedestals, etc. to the hull structure.

General provisions given in the Rules, Part 2 – Hull and Hull Equipment, Chapter V, 1.5 shall also be complied with, as applicable.

6.3.2 Hull scantlings

6.3.2.1 General

The hull scantlings shall, in general, not be less than required in the Rules, Part 2 – Hull and Hull Equipment, Chapter V – Hull scantlings, taking also into account above mentioned provisions concerning the structures permanently connected to vessel’s hull.

Strength check of structural members subjected to load concentrations (e.g. crane loads, wheeled cargo loads, mooring and towing loads, etc.) shall be carried out by direct calculation, in accordance with 6.1.3. Those structural members shall be adequately strengthened. The details of design shall be considered by the Register on a case by case basis.

6.3.2.2 Plating

The net thickness, $t$, of plating shall not be less than the following value:

$$t = 0.45 \cdot \sqrt{L \cdot k} + 0.55 \cdot s + 2.0 \text{, [mm]}$$

(6.3.2-1)

where:

- $k$ = material factor defined in the Rules, Part 2 – Hull and Hull Equipment, Chapter II, Section 2;
- $s$ = spacing of ordinary stiffeners defined in the Rules, Part 2 – Hull and Hull Equipment, Chapter II, 5.3.2, [m].

6.3.2.3 Supporting members

For parts of structure where primary supporting members form a grillage, the strength check shall be carried out by direct calculation, in accordance with 6.1.3.
7 VESSELS FOR DREDGING

7.1 General

7.1.1 Application

Vessels complying with the requirements of this Section may be assigned the following type notations, as defined in the Rules, Part 1 – Classification and Surveys, Chapter I, 3.5.4 as follows:
- Dredger;
- Hooper dredger;
- Hooper barge;
- Split hopper barge.

7.1.1.2 Vessels considered in this Section shall comply with the applicable requirements of the Rules, Part 1 – Classification and Surveys, Part 2 – Hull and Hull Equipment and Part 3 – Machinery, Systems and Electricity as well as with the requirements of this Section which are specific to vessels for dredging.

7.1.1.3 Only ranges of navigation IWW-0.6, IWW-1.2 and IWW-2.0 may be assigned.

7.1.1.4 Dredging equipment and installations are not covered by the Rules.

7.1.2 Design loads

7.1.2.1 General

The loads shall be calculated independently for each vessel’s condition (as given in the Rules, Part 2 – Hull and Hull Equipment, Chapter III, 2.3), by applying the associated loading conditions (as defined in the Rules, Part 2 – Hull and Hull Equipment, Chapter III, 2.2), to determine the most severe loading of the structural members analysed.

Where loading conditions other than standard design loading conditions are also expected, calculations for such conditions shall be submitted in addition to the standard conditions.

Structural members of compartments subjected to testing conditions, shall be checked for testing loads, calculated according to the Rules, Part 2 – Hull and Hull Equipment, Chapter III, 5.8.

Structural members of watertight boundaries of compartments not intended to carry liquids, shall be checked for flooding loads, calculated according to the Rules, Part 2 – Hull and Hull Equipment, Chapter III, 4.4.

7.1.2.2 Cargo loads

Cargo loads shall be determined in compliance with the present Rules, Chapter III, 3.2 or 3.3, as applicable, where the cargo density \( \rho_c \), in \([\text{t/m}^3]\), of the water and spoil mixture shall not be taken less than 1.8.

7.1.3 Direct calculation

Direct calculation may be adopted for the yielding and buckling checks of hull structural members instead of the Rules scantling formulae as well as for the analysis of structural members not covered by the Rules or for type of loading not covered by the Rules (e.g. heavy concentrated loads, unevenly distributed loads etc.), in accordance with the Rules, Part 2 – Hull and Hull Equipment, Chapter V, 1.8.

The following strength checks shall be carried out, as applicable:
1. level of normal stresses and shear stresses in way of significant structural discontinuities (e.g. considerable changes in structural arrangement and scantlings);
2. level of normal stresses and shear stresses in welds in way of highly stressed areas;
3. column buckling and local buckling of primary supporting members, bulkheads etc., subjected to significant compressive loads.

All calculation documents shall be submitted to the Register.

7.1.4 Materials other than normal strength hull structural steel

When steels with a minimum yield strength \( R_{y,0} \) other than 235 N/mm\(^2\) are used on a vessel, the scantlings shall be determined by taking into account the corresponding material factor, \( k \), Young’s modulus of elasticity, \( E \), yield strength, \( R_{y,0} \), for hull structural steels etc.

7.1.5 Safety factor

If not otherwise specified, safety factors, \( f_s \), covering uncertainties regarding material and resistance, of vessels covered by the present Rules are defined in the Rules, Part 2 – Hull and Hull Equipment, Chapter V, 1.7.

7.1.6 Stability

Proof of sufficient stability shall be required, in accordance with provisions given in the present Rules, Chapter III, 4.5.

7.1.7 Documentation to be submitted

In addition to the documentation specified in the Rules, Part 1 – Classification and Surveys, Chapter II, Table 3.2-1, for vessels intended to carry heavy cargoes, the following information shall be submitted to the Register:
1. dredging and other equipment arrangement, indicating weights and distributions;
2. transverse and longitudinal sections showing, as applicable, strengthened structural members subjected to heavy loads.

The aforementioned documentation shall, where applicable, be supported by direct calculations and shall clearly indicate the design loads of structural members subjected to load concentrations as well as relevant details of transitional structures ensuring adequate strength continuity.

General provisions given in the Rules, Part 2 – Hull and Hull Equipment, Chapter I, 1.2 shall be complied with.

7.1.8 Vessel types

1. Dredger

A dredger is a vessel intended to carry out dredging operations and that does not carry spoil, such as suction dredger or bucket dredger.

2. Hooper dredger and hopper barge
Chapter I - TYPE NOTATIONS

Hopper dredger is a vessel intended to carry out dredging operations and having one or several hopper spaces in the midship region.

Hopper barge is a vessel intended to carry out transport of dredging material and having one or several hopper spaces in the midship region.

.3 Split hopper barge

A split hopper barge is a hopper barge which opens longitudinally around hinges to allow fast unloading of cargo.

7.2 Vessel arrangement

7.2.1 General provisions

Hull structure shall, in general, be supported by transverses forming transverse rings, possibly of reinforced scantlings.

In general, the spacing, $S$, of transverse reinforced rings provided in way of hopper spaces shall not be greater than the following value:

$$S = 1,2 \cdot (0,02 \cdot L + 1) \cdot [m] \quad (7.2.1-1)$$

To provide sufficient transverse strength of the vessel, rings located in the same transverse section shall be connected at bottom and deck level by means of deep floor and strong deck beam, respectively.

The hatch coaming shall be supported by means of stays which shall be connected to the deck structure. As a rule, stays shall be fitted in way of the transverse rings.

The coaming sides shall, as a rule, extend beyond the hopper space ends over 1.5 times the coaming height approximately.

7.2.2 Bulkheads

At the ends of the hopper space, the transverse bulkheads shall, as a rule, extend from one side to the other side of the vessel. Where this is not the case, transverse rings of adequate scantlings shall be provided in a way of transverse bulkhead.

Continuity of the all longitudinal members shall be ensured at the ends of the hopper spaces.

At their lower and upper ends, longitudinal bulkheads shall be effectively extended to adjacent compartments by means of large smoothly shaped brackets coplanar with the plane of longitudinal bulkhead plating, each having arm lengths of about $0,25 \cdot D$.

Under the lower brackets, the bottom shall be supported by means of a bottom girders extending beyond the bracket end over three frame spacings at least.

It is recommended to provide a chafing allowance for plates subjected to rapid wear (hopper space bulkheads, weir etc.).

7.2.3 Suction pipe well

Continuity of longitudinal strength in way of suction pipe well shall be ensured. The side compartments shall, in general, be firmly connected to each other. Supporting members of the side compartments shall be effectively extended to adjacent compartments beyond the transverse bulkheads of the well by means of large smoothly shaped brackets or other adequate transitional structure.

Other arrangements may also be considered by the Register on a case by case basis, provided they are equally effective.

7.2.4 Dredgers

Where dredgers are likely to work in association with hopper barges, the sheer strake shall be protected. This can be accomplished slightly below the deck by a fender efficiently secured to the shell plating and extending at least over two thirds of the vessel length. The necessary compensations shall be provided in way of the break in the raised deck, if any.

In the case of bucket dredgers, dangerous flooding in case of damage to side shell by metal equipment shall be avoided. A watertight compartment shall be provided at the lower part of the caissons on either side of the suction pipe well in the area of the buckets. The compartment shall be of sufficient size to enable inspections and maintenance to be carried out.

7.3 Structural arrangement

7.3.1 General

General provisions given in 7.2 shall be complied with.

Adequate continuity of structure shall be maintained. Where significant changes in structural arrangement occur, adequate transitional structure shall be provided.

The transition shall be made gradually, with adequate tapering and sufficient scarfing, in accordance with requirements from the Rules, Part 2 – Hull and Hull Equipment, Chapter II, Section 6.

Special attention shall be paid in way of in way of suction pipe well and at the ends of the hopper spaces.

General provisions given in the Rules, Part 2 – Hull and Hull Equipment, Chapter V, 1.5 shall also be complied with, as applicable.

7.3.2 Hull scantlings

.1 General

The hull scantlings shall, in general, not be less than required in the Rules, Part 2 – Hull and Hull Equipment, Chapter V – Hull scantlings, taking also into account above mentioned provisions concerning continuity of structure.

Strength check of structural members subjected to load concentrations shall be carried out by direct calculation, in accordance with 7.1.3. Those structural members shall be adequately strengthened. The details of design shall be considered by the Register on a case by case basis.

Scantlings and details of arrangements of vessels with type notation Split hopper barge shall be considered by the Register on a case by case basis.

.2 Supporting members

The scantlings and details of arrangement of primary supporting members forming rings shall, in general, be considered by the Register on a case by case basis.
Stays for coamings shall have the section modulus at the lower end not less than that of the web frames or side transverses.

For parts of structure where primary supporting members form a grillage, if any, the strength check shall be carried out by direct calculation, in accordance with 7.1.3.

7.3.3 Hull outfitting

The rudder stock diameter shall not be less than 1.05 times its rule value, defined in the Rules, Part 2 – Hull and Hull Equipment, Chapter VI, 5.3.
II TRANSPORT OF DANGEROUS GOODS

1 GENERAL REQUIREMENTS

1.1 General

1.1.1 The following requirements of this Chapter apply to vessels intended for the carriage of dangerous goods.

1.1.2 Vessels considered in this Chapter shall comply with the applicable requirements of the Rules, Part 1 – Classification and Surveys, Part 2 – Hull and Hull Equipment and Part 3 – Machinery, Systems and Electricity, as applicable, and with the following requirements from the present Rules:

- for transport of dangerous, dry cargoes, see Section 2;
- for transport of liquefied gases see Section 3 and the present Rules, Chapter 1, Section 3;
- for transport of dangerous liquid cargoes see Section 4, Section 5 and the present Rules, Chapter 1, Section 3.

1.1.3 The basis of the following requirements is the ADN Regulations, Edition 2017. In any case the actual edition of the Regulations for the transport of dangerous goods has to be observed. The Register may approve equivalent arrangements providing the same level of safety for vessels not falling under ADN.

1.2 Classification of dangerous goods

1.2.1 In these Rules, classification of dangerous goods is defined according to the UN Model Regulations. The classes defined in the UN Model Regulations are given in the actual ADN.

1.2.2 Each class defines one type of dangerous goods. In some classes divisions are defined. The numerical order of the classes and divisions is not that of the degree of danger.

1.2.3 The classes defined in the UN Model Regulations are given in Table 1.2-1.

1.3 Substances approved for carriage in tank vessels

1.3.1 The following dangerous goods of the classes listed below may be carried in tank vessels complying with the Rules for carriage of the intended cargo:

- Class 2 - Gases compressed, liquefied or dissolved under pressure;
- Class 3 - Flammable liquids;
- Class 4.1 - Flammable solids;
- Class 6.1 - Toxic substances;
- Class 8 - Corrosive substances;
- Class 9 - Miscellaneous dangerous substances and articles.

1.3.2 Products listed in the product list (see Table C of Chapter 3.2, Part 3 of ADN) are permitted to be carried in tank vessels complying with the following Rules.

1.3.3 However, the current edition of the ADN regulations is always to be applied to the classification of substances and other requirements (e.g. the filling ratio).

1.4 Carriage of dangerous substances not listed in Table C of Chapter 3.2, Part 3 of ADN

1.4.1 The requirements of this Chapter are also applicable to substances, which may be considered to come within the scope of these Rules, but are not listed in Table C of Chapter 3.2, Part 3 of ADN.

1.4.2 Depending on the tank vessel design, construction and equipment, the Register may authorize the carriage of these substances, if their handling and transport conditions are found satisfactory.

Table 1.2-1 Classification of dangerous goods

<table>
<thead>
<tr>
<th>Class</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class 1 Explosives</td>
<td></td>
</tr>
<tr>
<td>1.1</td>
<td>Substances and articles which have a mass explosion hazard</td>
</tr>
<tr>
<td>1.2</td>
<td>Substances and articles which have a projection hazard but not a mass explosion hazard</td>
</tr>
<tr>
<td>1.3</td>
<td>Substances and articles which have a fire hazard and either a minor blast hazard or a minor projection hazard or both, but not a mass explosion hazard</td>
</tr>
<tr>
<td>1.4</td>
<td>Substances and articles which present no significant hazard</td>
</tr>
<tr>
<td>1.5</td>
<td>Very intensive substances which have a mass explosion hazard</td>
</tr>
<tr>
<td>1.6</td>
<td>Extremely intensive articles which do not have a mass explosion hazard</td>
</tr>
<tr>
<td>Class 2 Gases</td>
<td></td>
</tr>
<tr>
<td>2.1</td>
<td>Flammable gases</td>
</tr>
<tr>
<td>2.2</td>
<td>Non-flammable, non-toxic gases</td>
</tr>
<tr>
<td>2.3</td>
<td>Toxic gases</td>
</tr>
<tr>
<td>Class 3 Flammable liquids</td>
<td></td>
</tr>
<tr>
<td>Class 4 Flammable solids; substances liable to spontaneous combustion; substances which, in contact with water, emit flammable gases</td>
<td></td>
</tr>
<tr>
<td>4.1</td>
<td>Flammable solids, self-reactive substances and solid desensitized explosives</td>
</tr>
<tr>
<td>4.2</td>
<td>Substances liable to spontaneous combustion</td>
</tr>
<tr>
<td>4.3</td>
<td>Substances which in contact with water emit flammable gases</td>
</tr>
<tr>
<td>Class 5 Oxidizing substances and organic peroxides</td>
<td></td>
</tr>
<tr>
<td>5.1</td>
<td>Oxidizing substances</td>
</tr>
<tr>
<td>5.2</td>
<td>Organic peroxide</td>
</tr>
<tr>
<td>Class 6 Toxic and infectious substances</td>
<td></td>
</tr>
<tr>
<td>6.1</td>
<td>Toxic substances</td>
</tr>
<tr>
<td>6.2</td>
<td>Infectious substances</td>
</tr>
<tr>
<td>Class 7 Radioactive material</td>
<td></td>
</tr>
<tr>
<td>Class 8 Corrosive substances</td>
<td></td>
</tr>
<tr>
<td>Class 9 Miscellaneous dangerous substances and articles</td>
<td></td>
</tr>
</tbody>
</table>
1.5 Definitions and explanations

1.5.1 Accommodation

Accommodation refers to spaces intended for the use of persons normally living on board, including galleys, food stores, lavatories, washrooms, bathrooms, laundries, halls, alleyways, etc., but excluding the wheelhouse.

1.5.2 ADN

ADN is a European Agreement Concerning the International Carriage of Dangerous Goods by Inland Waterways.

1.5.3 Auto-ignition temperature

Auto-ignition temperature (EN 13237:2011) is the lowest temperature determined under prescribed test conditions of a hot surface on which a flammable substance in the form of a gas/air or vapour/air mixture ignites.

1.5.4 Bilge water

Bilge water refers to oily water from the engine room bilges, the peaks, the cofferdams and the double-hull spaces.

1.5.5 Boil-off

Boil-off refers to the vapour produced above the surface of a boiling cargo due to evaporation. It is caused by heat ingress or a drop in pressure.

1.5.6 Boiling point

Boiling point refers to the temperature at which a product exhibits a vapour pressure equal to the atmospheric pressure.

1.5.7 Bulk container

Bulk container is a containment system (including any liner or coating) intended for the carriage of solid substances which is in direct contact with the containment system.

Packaging, intermediate bulk containers (IBCs), large packaging and tanks are not included. A bulk container is:
- of a permanent character and accordingly strong enough to be suitable for repeated use;
- specially designed to facilitate the carriage of goods by one or more means of transport without intermediate reloading;
- fitted with devices permitting its ready handling;
- of a capacity of not less than 1,0 m³.

Examples of bulk containers are containers, offshore bulk containers, skips, bulk bins, swap bodies, trough-shaped containers, roller containers, load compartments of vehicles or wagons.

1.5.8 Bulkhead

Bulkhead is a metal wall, generally vertical, inside the vessel and which is bounded by the bottom, the side plating, a deck, the hatchway covers or by another bulkhead.

1.5.9 Cargo area of tank vessels

Cargo area of tank vessels refers to the whole of the following spaces defined in 1.5.9.1, 1.5.9.2 and 1.5.9.3 (see Figure 1.5.9-1).

1.5.9.1 Cargo area (additional part above deck) (when anti-explosion protection is required, comparable to zone 1) refers to the spaces not included in the main part of the cargo area above deck comprising 1,0 m radius spherical segments centred over the ventilation openings of the cofferdams and the service spaces located in the cargo area part below the deck and 2,0 m spherical segments centred over the ventilation openings of the cargo tanks and the opening of the pump rooms.

1.5.9.2 Cargo area (main part above deck) (when anti-explosion protection is required - comparable to zone 1) refers to the space which is bounded:
- at the sides, by the shell plating extending upwards from the decks sides;
- fore and aft, by planes inclined at 45° towards the cargo area, starting at the boundary of the cargo area part below deck;
- vertically, 3,0 m above the deck.

1.5.9.3 Cargo area (part below deck) refers to the space between two vertical planes perpendicular to the centre-line plane of the vessel, which comprises cargo tanks, hold spaces, cofferdams, double-hull spaces and double bottoms: these planes normally coincide with the outer cofferdam bulkheads or hold end bulkheads. Their intersection line with the deck is referred to as the boundary of the cargo area part below deck.

1.5.10 Cargo area of dry cargo vessels

See 1.5.48.

1.5.11 Cargo pump room

Cargo pump room (when anti-explosion protection is required, comparable to zone 1, see 1.5.16) is a service space where the cargo pumps and stripping pumps are installed together with their operational equipment.

1.5.12 Cargo residues

Cargo residues refers to liquid cargo which cannot be pumped out of the cargo tanks or piping by means of the stripping system.

1.5.13 Cargo tank

Cargo tank (when anti-explosion protection is required, comparable to zone 0, see 1.5.16) is a tank which is permanently attached to the vessel and intended for the carriage of dangerous goods.
1.5.14 Cargo tank design

a) **Pressure cargo tank** (cargo tank design 1) is a cargo tank independent of the vessel’s hull, built according to dedicated recognized standards for a working pressure ≥ 400,0 kPa (4,0 bar);

b) **Closed cargo tank** (cargo tank design 2) is a cargo tank connected to the outside atmosphere through a device preventing unacceptable internal overpressure or underpressure;

c) **Open cargo tank with flame arrester** (cargo tank design 3) is a cargo tank connected to the outside atmosphere through a device fitted with a flame arrester;

d) **Open cargo tank** (cargo tank design 4) is a cargo tank in open connection with the outside atmosphere.

1.5.15 Cargo tank type:

a) **Independent cargo tank** (cargo tank type 1) is a cargo tank which is permanently built in, but which is independent of the vessel’s structure;

b) **Integral cargo tank** (cargo tank type 2) is a cargo tank which is constituted by the vessel’s structure itself and bounded by the outer hull or by walls separate from the outer hull;

c) **Cargo tank with walls distinct from the outer hull** (cargo tank type 3) is an integral cargo tank of which the bottom and side walls do not form the outer hull of the vessel or an independent cargo tank.

1.5.16 Classification of zones

1.5.16.1 **Zone 0**: areas in which dangerous explosive atmospheres of gases, vapours or sprays exist permanently or during long periods. **Zone 0** includes:

- interior 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 and vapours.

1.5.16.2 **Zone 1**: areas in which dangerous explosive atmospheres of gases, vapours or sprays are likely to occur occasionally. **Zone 1** includes:
.1 hold spaces and spaces on open deck located in the cargo area including spaces adjacent to and below the top of a cargo tank (e.g. trunks and passageways),

.3 all areas on open deck, including semi enclosed spaces, within 2 m of any cargo tank outlet, gas or vapour outlet, cargo manifold valve, cargo valve and pipe flange, cargo pump-room ventilation outlets, cargo tank openings for pressure release to allow the free flow of gas or vapour mixtures caused by thermal oscillation,

.4 all areas on open deck, including semi enclosed spaces, within 1 m of any cargo pump-room entrances including cargo pump-room ventilation inlet, cofferdams openings, service spaces located in the cargo area below deck, or other Zone 1 areas and spaces,

.5 cofferdams and permanent ballast tanks adjacent to cargo tanks,

.6 cargo pump rooms and cargo compressor rooms,

.7 void spaces adjacent to integral cargo tanks,

1.5.16.3 Zone 2: areas in which dangerous explosive atmospheres of gases, vapours or sprays are likely to occur rarely and if so for short periods only. Zone 2 includes:

.1 spaces above deck, surrounding open or semi-enclosed spaces of Zone 1,

.2 spaces outside the cargo area and below the main deck having openings leading to the main deck or to the height less than 0.50 m above the main deck, unless the spaces are mechanically ventilated and the wall of the superstructures facing the cargo area extends from one side of the vessel to the other and has doors the sills of which have a height of not less than 0.50 m.

1.5.17 Closed type sampling device

Closed type sampling device is a device penetrating through the boundary of the cargo tank or through the piping for loading and unloading but constituting a part of a closed system designed so that during sampling no gas or liquid may escape from the cargo tank.

The device shall be of a type approved for this purpose.

1.5.18 Cofferdam

Cofferdam (when anti-explosion protection is required, comparable to zone 1, see 1.5.16) is an athwartship compartment which is bounded by watertight bulkheads and which can be inspected. The cofferdam shall extend over the whole area of the end bulkheads of the cargo tanks. The bulkhead not facing the cargo area shall extend from one side of the vessel to the other and from the bottom to the deck in one frame plane.

1.5.19 Dangerous goods

Dangerous goods are those substances and articles the carriage of which is prohibited by ADN, or authorized only under the conditions prescribed therein.

1.5.20 Design pressure/underpressure

Design pressure/underpressure is the pressure on the basis of which the cargo tank or the residual cargo tank has been designed and built. For cargo tanks where there is no temperature control and where the pressure of the cargo is dictated only by the ambient temperature, \( p_0 \) shall not be less than the gauge vapour pressure of the cargo at a temperature of 40°C.

1.5.21 Explosion group

Explosion group is a grouping of flammable gases and vapours according to their maximum experimental safe gaps (standard gap width, determined in accordance with specified conditions) and minimum ignition currents, and of electrical apparatus intended to be used in a potentially explosive atmosphere. The maximum experimental safe gaps shall be determined in accordance with standard IEC 60079-20-1.

The different explosion groups are shown in Table 1.5-1.

When anti-explosion protection is required and the relevant data are not provided, reference shall be made to explosion group II B, considered safe.

<table>
<thead>
<tr>
<th>Explosion group</th>
<th>Maximum experimental safe gap, [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>II A</td>
<td>&gt; 0,9</td>
</tr>
<tr>
<td>II B</td>
<td>≥ 0,5 to ≤ 0,9</td>
</tr>
<tr>
<td>II C</td>
<td>&lt; 0,5</td>
</tr>
</tbody>
</table>

1.5.22 Filling ratio

Filling ratio is the ratio of the mass of gas to the mass of water at 15°C that would fill completely a pressure receptacle fitted ready for use (capacity);

1.5.23 Filling ratio - level (cargo tank)

Where a filling ratio is given for a cargo tank, it refers to the percentage of the volume of the cargo tank which may be filled with liquid during loading.

1.5.24 Flame arrester

Flame arrester is a device mounted in the vent of part of an installation or in the interconnecting piping of a system of installations, the purpose of which is to permit flow but prevent the propagation of a flame front. This device shall be tested according to the European standard EN ISO 16852.

1.5.25 Flame arrester plate stack

Flame arrester plate stack is the part of the flame arrester the main purpose of which is to prevent the passage of a flame front.

1.5.26 Flame arrester housing

Flame arrester housing is the part of a flame arrester the main purpose of which is to form a suitable casing for the flame arrester plate stack and ensure a mechanical connection with other systems.

1.5.27 Flash point

Flash point is the lowest temperature of a liquid at which its vapours form a flammable mixture with air.
1.5.28 Gas detection system

Gas detection system is a fixed system capable of detecting in time significant concentrations of flammable gases given off by the cargoes at concentrations below the lower explosion limit and capable of activating the alarms;

1.5.29 Gas-freeing

The process where a portable or fixed ventilation system is used to introduce fresh air into a tank in order to reduce the concentration of hazardous gases or vapours to a level safe for tank entry.

1.5.30 High-velocity vent valve

High-velocity vent valve is a pressure relief valve designed to have nominal flow velocities which exceed the flame velocity of the flammable mixture, thus preventing flame transmission. This type of installation shall be tested by the Register in accordance with the European standard EN ISO 16852.

1.5.31 Hold

Hold (when anti-explosion protection is required, comparable to zone 1, see 1.5.16) is a part of the vessel which, whether covered by hatchway covers or not, is bounded fore and aft by bulkheads and which is intended to carry goods in packages or in bulk. The upper boundary of the hold is the upper edge of the hatchway coaming. Cargo extending above the hatchway coaming shall be considered as loaded on deck.

1.5.32 Hold space

Hold space (when anti-explosion protection is required, comparable to zone 1) is an enclosed part of the vessel which is bounded fore and aft by watertight bulkheads and which is intended only to carry cargo tanks independent of the vessel’s hull.

1.5.33 Intermediate bulk container (IBC)

Intermediate bulk container (IBC) is rigid or flexible portable packaging that:

a) has a capacity of not more than:
   - 3.0 m³ for solids and liquids of packing groups II and III;
   - 1.5 m³ for solids of packing group I when packed in flexible, rigid plastics, composite, fibreboard and wooden IBCs;
   - 3.0 m³ for solids of packing group I when packed in metal IBCs;
   - 3.0 m³ for radioactive material of Class 7;

b) is designed for mechanical handling;

c) is resistant to the stresses produced in handling and transport in compliance with applicable standards.

1.5.34 Limited explosion risk electrical apparatus

Limited explosion risk electrical apparatus is an electrical apparatus which, during normal operation, does not cause sparks or exhibits surface temperatures which are above the required temperature class, including e.g.:
   - three-phase squirrel cage rotor motors;
   - brushless generators with contactless excitation;
   - fuses with an enclosed fuse element;
   - contactless electronic apparatus;
   - or an electrical apparatus with an enclosure protected against water jets (degree of protection IP 55) which during normal operation does not exhibit surface temperatures which are above the required temperature class.

1.5.35 Lower explosive (flammable) limit

Lower explosive limit is the lowest content (by volume) of the flammable substance, which when mixed with air is capable of ignition at an open flame and sustain fire of the mixture (and spread of flame on the mixture).

1.5.36 Machinery spaces

Machinery spaces are all spaces containing propulsion machinery, boilers, fuel oil units, steam and internal combustion engines, generators and major electrical machinery, oil filling stations, refrigerating, stabilising, ventilation and air conditioning machinery, and similar spaces, and trunks to such spaces.

1.5.37 Maximum working pressure (\(p_{\text{w}}\))

Maximum working pressure is the maximum pressure occurring in a cargo tank or a residual cargo tank during operation. This pressure equals the opening pressure of high-velocity vent valves or pressure relief valves.

1.5.38 Multiple-element gas container (MEGC)

Multiple-element gas container (MEGC) is a unit containing elements which are linked to each other by a manifold and mounted on a frame. The following elements are considered to be elements of a multiple-element gas container: cylinders, tubes, pressure drums or bundles of cylinders as well as tanks for the carriage of gases having a capacity of more than 450,0 l.

1.5.39 Naked light

Naked light is a source of light using a flame which is not enclosed in a flameproof enclosure.

1.5.40 Opening pressure

Opening pressure is the pressure referred to in a list of substances in Chapter 3.2, Table C, Part 3 of ADN, at which the high-velocity vent valves open. For pressure tanks the opening pressure of the safety valve shall be established in accordance with the requirements of the Register.

1.5.41 Packing group

Packing group is a group to which, for packing purposes, certain substances may be assigned in accordance with their degree of danger. The packing groups have the following meanings:
   - packing group I: substances presenting high danger
   - packing group II: substances presenting medium danger
   - packing group III: substances presenting low danger.

1.5.42 Partly closed type sampling device

Partly closed type sampling device is a device penetrating through the boundary of the cargo tank or
through the piping for loading and unloading such that during sampling only a small quantity of gaseous or liquid cargo can escape into the open air. As long as the device is not used it shall be closed completely. The device shall be of a type approved for this purpose.

1.5.43 Piping for loading and unloading (cargo piping)

Piping for loading and unloading (cargo piping) refers to all piping which may contain liquid or gaseous cargo, including pipes, hose assemblies, connected pumps, filters and closure devices.

1.5.44 Possibility of cargo heating

Possibility of cargo heating refers to a cargo heating installation in the cargo tanks using a heat insulator. The heat insulator may be heated by means of a boiler on board the tank vessel or from shore.

1.5.45 Possibility of a sampling connection

Possibility of a sampling connection refers to a locking connection for a closed-type or partly closed sampling device. The connection shall be fitted with a locking mechanism resistant to the internal pressure of the cargo tank. The installation shall be of a type certified for the intended use.

1.5.46 Pressure relief device

Pressure relief device is a spring-loaded device which is activated automatically by pressure the purpose of which is to protect the cargo tank against unacceptable excess internal pressure. Pressure relief device shall be type tested by the Register.

1.5.47 Pressure tank

Pressure tank is a tank designed and approved for a working pressure ≥ 400,0 kPa (4,0 bar).

1.5.48 Protected area

Protected area means:

a) the cargo hold or holds (when anti-explosion protection is required, comparable to zone 1, see 1.5.16);

b) the space situated above the deck (when anti-explosion protection is required, comparable to zone 2), bounded:
   − athwartship, by vertical planes corresponding to the side plating;
   − fore and aft, by vertical planes corresponding to the end bulkheads of the hold; and
   − upwards, by a horizontal plane 2,0 m above the upper level of the load, but at least by a horizontal plane 3,0 m above the deck.

1.5.49 Receptacle

Receptacle refers to a containment vessel for receiving and holding substances or articles, including any means of closing.

Receptacle for residual products refers to a tank, intermediate bulk container or tank-container or portable tank intended to collect residual cargo, washing water, cargo residues or slops which are suitable for pumping;

1.5.50 Relative density (or specific density)

Relative density (or specific density) describes the ratio of the density of a substance to the density of pure water at 3,98°C (1000 kg/m³) and is dimensionless.

1.5.51 Residual cargo

Residual cargo refers to liquid cargo remaining in the cargo tank or cargo piping after unloading without the use of the stripping system.

1.5.52 Safe area

Safe area refers to a designated, recognisable area outside the cargo area which can be readily accessed by all persons on board. The safe area provides protection against the identified hazards of the cargo by a water spray system for at least 60 minutes. The safe area can be evacuated during an incident. A safe area is not acceptable when the identified danger is explosion;

1.5.53 Safety valve

Safety valve is a spring-loaded device which is activated automatically by pressure the purpose of which is to protect the cargo tank against unacceptable excess internal pressure or negative internal pressure. Safety valve shall be type tested by the Register.

1.5.54 Sampling opening

Sampling opening is an opening with a diameter of not more than 0,3 m. When the list of substances on the vessel according to 1.7.2.2 contains substances for which protection against explosion is required in column (17) of Table C of Chapter 3.2 of ADN, it shall be fitted with a flame arrester plate stack, capable of withstanding steady burning and so designed that the opening period will be as short as possible and that the flame arrester plate stack cannot remain open without external intervention.

1.5.55 Service space

Service space is a space which is accessible during the operation of the vessel and which is neither part of the accommodation nor of the cargo tanks, with the exception of the forepeak and after peak, provided no machinery has been installed in these latter spaces.

1.5.56 Slops

Slops refer to a mixture of cargo residues and washing water, rust or sludge which is either suitable or not suitable for pumping.

1.5.57 Steady burning

Steady burning refers to combustion stabilized for an indeterminate period (see EN ISO 16852).

1.5.58 Stripping system (efficient)

Stripping system is a system for complete draining, if possible, of the cargo tanks and stripping the cargo piping except for the cargo residues.

Receptacle for slops means a steel drum intended to collect slops which are unsuitable for pumping;
1.5.59 **Tank-container**

Tank container is an article of transport equipment meeting the definition of a container, and comprising a shell and items of equipment, including the equipment to facilitate movement of the tank-container without significant change of attitude, used for the carriage of gases, liquid, powdery or granular substances and, when used for the carriage of gases having a capacity of more than 0.45 m³ (450.0 l).

1.5.60 **Tank vessel**

Tank vessel is a vessel intended for the carriage of substances in cargo tanks.

1.5.61 **Temperature class**

Temperature class refers to a grouping of flammable gases and vapours of flammable liquids according to their ignition temperature; and of the electrical apparatus intended to be used in the corresponding potentially explosive atmosphere according to their maximum surface temperature (see EN 13237).

Flammable substances shall be assigned to a temperature class on the basis of their auto-ignition point, see Table 1.5-2. When anti-explosion protection is required and the auto-ignition temperature is not known, reference shall be made to temperature class T₄, considered safe.

<table>
<thead>
<tr>
<th>Temperature class</th>
<th>Auto-ignition temperature T of flammable liquids and gases, °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>T₁</td>
<td>T &gt; 450</td>
</tr>
<tr>
<td>T₂</td>
<td>300 &lt; T ≤ 450</td>
</tr>
<tr>
<td>T₃</td>
<td>200 &lt; T ≤ 300</td>
</tr>
<tr>
<td>T₄</td>
<td>135 &lt; T ≤ 200</td>
</tr>
<tr>
<td>T₅</td>
<td>100 &lt; T ≤ 135</td>
</tr>
<tr>
<td>T₆</td>
<td>80 &lt; T ≤ 100</td>
</tr>
</tbody>
</table>

1.5.62 **Test pressure**

Test pressure is the pressure at which a cargo tank, a residual cargo tank, a cofferdam or the loading and unloading piping shall be tested prior to being brought into service for the first time and subsequently regularly within prescribed times.

1.5.63 **UN Model Regulations**


1.5.64 **UN number**

UN number is the four-figure identification number of the substance or article taken from the United Nations Model Regulations.

1.5.65 **Vacuum design pressure**

Vacuum design pressure is the vacuum pressure on the basis of which the cargo tank or the residual cargo tank has been designed and built;

1.5.66 **Vacuum valve**

Vacuum valve is a spring-loaded device which is activated automatically by pressure the purpose of which is to protect the cargo tank against unacceptable negative internal pressure. Vacuum valve shall be type tested by the Register.

1.5.67 **Vapour pressure**

Vapour pressure is the equilibrium pressure of the saturated vapour above a liquid, in [Pa], at a specified temperature.

1.5.68 **Vapour return piping (on shore)**

Vapour return piping (on shore) refers to a pipe of the shore facility which is connected during loading or unloading to the vessel’s venting piping. This pipe is designed so as to protect the vessel against detonations or the passage of flames from the shore side.

1.5.69 **Venting piping (on board)**

Venting piping refers to a pipe of the vessel’s installation connecting one or more cargo tanks to the vapour return piping during loading or unloading. This pipe is fitted with safety valves protecting the cargo tank(s) against unacceptable internal overpressure or vacuums.

1.5.70 **Void space**

Void space refers to an enclosed space in the cargo area external to a cargo tank, other than a hold space, ballast space, fuel oil tank, cargo pumps or compressor room or any space in normal use by personnel.

1.5.71 **Water spray system**

Water spray system is an on-board installation that, by means of a uniform distribution of water, is capable of protecting all the vertical external surfaces of the vessel’s hull fore and aft, all vertical surfaces of superstructures and deckhouses and deck surfaces above the superstructures, engine rooms and spaces in which combustible materials may be stored. The capacity of the water spray system for the area to be protected should be at least 10.0 l/m² per minute. The water spray system shall be designed for full-year use. The water spray system should be operable from the wheelhouse and the safe area.

1.5.72 **Watertight**

Watertight refers to a structural component or device so fitted as to prevent any ingress of water.

1.5.73 **Weathertight**

Weathertight refers to a structural component or device so fitted that in normal conditions it allows only a negligible quantity of water to penetrate.

1.5.74 **Working pressure**

Working pressure is the settled pressure of a compressed gas at a reference temperature of 15°C in a full pressure receptacle.
1.6 Dry cargoes

1.6.1 Mode of carriage of goods

**Carriage of packages**

Unless otherwise specified, the masses given for packages shall be the gross masses. When packages are carried in containers or vehicles, the mass of the container or vehicle shall not be included in the gross mass of such packages.

1.6.2 Carriage in bulk

Carriage of dangerous goods in bulk shall be prohibited except where this mode of carriage is explicitly authorized in column (8) of Table A of Chapter 3.2, Part 3 of ADN. The code “B” shall then appear in this column.

1.6.3 Carriage in containers, in bulk containers, in intermediate bulk containers (IBCs) and in large packaging, in MEGCs, in portable tanks and in tank-containers

The carriage of containers, bulk containers, IBCs, large packaging, MEGCs, portable tanks and tank-containers shall be in accordance with the ADN provisions applicable to the carriage of packages.

1.6.4 Vehicles and wagons

The carriage of vehicles and wagons shall be in accordance with the ADN provisions applicable to the carriage of packages.

1.6.5 Carriage in cargo tanks

The carriage of dangerous goods in cargo tanks in dry cargo vessels is prohibited.

1.6.6 Permitted vessels

Dangerous goods may be carried in quantities not exceeding those indicated in 7.1.4.1.1, or, if applicable, in 7.1.4.1.2, Part 7, Chapter 7.1 of ADN, in dry cargo vessels conforming to the applicable construction requirements of Section 2.

Dangerous goods of classes 2, 3, 4.1, 4.2, 4.3, 5.1, 5.2, 6.1, 7, 8 or 9, with the exception of those for which a No. 1 model label is required in column (5) of Table A of Chapter 3.2, Part 3 of ADN, may be carried in quantities greater than those indicated in 7.1.4.1.1 and 7.1.4.1.2 in double-hull dry cargo vessels conforming to the applicable construction requirements of Section 2.

1.6.7 Pushed convoys and side-by-side formations

1.6.7.1 Where a pushed convoy or side-by-side formation comprises a dry cargo vessel carrying dangerous goods, the requirements from Section 9 shall apply.

1.6.7.2 Vessels carrying dangerous goods shall comply with the requirements of Section 2. See also 1.6.6.

1.6.7.3 The propulsion vessel and vessels not carrying dangerous goods shall comply with the requirements of Section 9.

1.6.8 Opening of holds

Dangerous goods shall be protected against the influences of weather and against spray water except during loading and unloading or during inspection.

This provision does not apply when dangerous goods are loaded in spray-proof containers, IBCs, or large packaging, or in MEGCs, portable tanks, tank-containers, vehicles or wagons which are closed or sheeted.

Where dangerous goods are carried in bulk, the holds shall be covered with hatch covers.

1.6.9 Materials of construction

The vessel’s hull has to be constructed of shipbuilding steel or other metal, provided that this metal has at least equivalent mechanical properties and resistance to the effects of temperature and fire.

1.7 Liquid cargoes

1.7.1 Carriage in cargo tanks

1.7.1.1 Substances, their assignment to the various types of tank vessels and the special conditions for their carriage in these tank vessels, are listed in Table C of Chapter 3.2, Part 3 of ADN.

1.7.1.2 Substances, which according to column (6) of Table C of Chapter 3.2, Part 3 of ADN, have to be carried in a tank vessel of type N open, may also be carried in a tank vessel of type N open with flame arresters, type N closed, types C or G provided that all conditions of carriage prescribed for tank vessels of type N open, as well as all other conditions of carriage required for these substances in Table C of Chapter 3.2, Part 3 of ADN, are met.

1.7.1.3 Substances which, according to column (6) of Table C of Chapter 3.2, Part 3 of ADN, have to be carried in a tank vessel of type N open with flame arresters, may also be carried in tank vessels of type N closed and types C or G provided that all conditions of carriage prescribed for tank vessels of type N open with flame arresters, as well as all other conditions of carriage required for these substances in Table C of Chapter 3.2, Part 3 of ADN, are met.

1.7.1.4 Substances which, according to column (6) of Table C of Chapter 3.2, Part 3 of ADN, have to be carried in a tank vessel of type N closed, may also be carried in tank vessels of type C or G provided that all conditions of carriage prescribed for tank vessels of type N closed, as well as all other conditions of carriage required for these substances in Table C of Chapter 3.2, Part 3 of ADN, are met.

1.7.1.5 Substances which, according to column (6) of Table C of Chapter 3.2, Part 3 of ADN, have to be carried in tank vessels of type C may also be carried in tank vessels of type G provided that all conditions of carriage prescribed for tank vessels of type C as well as all other conditions of carriage required for these substances in Table C of Chapter 3.2, Part 3 of ADN, are met.

1.7.1.6 Oilly and greasy wastes resulting from the operation of the vessel may only be carried in fire-resistant receptacles, fitted with a lid, or in cargo tanks.

A substance which according to column (8) of Table C of Chapter 3.2, Part 3 of ADN, must be carried in
Chapter II - TRANSPORT OF DANGEROUS GOODS

Part 4 – Additional Requirements for Notations

cargo tank type 2 (integral cargo tank), may also be carried in a cargo tank type 1 (independent cargo tank) or cargo tank type 3 (cargo tank with walls distinct from the outer hull) of the vessel type prescribed in Table C or a vessel type prescribed in 1.7.1.2 to 1.7.1.5, provided that all other conditions of carriage required for this substance by Table C of Chapter 3.2, Part 3 of ADN, are met.

1.7.1.7 A substance which according to column (8) of Table C of Chapter 3.2, Part 3 of ADN, must be carried in a cargo tank type 3 (cargo tank with walls distinct from the outer hull), may also be carried in a cargo tank type 1 (independent cargo tank) of the vessel type prescribed in Table C or a vessel type prescribed in 1.7.1.2 to 1.7.1.5 or in a type C vessel with cargo tank type 2 (integral cargo tank), provided that at least the conditions of carriage concerning the prescribed N type are met and all other conditions of carriage required for this substance by Table C of Chapter 3.2, Part 3 of ADN, or 1.7.1.2 to 1.7.1.5 are met.

1.7.2 Permitted vessels

1.7.2.1 Dangerous substances may be carried in tank vessels of types G, C or N in accordance with the requirements of Section 3 to Section 7. The type of tank vessel to be used is specified in column (6) of Table C in Chapter 3.2, Part 3 of ADN, and in 1.7.1.

1.7.2.2 The substances accepted for carriage in the vessel will be indicated in a list issued by the Register.

1.7.2.3 The relief pressure of the safety valves or of the high velocity vent valves, the design pressure and the test pressure of cargo tanks will be indicated.

1.7.2.4 Where a vessel carries cargo tanks with different valve-relief pressures, the relief pressure of each tank shall be indicated in the Certificate of Class. Design and test pressures of each tank shall be indicated in the Certificate of Class as well.

1.7.3 Pushed convoys and side-by-side formations

1.7.3.1 Where a pushed convoy or side-by-side formation comprises a tank vessel carrying dangerous goods, the requirements from Section 8 shall apply.

1.7.3.2 Vessels carrying dangerous goods shall comply with the applicable requirements of Section 3 to Section 7. See also 1.7.2.

1.7.3.3 The propulsion vessel and vessels not carrying dangerous goods shall comply with the requirements of Section 8.

1.7.4 Basic types of tank vessels

The tank vessel type, cargo tank design and cargo tank type shall be determined in compliance with the Table C of Chapter 3.2, Part 3 of ADN. See also 1.5.14 and 1.5.15.

With regard to kind of cargo, a distinction can be made between the following three different basic tanker types:

1.7.4.1 Type G (gas) - is a tank vessel with independent pressure tanks designed and approved for the carriage of gases liquefied under pressure or by refrigeration.
Type N (normal) - is a tank vessel intended for the carriage of liquids.

Tank vessel type N may be arranged in three different cargo tank designs in respect of cargo tank venting with due regard to the products as specified in the list of substances permitted to be carried (see Table C of Chapter 3.2, Part 3 of AND, 1.5.14 and 1.5.15). There are closed cargo tank, open cargo tank with flame arrester and open cargo tank design. This vessel may be used for carriage of products of Class 3, Class 8 or Class 9.

Type N closed - a tank vessel intended for the carriage of liquids in closed cargo tanks.

Type N open with flame arrester - a tank vessel intended for the carriage of liquids in open cargo tanks whose openings to the atmosphere are equipped with a flame arrester capable of withstanding steady burning.

Type N open - a tank vessel intended for the carriage of liquids in open cargo tanks.
1.7.5 Connections between pipes
1.7.5.1 Connecting two or more of the following groups of pipes is prohibited:
   a) piping for loading and unloading;
   b) pipes for ballasting and draining cargo tanks, cofferdams, hold spaces, double-hull spaces and double bottoms;
   c) pipes located outside the cargo area.
1.7.5.2 The provisions of 1.7.5.1 do not apply to removable pipe connections between cofferdams pipes and:
   a) piping for loading and unloading;
   b) pipes located outside the cargo area while the cofferdams have to be filled with water in an emergency.

In these cases the connections shall be designed so as to prevent water from being drawn from the cargo tanks. The cofferdams shall be emptied only by means of ejectors or an independent system within the cargo area.
1.7.5.3 The provisions of 1.7.5.1, b) and 1.7.5.1, c) do not apply to:
   a) pipes intended for ballasting and draining double-hull spaces and double bottoms which do not have a common boundary with the cargo tanks;
   b) pipes intended for ballasting hold spaces where the pipes of the firefighting system within the cargo area are used for this purpose. Double-hull and double bottom spaces and hold spaces shall be stripped only by means of ejectors or an independent system within the cargo area.

1.7.6 Cargo heating system
1.7.6.1 Heating of the cargo is not permitted except where there is risk of solidification of the cargo or where the cargo, because of its viscosity, cannot be unloaded in the usual manner.

In general, a liquid shall not be heated up to a temperature above its flash-point.

Special provisions are included in column (20) of Table C of Chapter 3.2, Part 3 of ADN.
1.7.6.2 Cargo tanks containing substances which are heated during transport shall be equipped with devices for measuring the temperature of the cargo.
1.7.6.3 During unloading, the cargo heating system may be used provided that the space where it has been installed meets in all respects the provisions of 4.9.4.6 and 5.9.4.6.
1.7.6.4 The provisions of 1.7.6.3 do not apply when the cargo heating system is supplied with steam from shore and only the circulation pump is in operation, as well as when the flash-point of cargo in the process of unloading is not less than 60°C.
1.7.6.5 The maximum permissible temperature for carriage indicated in column (20) of Table C of Chapter 3.2, Part 3 of ADN, shall not be exceeded.
1.7.6.6 A possibility of heating the cargo shall be required on board:
   - when the melting point of the substance to be transported is +15°C or greater; or
   - when the melting point of the substance to be transported is greater than 0°C but less than +15°C and the outside temperature is no more than 4 K above the melting point. In column (20) of Table C of Chapter 3.2, Part 3 of ADN, reference shall be made to remark 6 with the temperature derived as follows: melting point 4 K.
1.7.6.7 A cargo heating system shall be required on board:
   - for substances that must not be permitted to solidify owing to the possibility of dangerous reactions on reheating; and
   - for substances that must be maintained at a guaranteed temperature not less than 15 K below their flash-point.

1.7.7 Blanketing of the cargo and inerting
1.7.7.1 In cargo tanks and the corresponding piping, inerting in the gaseous phase or blanketing of the cargo may be necessary. Inerting andblanketing of the cargo are defined as follows:
   .1 Inerting: cargo tanks and the corresponding piping and other spaces for which this process is prescribed in column (20) of Table C of Chapter 3.2, Part 3 of ADN, are filled with gases or vapours which prevent combustion, do not react with the cargo and maintain this state;
   .2 Blanketing of the cargo: spaces in the cargo tanks above the cargo and the corresponding piping are filled with a liquid, gas or vapour so that the cargo is separated from the air and this state is maintained.
1.7.7.2 For certain substances the requirements for inerting and blanketing of the cargo in cargo tanks, in the corresponding piping and in adjacent empty spaces are given in column (20) of Table C of Chapter 3.2, Part 3 of ADN.
1.7.7.3 Inerting or blanketing of flammable cargoes shall be carried out in such a way as to reduce the electrostatic charge as far as possible when the inerting agent is added.

1.7.8 Materials of construction
1.7.8.1 The vessel’s hull and the cargo tanks shall be constructed of shipbuilding steel conforming to the applicable requirements of the Rules, Part 25 - Metallic Materials or other at least equivalent metal.
1.7.8.2 The independent cargo tanks may also be constructed of other materials provided these have at least equivalent mechanical properties and resistance against the effects of temperature and fire.
1.7.8.3 Every part of the vessel including any installation and equipment which may come into contact with the cargo shall consist of materials which can neither be dangerously affected by the cargo nor cause decomposition of the cargo or react with it so as to form harmful or hazardous products.
1.7.8.4 Venting piping and gas discharge pipes shall be protected against corrosion (not for tank vessel type G). See the Rules, Part 3 - Machinery, Systems and Electricity, Chapter I, 7.4.5.
1.7.8.5 The use of wood, aluminium alloys or synthetic materials within the cargo area is only permitted for:
   - gangways and external ladders;
   - movable items of equipment (aluminium gauging rods are, however permitted, provided that they are fitted with brass feet or protected in another way to avoid sparking);
– chocking of cargo tanks which are independent of the vessel’s hull and chocking of installations and equipment;
– masts and similar round timber;
– engine parts;
– parts of the electrical installation;
– loading and unloading appliances (not for tank vessel type G);
– lids of boxes which are placed on the deck.

1.7.8.6 The use of wood or synthetic materials within the cargo area is only permitted for supports and stops of any kind.

1.7.8.7 The use of synthetic materials or rubber within the cargo area is only permitted for:
– coating of cargo tanks and of piping for loading and unloading (not for tank vessel type G);
– all kinds of gaskets (e.g. for dome or hatch covers);
– electric cables;
– hose assemblies for loading and unloading;
– insulation of cargo tanks and of piping for loading and unloading.

1.7.8.8 All permanently fitted materials in the accommodation or wheelhouse, with the exception of furniture, shall not readily ignite (see the Rules, Part 3 – Machinery, Systems and Electricity, Chapter III, 1.2.11). They shall not evolve fumes or toxic gases in dangerous quantities, if involved in a fire.

1.7.8.9 The paint used in the cargo area shall not be liable to produce sparks in case of impact.

1.7.8.10 The use of synthetic material for vessel’s boats is permitted only if the material does not readily ignite.

1.7.9 Type approval of equipment

The following equipment is subject to type approval:
– expansion joints and cargo hoses
– gas-tight penetration glands
– cargo tank P/V and high velocity valves shall be tested according to EN 12874 (1999) or equivalent standard
– gas detection system
– instrumentation
– fans for enclosed spaces
– insulation materials
– safety relief valves flame arresters: to be tested according to European standard EN 12874 (1999) or equivalent standard.

NOTE: Scope of certification, including required inspections and tests required for cargo piping and other equipment shall be in accordance with applicable Rules requirements.
Chapter II - TRANSPORT OF DANGEROUS GOODS

2.3.1.4 The stripping pumps intended for the holds shall be located in the protected area. This requirement shall not apply when stripping is effect by eductors.

2.3.2 Ventilation
2.3.2.1 Ventilation of each hold shall be provided by means of two mutually independent extraction ventilators having a capacity of not less than five changes of air per hour based on the volume of the empty hold.

The ventilator fan shall be designed so that no sparks may be emitted on contact of the impeller blades with the housing and no static electricity may be generated.

The extraction ducts shall be positioned at the extreme ends of the hold and extend down to not more than 50 mm above the bottom. The extraction of gases and vapours through the duct shall also be ensured for carriage in bulk.

If the extraction ducts are movable they shall be suitable for the ventilator assembly and capable of being firmly fixed. Protection shall be ensured against bad weather and spray. The air intake shall be ensured during ventilation.

2.3.2.2 The ventilation system of a hold shall be arranged so that dangerous gases cannot penetrate into the accommodation, wheelhouse or engine rooms.

2.3.2.3 Ventilation shall be provided for the accommodation and for service spaces.

2.3.3 Accommodation and service spaces
2.3.3.1 The accommodation shall be separated from the holds by metal bulkheads having no openings.

2.3.3.2 Gastight closing appliances shall be provided for openings in the accommodation and wheelhouse facing the holds.

2.3.3.3 No entrances or openings of the engine rooms and service spaces shall face the protected area.

2.3.4 Water ballast
The double-hull spaces and double bottoms may be arranged for being filled with water ballast.

2.3.5 Engines
2.3.5.1 Only internal combustion engines running on fuel with a flashpoint of more than 55 °C are permitted.

2.3.5.2 The air vents in the engine rooms and the air intakes of the engines which do not take air in directly from the engine room shall be located not less than 2,0 m from the protected area.

2.3.5.3 Sparking shall not be possible in the protected area.

2.3.6 Fuel oil tanks
2.3.6.1 Double bottoms within the hold area may be arranged as fuel oil tanks provided their depth is not less than 0,6 m. Fuel oil pipes and openings to such tanks are not permitted in the holds.

2.3.6.2 The air pipes of all fuel oil tanks shall be led to 0,5 m above the open deck. Their open ends and the open ends of the overflow pipes leading to the deck shall be fitted with a protective device consisting of a gauze grid or by a perforated plate.

2.3.7 Exhaust pipes
2.3.7.1 Exhausts shall be evacuated from the vessel into the open air either upwards through an exhaust pipe or through the shell plating. The exhaust outlet shall be located not less than 2,0 m from the hatchway openings. The exhaust pipes of engines shall be arranged so that the exhausts are led away from the vessel. The exhaust pipes shall not be located within the protected area.

2.3.7.2 Exhaust pipes shall be provided with a device preventing the escape of sparks, e.g. spark arresters.

2.4 Electrical installation
2.4.1 Type and location of electrical equipment
2.4.1.1 It shall be possible to isolate the electrical equipment in the protected area by means of centrally located switches except where:

– in the holds it is of a certified safe type (see the Rules, Part 3 – Machinery, Systems and Electricity, Chapter II, 1.2.16) corresponding at least to temperature class T4 and explosion group II B; and

– in the protected area on the deck it is of the limited explosion risk type.

The corresponding electrical circuits shall have control lamps to indicate whether or not the circuits are live.

The switches shall be protected against unintended unauthorized operation. The sockets used in this area shall be so designed as to prevent connections being made except when they are not live.

Submerged pumps installed or used in the holds shall be of the certified safe type at least for temperature class T4 and explosion group II B.

2.4.1.2 Electric motors for hold ventilators which are arranged in the air flow shall be of the certified safe type.

2.4.1.3 Sockets for the connection of signal lights and gangway lighting shall be solidly fitted to the vessel close to the signal mast or the gangway. Sockets intended to supply the submerged pumps, hold ventilators and containers shall be permanently fitted to the vessel in the vicinity of the hatches.

2.4.2 Electric cables
2.4.2.1 Cables and sockets in the protected area shall be protected against mechanical damage.

2.4.2.2 Movable cables are prohibited in the protected area, except for intrinsically safe electric circuits or for the supply of signal lights and gangway lighting, for containers, for submerged pumps, hold ventilators and for electrically operated cover gantries.
2.4.2.3 For movable cables permitted in accordance with 2.4.2.2, only rubber-sheathed cables of type H07 RN-F in accordance with standard IEC-60 245-4:1994 or cables of at least equivalent design having conductors with a cross-section of not less than 1,5 mm², shall be used. These cables shall be as short as possible and installed so that damage is not likely to occur.

2.4.3 Metal wires, masts

All metal wires passing over the holds and all masts shall be earthed, unless they are electrically bonded to the metal hull of the vessel through their installation.

2.4.4 Accumulators

Accumulators shall be located outside the protected area.

2.5 Fire protection and fire-extinguishing

2.5.1 Fire and naked light

2.5.1.1 The outlets of funnels shall be located not less than 2,0 m from the hatchway openings. Arrangements shall be provided to prevent the escape of sparks and the entry of water.

2.5.1.2 Heating, cooking and refrigerating appliances shall not be fuelled with liquid fuels, liquid gas or solid fuels.

The installation in the engine room or in another separate space of heating appliances fuelled with liquid fuel having a flashpoint above 55°C is, however, permitted.

Cooking and refrigerating appliances are permitted only in wheelhouses with metal floor and in the accommodation.

2.5.1.3 Electric lighting appliances are only permitted outside the accommodation and the wheelhouse.

2.5.2 Fire extinguishing systems

In addition to the requirements of the Rules, Part 3 – Machinery, Systems and Electricity, Chapter III, Section 5, the fire extinguishing arrangements in 2.5.4 and 2.5.5 shall be complied with.

2.5.3 Portable fire extinguishers

In addition to the fire extinguishing appliances prescribed in the Rules, Part 3 – Machinery, Systems and Electricity, Chapter III, 5.5.2 and 5.5.3, each vessel shall be equipped with at least two additional portable fire extinguishers having the same capacity.

These additional portable fire extinguishers shall be suitable for fighting fires involving the dangerous goods carried.

These two portable fire extinguishers shall be located in the protected area or in proximity to it.

2.5.4 Fire-extinguishing system

A fire-extinguishing system shall be installed on the vessel. This system shall comply with the following requirements:

- it shall be supplied by two independent fire or ballast pumps, one of which shall be ready for use at any time.

These pumps and their means of propulsion and electrical equipment shall not be installed in the same space;

- it shall be provided with a water main fitted with at least three hydrants in the protected area above deck. Three suitable and sufficiently long hoses with jet/spray nozzles having a diameter of not less than 12,0 mm shall be provided. Alternatively one or more of the hose assemblies may be substituted by directable jet/spray nozzles having a diameter of not less than 12,0 mm. It shall be possible to reach any point of the deck in the protected area simultaneously with at least two jets of water which do not emanate from the same hydrant.

A spring-loaded non-return valve shall be fitted to ensure that no gases can escape through the fire-extinguishing system into the accommodation or service spaces outside the cargo area.

- the capacity of the system shall be at least sufficient for a jet of water to reach a distance of not less than the vessel’s breadth from any location on board with two spray nozzles being used at the same time;

- the water supply system shall be capable of being put into operation from the wheelhouse and from the deck;

- measures shall be taken to prevent the freezing of fire mains and hydrants.

A single fire or ballast pump shall suffice on board pushed barges without their own means of propulsion.

2.5.5 Fixed fire-extinguishing system

In addition, the engine room, the pump room and all spaces containing essential equipment (switchboards, compressors, etc.) for the refrigeration equipment, if any, shall be provided with a fixed fire-extinguishing system meeting the requirements of the Rules, Part 3 – Machinery, Systems and Electricity, Chapter III, 5.3.

2.6 Additional requirements applicable to double hull vessels

2.6.1 General

2.6.1.1 The requirements of this Head are applicable to double hull vessels intended to carry dangerous goods of Classes 2, 3, 4.1, 4.2, 4.3, 5.1, 5.2, 6.1, 7, 8 or 9, except those for which label No. 1 is prescribed in column (5) of Table A of Chapter 3.2, Part 3 of ADN, in quantities exceeding those of 7.1.4.1.1 (see Part 7, Chapter 7.1 of ADN).

2.6.1.2 Double-hull vessels intended to carry dangerous goods of Classes 2, 3, 4.1, 4.2, 4.3, 5.1, 5.2, 6.1, 7, 8 or 9 except those for which label No. 1 is prescribed in column (5) of Table A of Chapter 3.2, Part 3 of ADN, in quantities exceeding those referred to in 7.1.4.1.1 shall be built or converted under survey of the Register in accordance with the Rules established by the Register to its highest class. This shall be confirmed by the Register issuing of an appropriate certificate.

Continuation of Class is not required.

Future conversions and major repairs to the hull shall be carried out under survey of the Register.
Chapter II - TRANSPORT OF DANGEROUS GOODS

2.6.2 Holds

2.6.2.1 The vessel shall be built as a double-hull vessel with double-hull spaces and double bottom within the protected area in compliance to 2.6.2.2 and 2.6.2.3.

2.6.2.2 The distance between the sides of the vessel and the longitudinal bulkheads of the hold shall not be less than 0.8 m.

Regardless of the requirements relating to the width of walkways on deck, a reduction of this distance to 0.6 m is permitted, provided that, compared with the scantlings specified in the Rules, Part 2 – Hull and Hull Equipment, the following reinforcements have been made:

a) where the vessel’s sides are constructed according to the longitudinal framing system, the frame spacing shall not exceed 0.6 m.

The longitudinals shall be supported by web frames with lightening holes similar to the floors in the double bottom and spaced not more than 1.8 m apart. These intervals may be increased if the construction is correspondingly reinforced;

b) where the vessel’s sides are constructed according to the transverse framing system, either:

- two longitudinal side shell stringers shall be fitted. The distance between the two stringers and between the uppermost stringer and the gangboard shall not exceed 0.8 m.

The depth of the stringers shall be at least equal to that of the transverse frames and the cross-section of the face plate shall not be less than 15.0 cm². The longitudinal stringers shall be supported by web frames with lightening holes similar to plate floors in the double bottom and spaced not more than 3.60 m apart. The transverse shell frames and the hold bulkhead vertical stiffeners shall be connected at the bilge by a bracket plate with a height of not less than 0.9 m and thickness equal to the thickness of the floors; or

- web frames with lightening holes similar to the double bottom plate floors shall be arranged on each transverse frame;

c) the gangboards shall be supported by transverse bulkheads or cross-ties spaced not more than 32.0 m apart.

As an alternative to compliance with the requirements, a proof by calculation, issued by the Register confirming that additional reinforcements have been fitted in the double-hull spaces and that the vessel’s transverse strength may be regarded as satisfactory.

2.6.2.3 The depth of the double bottom shall be at least 0.5 m. The depth below the suction wells may, however, be locally reduced, but the space between the bottom of the suction well and the bottom of the vessel floor shall be at least 0.4 m. If spaces are between 0.4 m and 0.49 m, the surface area of the suction well shall not exceed 0.5 m².

The capacity of the suction wells must not exceed 0.12 m³.

2.6.3 Emergency exit

Spaces the entrances or exits of which are partly or fully immersed in damaged condition shall be provided with an emergency exit not less than 0.1 m above the damage waterline. This requirement does not apply to fore peak and aft peak.

2.6.4 Buoyancy and stability

2.6.4.1 General

General requirements of the Rules, Part 2 – Hull and Hull Equipment, Chapter II, Section 11 shall be complied with.

.1 proof of sufficient stability shall be furnished including stability in the damaged condition;

.2 the basic values for the stability calculation - the vessel’s lightweight and the location of the centre of gravity - shall be determined either by means of an inclining experiment or by detailed mass and moment calculation. In the latter case the lightweight shall be checked by means of a lightweight test with a resulting difference of not more than ± 5% between the mass determined by the calculation and the displacement determined by the draught readings;

.3 proof of sufficient intact stability shall be furnished for all stages of loading and unloading and for the final loading condition;

.4 floatability after damage shall be proved for the most unfavourable loading condition. For this purpose calculated proof of sufficient stability shall be established for critical intermediate stages of flooding and for the final stage of flooding. Negative values of stability in intermediate stages of flooding may be accepted only if sufficient stability in intermediate stages is verified.

2.6.4.2 Intact stability

The requirements for intact stability resulting from the damaged stability calculation shall be fully complied with.

2.6.4.3 Damage stability

2.6.4.3.1 Sufficient buoyancy and stability of the vessel in the event of flooding shall be proven with a cargo corresponding to its maximum draught and evenly distributed among all the holds and with maximum supplies and fully fuelled.

For diversified cargo, the stability calculation shall be performed for the most unfavourable loading condition. For this purpose, mathematical proof of sufficient stability shall be determined for the intermediate stages of flooding (25%, 50% and 75% of flood build up, and, where appropriate, for the stage immediately prior to transverse equilibrium) and for the final stage of flooding, in the loading conditions specified above.

The following assumptions shall be taken into consideration for the damaged condition:

a) the extent of side damage is as follows:

- longitudinal extent: at least 0.1 L, but not less than 5.0 m;
- transverse extent: 0.59 m inboard from the vessel’s side at right angles to the centreline at the level corresponding to the maximum draught;
- vertical extent: from the baseline upwards without limit;

b) the extent of bottom damage is as follows:
Chapter II - TRANSPORT OF DANGEROUS GOODS

2.6.4.3.2 For all intermediate stages of flooding referred above (25%, 50% and 75% of flood build up, and, where appropriate, for the stage immediately prior to transverse equilibrium), the following criteria shall be met:

- the heeling angle \( \phi \) at the equilibrium position of the intermediate stage in question shall not exceed 15° (5° where containers are not secured), see Figure 2.6.4-1;

- non-watertight openings shall not be immersed before the heel in the equilibrium position of the intermediate stage in question has been reached;

- the positive part of the righting lever curve shall display a righting lever value of \( GZ \geq 0,02 \text{ m} \) (0,03 m where containers are not secured) before the first unprotected (non-watertight) opening becomes immersed or a heeling angle \( \phi \) of 27° is reached (10° where containers are not secured).

2.6.4.3.3 At the stage of equilibrium (final stage of flooding), the following criteria shall be met:

- angle of heel shall not exceed 12° (5° where containers are not secured);

b) non-watertight openings shall not be immersed before reaching the stage of equilibrium. If such openings are immersed before that stage, the corresponding spaces shall be considered as flooded for the purpose of stability calculation;

c) the positive range of the righting lever curve beyond the position of equilibrium shall have a righting lever of \( GZ \geq 0,05 \text{ m} \) in association with an area under the curve of \( \geq 0,0065 \text{ m} \cdot \text{rad} \);

d) the minimum values of stability given in c) shall be satisfied up to immersion of the first unprotected (non-watertight) opening and in any event up to an angle of heel \( \leq 27^\circ \) (10° where containers are not secured). If non-watertight openings are immersed before the requirements given in c) are complied with, the corresponding spaces shall be considered as flooded for the purposes of stability calculation.

If openings through which undamaged compartments may become additionally flooded are capable of being closed watertight, the closing devices shall be appropriately marked.

For the main engine room only the one-compartment standard needs to be taken into account, i.e. the end bulkheads of the engine room shall be assumed as not damaged.

The calculation of free surface effect in intermediate stages of flooding shall be based on the gross surface area of the damaged compartments.

The calculation of free surface effect in intermediate stages of flooding shall be based on the gross surface area of the damaged compartments. For all intermediate stages of flooding referred above (25%, 50% and 75% of flood build up, and, where appropriate, for the stage immediately prior to transverse equilibrium), the following criteria shall be met:

2.6.4.3.2 For all intermediate stages of flooding referred above (25%, 50% and 75% of flood build up, and, where appropriate, for the stage immediately prior to transverse equilibrium), the following criteria shall be met:

a) the heeling angle \( \phi \) at the equilibrium position of the intermediate stage in question shall not exceed 15° (5° where containers are not secured), see Figure 2.6.4-1;

b) non-watertight openings shall not be immersed before the heel in the equilibrium position of the intermediate stage in question has been reached;

c) beyond the heel in the equilibrium position of the intermediate stage of flooding in question, the positive part of the righting lever curve beyond the position of equilibrium shall display a righting lever value of \( GZ \geq 0,02 \text{ m} \) (0,03 m where containers are not secured) before the first unprotected (non-watertight) opening becomes immersed or a heeling angle \( \phi \) of 27° is reached (10° where containers are not secured).

2.6.4.3.3 At the stage of equilibrium (final stage of flooding), the following criteria shall be met:

a) angle of heel shall not exceed 12° (5° where containers are not secured);

b) non-watertight openings shall not be immersed before reaching the stage of equilibrium. If such openings are immersed before that stage, the corresponding spaces shall be considered as flooded for the purpose of stability calculation;

c) the positive range of the righting lever curve beyond the position of equilibrium shall have a righting lever of \( GZ \geq 0,05 \text{ m} \) in association with an area under the curve of \( \geq 0,0065 \text{ m} \cdot \text{rad} \);

d) the minimum values of stability given in c) shall be satisfied up to immersion of the first unprotected (non-watertight) opening and in any event up to an angle of heel \( \leq 27^\circ \) (10° where containers are not secured). If non-watertight openings are immersed before the requirements given in c) are complied with, the corresponding spaces shall be considered as flooded for the purposes of stability calculation.

If openings through which undamaged compartments may become additionally flooded are capable of being closed watertight, the closing devices shall be appropriately marked.

The calculation of free surface effect in intermediate stages of flooding shall be based on the gross surface area of the damaged compartments. For all intermediate stages of flooding referred above (25%, 50% and 75% of flood build up, and, where appropriate, for the stage immediately prior to transverse equilibrium), the following criteria shall be met:

a) the heeling angle \( \phi \) at the equilibrium position of the intermediate stage in question shall not exceed 15° (5° where containers are not secured), see Figure 2.6.4-1;

b) non-watertight openings shall not be immersed before the heel in the equilibrium position of the intermediate stage in question has been reached;

c) beyond the heel in the equilibrium position of the intermediate stage of flooding in question, the positive part of the righting lever curve beyond the position of equilibrium shall display a righting lever value of \( GZ \geq 0,02 \text{ m} \) (0,03 m where containers are not secured) before the first unprotected (non-watertight) opening becomes immersed or a heeling angle \( \phi \) of 27° is reached (10° where containers are not secured).

2.6.4.3.2 For all intermediate stages of flooding referred above (25%, 50% and 75% of flood build up, and, where appropriate, for the stage immediately prior to transverse equilibrium), the following criteria shall be met:

- the heeling angle \( \phi \) at the equilibrium position of the intermediate stage in question shall not exceed 15° (5° where containers are not secured), see Figure 2.6.4-1;

- non-watertight openings shall not be immersed before the heel in the equilibrium position of the intermediate stage in question has been reached;

- beyond the heel in the equilibrium position of the intermediate stage of flooding in question, the positive part of the righting lever curve shall display a righting lever value of \( GZ \geq 0,02 \text{ m} \) (0,03 m where containers are not secured) before the first unprotected (non-watertight) opening becomes immersed or a heeling angle \( \phi \) of 27° is reached (10° where containers are not secured).

2.6.4.3.3 At the stage of equilibrium (final stage of flooding), the following criteria shall be met:

a) angle of heel shall not exceed 12° (5° where containers are not secured);

b) non-watertight openings shall not be immersed before reaching the stage of equilibrium. If such openings are immersed before that stage, the corresponding spaces shall be considered as flooded for the purpose of stability calculation;

c) the positive range of the righting lever curve beyond the position of equilibrium shall have a righting lever of \( GZ \geq 0,05 \text{ m} \) in association with an area under the curve of \( \geq 0,0065 \text{ m} \cdot \text{rad} \);

d) the minimum values of stability given in c) shall be satisfied up to immersion of the first unprotected (non-watertight) opening and in any event up to an angle of heel \( \leq 27^\circ \) (10° where containers are not secured). If non-watertight openings are immersed before the requirements given in c) are complied with, the corresponding spaces shall be considered as flooded for the purposes of stability calculation.

If openings through which undamaged compartments may become additionally flooded are capable of being closed watertight, the closing devices shall be appropriately marked.

Fig 2.6.4-1
Chapter II - TRANSPORT OF DANGEROUS GOODS

3 TANKERS TYPE G

3.1 General

3.1.1 The requirements of this Section apply to vessels intended for the carriage in bulk of gases under pressure or under refrigeration assigned with additional Character of class Type G, as defined in the Rules, Part I – Classification and Surveys, Chapter I, 3.6.2.

3.1.2 Vessels considered in this Section shall comply with the applicable requirements of the Rules, Part 1 – Classification and Surveys, Part 2 – Hull and Hull Equipment and Part 3 – Machinery, Systems and Electricity, as applicable, and with the specific requirements from Section 1 and the present Rules, Chapter I, Section 3.

3.1.3 For scantling of the hull of vessels with independent tanks, see the present Rules, Chapter I, 3.3.4.

3.1.4 Design and construction of pressure tanks shall conform to the Rules, Part 3 – Machinery, Systems and Electricity, Chapter I, Section 5.

3.1.5 Definitions

3.1.5.1 Design pressure and testing pressure

The design pressure \( p_d \) is defined in 1.5.20. For cargo tanks where there is no temperature control and where the pressure of the cargo is dictated only by the ambient temperature, \( p_d \) shall not be less than the gauge vapour pressure of the cargo at a temperature of 40°C. In all cases \( p_d \) shall not be less than MARVS.

The testing pressure for the cargo tanks and the cargo handling system shall comply with the requirements stated under the Rules, Part I – Classification and Surveys, Chapter III, 4.7.2.5 and 4.7.2.6, respectively. The testing pressure for the cofferdams shall not be less than 10,0 kPa (0,1 bar) gauge pressure.

3.1.5.2 Design temperature

The design temperature for selection of materials is the minimum temperature at which cargo may be loaded or transported in the cargo tanks. Provisions to the satisfaction of the Register shall be made that the tank or cargo temperature cannot be lowered below the design temperature.

3.1.5.3 Gas

A gas (for the purposes of Class 2) is a substance which:

- at 50°C has a vapour pressure greater than 300,0 kPa (3 bar); or
- is completely gaseous at 20°C under standard pressure of 101,3 kPa.

Liquefied gas is a cargo with a vapour pressure equal to or above 0,275 MPa absolute at 37,8°C.

3.1.5.4 MARVS

MARVS is the maximum permissible relief valve setting of a cargo tank (gauge pressure).

3.1.5.5 Tank dome

Tank dome is the upward extension of a portion of a cargo tank.

3.2 Documentation to be submitted

In addition to the documentation required in the other applicable Parts of the Rules for the parts of the vessel not affected by the cargo, the following documentation shall be submitted, as applicable:

1. list of substances intended to be carried with their UN numbers including all design characteristics of substances and other important design conditions;
2. general arrangement plan, showing location of cargo tanks and fuel oil, ballast and other tanks, void spaces, etc.;
3. loading and unloading operation description, including cargo tank filling limits;
4. cargo area plan, location of the electrical equipment installed in these areas and list of the electrical equipment installed in cargo tank and cargo area (comparable to zone 0 and 1), including the following equipment particulars: location, type of protection, type of protection against explosion, testing body and approval number;
5. location of void spaces and accesses to dangerous zones;
6. air locks between safe and dangerous zones;
7. list of equipment installed in cargo area (comparable to zone 2) which may be used during loading, unloading and gas-freeing and red equipment;
8. details of hull structure in way of cargo tanks, including support arrangement for tanks, saddles, anti-floating and anti-lifting devices, deck sealing arrangements, independent cargo tanks, etc.;
9. calculation of the hull temperature in all the design cargo conditions;
10. intact and damage stability calculations;
11. scantlings, material and arrangement of the cargo containment system;
12. details of insulation;
13. drawings of the gastight shaft penetrations for pumps, compressors and fans;
14. details of tank domes and deck sealings;
15. drawings and calculation of the safety relief valves;
16. details of cargo handling and venting system, including arrangements and details of piping and fitting;
17. locations and details of cargo pumps and gas compressors including their driving machinery;
18. details of process pressure vessels and relative valving arrangement;
19. ventilation duct arrangement in gas-dangerous spaces and adjacent zones including schemes and calculations of ventilation system in cargo area;
20. details of the cargo tank instrumentation including gauging/sounding devices, level/overfill alarms and pressure and temperature indicating equipment;
21. arrangement drawing of the various fire bulkheads and decks with standard fire test reports for the various arrangements, surface coverings, paints and similar;
22. details of fire extinguishing appliances and systems in cargo area;
23. drawings of the bilge and ballast water systems within the cargo area.
Part 4 – Additional Requirements for Notations

3.3 Vessel arrangement

3.3.1 Hold spaces

3.3.1.1 Hold spaces shall be separated from the accommodation and service spaces outside the cargo area below deck by bulkheads provided with Class “A-60” fire protection insulation (see the Rules, Part 3 – Machinery, Systems and Electricity, Chapter III, 1.2.6). A space of not less than 0,2 m shall be provided between the cargo tanks and the end bulkheads of the hold spaces. Where the cargo tanks have plane end bulkheads this space shall not be less than 0,5 m.

Hold spaces and cargo tanks shall be capable of being inspected.

All spaces in the cargo area shall be capable of being ventilated. Means for checking their gas-free condition shall be provided.

3.3.1.2 The bulkheads bounding the hold spaces shall be watertight. The cargo tanks and the bulkheads bounding the cargo area shall have no openings or penetrations below deck.

The bulkhead between the engine room and the service spaces within the cargo area or between the engine room and a hold space may be fitted with penetrations provided that they conform to the requirements of 3.3.4.5.

3.3.1.3 Double-hull spaces and double bottoms in the cargo area shall be arranged for being filled with ballast water only. Double bottoms may, however, be used as fuel oil tanks, provided they comply with the requirements of 3.3.6.

3.3.1.4 A space in the cargo area below deck may be arranged as a service space, provided that the bulkhead bounding the service space extends vertically to the bottom and the bulkhead not facing the cargo area extends from one side of the vessel to the other in one frame plane. This service space shall only be accessible from the deck.

The service space shall be watertight with the exception of its access hatches and ventilation inlets.

No piping for loading or unloading shall be fitted within the service space referred to above.

Chapter II - TRANSPORT OF DANGEROUS GOODS

Piping for loading and unloading may be fitted in the cargo pump rooms below deck only when they conform to the provisions of 3.3.4.6. 3.3.1.5 Where service spaces are located in the cargo area under deck, they shall be arranged so as to be easily accessible and to permit persons wearing protective clothing and breathing apparatus to safely operate the service equipment contained therein. They shall be designed so as to allow injured or unconscious personnel to be removed from such spaces without difficulties, if necessary by means of fixed equipment.

3.3.1.6 Hold spaces and other accessible spaces within the cargo area shall be arranged so as to ensure that they may be completely inspected and cleaned in an appropriate manner.

The dimensions of openings, except for those of double-hull spaces and double bottoms which do not have a wall adjoining the cargo tanks, shall be sufficient to allow a person wearing breathing apparatus to enter or leave the space without difficulties. These openings shall have a minimum cross-sectional area of 0,36 m² and a minimum side length of 0,5 m.

They shall be designed so as to allow injured or unconscious persons to be removed from the bottom of such spaces without difficulties, if necessary by means of fixed equipment. In these spaces the distance between the reinforcements shall not be less than 0,5 m. In double bottoms this distance may be reduced to 0,45 m.

Cargo tanks may have circular openings with a diameter of not less than 0,68 m.

3.3.1.7 In case the vessel has insulated cargo tanks, the hold spaces shall only contain dry air to protect the insulation of the cargo tanks against moisture.

3.3.2 Protection against the penetration of gases

3.3.2.1 The vessel shall be designed so as to prevent gases from penetrating into the accommodation and the service spaces.

3.3.2.2 Outside the cargo area, the lower edges of door openings in the sidewalls of superstructures and the coamings of access hatches to under-deck spaces shall have a height of not less than 0,5 m above the deck.

This requirement need not be complied with if the wall of the superstructures facing the cargo area extends from one side of the vessel to the other and has doors the sills of which have a height of not less than 0,5 m.

The height of this wall shall not be less than 2,0 m. In this case, the lower edges of door-openings in the sidewalls of superstructures and the coamings of access hatches behind this wall shall have a height of not less than 0,1 m. The sills of engine room doors and the coamings of its access hatches shall, however, always have a height of not less than 0,5 m.

3.3.2.3 In the cargo area, the lower edges of door-openings in the sidewalls of superstructures shall have a height of not less than 0,5 m above the deck and the sills of hatches and ventilation openings of premises located under the deck shall have a height of not less than 0,5 m above the deck.

This requirement does not apply to access openings to double-hull and double bottom spaces.
Chapter II - TRANSPORT OF DANGEROUS GOODS

3.3.2.4 The bulwarks, foot-rails, etc. shall be provided with sufficiently large openings which are located directly above the deck.

3.3 Engine rooms

3.3.3.1 Internal combustion engines for the vessel’s propulsion as well as internal combustion engines for auxiliary machinery shall be located outside the cargo area.

Entrances and other openings of engine rooms shall be at a distance of not less than 2,0 m from the cargo area.

3.3.3.2 The engine room shall be accessible from the deck; the entrances shall not face the cargo area. Where the doors are not located in a recess whose depth is at least equal to the door width, the hinges shall face the cargo area.

3.3.4 Accommodation and service spaces

3.3.4.1 Accommodation spaces and the wheelhouse shall be located outside the cargo area forward of the fore vertical plane or aft of the aft vertical plane bounding the part of cargo area below deck. Windows of the wheelhouse which are located not less than 1,0 m above the bottom of the wheelhouse may tilt forward.

3.3.4.2 Entrances to spaces and openings of superstructures shall not face the cargo area. Doors opening outward and not located in a recess the depth of which is at least equal to the width of the doors shall have their hinges facing the cargo area.

3.3.4.3 Entrances from the deck and openings of spaces facing the weather shall be capable of being closed.

The following instruction shall be displayed at the entrance of such spaces:

Do not open during loading and unloading without the permission of the master. Close immediately.

3.3.4.4 Entrances and windows of superstructures and accommodation spaces which can be opened as well as other openings of these spaces shall be located not less than 2,0 m from the cargo area. No wheelhouse doors and windows shall be located within 2,0 m from the cargo area, except where there is no direct connection between the wheelhouse and the accommodation.

3.3.4.5

a) driving shafts of the bilge or ballast pumps may penetrate through the bulkhead between the service space and the engine room, provided the arrangement of the service space is in compliance with 3.3.1.4.

b) the penetration of the shaft through the bulkhead shall be gastight and shall have been approved by the Register.

c) penetrations through the bulkhead between the engine room and the service space in the cargo area, and thebulkhead between the engine room and the hold spaces may be provided for electrical cables, hydraulic lines and piping for measuring, control and alarm systems, provided that the penetrations have been approved by the Register. The penetrations shall be gastight. Penetrations through a bulkhead with a “A-60” fire protection insulation (see the Rules, Part 3 – Machinery, Systems and Electricity, Chapter III, 1.2.6), shall have an equivalent fire protection.

d) pipes may pass through the bulkhead between the engine room and the service space in the cargo area provided that these are pipes between the mechanical equipment in the engine room and the service space which do not have any openings within the service space and which are provided with shut-off devices at the bulkhead in the engine room.

e) notwithstanding 3.3.1.2, pipes from the engine room may pass through the service space in the cargo area or a cofferdam or a hold space or a double-hull space to the outside provided that within the service space or cofferdam or hold space or double hull space they are of the thick-walled type and have no flanges or openings.

f) where a driving shaft of auxiliary machinery penetrates through a wall located above the deck the penetration shall be gastight.

3.3.4.6 A service space located within the cargo area below deck shall not be used as a cargo pump room for the vessel’s own gas discharging system, e.g. compressors or the compressor/ heat exchanger/pump combination, except where:

a) the pump room is separated from the engine room or from service spaces outside the cargo area by a cofferdam or a bulkhead with an “A-60” fire protection insulation (see the Rules, Part 3 – Machinery, Systems and Electricity, Chapter III, 1.2.6), or by a service space or a hold space;

b) the “A-60” bulkhead required above does not include penetrations referred to in 3.3.4.5, a);

c) ventilation exhaust outlets are located not less than 6,0 m from entrances and openings of the accommodation and service spaces;

d) the access hatches and ventilation inlets can be closed from the outside;

e) all pipes for loading and unloading (at the suction side and delivery side) are led through the deck above the pump-room. The necessary operation of the control devices in the pump-room, starting of pumps or compressors and control of the liquid flow rate shall be effected from the deck;

f) the system is fully integrated in the gas and liquid piping system;

g) the cargo pump-room is provided with a permanent gas detection system which automatically indicates the presence of explosive gases or lack of oxygen by means of direct-measuring sensors and which actuates a visual and audible alarm when the gas concentration has reached 20% of the lower explosive limit. The sensors of this system shall be placed at suitable positions at the bottom and directly below the deck. Measurement shall be continuous;

h) the audible and visual alarms are installed in the wheelhouse and in the cargo pump-room and, when the alarm is actuated, the loading and unloading system is shut down. Failure of the gas detection system shall be immediately signalled in the wheelhouse and on deck by means of audible and visual alarms;
3.3.9 Ventilation

3.3.9.1 Each hold space shall have two openings the dimensions and location of which shall be such as to permit effective ventilation of any part of the hold space. If there are no such openings, it shall be possible to fill the hold spaces with inert gas or dry air.

3.3.9.2 Double-hull spaces and double bottoms within the cargo area which are not arranged for being filled with ballast water and cofferdams between engine rooms and pump-rooms, if they exist, shall be provided with ventilation systems.

3.3.9.3 Any service spaces located in the cargo area below deck shall be provided with a system of forced ventilation with sufficient power for ensuring at least 20 changes of air per hour based on the volume of the space.

The ventilation exhaust ducts shall extend down to 50,0 mm above the bottom of the service space. The air shall be supplied through a duct at the top of the service space. The air inlets shall be located not less than 2,0 m above the deck, at a distance of not less than 2,0 m from tank openings and 6,0 m from the outlets of safety valves.

The extension pipes, which may be necessary, may be of the hinged type.

3.3.9.4 Ventilation of accommodation and service spaces shall be possible.

3.3.9.5 Ventilators used in the cargo area shall be designed so that no sparks may be emitted on contact of the impeller blades with the housing and no static electricity may be generated.

3.3.9.6 All ventilation inlets of accommodation and service spaces leading outside shall be fitted with fire flaps. Such ventilation inlets shall be located not less than 2,0 m from the cargo area.

3.3.9.7 Ventilation inlets of service spaces in the cargo area may be located within such area.

3.3.10 Ventilation of cargo pump rooms and gas compressor rooms

3.3.10.1 Cargo pump and compressor rooms shall be provided with extraction type ventilation systems, independent of other vessel's spaces, providing at least 30 changes of air per hour based on total volume of the service space.

3.3.10.2 The following instruction shall be displayed at the entrance of the cargo pump-room:

*Before entering the cargo pump-room check whether it is free from gases and contains sufficient oxygen. Do not open doors and entrance openings without the permission of the master.
Leave immediately in the event of alarm.*
3.4 Cargo containment

3.4.1 Cargo area hull design

In the cargo area, the hull shall be designed either as a double hull and double bottom vessel, or a single hull vessel.

The vessels shall comply with the following:

3.4.1.1 Double-hull and double bottom vessel

The internal distance between the side platings of the vessel and the longitudinal bulkheads shall not be less than 0.8 m.

The height of the double bottom shall not be less than 0.6 m.

The cargo tanks shall be supported by saddles extending between the tanks to not less than 20° below the horizontal centreline of the cargo tanks.

3.4.1.2 Single hull vessel

A single hull vessel shall be fitted with the side platings between gangboard and top of floor plates provided with side stringers at regular intervals of not more than 0.60 m which are supported by web frames spaced at intervals of not more than 2.0 m.

The side stringers and the web frames shall have a height of not less than 10% of the depth, however, not less than 0.3 m.

The side stringers and web frames shall be fitted with a face plate made of flat steel and having a cross-section of not less than 7.5 cm² and 15.0 cm², respectively.

The distance between the side plating of the vessel and the cargo tanks shall not be less than 0.8 m and between the bottom and the cargo tanks not less than 0.6 m. The depth below the suction wells may be reduced to 0.5 m.

The lateral distance between the suction well of the cargo tanks and the bottom structure shall not be less than 0.1 m.

The cargo tank supports and fastenings should extend to not less than 10° below the horizontal centreline of the cargo tanks.

3.4.1.3 The capacity of a suction well shall be limited to not more than 0.1 m³. For pressure cargo tanks, however, the capacity of a suction well may be of 0.2 m³.

Side-struts linking or supporting the load-bearing components of the sides of the vessel with the load-bearing components of the longitudinal walls of cargo tanks and side-struts linking the load-bearing components of the vessel’s bottom with the tank bottom are prohibited.

NOTE: For a different design of the hull in the cargo area, proof shall be furnished by way of calculation that in the event of a lateral collision with another vessel having a straight bow, an energy of 22,0 MJ can be absorbed without any rupture of the cargo tanks and the piping leading to the cargo tanks. Alternative constructions in accordance with Section 8 are permitted.

3.4.2 Carriage of liquefied gases under pressure

3.4.2.1 Cargo tank design

Pressure tanks whose ratio of length to diameter exceeds 7 are prohibited. The pressure tanks shall be designed for a cargo temperature of 40°C;

.2 pressure vessels shall, in general, be designed as a domed type. Fittings must be mounted on the domes or elsewhere on the upper part of the tanks above the open deck in the cargo area. They shall be protected against damage and must be secured in such a way that undue stresses caused by vibration or expansion cannot occur. At least one manhole shall be arranged in the tank dome or as a separate dome with the access opening located on the open deck;

.3 with the cargo at the reference temperature specified in 3.1.5.2, pressure vessels may not be filled to more than 91% for uncooled and 95% for cooled carriage;

.4 the cargo tanks shall be fixed so that they cannot float.

3.4.2.2 Protective painting

Pressure vessels shall be painted externally for protection against corrosion. Uninsulated or unprotected portions on the open deck shall be coated with reflecting paints.

3.4.2.3 Installation of cargo tanks

Pressure vessels shall be so installed as to allow their inspection as well as the adjoining vessel’s structure.

3.4.2.4 Name plates

Each pressure vessel shall bear a name plate showing the following data:

– name of manufacturer, serial number, year of manufacture;
– cubic capacity; [m³]
– design pressure and test pressure; [bar]
– certificate No., month and year of test;
– Register stamp;
– lowest operation temperature; [°C]
– vapour pressure, in bar at reference temperature, in °C.

The name plates must be legible from the deck.

3.4.3 Carriage of refrigerated liquefied gases

3.4.3.1 Requirements as set out in the applicable statutory Regulations or a recognized standard shall be observed.

Further individual requirements shall be decided in consultation with the Register on a the case-by-case basis in accordance with requirements of the IGC Code for Type A and Type B liquefied gas carriers.

3.4.3.2 Refrigerated cargo tanks and cargo tanks used for the transport of refrigerated liquefied gases shall be installed only in hold spaces bounded by double hull spaces and double bottom.

3.4.3.3 Cargo tanks intended to contain products at a temperature below −10°C shall be suitably insulated to ensure that the temperature of the vessel’s structure does not fall below the minimum permissible material design temperature. The insulation material shall be resistant to flame spread.

3.4.4 Cargo tank openings

3.4.4.1 Cargo tank openings shall be located on deck in the cargo area.
Cargo tank openings with a cross-section greater than 0,1 m² shall be located not less than 0,5 m above the deck.

3.4.4.2 The exhaust outlets of the pressure relief valves shall be located not less than 2,0 m above the deck at a distance of not less than 6,0 m from the accommodation and from the service spaces located outside the cargo area. This height may be reduced when within a radius of 1,0 m round the pressure relief valve outlet there is no equipment, no work is being carried out and signs indicate the area.

3.4.4.3 The closing devices normally used in loading and unloading operations shall not be capable of producing sparks when operated.

3.4.4.4 Each tank in which refrigerated substances are carried shall be equipped with a safety system to prevent unauthorized vacuum or overpressure.

3.4.4.5 Cargo tank connections for gauging or measuring devices need not to be equipped with excess flow or emergency shut-off valves, provided that the devices are so constructed that the outward flow of tank contents cannot exceed that passed by a 1,5 mm diameter circular hole.

3.5 Cargo piping system

3.5.1 General

Pumps, compressors and accessory loading and unloading piping shall be placed in the cargo area. Cargo pumps and compressors shall be capable of being shut down from the cargo area and, in addition, from a position outside the cargo area. Cargo pumps and compressors situated on deck shall be located not less than 6,0 m from entrances to, or openings of, the accommodation and service spaces outside the cargo area.

3.5.2 Arrangement of cargo piping

3.5.2.1 Piping for loading and unloading shall be independent of any other piping of the vessel. No cargo piping shall be located below deck, except those inside the cargo tanks and in the service spaces intended for the installation of the vessel’s own gas discharging system.

3.5.2.2 Piping for loading and unloading shall be clearly distinguishable from other piping, e.g. by means of colour marking.

3.5.2.3 The piping for loading and unloading on deck, the venting piping with the exception of the shore connections but including the safety valves, and the valves shall be located within the longitudinal line formed by the outer boundaries of the domes and not less than one quarter of the vessel’s breadth from the outer shell. This requirement does not apply to the relief pipes situated behind the safety valves. If there is, however, only one dome athwartship, these pipes and their valves shall be located at a distance not less than 2,7 m from the shell.

3.5.2.4 Where cargo tanks are placed side by side, all the connections to the domes shall be located on the inner side of the domes. The external connections may be located on the fore and aft centre line of the dome. The shut-off devices shall be located directly at the dome or as close as possible to it. The shut-off devices of the loading and unloading piping shall be duplicated, one of the devices being constituted by a remote controlled quick-action stop device. When the inside diameter of a shut-off device is less than 50 mm this device may be regarded as a safety device against bursts in the piping.

3.5.2.5 The shore connections shall be located not less than 6,0 m from the entrances to or openings of, the accommodation and service spaces outside the cargo area.

Each shore connection of the venting piping and shore connections of the piping for loading and unloading, through which the loading or unloading operation is carried out, shall be fitted with a shut-off device and a quick-action stop valve. However, each shore connection shall be fitted with a blind flange when it is not in operation.

3.5.2.6 Piping for loading and unloading, and venting piping, shall not have flexible connections fitted with sliding seals.

3.5.2.7 For transport of refrigerated liquefied gases

a) The piping for loading and unloading and cargo tanks shall be protected from excessive stresses due to thermal movement and from movements of the tank and hull structure.

b) Where necessary, piping for loading and unloading shall be thermally insulated from the adjacent hull structure to prevent the temperature of the hull falling below the design temperature of the hull material.

c) All piping for loading and unloading, which may be closed off at each end when containing liquid (residue), shall be provided with safety valves. These safety valves shall discharge into the cargo tanks and shall be protected against inadvertent closing.

3.5.2.8 The distance referred to in 3.5.1 and 3.5.2.5 above may be reduced to 3,0 m if a transverse bulkhead complying with the 3.3.2.2 is situated at the end of the cargo area. The openings shall be provided with doors.

The following notice shall be displayed on the doors:

Do not open during loading and unloading without the permission of the master.

Close immediately.

3.5.2.9 Every component of the piping for loading and unloading shall be electrically connected to the hull.

3.5.2.10 The stop valves or other shut-off devices of the piping for loading and unloading shall indicate whether they are open or shut.

3.5.2.11 The piping for unloading shall be fitted with pressure gauges at the inlet and outlet of the pump.

Reading of the pressure gauges shall be possible from the control position of the vessel’s own gas discharging system. The maximum permissible overpressure or vacuum
shall be indicated by a measuring device. Readings shall be possible in all weather conditions.

3.5.2.12 Use of the cargo piping for ballasting purposes shall not be possible.

3.5.2.13 Compressed air generated outside the cargo area or wheelhouse can be used in the cargo area subject to the installation of a spring-loaded non-return valve to ensure that no gases can escape from the cargo area through the compressed air system into accommodation or service spaces outside the cargo area.

3.5.2.14 Materials

Stainless steel pipes, valves and fittings shall be grades 304L, 316L, 321 or 347 in accordance with the Rules, Part 25 - Metallic Materials, 3.6.

The materials used in Class I and Class II piping systems shall be produced under supervision of the Register.

For stainless steel pipes, valve casings and forgings intended for service temperatures down to \(-55^\circ\mathrm{C}\), the Register’s certificate for material (EN 10204, type 3.2) is required, unless:

- \(\mathrm{DN} \leq 50\); or
- \(\mathrm{DN} \leq 150\) and \(\mathrm{DN} \cdot p_w < 2500\) (\(p_w\) - maximum permissible working pressure [bar]);

where a manufacturer’s material certificate (EN 10204 type 3.1) is acceptable.

Properties of materials other than stainless steel shall be submitted and will be specially considered.

3.5.2.15 Valves and piping components

For valves and piping components fitted in the cargo piping system of each type of valve and piping component shall have evidence of satisfactory type testing.

3.6 Cargo pressure and temperature control

3.6.1 Regulation of cargo pressure and temperature

3.6.1.1 Unless the entire cargo system is designed to resist the full effective vapour pressure of the cargo at the upper limits of the ambient design temperatures, the pressure of the tanks shall be kept below the permissible maximum set pressure of the safety valves, by one or more of the following means:

a) a system for the regulation of cargo tank pressure using mechanical refrigeration

b) a system ensuring safety in the event of the heating or increase in pressure of the cargo. The insulation or the design pressure of the cargo tank, or the combination of these two elements, shall be such as to leave an adequate margin for the operating period and the temperatures expected; in each case the system shall be deemed acceptable by the Register and shall ensure safety for a minimum time of three times the operation period

c) for UN No. 1972 only, and when the use of LNG as fuel is authorized, a system for the regulation of cargo tank pressure whereby the boil-off vapours are utilized as fuel

d) other systems deemed acceptable by the Register.

3.6.1.2 The systems prescribed in 3.6.1.1 shall be constructed, installed and tested to the satisfaction of the Register. The materials used in their construction shall be compatible with the cargoes to be carried. For normal service, the upper ambient design temperature limits shall be:

- air: +30^\circ\mathrm{C}
- water: +20^\circ\mathrm{C}.

3.6.2 Refrigeration system

3.6.2.1 The refrigeration system referred to in 3.6.1.1 shall be composed of one or more units capable of keeping the pressure and temperature of the cargo at the upper limits of the ambient design temperatures at the prescribed level. Unless another means of regulating cargo pressure and temperature deemed satisfactory by the Register is provided, provision shall be made for one or more stand-by units with an output at least equal to that of the largest prescribed unit. Provision shall be made for a stand-by heat-exchanger unless the system’s normal heat-exchanger has a surplus capacity equal to at least 25% of the largest prescribed capacity.

Cargo tanks, piping and accessories shall be insulated so that, in the event of a failure of all cargo refrigeration systems, the entire cargo remains for at least 52 hours in a condition not causing the safety valves to open.

3.6.2.2 When several refrigerated cargoes with a potentially dangerous chemical reaction are carried simultaneously, particular care shall be given to the refrigeration systems so as to prevent any mixing of the cargoes. For the carriage of such cargoes, separate refrigeration systems, each including the full stand-by unit referred to in 3.6.2.1, shall be provided for each cargo.

3.6.2.3 When several refrigerated cargoes are not soluble in each other under conditions of carriage such that their vapour pressures are added together in the event of mixing, particular care shall be given to the refrigeration systems to prevent any mixing of the cargoes.

3.6.2.4 All primary and secondary coolant fluids shall be compatible with each other and with the cargo with which they may come into contact.

3.6.2.5 When the refrigeration system is installed in a separate service space, this service space shall meet the requirements of 3.3.4.6.

3.6.3 Water spray system

3.6.3.1 When water spraying is required in column (9) of Table C of Chapter 3.2, Part 3 of AND, a water spray system shall be installed in the cargo area on deck for the purpose of reducing gases given off by the cargo by spraying water.

3.6.3.2 The system shall be fitted with a connection device for supply from the shore. The spray nozzles shall be so installed that released gases are precipitated safely. The system shall be capable of being put into operation from the wheelhouse and from the deck. The capacity of the water spray system shall be such that when all the spray nozzles are in operation, the outflow is not less than 50,0 l per square metre of cargo deck area and per hour.
3.7 Pressure cargo tank venting system

3.7.1 Safety valves

3.7.1.1 The highest part of the vapour space (tank dome) of pressure vessels with a capacity of less than 20,0 m³ shall be fitted with at least one, and pressure vessels with a capacity of more than 20,0 m³ two independent, spring loaded safety valves. Means shall be provided to prevent the accumulation of liquid cargo in the pipe upstream to the safety valves taking into account the vessel’s trim and list.

Safety valves shall be of a type tested design.

3.7.1.2 The materials used for construction of safety valves shall be produced in a works approved by the Register and be provided with the Register’s certificate for material (EN 10204, type 3.2).

3.7.2 Discharge capacity of safety valves

3.7.2.1 The total discharge capacity of the safety valves shall be according to the formula here below. During blowing down the pressure in the tank shall not rise more than 20% above the maximum permissible relief valve setting (MARVS).

\[ Q = F \cdot G \cdot A^{0.82} \text{, \ m}^3/\text{s} \]  

(3.7-1)

where:

- \( Q \) = minimum required equivalent discharge rate of air, in \( \text{m}^3/\text{s} \), at standard conditions of 273 K and 1,013 bar;
- \( F \) = fire exposure factor for different cargo tank types;
- \( = 1.0 \) for uninsulated tanks located on deck;
- \( = 0.5 \) for tanks above the deck when insulation is approved by the Register (approval will be based on the use of an approved fire proofing material, the thermal conductance of insulation, and its stability under fire exposure);
- \( = 0.5 \) for uninsulated independent tanks installed in holds;
- \( = 0.2 \) for insulated independent tanks in holds (or uninsulated independent tanks in insulated holds);
- \( = 0.1 \) for insulated independent tanks in inerted holds (or uninsulated independent tanks in inerted, insulated holds);
- \( G \) = gas factor;

\[ G = \frac{12.4 \cdot \left[ \frac{Z}{r \cdot D} \right]}{M} \];

\( T \) = temperature (273 + °C) at the relieving conditions, i.e. 120% of the design pressure, [K];

\( r \) = latent heat of the material being vaporized at relieving conditions, [kJ/kg];

\( Z \) = compressibility factor of the gas at relieving conditions; if not known, it may also be calculated by the following formula:

\[ D = \sqrt{k+1} \left\{ \frac{2}{k+1} \right\}^{D} \]

\( A \) = external surface area of the tank for different tank types, [m²];

- for body of revolution type tanks, \( A \) is the external surface area;
- for other than bodies of revolution type tanks, \( A \) is the external surface area less the projected bottom surface area;
- for tanks consisting of an array of pressure vessels tanks, \( A \) is the external surface area of the hold less its projected bottom area;
- insulation on the tank structure, \( A \) is the external surface area of the array of pressure vessels excluding insulation, less the projected bottom area as shown in Figure 3.7-1.

### Table 3.7-1

<table>
<thead>
<tr>
<th>( k )</th>
<th>( D )</th>
<th>( k )</th>
<th>( D )</th>
<th>( k )</th>
<th>( D )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00</td>
<td>0.606</td>
<td>1.26</td>
<td>0.660</td>
<td>1.52</td>
<td>0.704</td>
</tr>
<tr>
<td>0.02</td>
<td>0.611</td>
<td>1.28</td>
<td>0.664</td>
<td>1.54</td>
<td>0.707</td>
</tr>
<tr>
<td>0.04</td>
<td>0.615</td>
<td>1.30</td>
<td>0.667</td>
<td>1.56</td>
<td>0.710</td>
</tr>
<tr>
<td>0.06</td>
<td>0.620</td>
<td>1.32</td>
<td>0.671</td>
<td>1.58</td>
<td>0.713</td>
</tr>
<tr>
<td>0.08</td>
<td>0.624</td>
<td>1.34</td>
<td>0.674</td>
<td>1.60</td>
<td>0.716</td>
</tr>
<tr>
<td>0.10</td>
<td>0.628</td>
<td>1.36</td>
<td>0.677</td>
<td>1.62</td>
<td>0.719</td>
</tr>
<tr>
<td>0.12</td>
<td>0.633</td>
<td>1.38</td>
<td>0.681</td>
<td>1.64</td>
<td>0.722</td>
</tr>
<tr>
<td>0.14</td>
<td>0.637</td>
<td>1.40</td>
<td>0.685</td>
<td>1.66</td>
<td>0.725</td>
</tr>
<tr>
<td>0.16</td>
<td>0.641</td>
<td>1.42</td>
<td>0.688</td>
<td>1.68</td>
<td>0.728</td>
</tr>
<tr>
<td>0.18</td>
<td>0.645</td>
<td>1.44</td>
<td>0.691</td>
<td>1.70</td>
<td>0.731</td>
</tr>
<tr>
<td>0.20</td>
<td>0.649</td>
<td>1.46</td>
<td>0.695</td>
<td>1.72</td>
<td>0.734</td>
</tr>
<tr>
<td>0.22</td>
<td>0.652</td>
<td>1.48</td>
<td>0.698</td>
<td>1.74</td>
<td>0.736</td>
</tr>
<tr>
<td>0.24</td>
<td>0.656</td>
<td>1.50</td>
<td>0.701</td>
<td>1.76</td>
<td>0.739</td>
</tr>
</tbody>
</table>

\[ = \] constant based on relation of specific heats \((\gamma)\), shown in Table 3.7-1; 

\( = 0.606 \) if \( k \) is not known

3.7.2.2 The setting of the pressure relief valves shall not be higher than the maximum pressure for which the cargo tank is designed.
Chapter II - TRANSPORT OF DANGEROUS GOODS

3.7.2.3 It is recommended that a device may be fitted enabling one safety valve at a time to be isolated for a short period for repair/maintenance. In this case, however, at least half the required safety valve cross-section shall remain operative.

3.7.3 Safety valves blow-off lines

3.7.3.1 The blow-off lines of pressure vessel safety valves may be arranged individual or with common headers. The outlets shall be arranged at least 2.0 m above deck at a horizontal distance of 6.0 m from accommodation or other safe spaces. The height may be reduced to less than 2.0 m in case the area of 1.0 m around the high-velocity valve is designed as non-accessible.

3.7.3.2 The total cross-section of the blow-off piping must be sufficient to discharge safely the quantity of gas calculated in 3.7.2.1.

3.7.3.3 The outlets to the atmosphere rising straight up shall be fitted with protective wire gauze.

3.8 Inerting facility

3.8.1 In cases in which inerting or blanketing of the cargo is prescribed, the vessel shall be equipped with an inerting system.

3.8.2 This system shall be capable of maintaining a permanent minimum pressure of 7.0 kPa (0.07 bar) in the spaces to be inerted. In addition, the inerting system shall not increase the pressure in the cargo tank to a pressure greater than that at which the pressure valve is regulated. The set pressure of the vacuum-relief valve shall be 3.5 kPa (0.035 bar).

3.8.3 The premises to be inerted shall be equipped with connections for introducing the inert gas and monitoring systems so as to ensure the correct atmosphere on a permanent basis.

3.9 Electrical installations

3.9.1 Only distribution systems without return connection to the hull are permitted. This provision does not apply to:
- local installations outside the cargo area (e.g. connections of starters of diesel engines)
- device for checking the insulation level referred to in 3.9.2,
- active cathodic corrosion protection.

3.9.2 Every insulated distribution network shall be fitted with an automatic device with a visual and audible alarm for checking the insulation level.

3.9.3 For the selection of electrical equipment to be used in zones presenting an explosion risk, the explosion groups and temperature classes assigned to the substances carried in the list of substances shall be taken into consideration (see columns (15) and (16) of Table C of Chapter 3.2, Part 3 of ADN).

3.9.4 Type and location of electrical equipment

3.9.4.1 Only the following equipment may be installed in cargo tanks, residual cargo tanks and piping for loading and unloading (comparable to zone 0): measuring, regulation and alarm devices of the EEx (ia) type of protection.

3.9.4.2 Only the following equipment may be installed in the cofferdams, double hull spaces, double bottoms and hold spaces (comparable to zone 1):
- measuring, regulation and alarm devices of the certified safe type;
- lighting appliances of the “flame-proof enclosure” or “apparatus protected by pressurization“ type of protection;
- hermetically sealed echo sounding devices the cables of which are led through thick-walled steel tubes with gastight connections up to the main deck;
- cables for the active cathodic protection of the shell plating in protective steel tubes such as those provided for echo sounding devices

The following equipment may be installed only in double hull spaces and double bottom if used for ballasting:
- permanently fixed submerged pumps with temperature monitoring, of the certified safe type.

3.9.4.3 Only the following equipment may be installed in the service spaces in the cargo area below deck (comparable to zone 1):
- measuring, regulation and alarm devices of the certified safe type;
- lighting appliances of the “flame-proof enclosure” or “apparatus protected by pressurization“ type of protection;
- motors driving essential equipment such as ballast pumps; they shall be of the certified safe type.

3.9.4.4 The control and protective equipment of the electrical equipment referred to in 3.9.4.1, 3.9.4.2 and 3.9.4.3 above shall be located outside the cargo area if they are not intrinsically safe.

3.9.4.5 The electrical equipment in the cargo area on deck (comparable to zone 1) shall be of the certified safe type.

3.9.4.6 Electrical equipment used during loading, unloading and gas-freeing during berthing and which are located outside the cargo area (comparable to zone 2) shall be at least of the “limited explosion risk” type.

This provision does not apply to:
1. lighting installations in the accommodation, except for switches near entrances to accommodation;
2. radiotelephone installations in the accommodation or the wheelhouse;
3. mobile and fixed telephone installations in the accommodation or the wheelhouse;
4. electrical installations in the accommodation, the wheelhouse or the service spaces, if:
   - these spaces are fitted with a ventilation system ensuring an overpressure of 0.1 kPa (0.001 bar) and none of the windows is capable of being opened; the air intakes of the ventilation system located as far
away as possible, however, not less than 6,0 m from the cargo area and not less than 2,0 m above the deck;
- the spaces are fitted with a gas detection system with sensors at the suction inlets of the ventilation system and directly at the top edge of the sill of the entrance doors of the accommodation and service spaces when the cargo in the gas phase is heavier than air. Otherwise sensors shall be fitted close to the ceiling;
- the gas concentration measurement is continuous;
- when the gas concentration reaches 20% of the lower explosive limit, the ventilators shall be switched off. In such a case and when the overpressure is not maintained or in the event of failure of the gas detection system, the electrical installations which do not comply with item / above, shall be switched off. These operations shall be performed immediately and automatically and activate the emergency lighting in the accommodation, the wheelhouse and the service spaces, which shall comply at least with the “limited explosion risk” type. The switching-off shall be indicated in the accommodation and wheelhouse by visual and audible signals;
- the ventilation system, the gas detection system and the alarm of the switch-off device fully comply with the requirements of item / above;
- the automatic switch-off device is set so that no automatic switching-off may occur while the vessel is under way.

3.9.4.7 The electrical equipment which does not meet the requirements set out in 3.9.4.6 together with its switches shall be marked in red. The disconnection of such equipment shall be operated from a centralized location on board.

3.9.4.8 An electric generator which is permanently driven by an engine and which does not meet the requirements of 3.9.4.6, shall be fitted with a switch capable of shutting down the excitation of the generator. A notice board with the operating instructions shall be displayed near the switch.

3.9.4.9 Sockets for the connection of signal lights and gangway lighting shall be permanently fitted to the vessel close to the signal mast or the gangway. Connecting and disconnecting shall not be possible except when the sockets are not live.

3.9.4.10 The failure of the power supply for the safety and control equipment shall be immediately indicated by visual and audible signals at the locations where the alarms are usually actuated.

3.9.5 Earthing

3.9.5.1 The metal parts of electrical appliances in the cargo area which are not live as well as protective metal tubes or metal sheaths of cables in normal service shall be earthed, unless they are so arranged that they are automatically earthed by bonding to the metal structure of the vessel.

3.9.5.2 The provisions of 3.9.5.1 apply also to equipment having service voltages of less than 50,0 V.

3.9.5.3 Independent cargo tanks shall be earthed.

3.9.5.4 Receptacles for residual products shall be capable of being earthed.

3.9.6 Electric cables

3.9.6.1 All cables in the cargo area shall have a metallic sheath.

3.9.6.2 Cables and sockets in cargo area shall be protected against mechanical damage.

3.9.6.3 Movable cables are prohibited in the cargo area, except for intrinsically safe electric circuits or for the supply of signal lights and gangway lighting.

3.9.6.4 Cables of intrinsically safe circuits shall only be used for such circuits and shall be separated from other cables not intended for being used in such circuits (e.g. they shall not be installed together in the same string of cables and they shall not be fixed by the same cable clamps).

3.9.6.5 For movable cables intended for signal lights and gangway lighting, only sheathed cables of type H 07 RN-F in accordance with standard IEC 60 245-4:1994 or cables of at least equivalent design having conductors with a cross-section of not less than 1,5 mm² shall be used. These cables shall be as short as possible and installed so that damage is not likely to occur.

3.9.6.6 The cables required for the electrical equipment referred to in 3.9.6.2 and 3.9.6.3 are accepted in cofferdams, double hull spaces, double bottoms, hold spaces and service spaces below deck.

3.9.7 Accumulators

Accumulators shall be located outside the cargo area.

3.10 Fire protection and fire-extinguishing

3.10.1 Fire and naked light

3.10.1.1 The outlets of funnels shall be located not less than 2,0 m from the hatchway openings. Arrangements shall be provided to prevent the escape of sparks and the entry of water.

3.10.1.2 Heating, cooking and refrigerating appliances shall not be fuelled with liquid fuels, liquid gas or solid fuels.

The installation in the engine room or in another separate space of heating appliances fuelled with liquid fuel having a flashpoint above 55°C is, however, permitted.

Cooking and refrigerating appliances are permitted only in wheelhouses with metal floor and in the accommodation.

3.10.1.3 Only electrical lighting appliances are permitted.

3.10.2 Fire extinguishing systems

In addition to the requirements of the Rules, Part 3 – Machinery, Systems and Electricity, Chapter III, Section 5, the fire extinguishing arrangements in 3.10.4 and 3.10.5 shall be complied with.

3.10.3 Portable fire extinguishers

In addition to the fire extinguishing appliances prescribed in the Rules, Part 3 – Machinery, Systems and Electricity, Chapter III, 5.5.2 and 5.5.3, each vessel shall be
Chapter II - TRANSPORT OF DANGEROUS GOODS

3.10.4 Fire-extinguishing system

A fire-extinguishing system shall be installed on the vessel. This system shall comply with the following requirements:

- it shall be supplied by two independent fire or ballast pumps, one of which shall be ready for use at any time. These pumps and their means of propulsion and electrical equipment shall not be installed in the same space;
- it shall be provided with a water main fitted with at least three hydrants in the protected area above deck. Three suitable and sufficiently long hoses with jet/spray nozzles having a diameter of not less than 12,0 mm shall be provided. Alternatively one or more of the hose assemblies may be substituted by directable jet/spray nozzles having a diameter of not less than 12,0 mm. It shall be possible to reach any point of the deck in the protected area simultaneously with at least two jets of water which do not emanate from the same hydrant.

A spring-loaded non-return valve shall be fitted to ensure that no gases can escape through the fire-extinguishing system into the accommodation or service spaces outside the cargo area;

- the capacity of the system shall be at least sufficient for a jet of water to reach a distance of not less than the vessel’s breadth from any location on board with two spray nozzles being used at the same time;
- the water supply system shall be capable of being put into operation from the wheelhouse and from the deck;
- measures shall be taken to prevent the freezing of fire-mains and hydrants;
- a single fire or ballast pump shall suffice on board pushed barges without their own means of propulsion.

3.10.5 Fixed fire-extinguishing system

In addition, the engine room, the pump room and all spaces containing essential equipment (switchboards, compressors, etc.) for the refrigeration equipment, if any, shall be provided with a fixed fire-extinguishing system meeting the requirements of the Rules, Part 3 – Machinery, Systems and Electricity, Chapter III, 5.3.

3.11 Safety and control installations

3.11.1 General

Cargo tanks shall be provided with the following equipment:

a) a level gauge;
b) a level alarm device which is activated at the latest when a degree of filling of 86% is reached;
c) a high level sensor for actuating the facility against overflowing at the latest when a degree of filling of 97,5% is reached;
d) an instrument for measuring the pressure of the gas phase in the cargo tank;
e) an instrument for measuring the temperature of the cargo;
f) a connection for a closed-type sampling device.

3.11.2 Cargo tank level indicators

3.11.2.1 Each cargo tank shall be equipped with a closed gauging device approved by the Register. If only one device is installed per tank, it shall be so arranged/designed that any failure can be rectified and its function can be restored when tank under pressure.

3.11.2.2 The level gauge shall allow readings from the control position of the shut-off devices of the particular cargo tank. The permissible maximum filling levels of 91%, 95% and 97%, as given in the list of substances, shall be marked on each level gauge.

Readings shall be possible in all weather conditions.

3.11.3 Level alarm device

Cargo tank shall be provided with a level alarm device which is activated at the latest when a degree of filling of 86% is reached.

The level alarm device shall give a visual and audible warning on board when actuated. The level alarm device shall be independent of the level gauge.

3.11.4 High level sensor

Cargo tank shall be provided with a high level sensor for actuating the facility against overflowing at the latest when a degree of filling of 97,5% is reached.

The high level sensor referred to above shall give a visual and audible alarm on board and at the same time actuate an electrical contact which in the form of a binary signal interrupts the electric current loop provided and fed by the shore facility, thus initiating measures at the shore facility against overflowing during loading operations.

The signal shall be transmitted to the shore facility via a watertight two-pin plug of a connector device in accordance with standard EN 60309-2:1999 + A1:2007 + A2:2012 for direct current of 40,0 to 50,0 volts, identification colour white, position of the nose 10 h.

The plug shall be permanently fitted to the vessel close to the shore connections of the loading and unloading piping.

The high level sensor shall also be capable of switching off the vessel’s own discharging pump.

The high level sensor shall be independent of the level alarm device, but it may be connected to the level gauge.

3.11.5 Cargo tank pressure monitoring

Each cargo tank shall be equipped with a pressure indicator for the vapour space activating a high pressure alarm when the working pressure is exceeded.

Pressure indicators shall be fitted on loading and discharge lines, pumps, compressors and manifold connections marked with the maximum permissible working pressure.
3.11.6 Cargo temperature monitoring

Temperature indicating devices in each cargo tank shall be provided for the mean temperature of the cargo.

3.11.7 Cargo tank sampling equipment

Each cargo tank shall be equipped with a connection for a closed-type sampling device.

3.11.8 Safety valves

Cargos pumps and compressors must be fitted with safety valves discharging to their suction side, in compliance with 3.6.2.

Pipeline sections of more than 50,0 l volume which may be isolated in liquid full condition shall be provided with safety relief valves. The blow-off lines shall be returned to the cargo tanks or a blow down header.

3.11.9 Gas detection and alarm system

For the hold spaces of pressure vessel cargo tanks, portable gas detectors shall be approved by the Register.

3.11.10 Other protective measures

On vessels certified to carry refrigerated liquefied gases the following protective measures shall be provided in the cargo area:

1. drips trays shall be installed under the shore connections of the piping for loading and unloading through which the loading and unloading operation is carried out. They must be made of materials which are able to resist the temperature of the cargo and be insulated from the deck. The drip trays shall have a sufficient volume and an overboard drain;

2. a water spray system to cover:
   - exposed cargo tank domes and exposed parts of cargo tanks;
   - exposed on-deck storage vessels for flammable or toxic products;
   - parts of the cargo deck area where a leakage may occur;

3. a water film around the shore connection of the piping for loading and unloading in use during connecting and disconnecting the loading arm or hose. The water film shall have sufficient capacity.

3.12 Buoyancy and stability

3.12.1 General

General requirements of the Rules, Part 2 – Hull and Hull Equipment, Chapter II, Section 11 shall be complied with.

1. proof of sufficient stability shall be furnished including stability in the damaged condition;

2. the basic values for the stability calculation - the vessel’s lightweight and the location of the centre of gravity - shall be determined either by means of an inclining experiment or by detailed mass and moment calculation. In the latter case the lightweight shall be checked by means of a lightweight test with a tolerance limit of ± 5% between the mass determined by the calculation and the displacement determined by the draught readings;

3. proof of sufficient intact stability shall be furnished for all stages of loading and unloading and for the final loading condition for all the relative densities of the substances transported contained in the vessel substance list according to 1.7.2.2;

4. for every loading case, taking account of the actual fillings and floating position of cargo tanks, ballast tanks and compartments, drinking water and sewage tanks and tanks containing products for the operation of the vessel, the vessel shall comply with the intact and damage stability requirements.

Intermediate stages during operations shall also be taken into consideration;

5. floatability after damage shall be proved for the most unfavourable loading condition. For this purpose calculated proof of sufficient stability shall be established for critical intermediate stages of flooding and for the final stage of flooding.

3.12.2 Intact stability

3.12.2.1 The requirements for intact stability resulting from the damaged stability calculation shall be fully complied with.

3.12.2.2 For vessels with cargo tanks of more than 0,7 \(B\) in width, proof shall be furnished that the following stability requirements have been complied with:

   a) in the positive area of the righting lever curve up to immersion of the first unprotected (non-weathertight) opening there shall be a righting lever (\(GZ\)) of not less than 0,1 m;

   b) the surface of the positive area of the righting lever curve up to immersion of the first unprotected (non-weathertight) opening and in any event up to an angle of heel ≤ 27° shall not be less than 0,024 m/\(\text{rad}\);

   c) the metacentric height \(GM\) shall not be less than 0,1 m.

   These conditions shall be met bearing in mind the influence of all free surfaces in tanks for all stages of loading and unloading.

3.12.2.3 The most stringent requirement of 3.12.2.1 and 3.12.2.2 is applicable to the vessel.

3.12.3 Damage stability

3.12.3.1 The following assumptions shall be taken into consideration for the damaged condition:

   a) the extent of side damage is as follows:
      - longitudinal extent: at least 0,1 \(L\), but not less than 5,0 m;
      - transverse extent: 0,79 m inboard from the vessel’s side at right angles to the centreline at the level corresponding to the maximum draught, or when applicable, \(B_{ST}\) -0,01 m, where \(B_{ST}\) is the width of the side compartment (double side);
      - vertical extent: from the baseline upwards without limit;

   b) the extent of bottom damage is as follows:
      - longitudinal extent: at least 0,1 \(L\), but not less than 5,0 m;
c) any bulkheads within the damaged area shall be assumed damaged, which means that the location of bulkheads shall be chosen so as to ensure that the vessel remains afloat after the flooding of two or more adjacent compartments in the longitudinal direction.

The following provisions are applicable:
- For bottom damage also two adjacent athwartship compartments shall also be assumed as flooded;
- The lower edge of any non-watertight openings (e.g. doors, windows, access hatchways) shall, at the final stage of flooding, be not less than 0.1 m above the damage waterline;
- In general, permeability shall be assumed to be 95%. Where an average permeability of less than 95% is calculated for any compartment, this calculated value may be used.

However, the following minimum values shall be used:
- engine rooms: 85%
- accommodation: 95%
- double bottoms, fuel oil tanks, ballast tanks, etc., depending on whether, according to their function, they have to be assumed as full or empty for the vessel floating at the maximum permissible draught: 0% or 95%.

For the main engine room only the one-compartment standard needs to be taken into account, i.e. the end bulkheads of the engine room shall be assumed as not damaged.

3.12.3.2 For critical intermediate stages of flooding, beyond the equilibrium stage, the following criteria for the righting lever curve have to be fulfilled:

Righting lever ($GZ$) ≥ 0.03 m;
Range of positive $GZ$: 5°.

3.12.3.3 At the stage of equilibrium (final stage of flooding), the angle of heel shall not exceed 12° (see Figure 3.12-1).

Non-watertight openings shall not be flooded before reaching the stage of equilibrium. If such openings are immersed before that stage, the corresponding spaces shall be considered as flooded for the purpose of stability calculation.

The positive range of the righting lever curve beyond the stage of equilibrium shall have a righting lever of ≥ 0.05 m in association with an area under the curve of ≥ 0.0065 m.rad.

The minimum values of stability shall be satisfied up to immersion of the first unprotected (non-weathertight) opening and in any event up to an angle of heel ≤ 27°. If non-weathertight openings are immersed before the requirements for minimum values of stability are complied with, the corresponding spaces shall be considered as flooded for the purposes of stability calculation.

If openings through which undamaged compartments may become additionally flooded are capable of being closed watertight, the closing devices shall be appropriately marked.

Where cross- or down-flooding openings are provided for reduction of unsymmetrical flooding, the time for equalisation shall not exceed 15 minutes, provided during the intermediate stages of flooding sufficient stability has been proved.

![Figure 3.12-1](image-url)

**3.13 Notice boards**

The notice boards displaying the prohibition of admittance on board including prohibition of smoking, fire and naked light shall be clearly legible from either side of the vessel.
4 TANKERS TYPE C

4.1 General

4.1.1 The following requirements of this Section apply to vessels intended for the carriage of dangerous liquids in bulk assigned with additional Character of class Type C, as defined in the Rules, Part 1 – Classification and Surveys, Chapter I, 3.6.2.

4.1.2 Vessels considered in this Section shall comply with the applicable requirements of the Rules, Part 1 – Classification and Surveys, Part 2 – Hull and Hull Equipment and Part 3 – Machinery, Systems and Electricity, as applicable, and with the specific requirements from Section I and the present Rules, Chapter I, Section 3.

4.1.3 For scantling of the hull of vessels with independent tanks, see the present Rules, Chapter I, 3.3.4.

4.1.4 Design and construction of pressure tanks shall conform to the Rules, Part 3 – Machinery, Systems and Electricity, Chapter I, Section 5.

4.2 Documentation to be submitted

In addition to the documentation required in the other applicable Parts of the Rules for the parts of the vessel not affected by the cargo, the following documentation shall be submitted, as applicable:

.1 list of substances intended to be carried with their UN numbers including all design characteristics of substances and other important design conditions;

.2 general arrangement plan, showing location of cargo tanks and fuel oil, ballast and other tanks, void spaces, etc.;

.3 loading and unloading operation description, including cargo tank filling limits;

.4 cargo area plan, location of the electrical equipment installed in these areas and list of the electrical equipment installed in cargo tank and cargo area (comparable to zone 0 and 1), including the following equipment particulars: location, type of protection, type of protection against explosion, testing body and approval number;

.5 list of equipment installed in cargo area (comparable to zone 2) which may be used during loading, unloading and gas-freeing and red equipment;

.6 details of hull structure in way of cargo tanks, including support arrangement for tanks, saddles, anti-floating and anti-lifting devices, deck sealing arrangements, independent cargo tanks, etc.;

.7 intact and damage stability calculations;

.8 scantlings, material and arrangement of the cargo containment system;

.9 details of cargo handling and venting system, including arrangements and details of piping and fitting

.10 locations and details of cargo pumps including their driving machinery;

.11 ventilation duct arrangement in gas-dangerous spaces and adjacent zones including schemes and calculations of ventilation system in cargo area;

.12 details of the cargo tank instrumentation including gauging/sounding devices, level/overfill alarms and pressure and temperature indicating equipment;

.13 pressure drop calculation of the vent system based on the maximum loading/unloading rates;

.14 arrangement drawing of the various fire bulkheads and decks with standard fire test reports for the various arrangements, surface coverings, paints and similar

.15 details of fire extinguishing appliances and systems in cargo area;

.16 drawings of the bilge and ballast water systems within the cargo area;

.17 details of the gas-freeing arrangements for cargo tanks including inert gas system

.18 details of the gas detection system;

.19 gas return system

.20 schematic electrical wiring diagrams in cargo area;

NOTE: Items 1, 2 and 3 shall be submitted for information only. Others shall be submitted for approval.

4.3 Vessel arrangement

4.3.1 Hold spaces

4.3.1.1 The cargo tanks shall be separated by cofferdams of at least 0.6 m in width from the accommodation, engine rooms and service spaces outside the cargo area below deck or, if there are no such accommodation, engine rooms and service spaces, from the vessel’s end. Where the cargo tanks are installed in hold space, a space of not less than 0.5 m shall be provided between such tanks and the end bulkheads of the hold space. In this case an end bulkhead meeting at least the definition for Class “A-60” (see the Rules, Part 3 – Machinery, Systems and Electricity, Chapter I, 1.2.6), shall be deemed equivalent to a cofferdam.

For pressure cargo tanks, the 0.5 m distance may be reduced to 0.2 m.

4.3.1.2 Hold spaces and cargo tanks shall be capable of being inspected.

4.3.1.3 All spaces in the cargo area shall be capable of being ventilated. Means for checking their gas-free condition shall be provided.

4.3.1.4 The bulkheads bounding the cargo tanks, cofferdams and hold spaces shall be watertight. The cargo tanks and the bulkheads bounding the cargo area shall have no openings or penetrations below deck.

The bulkhead between the engine room and the service spaces in the cargo area or between the engine room and a hold space may be fitted with penetrations provided that they conform to the provisions of 4.3.3.5.

The bulkhead between the cargo tank and the cargo pump-room below deck may be fitted with penetrations provided that they conform to the provisions of 4.3.3.6.

The bulkheads between the cargo tanks may be fitted with penetrations provided that the loading or unloading piping are fitted with shut-off devices in the cargo tank from which they come.

These shut-off devices shall be operable from the deck.
Chapter II - TRANSPORT OF DANGEROUS GOODS

4.3.1.5 Double-hull spaces and double bottoms in the cargo area shall be arranged for being filled with ballast water only. Double bottoms may, however, be used as fuel oil tanks, provided they comply with the requirements of 4.3.7.

4.3.1.6 A cofferdam, the centre part of a cofferdam or another space below deck in the cargo area may be arranged as a service space, provided the bulkheads bounding the service space extend vertically to the bottom. This service space shall only be accessible from the deck.

The service space shall be watertight with the exception of its access hatches and ventilation inlets.

No piping for loading and unloading shall be fitted within the service space referred to above.

Piping for loading and unloading may be fitted in the cargo pump-rooms below deck only when they conform to the provisions of 4.3.5.6.

4.3.1.7 Where service spaces are located in the cargo area under deck, they shall be arranged so as to be easily accessible and to permit persons wearing protective clothing and breathing apparatus to safely operate the service equipment contained therein. They shall be designed so as to allow injured or unconscious personnel to be removed from such spaces without difficulties, if necessary by means of fixed equipment.

4.3.1.8 Cofferdams, double-hull spaces, double bottoms, cargo tanks, hold spaces and other accessible spaces within the cargo area shall be arranged so that they may be completely inspected and cleaned in an appropriate manner. The dimensions of openings except for those of double-hull spaces and double bottoms which do not have a wall adjoining the cargo tanks shall be in compliance with the Rules, Part 2 – Hull and Hull Equipment, Chapter II, 4.2.

4.3.2 Arrangement of cofferdams

4.3.2.1 Cofferdams or cofferdam compartments remaining once a service space has been arranged in accordance with 4.3.1.6 shall be accessible through an access hatch.

4.3.2.2 Cofferdams shall be capable of being filled with water and emptied by means of a pump. Filling shall be effected within 30 minutes. These requirements are not applicable when the bulkhead between the engine room and the cofferdam comprises fire-protection insulation „A-60“ in accordance with the Rules, Part 3 – Machinery, Systems and Electricity, Chapter III, 1.2.6 or has been fitted out as a service space.

The cofferdams shall not be fitted with inlet valves.

4.3.2.3 No fixed pipe shall permit connection between a cofferdam and other piping of the vessel outside the cargo area.

4.3.2.4 When the list of substances on the vessel according to 1.7.2.2 contains substances for which protection against explosion is required in column (17) of Table C of Chapter 3.2, Part 3 of ADN, the ventilation openings of cofferdams shall be fitted with a flame arrester capable of withstanding a deflagration.

4.3.3 Protection against the penetration of gases

4.3.3.1 The vessel shall be designed so as to prevent gases from penetrating into the accommodation and the service spaces.

4.3.3.2 Outside the cargo area, the lower edges of door openings in the sidewalls of superstructures and the coamings of access hatches to under-deck spaces shall have a height of not less than 0,5 m above the deck.

This requirement need not be complied with if the wall of the superstructures facing the cargo area extends from one side of the vessel to the other and has doors the sills of which have a height of not less than 0,5 m.

The height of this wall shall not be less than 2,0 m. In this case, the lower edges of door-openings in the sidewalls of superstructures and the coamings of access hatches behind this wall shall have a height of not less than 0,1 m. The sills of engine room doors and the coamings of its access hatches shall, however, always have a height of not less than 0,5 m.

4.3.3.3 In the cargo area, the lower edges of door-openings in the sidewalls of superstructures shall have a height of not less than 0,5 m above the deck and the sills of hatches and ventilation openings of premises located under the deck shall have a height of not less than 0,5 m above the deck.

This requirement does not apply to access openings to double-hull and double bottom spaces.

4.3.3.4 The bulwarks, foot-rails, etc. shall be provided with sufficiently large openings which are located directly above the deck.

4.3.4 Engine rooms

Internal combustion engines for the vessel’s propulsion as well as internal combustion engines for auxiliary machinery shall be located outside the cargo area.

Entrances and other openings of engine rooms shall be at a distance of not less than 2,0 m from the cargo area.

The engine room shall be accessible from the deck; the entrances shall not face the cargo area. Where the doors are not located in a recess whose depth is at least equal to the door width, the hinges shall face the cargo area.

4.3.5 Accommodation and service spaces

4.3.5.1 Accommodation spaces and the wheelhouse shall be located outside the cargo area forward of the fore vertical plane or abaft the aft vertical plane bounding the part of cargo area below deck. Windows of the wheelhouse which are located not less than 1,0 m above the bottom of the wheelhouse may tilt forward.

4.3.5.2 Entrances to spaces and openings of superstructures shall not face the cargo area. Doors opening outward and not located in a recess the depth of which is at least equal to the width of the doors shall have their hinges facing the cargo area.

4.3.5.3 Entrances from the deck and openings of spaces facing the weather shall be capable of being closed.

The following instruction shall be displayed at the entrance of such spaces:
Do not open during loading and unloading without the permission of the master. Close immediately.

4.3.5.4 Entrances and windows of superstructures and accommodation spaces which can be opened as well as other openings of these spaces shall be located not less than 2,0 m from the cargo area. No wheelhouse doors and windows shall be located within 2,0 m from the cargo area, except where there is no direct connection between the wheelhouse and the accommodation.

4.3.5.5 a) Driving shafts of the bilge or ballast pumps may penetrate through the bulkhead between the engine room and the service space in the cargo area, provided the arrangement of the service space is in compliance with 4.3.1.6; b) the penetration of the shaft through the bulkhead shall be gastight and shall have been approved by the Register; c) penetrations through the bulkhead between the engine room and the service space in the cargo area, and the bulkhead between the engine room and the hold spaces may be provided for electrical cables, hydraulic lines and piping for measuring, control and alarm systems, provided that these penetrations have been approved by the Register. The penetrations shall be gastight. Penetrations through a bulkhead with a "A-60" fire protection insulation (see the Rules, Part 3 – Machinery, Systems and Electricity, Chapter III, 1.2.6), shall have an equivalent fire protection; d) pipes may penetrate through the bulkhead between the engine room and the service space in the cargo area provided that these are pipes between the mechanical equipment in the engine room and the service space which do not have any openings within the service space and which are provided with shut-off devices at the bulkhead in the engine room; e) notwithstanding 4.3.1.4, pipes from the engine room may pass through the service space in the cargo area or a cofferdam or a hold space or a double-hull space to the outside provided that within the service space or cofferdam or hold space or double hull space they are of the thick-walled type and have no flanges or openings; f) where a driving shaft of auxiliary machinery penetrates through a wall located above the deck the penetration shall be gastight.

4.3.5.6 A service space located within the cargo area below deck shall not be used as a cargo pump room for the vessel’s own gas discharging system, e.g. compressors or the compressor/heat exchanger/pump combination, except where:
- the pump room is separated from the engine room or from service spaces outside the cargo area by a cofferdam or a bulkhead with an "A-60" fire protection insulation (see the Rules, Part 3 – Machinery, Systems and Electricity, Chapter III, 1.2.6), or by a service space or a hold space;
- the “A-60” bulkhead required above does not include penetrations referred to in 4.3.5.5, a);
- ventilation exhaust outlets are located not less than 6,0 m from entrances and openings of the accommodation and service spaces;
- the access hatches and ventilation inlets can be closed from the outside;
- all pipes for loading and unloading (at the suction side and delivery side) are led through the deck above the pump-room. The necessary operation of the control devices in the pump-room, starting of pumps or compressors and control of the liquid flow rate shall be effected from the deck;
- the bilge of the cargo pump-room is equipped with a gauging device for measuring the filling level which activates a visual and audible alarm in the wheelhouse when a liquid is accumulating in the cargo pump-room bilge;
- the cargo pump-room is provided with a permanent gas detection system which automatically indicates the presence of explosive gases or lack of oxygen by means of direct-measuring sensors and which actuates a visual and audible alarm when the gas concentration has reached 20% of the lower explosive limit. The sensors of this system shall be placed at suitable positions at the bottom and directly below the deck. Measurement shall be continuous;
- the audible and visual alarms are installed in the wheelhouse and in the cargo pump-room and, when the alarm is actuated, the loading and unloading system is shut down. Failure of the gas detection system shall be immediately signalled in the wheelhouse and on deck by means of audible and visual alarms;
- the ventilation system prescribed in 4.3.10.3 has a capacity of not less than 30 changes of air per hour based on the total volume of the service space.

4.3.6 Engines

4.3.6.1 Only internal combustion engines running on fuel with a flashpoint of more than 55°C are permitted.

4.3.6.2 Ventilation inlets of the engine room and, when the engines do not take in air directly from the engine room, the air intakes of the engines shall be located not less than 2,0 m from the cargo area.

4.3.6.3 Sparking shall not be possible within the cargo area.

4.3.7 Oil fuel tanks

4.3.7.1 When the vessel is fitted with hold spaces and double bottoms, double bottoms within the cargo area may be arranged as a liquid oil fuel tanks, provided their depth is not less than 0,6 m. Oil fuel pipes and openings of such tanks are not permitted in the hold space.

4.3.7.2 The open ends of air pipes of all oil fuel tanks shall extend to not less than 0,5 m above the open deck. The open ends and the open ends of overflow pipes leading on the deck shall be fitted with a protective device consisting of a gauze diaphragm or a perforated plate.
Chapter II - TRANSPORT OF DANGEROUS GOODS

4.3.8 Exhaust pipes

4.3.8.1 Exhausts shall be evacuated from the vessel into the open air either upwards through an exhaust pipe or through the shell plating. The exhaust outlet shall be located not less than 2,0 m from the cargo area. The exhaust pipes of engines shall be arranged so that the exhausts are led away from the vessel. The exhaust pipes shall not be located within the cargo area.

4.3.8.2 Exhaust pipes shall be provided with a device preventing the escape of sparks, e.g. spark arresters.

4.3.9 Bilge pumping and ballasting arrangements

4.3.9.1 Bilge and ballast pumps for spaces within the cargo area shall be installed within such area.

This provision does not apply to:
– double-hull spaces and double bottoms which do not have a common boundary wall with the cargo tanks;
– cofferdams and hold spaces where ballasting is carried out using the piping of the firefighting system in the cargo area and bilge-pumping is performed using eductors.

4.3.9.2 Where the double bottom is used as a liquid oil fuel tank, it shall not be connected to the bilge piping system.

4.3.9.3 Where the ballast pump is installed in the cargo area, the standpipe and its outboard connection for suction of ballast water shall be located within the cargo area but outside the cargo tanks.

4.3.9.4 A cargo pump-room below deck shall be capable of being drained in an emergency by an installation located in the cargo area and independent from any other installation. This installation shall be provided outside the cargo pump-room.

4.3.10 Ventilation

4.3.10.1 Each hold space shall have two openings the dimensions and location of which shall be such as to permit effective ventilation of any part of the hold space. If there are no such openings, it shall be possible to fill the hold spaces with inert gas or dry air.

4.3.10.2 Double-hull spaces and double bottoms within the cargo area which are not arranged for being filled with ballast water and cofferdams between engine rooms and pump-rooms, if they exist, shall be provided with ventilation systems.

4.3.10.3 Any service spaces located in the cargo area below deck shall be provided with a system of forced ventilation with sufficient power for ensuring at least 20 changes of air per hour based on the volume of the space.

The ventilation exhaust ducts shall extend down to 50,0 mm above the bottom of the service space. The air shall be supplied through a duct at the top of the service space. The air inlets shall be located not less than 2,0 m above the deck, at a distance of not less than 2,0 m from tank openings and 6,0 m from the outlets of safety valves.

The extension pipes, which may be necessary, may be of the hinged type.

4.3.10.4 Ventilation of accommodation and service spaces shall be possible.

4.3.10.5 Ventilators used in the cargo area shall be designed so that no sparks may be emitted on contact of the impeller blades with the housing and no static electricity may be generated.

4.3.10.6 All ventilation inlets of accommodation and service spaces leading outside shall be fitted with fire flaps. Such ventilation inlets shall be located not less than 2,0 m from the cargo area.

4.3.10.7 Ventilation inlets of service spaces in the cargo area may be located within such area.

4.3.10.8 The flame arresters prescribed in 4.3.2.4, 4.4.7, and 4.4.9 shall be of a type approved for this purpose by the Register.

4.3.11 Ventilation of cargo pump rooms

4.3.11.1 Cargo pump rooms shall be provided with extraction type ventilation systems, independent of other vessel's spaces, providing at least 30 changes of air per hour based on total volume of the service space.

4.3.11.2 The following instruction shall be displayed at the entrance of the cargo pump-room:

Before entering the cargo pump-room check whether it is free from gases and contains sufficient oxygen.
Do not open doors and entrance openings without the permission of the master.
Leave immediately in the event of alarm.

4.3.11.3 Portable means shall be provided for gas-freeing of cargo tanks and other spaces not equipped with fixed ventilation.

4.4 Cargo containment

4.4.1 General

4.4.1.1 The scantlings and structural arrangements shall be in compliance with applicable requirements of the present Rules, Chapter I, Section 3.

4.4.1.2 In the cargo area, the vessel shall be designed according to 4.4.2.

Alternative constructions will be specially considered by the Register on a case-by-case basis.

4.4.1.3 Testing pressures

Cargo tanks, residual cargo tanks, cofferdams, piping for loading and unloading shall be capable of withstanding testing pressure in accordance with the Rules, Part 2 – Hull and Hull Equipment, Chapter III, 5.8.

In addition, the testing pressure for the cargo tanks and residual cargo tanks shall not be less than 1,3 times the construction pressure. The testing pressure for the cofferdams shall not be less than 10,0 kPa (0,1 bar) gauge pressure.

The testing pressure for piping for loading and unloading shall not be less than 1000,0 kPa (10,0 bar) gauge pressure.

4.4.2 Cargo area hull design

4.4.2.1 In the cargo area, except cofferdams, the vessel shall be designed as a flush-deck double hull vessel, with double hull spaces and double bottoms, but without trunk.
4.4.2.2 Cargo tanks independent of the vessel’s hull and refrigerated cargo tanks may only be installed in a hold space which is bounded by double-hull spaces and double bottoms in accordance with 4.4.2.4 below. The cargo tanks shall not extend beyond the deck.

4.4.2.3 Side-struts linking or supporting the load-bearing components of the sides of the vessel with the load-bearing components of the longitudinal walls of cargo tanks and side-struts linking the load-bearing components of the vessel’s bottom with the tank bottom are prohibited.

4.4.2.4 A local recess in the cargo deck, contained on all sides, with a depth greater than 0,1 m, designed to house the loading and unloading pump, is permitted if it fulfills the following conditions:
- the recess shall not be greater than 1,0 m in depth;
- the recess shall be located not less than 6,0 m from entrances and openings to accommodation and service spaces outside the cargo area;
- the recess shall be located at a minimum distance from the side plating equal to one quarter of the vessel’s breadth;
- all pipes linking the recess to the cargo tanks shall be fitted with shut-off devices fitted directly on the bulkhead;
- all the controls required for the equipment located in the recess shall be activated from the deck;
- if the recess is deeper than 0,5 m, it shall be provided with a permanent gas detection system which automatically indicates the presence of explosive gases by means of direct-measuring sensors and actuates a visual and audible alarm when the gas concentration has reached 20% of the lower explosion limit. The sensors of this system shall be placed at suitable positions at the bottom of the recess. Measurement shall be continuous;
- visual and audible alarms shall be installed in the wheelhouse and on deck and, when the alarm is actuated, shall be immediately signalled in the wheelhouse and on deck by means of visual and audible alarms;
- it shall be possible to drain the recess using a system installed on deck in the cargo area and independent of any other system;
- the recess shall be provided with a level alarm device which activates the draining system and triggers a visual and audible alarm in the wheelhouse when liquid accumulates at the bottom;
- when the recess is located above the cofferdam, the engine room bulkhead shall have an “A-60” fire protection insulation according to the Rules, Part 3 – Machinery, Systems and Electricity, Chapter III, 1.2.6;
- when the cargo area is fitted with a water spray system, electrical equipment located in the recess shall be protected against infiltration of water;
- wipes connecting the recess to the hull shall not pass through the cargo tanks.

4.4.2.5 For double-hull construction with the cargo tanks integrated in the vessel’s structure, the distance between the side wall of the vessel and the longitudinal bulkhead of the cargo tanks shall not be less than 1,0 m.

A distance of 0,8 m may however be permitted, provided that, compared with the scantling requirements specified in the rules for construction of the Register, the following reinforcements have been made:
a) 25% increase in the thickness of the deck stringer plate;
b) 15% increase in the side plating thickness;
c) arrangement of a longitudinal framing stringer system at the vessel’s side, where depth of the longitudinal shall not be less than 0,15 m and the longitudinals shall have a face plate with the cross-sectional area of at least 7,0 cm²;
d) the stringer or longitudinal framing systems shall be supported by web frames, and like bottom girders fitted with lightening holes, at a maximum spacing of 1,8 m. These distances may be increased if the longitudinals are strengthened accordingly.

4.4.2.6 When a vessel is built according to the transverse framing system, a longitudinal stringer system shall be arranged instead of 4.4.2.5, c) above. The distance between the longitudinal stringers shall not exceed 0,8 m and their depth shall not be less than 0,15 m, provided they are completely welded to the frames.

The cross-sectional area of the face bar or faceplate shall not be less than 7,0 cm² as in 4.4.2.5, c) above.

Where cut-outs are arranged in the stringer at the connection with the frames, the web depth of the stringer shall be increased with the depth of cut-outs.

4.4.2.7 The mean depth of the double bottoms shall not be less than 0,70 m. It shall, however, never be less than 0,6 m.

4.4.2.8 The depth below the suction wells may be reduced to 0,5 m.

4.4.2.9 When a vessel is built with cargo tanks located in a hold space or refrigerated cargo tanks, the distance between the double walls of the hold space shall not be less than 0,8 m and the depth of the double bottom shall not be less than 0,6 m.

4.4.3 Cargo tank arrangements

4.4.3.1 For vessels with a length of not more than 50,0 m, the length of a cargo tank shall not exceed 10,0 m.

4.4.3.2 For vessels with a length of more than 50,0 m, the length of a cargo tank shall not exceed 0,2 L.

4.4.3.3 Provisions in 4.4.3.1 and 4.4.3.2 do not apply to vessels with independent built-in cylindrical tanks having a length to diameter ratio ≤ 7.

4.4.3.4 The cargo tanks independent of the vessel’s hull shall be fixed so that they cannot float.

4.4.3.5 The capacity of a suction well shall be limited to not more than 0,1 m³.

4.4.4 Integrated tank scantlings

The scantlings of the integrated tank structure shall be determined in accordance with the present Rules, Chapter I, 3.3.3.
Chapter II - TRANSPORT OF DANGEROUS GOODS

4.4.5 Independent cargo tank scantling

4.4.5.1 The scantlings of the independent tank structure shall be determined in accordance with the present Rules, Chapter I, 3.3.4.

When the vessel is provided with pressure cargo tanks, these tanks shall be designed in compliance with the Rules, Part 3 – Machinery, Systems and Electricity, Chapter I, Section 5, for a working pressure of 400.0 kPa.

4.4.5.2 The scantlings of the tank supports and fastenings shall be in compliance with the present Rules, Chapter I, 3.3.4.

4.4.6 Cargo tank openings

4.4.6.1 Cargo tank openings shall be located on deck in the cargo area.

4.4.6.2 Cargo tank openings with a cross-section of more than 0.1 m² and openings of safety devices for preventing overpressures shall be located not less than 0.50 m above deck.

4.4.6.3 Cargo tank openings shall be fitted with gastight closures capable of withstanding the test pressure in accordance with the 4.4.1.3.

4.4.6.4 Closures which are normally used during loading or unloading operations shall not cause sparking when operated.

4.4.7 Safety devices

Each cargo tank or group of cargo tanks connected to a common venting pipe shall be fitted with:

– safety devices for preventing unacceptable overpressures or vacuums. When anti-explosion protection is required in column (17) of Table C of Chapter 3.2, Part 3 of ADN, the vacuum valve shall be fitted with a flame arrester capable of withstanding a deflagration and the pressure-relief valve with a high-velocity vent valve capable of withstanding steady burning.

The gases shall be discharged upwards. The opening pressure of the high-velocity vent valve and the opening pressure of the vacuum valve shall be indelibly indicated on the valves.

– a connection for the safe return ashore of gases expelled during loading

– a device for the safe depressurisation of the tanks. When the list of substances on the vessel according to 1.7.2.2 contains substances for which protection against explosion is required in column (17) of Table C of Chapter 3.2, Part 3 of ADN, this device shall include at least a fire-resistant flame arrester and a stop valve which clearly indicates whether it is open or shut.

4.4.8 Safety devices arrangements

The outlets of high-velocity vent valves shall be located of less than 2.0 m above the deck and at a distance of not less than 6.0 m from the accommodation and from the service spaces outside the cargo area.

This height may be reduced when within a radius of 1.0 m round the outlet of the high-velocity vent valve, there is no equipment, no work is being carried out and signs indicate the area. The setting of the high-velocity vent valves shall be such that during the transport operation they do not blow off until the maximum permissible working pressure of the cargo tanks is reached.

4.4.9 Anti-explosion protection

4.4.9.1 As far as anti-explosion protection is prescribed in column (17) of Table C of Chapter 3.2, Part 3 of ADN, the requirements of 4.4.9.2 to 4.4.9.4 apply.

4.4.9.2 A venting piping connecting two or more cargo tanks shall be fitted, at the connection to each cargo tank, with a flame arrester with a fixed or spring-loaded plate stack, capable of withstanding a detonation.

This equipment may consist of:

a) a flame arrester fitted with a fixed plate stack, where each cargo tank is fitted with a vacuum valve capable of withstanding a deflagration and a high-velocity vent valve capable of withstanding steady burning;

b) a flame arrester fitted with a spring-loaded plate stack, where each cargo tank is fitted with a vacuum valve capable of withstanding a deflagration;

c) a flame arrester with a fixed or spring-loaded plate stack;

d) a flame arrester with a fixed plate stack, where the pressure-measuring device is fitted with an alarm system in accordance with 4.11.5.

When a fire-fighting installation is permanently mounted on deck in the cargo area and can be brought into service from the deck and from the wheelhouse, flame arresters need not be required for individual cargo tanks.

Only substances which do not mix and which do not react dangerously with each other may be carried simultaneously in cargo tanks connected to a common venting piping; or

4.4.9.3 A venting piping connecting two or more cargo tanks shall be fitted, at the connection to each cargo tank, with a pressure/vacuum relief valve incorporating a flame arrester capable of withstanding a detonation/deflagration so that any gas released is removed by the venting piping.

Only substances which do not mix and which do not react dangerously with each other may be carried simultaneously in cargo tanks connected to a common venting piping; or

An independent venting piping for each cargo tank, fitted with a vacuum valve incorporating a flame arrester capable of withstanding a deflagration and a high velocity vent valve incorporating a flame arrester capable of withstanding steady burning. Several different substances may be carried simultaneously; or

4.4.9.4 A venting piping connecting two or more cargo tanks shall be fitted, at the connection to each cargo tank, with a shut-off device capable of withstanding a detonation, where each cargo tank is fitted with a vacuum valve capable of withstanding a deflagration and a high-velocity vent valve capable of withstanding steady burning.

Only substances which do not mix and which do not react dangerously with each other may be carried simultaneously in cargo tanks connected to a common venting piping.
4.5 Cargo piping system

4.5.1 General

Pumps, compressors and accessory loading and unloading piping shall be placed in the cargo area. Cargo pumps and compressors shall be capable of being shut down from the cargo area and, in addition, from a position outside the cargo area. Cargo pumps and compressors situated on deck shall be located not less than 6,0 m from entrances to, or openings of, the accommodation and service spaces outside the cargo area.

4.5.2 Arrangement of cargo piping

4.5.2.1 Piping for loading and unloading shall be independent of any other piping of the vessel. No cargo piping shall be located below deck, except those inside the cargo tanks and inside the cargo pump-room.

4.5.2.2 The piping for loading and unloading shall be arranged so that, after loading or unloading operations, the liquid remaining in these pipes may be safely removed and may flow either into the vessel’s tanks or the tanks ashore.

4.5.2.3 Piping for loading and unloading shall be clearly distinguishable from other piping, e.g. by means of colour marking.

4.5.2.4 The piping for loading and unloading located on deck, with the exception of the shore connections, shall be located not less than 0,25 B from the outer shell.

4.5.2.5 The shore connections shall be located not less than 6,0 m from the entrances to, or openings of, the accommodation and service spaces outside the cargo area.

4.5.2.6 Each shore connection of the venting piping and shore connections of the piping for loading and unloading, through which the loading or unloading operation is carried out, shall be fitted with a shut-off device. However, each shore connection shall be fitted with a blind flange when it is not in operation.

4.5.2.7 The flanges and stuffing boxes shall be provided with a spray protection device.

4.5.2.8 Piping for loading and unloading, and venting piping, shall not have flexible connections fitted with sliding seals.

4.5.2.9 The piping for loading shall extend down to the bottom of the tank.

4.5.2.10 The distance referred to in 4.5.1 and 4.5.2.5 may be reduced to 3,0 m if a transverse bulkhead complying with 4.3.3.2 is situated at the end of the cargo area. The openings shall be provided with doors.

The following notice shall be displayed on the doors:

Do not open during loading and unloading without the permission of the master.
Close immediately.

4.5.2.11 If the vessel is carrying several dangerous substances liable to react dangerously with each other, a separate pump with its own piping for loading and unloading shall be installed for each substance. The piping shall not pass through a cargo tank containing dangerous substances with which the substance in question is liable to react.

4.5.3 Control, monitoring and alarm devices

4.5.3.1 The stop valves or other shut-off devices of the piping for loading and unloading shall indicate whether they are open or shut.

4.5.3.2 The piping for loading and unloading shall be fitted with pressure gauges at the outlet of the pumps. The permissible maximum overpressure or vacuum value shall be indicated on each measuring device.

4.5.4 Bonding

Every component of the piping for loading and unloading shall be electrically connected to the hull.

4.5.5 Washing or ballast water supply

4.5.5.1 When piping for loading and unloading are used for supplying the cargo tanks with washing or ballast water, the suction of these pipes shall be located within the cargo area but outside the cargo tanks.

Pumps for tank washing systems with associated connections may be located outside the cargo area, provided the discharge side of the system is arranged in such a way that the suction is not possible through that part.

A spring-loaded non-return valve shall be provided to prevent any gases from being expelled from the cargo area through the tank washing system.

4.5.5.2 A non-return valve shall be fitted at the junction between the water suction pipe and the cargo loading pipe.

4.5.6 Permissible loading and unloading flows

4.5.6.1 The permissible loading and unloading flows shall be calculated.

4.5.6.2 Calculations concern the permissible maximum loading and unloading flow for each cargo tank or each group of cargo tanks, taking into account the design of the ventilation system.

These calculations shall take into consideration the fact that in the event of an unforeseen cut-off of the vapour return piping of the shore facility, the safety devices of the cargo tanks will prevent pressure in the cargo tanks from exceeding the following values:

- over-pressure: 115% of the opening pressure of the high-velocity vent valve;
- vacuum pressure: not more than the construction vacuum pressure but not exceeding 5,0 kPa (0,05 bar).
4.6 Cargo pressure and temperature control

4.6.1 Regulation of cargo pressure and temperature

4.6.1.1 Unless the entire cargo system is designed to resist the full effective vapour pressure of the cargo at the upper limits of the ambient design temperatures, the pressure of the tanks shall be kept below the permissible maximum set pressure of the safety valves, by one or more of the following means:

a) a system for the regulation of cargo tank pressure using mechanical refrigeration

b) a system ensuring safety in the event of the heating or increase in pressure of the cargo. The insulation or the design pressure of the cargo tank, or the combination of these two elements, shall be such as to leave an adequate margin for the operating period and the temperatures expected; in each case the system shall be deemed acceptable by the Register and shall ensure safety for a minimum time of three times the operation period

c) other systems deemed acceptable by the Register.

4.6.1.2 The systems prescribed in 4.6.1.1 shall be constructed, installed and tested to the satisfaction of the Register. The materials used in their construction shall be compatible with the cargoes to be carried. For normal service, the upper ambient design temperature limits shall be:

- air: +30°C
- water: +20°C.

4.6.2 Refrigeration system

4.6.2.1 The refrigeration system referred to in 4.6.1.1 shall be composed of one or more units capable of keeping the pressure and temperature of the cargo at the upper limits of the ambient design temperatures at the prescribed level. Unless another means of regulating cargo pressure and temperature deemed satisfactory by the Register is provided, provision shall be made for one or more stand-by units with an output at least equal to that of the largest prescribed unit. Provision shall be made for a stand-by heat-exchanger unless the system’s normal heat-exchanger has a surplus capacity equal to at least 25% of the largest prescribed capacity.

Cargo tanks, piping and accessories shall be insulated so that, in the event of a failure of all cargo refrigeration systems, the entire cargo remains for at least 52 hours in a condition not causing the safety valves to open.

4.6.2.2 When several refrigerated cargoes with a potentially dangerous chemical reaction are carried simultaneously, particular care shall be given to the refrigeration systems so as to prevent any mixing of the cargoes. For the carriage of such cargoes, separate refrigeration systems, each including the full stand-by unit referred to in 4.6.2.1, shall be provided for each cargo.

4.6.2.3 When several refrigerated cargoes are not soluble in each other under conditions of carriage such that their vapour pressures are added together in the event of mixing, particular care shall be given to the refrigeration systems to prevent any mixing of the cargoes.

4.6.2.4 All primary and secondary coolant fluids shall be compatible with each other and with the cargo with which they may come into contact.

4.6.2.5 When the refrigeration system is installed in a separate service space, this service space shall meet the requirements of 4.3.5.6.

4.6.3 Cargo tank heating

4.6.3.1 Boilers which are used for heating the cargo shall be fuelled with a liquid fuel having a flashpoint of more than 55°C. They shall be placed either in the engine room or in another separate space below deck and outside the cargo area, which is accessible from the deck or from the engine room.

4.6.3.2 The cargo heating system shall be designed so that the cargo cannot penetrate into the boiler in the case of a leak in the heating coils. A cargo heating system with artificial draught shall be ignited electrically.

4.6.3.3 The ventilation system of the engine room shall be designed taking into account the air required for the boiler.

4.6.3.4 Where the cargo heating system is used during loading, unloading or gas-freeing, the service space which contains this system shall fully comply with the requirements of 4.9.4.6.

This requirement does not apply to the inlets of the ventilation system. These inlets shall be located at a minimum distance of 2,0 m from the cargo area and 6,0 m from the openings of cargo tanks or residual cargo tanks, loading pumps situated on deck, openings of high velocity vent valves, pressure relief devices and shore connections of loading and unloading piping and must be located not less than 2,0 m above the deck.

4.6.3.5 The requirements of 4.9.4.6 are not applicable to the unloading of substances having a flash point of 60°C or more when the temperature of the product is at least 15 K lower at the flash point.

4.6.4 Water spray system

4.6.4.1 When water spraying is required in column (9) of Table C of Chapter 3.2, Part 3 of ADN, a water spray system shall be installed in the cargo area on deck to enable gas emissions from loading to be precipitated and to cool the tops of cargo tanks by spraying water over the whole surface so as to avoid safely the activation of the high velocity vent valve at 50,0 kPa (0,5 bar).

4.6.4.2 The gas precipitation system shall be fitted with a connection device for supply from a shore installation.

4.6.4.3 The spray nozzles shall be so installed that the entire cargo deck area is covered and the gases released are precipitated safely.

4.6.4.4 The system shall be capable of being put into operation from the wheelhouse and from the deck. Its capacity shall be such that when all the spray nozzles are in operation, the outflow is not less than 50,0 l per square metre of deck area and per hour.

4.7 Tanks and receptacles for residual products and receptacles for slops

4.7.1 If vessels are provided with a tank for residual products, it shall comply with the provisions of 4.7.3 and 4.7.4. Receptacles for residual products and receptacles for slops shall be located only in the cargo area. During the filling of the receptacles for residual products, means for
collecting any leakage shall be placed under the filling connections.

4.7.2 Receptacles for slops shall be fire resistant and shall be capable of being closed with lids. The receptacles for slops shall be marked and be easy to handle.

4.7.3 The maximum capacity of a tank for residual products is 30,0 m³.

4.7.4 The tank for residual products shall be equipped with:
- pressure relief and vacuum relief valves.
  The high velocity vent valve shall be so regulated as not to open during carriage. This condition is met when the opening pressure of the valve meets the conditions set out in column (10) of Table C of Chapter 3.2, Part 3 of ADN;
- level indicator;
- connections with shut-off devices, for pipes and hose assemblies.

4.7.5 Receptacles for residual products shall be equipped with:
- a connection enabling gases released during filling to be evacuated safely;
- a possibility of indicating the degree of filling;
- connections with shut-off devices, for pipes and hose assemblies.

4.7.6 Receptacles for residual products shall be connected to the venting piping of cargo tanks only for the time necessary to fill them.

4.7.7 Receptacles for residual products and receptacles for slops placed on the deck shall be located at a minimum distance from the hull equal to one quarter of the vessel's breadth.

4.8 Inerting facility

4.8.1 In cases in which inverting orblanketing of the cargo is prescribed, the vessel shall be equipped with an inerting system.

4.8.2 This system shall be capable of maintaining a permanent minimum pressure of 7,0 kPa (0,07 bar) in the spaces to be inverted. In addition, the inerting system shall not increase the pressure in the cargo tank to a pressure greater than that at which the pressure valve is regulated. The set pressure of the vacuum-relief valve shall be 3,5 kPa (0,035 bar).

4.8.3 The premises to be inverted shall be equipped with connections for introducing the inert gas and monitoring systems so as to ensure the correct atmosphere on a permanent basis.

4.9 Electrical installations

4.9.1 Only distribution systems without return connection to the hull are permitted. This provision does not apply to:
- active cathodic corrosion protection.
- local installations outside the cargo area (e.g. connections of starters of diesel engines)
- device for checking the insulation level referred to in 4.9.2.

4.9.2 Every insulated distribution network shall be fitted with an automatic device with a visual and audible alarm for checking the insulation level.

4.9.3 For the selection of electrical equipment to be used in zones presenting an explosion risk, the explosion groups and temperature classes assigned to the substances carried in the list of substances shall be taken into consideration (see columns (15) and (16) of Table C of Chapter 3.2, Part 3 of ADN).

4.9.4 Type and location of electrical equipment

4.9.4.1 Only the following equipment may be installed in cargo tanks, residual cargo tanks and piping for loading and unloading (comparable to zone 0):
- measuring, regulation and alarm devices of the EEx (ia) type of protection.

4.9.4.2 Only the following equipment may be installed in the cofferdams, double hull spaces, double bottoms and hold spaces (comparable to zone 1):
- measuring, regulation and alarm devices of the certified safe type;
- lighting appliances of the “flame-proof enclosure” or “apparatus protected by pressurization” type of protection;
- hermetically sealed echo sounding devices the cables of which are led through thick-walled steel tubes with gastight connections up to the main deck;
- cables for the active cathodic protection of the shell plating in protective steel tubes such as those provided for echo sounding devices.

4.9.4.3 Only the following equipment may be installed in the service spaces in the cargo area below deck (comparable to zone 1):
- measuring, regulation and alarm devices of the certified safe type;
- lighting appliances of the “flame-proof enclosure” or “apparatus protected by pressurization” type of protection;
- motors driving essential equipment such as ballast pumps; they shall be of the certified safe type.
Chapter II - TRANSPORT OF DANGEROUS GOODS

4.9.4.4 The control and protective equipment of the electrical equipment referred to in 4.9.4.1 to 4.9.4.3 above shall be located outside the cargo area if they are not intrinsically safe.

4.9.4.5 The electrical equipment in the cargo area on deck (comparable to zone 1) shall be of the certified safe type.

4.9.4.6 Electrical equipment used during loading, unloading and gas-freeing during berthing and which are located outside the cargo area (comparable to zone 2) shall be at least of the "limited explosion risk" type.

This provision does not apply to:

1. lighting installations in the accommodation, except for switches near entrances to accommodation;

2. radiotelephone installations in the accommodation or the wheelhouse;

3. mobile and fixed telephone installations in the accommodation or the wheelhouse;

4. electrical installations in the accommodation, the wheelhouse or the service spaces, if:
   - these spaces are fitted with a ventilation system ensuring an overpressure of 0,1 kPa (0,001 bar) and none of the windows is capable of being opened; the air intakes of the ventilation system located as far away as possible, however, not less than 6,0 m from the cargo area and not less than 2,0 m above the deck;
   - the spaces are fitted with a gas detection system with sensors at the suction inlets of the ventilation system and directly at the top edge of the sill of the entrance doors of the accommodation and service spaces;
   - the gas concentration measurement is continuous when the gas concentration reaches 20% of the lower explosive limit, the ventilators shall be switched off. In such a case and when the overpressure is not maintained or in the event of failure of the gas detection system, the electrical installations which do not comply with item 1 above, shall be switched off. These operations shall be performed immediately and automatically and activate the emergency lighting in the accommodation, the wheelhouse and the service spaces, which shall comply at least with the "limited explosion risk" type. The switching-off shall be indicated in the accommodation and wheelhouse by visual and audible signals;
   - the ventilation system, the gas detection system and the alarm of the switch-off device fully comply with the requirements of item 1 above;
   - the automatic switch-off device is set so that no automatic switching-off may occur while the vessel is under way.

4.9.4.7 The electrical equipment which does not meet the requirements set out in 4.9.4.6 together with its switches shall be marked in red. The disconnection of such equipment shall be operated from a centralized location on board.

4.9.4.8 An electric generator which is permanently driven by an engine and which does not meet the requirements of 4.9.4.6, shall be fitted with a switch capable of shutting down the excitation of the generator. A notice board with the operating instructions shall be displayed near the switch.

4.9.4.9 Sockets for the connection of signal lights and gangway lighting shall be permanently fitted to the vessel close to the signal mast or the gangway. Connecting and disconnecting shall not be possible except when the sockets are not live.

4.9.4.10 The failure of the power supply for the safety and control equipment shall be immediately indicated by visual and audible signals at the locations where the alarms are usually actuated.

4.9.5 Earthing

4.9.5.1 The metal parts of electrical appliances in the cargo area which are not live as well as protective metal tubes or metal sheaths of cables in normal service shall be earthed, unless they are so arranged that they are automatically earthed by bonding to the metal structure of the vessel.

4.9.5.2 The provisions of 4.9.5.1 apply also to equipment having service voltages of less than 50,0 V.

4.9.5.3 Independent cargo tanks, metal intermediate bulk containers and tank-containers shall be earthed.

4.9.5.4 Receptacles for residual products shall be capable of being earthed.

4.9.6 Electric cables

4.9.6.1 All cables in the cargo area shall have a metallic sheath.

4.9.6.2 Cables and sockets in cargo area shall be protected against mechanical damage.

4.9.6.3 Movable cables are prohibited in the cargo area, except for intrinsically safe electric circuits or for the supply of signal lights and gangway lighting.

4.9.6.4 Cables of intrinsically safe circuits shall only be used for such circuits and shall be separated from other cables not intended for being used in such circuits (e.g. they shall not be installed together in the same string of cables and they shall not be fixed by the same cable clamps).

4.9.6.5 For movable cables intended for signal lights and gangway lighting, only sheathed cables of type H 07 RN-F in accordance with standard IEC 60 245-4:1994 or cables of at least equivalent design having conductors with a cross-section of not less than 1,5 mm² shall be used. These cables shall be as short as possible and installed so that damage is not likely to occur.

4.9.6.6 The cables required for the electrical equipment referred to in 4.9.4.2 and 4.9.4.3 are accepted in cofferdams, double hull spaces, double bottoms, hold spaces and service spaces below deck.

4.9.7 Accumulators

Accumulators shall be located outside the cargo area.
4.10 Fire protection and fire-extinguishing

4.10.1 Fire and naked light

4.10.1.1 The outlets of funnels shall be located not less than 2,0 m from the hatchway openings. Arrangements shall be provided to prevent the escape of sparks and the entry of water.

4.10.1.2 Heating, cooking and refrigerating appliances shall not be fuelled with liquid fuels, liquid gas or solid fuels.

The installation in the engine room or in another separate space of heating appliances fuelled with liquid fuel having a flashpoint above 55°C is, however, permitted.

Cooking and refrigerating appliances are permitted only in wheelhouses with metal floor and in the accommodation.

4.10.1.3 Only electrical lighting appliances are permitted.

4.10.2 Fire extinguishing systems

In addition to the requirements of the Rules, Part 3 – Machinery, Systems and Electricity, Chapter III, Section 5, the fire extinguishing arrangements in 4.10.4 and 4.10.5 shall be complied with.

4.10.3 Portable fire extinguishers

In addition to the fire extinguishing appliances prescribed in the Rules, Part 3 – Machinery, Systems and Electricity, Chapter III, 5.5.2 and 5.5.3, each vessel shall be equipped with at least two additional portable fire extinguishers having the same capacity.

These additional portable fire extinguishers shall be suitable for fighting fires involving the dangerous goods carried.

These two portable fire extinguishers shall be located in the protected area or in proximity to it.

4.10.4 Fire-extinguishing system

A fire-extinguishing system shall be installed on the vessel. This system shall comply with the following requirements:

.1 it shall be supplied by two independent fire or ballast pumps, one of which shall be ready for use at any time. These pumps and their means of propulsion and electrical equipment shall not be installed in the same space;

.2 it shall be provided with a water main fitted with at least three hydrants in the protected area above deck. Three suitable and sufficiently long hoses with jet/spray nozzles having a diameter of not less than 12,0 mm shall be provided. Alternatively one or more of the hose assemblies may be substituted by directable jet/spray nozzles having a diameter of not less than 12,0 mm. It shall be possible to reach any point of the deck in the protected area simultaneously with at least two jets of water which do not emanate from the same hydrant.

A spring-loaded non-return valve shall be fitted to ensure that no gases can escape through the fire-extinguishing system into the accommodation or service spaces outside the cargo area;

.3 the capacity of the system shall be at least sufficient for a jet of water to reach a distance of not less than the vessel’s breadth from any location on board with two spray nozzles being used at the same time;

.4 the water supply system shall be capable of being put into operation from the wheelhouse and from the deck;

.5 measures shall be taken to prevent the freezing of fire-mains and hydrants;

.6 a single fire or ballast pump shall suffice on board pushed barges without their own means of propulsion.

4.10.5 Fixed fire-extinguishing system

In addition, the engine room, the pump room and all spaces containing essential equipment (switchboards, compressors, etc.) for the refrigeration equipment, if any, shall be provided with a fixed fire-extinguishing system meeting the requirements of the Rules, Part 3 – Machinery, Systems and Electricity, Chapter III, 5.3.

4.11 Safety and control installations

4.11.1 General

Cargo tanks shall be provided with the following equipment:

a) a mark inside the tank indicating the liquid level of 95 %

b) a level gauge

c) a level alarm device which is activated at the latest when a degree of filling of 90% is reached

d) a high level sensor for actuating the facility against overflowing at the latest when a degree of filling of 97,5% is reached

e) an instrument for measuring the pressure of the vapour phase inside the cargo tank

f) an instrument for measuring the temperature of the cargo, if in column (9) of Table C of Chapter 3.2, Part 3 of ADN a heating installation is required, or if maximum temperature is indicated in column (20) of that list

g) a connection for a closed-type or partly closed-type sampling device, and/or at least one sample opening as required in column (13) of Table C of Chapter 3.2, Part 3 of ADN.

4.11.2 Cargo tank level indicators

Each cargo tank shall be equipped with a closed gauging device approved by the Register.

The level gauge shall allow readings from the control position of the shut-off devices of the particular cargo tank. The maximum permissible maximum filling levels of 95% and 97%, as given in the list of substances, shall be marked on each level gauge.

4.11.3 Level alarm device

Cargo tank shall be provided with a level alarm device which is activated at the latest when a degree of filling of 90% is reached.

The level alarm device shall give a visual and audible warning on board when actuated. The level alarm device shall be independent of the level gauge.
Chapter II - TRANSPORT OF DANGEROUS GOODS

4.11.4 High level sensor

Cargo tank shall be provided with a high level sensor for actuating the facility against overflowing at the latest when a degree of filling of 97,5% is reached.

The high level sensor referred to above shall give a visual and audible alarm on board and at the same time actuate an electrical contact which in the form of a binary signal interrupts the electric current loop provided and fed by the shore facility, thus initiating measures at the shore facility against overflowing during loading operations.

The signal shall be transmitted to the shore facility via a watertight two-pin plug of a connector device in accordance with standard EN 60309-2:1999 + A1:2007 + A2:2012 for direct current of 40,0 to 50,0 volts, identification colour white, position of the nose 10 h.

The plug shall be permanently fitted to the vessel close to the shore connections of the loading and unloading piping.

The high level sensor shall also be capable of switching off the vessel's own discharging pump. The high level sensor shall be independent of the level alarm device, but it may be connected to the level gauge.

4.11.5 Cargo tank pressure monitoring

When the pressure or temperature exceeds a set value, instruments for measuring the vacuum or overpressure of the gaseous phase in the cargo tank or the temperature of the cargo, shall activate a visual and audible alarm in the wheelhouse. When the wheelhouse is unoccupied the alarm shall also be perceptible in a location occupied by a crew member.

When the pressure exceeds the set value during loading and unloading, the instrument for measuring the pressure shall, initiate immediately an electrical contact which shall put into effect measures to interrupt the loading or unloading operation.

If the vessel's own discharge pump is used, it shall be switched off automatically.

The instrument for measuring the overpressure or vacuum shall activate the alarm at latest when an overpressure is reached equal to 1,15 times the opening pressure of the pressure relief device, or a vacuum pressure of 5,0 kPa (0,05 bar).

4.11.6 Cargo temperature monitoring

An instrument for measuring the temperature of the cargo shall be provided, if in column (9) of Table C of Chapter 3.2, Part 3 of ADN a heating installation is required, or if maximum temperature is indicated in column (20) of that list.

4.11.7 Cargo tank sampling equipment

Each cargo tank shall be equipped with a connection for a sampling device, closed or partially closed, and/or at least one sampling opening as required in column a connection for a closed-type or partly closed-type sampling device, and/or at least one sample opening as required in column (13) of Table C of Chapter 3.2, Part 3 of ADN.

4.12 Buoyancy and stability

4.12.1 General

General requirements of the Rules, Part 2 – Hull and Hull Equipment, Chapter II, Section 11 shall be complied with.

1. proof of sufficient stability shall be furnished including stability in the damaged condition;

2. the basic values for the stability calculation - the vessel’s lightweight and the location of the centre of gravity - shall be determined either by means of an inclining experiment or by detailed mass and moment calculation. In the latter case the lightweight shall be checked by means of a lightweight test with a tolerance limit of ± 5% between the mass determined by the calculation and the displacement determined by the draught readings;

3. proof of sufficient intact stability shall be furnished for all stages of loading and unloading and for the final loading condition for all the relative densities of the substances transported contained in the vessel substance list according to 1.7.2.2;

4. for every loading case, taking account of the actual fillings and floating position of cargo tanks, ballast tanks and compartments, drinking water and sewage tanks and tanks containing products for the operation of the vessel, the vessel shall comply with the intact and damage stability requirements. Middle stages during operations shall also be taken into consideration;

5. floatability after damage shall be proved for the most unfavourable loading condition. For this purpose calculated proof of sufficient stability shall be established for critical intermediate stages of flooding and for the final stage of flooding.

4.12.2 Intact stability

4.12.2.1 The requirements for intact stability resulting from the damaged stability calculation shall be fully complied with.

4.12.2.2 For vessels with cargo tanks of more than 0,7© in width, proof shall be furnished that the following stability requirements have been complied with:

a) In the positive area of the righting lever curve up to immersion of the first unprotected (non-weathertight) opening there shall be a righting lever (GZ) of not less than 0,1 m

b) The surface of the positive area of the righting lever curve up to immersion of the first unprotected (non-weathertight) opening and in any event up to an angle of heel ≤ 27° shall not be less than 0,024 m rad

c) the metacentric height GM shall not be less than 0,1 m.

These conditions shall be met bearing in mind the influence of all free surfaces in tanks for all stages of loading and unloading.

4.12.2.3 The most stringent requirement of 4.12.2.1 and 4.12.2.2 is applicable to the vessel.

4.12.3 Damage stability

4.12.3.1 The following assumptions shall be taken into consideration for the damaged condition:
a) the extent of side damage is as follows:
   - longitudinal extent: at least 0,1\(\times L\), but not less than 5,0 m;
   - transverse extent: 0,79 m inboard from the vessel’s side at right angles to the centreline at the level corresponding to the maximum draught, or when applicable, \(B_{ST}-0,01\) m, where \(B_{ST}\) is the width of the side compartment (double side);
   - vertical extent: from the baseline upwards without limit;

b) the extent of bottom damage is as follows:
   - longitudinal extent: at least 0,1\(\times L\), but not less than 5,0 m;
   - transverse extent: 3,0 m;
   - vertical extent: from the base 0,59 m upwards, the sump excepted;

c) any bulkheads within the damaged area shall be assumed damaged, which means that the location of bulkheads shall be chosen so as to ensure that the vessel remains afloat after the flooding of two or more adjacent compartments in the longitudinal direction.

The following provisions are applicable:
   - for bottom damage also two adjacent athwartship compartments shall also be assumed as flooded;
   - the lower edge of any non-watertight (e.g. doors, windows, access hatchways) shall, at the final stage of flooding, be not less than 0,1 m above the damage waterline;
   - in general, permeability shall be assumed to be 95%. Where an average permeability of less than 95% is calculated for any compartment, this calculated value obtained may be used.

However, the following minimum values shall be used:
   - engine rooms: 85%
   - accommodation: 95%
   - double bottoms, fuel oil tanks, ballast tanks, etc., depending on whether, according to their function, they have to be assumed as full or empty for the vessel floating at the maximum permissible draught: 0% or 95%.

For the main engine room only the one-compartment standard needs to be taken into account, i.e. the end bulkheads of the engine room shall be assumed as not damaged.

4.12.3.2 For critical intermediate stages of flooding, beyond the equilibrium stage, the following criteria for the righting lever curve have to be fulfilled:

   Righting lever \((GZ)\) \(\geq 0,03\) m;

   Range of positive \(GZ\): 5°.

4.12.3.3 At the stage of equilibrium (final stage of flooding), the angle of heel shall not exceed 12° (see Figure 4.12-1).

   Non-watertight openings shall not be flooded before reaching the stage of equilibrium. If such openings are immersed before that stage, the corresponding spaces shall be considered as flooded for the purpose of stability calculation.

   The positive range of the righting lever curve beyond the stage of equilibrium shall have a righting lever of \(\geq 0,05\) m in association with an area under the curve of \(\geq 0,0065\) m\(\times\)rad.

   The minimum values of stability shall be satisfied up to immersion of the first unprotected (non-watertight) opening and in any event up to an angle of heel \(\leq 27^\circ\). If non-watertight openings are immersed before the requirements for minimum values of stability are complied with, the corresponding spaces shall be considered as flooded for the purposes of stability calculation.

   If openings through which undamaged compartments may additionally become flooded are capable of being closed watertight, the closing devices shall be marked accordingly.

   Where cross- or down-flooding openings are provided for reduction of unsymmetrical flooding, the time for equalisation shall not exceed 15 minutes, provided during the intermediate stages of flooding sufficient stability has been proved.

![Figure 4.12-1](image)

4.13 Notice boards

The notice boards displaying the prohibition of admittance on board including prohibition of smoking, fire and naked light shall be clearly legible from either side of the vessel.
5 TANKERS TYPE N

5.1 General

5.1.1 The following requirements of this Section apply to vessels intended for the carriage of dangerous liquids in bulk assigned with one of the following additional Character of class:

– Type N closed, as defined in the Rules, Part 1 – Classification and Surveys, Chapter I, 3.6.2.
– Type N open with flame arresters, as defined in the Rules, Part 1 – Classification and Surveys, Chapter I, 3.6.2.
– Type N open, as defined in the Rules, Part 1 – Classification and Surveys, Chapter I, 3.6.2.

5.1.2 Vessels considered in this Section shall comply with the applicable requirements of the Rules, Part 1 Classification and Surveys, Part 2 – Hull and Hull Equipment and Part 3 – Machinery, Systems and Electricity, as applicable, and with the specific requirements from Section I and the present Rules, Chapter I, Section 3.

5.2 Documentation to be submitted

In addition to the documentation required in the other applicable Parts of the Rules for the parts of the vessel not affected by the cargo, the following documentation shall be submitted, as applicable:

.1 list of substances intended to be carried with their UN numbers including all design characteristics of substances and other important design conditions;
.2 general arrangement plan, showing location of cargo tanks and fuel oil, ballast and other tanks, void spaces, etc.;
.3 loading and unloading operation description, including cargo tank filling limits;
.4 cargo area plan, location of the electrical equipment installed in these areas and list of the electrical equipment installed in cargo tank and cargo area (comparable to zone 0 and 1), including the following equipment particulars: location, type of protection, type of protection against explosion, testing body and approval number;
.5 list of equipment installed in cargo area (comparable to zone 2) which may be used during loading, unloading and gas-freeing and red equipment;
.6 details of hull structure in way of cargo tanks, including support arrangement for tanks, saddles, anti-floating and anti-lifting devices, deck sealing arrangements, independent cargo tanks, etc.;
.7 intact and damage stability calculations;
.8 scantlings, material and arrangement of the cargo containment system;
.9 details of cargo handling and venting system, including arrangements and details of piping and fitting;
.10 locations and details of cargo pumps including their driving machinery;
.11 ventilation duct arrangement in gas-dangerous spaces and adjacent zones including schemes and calculations of ventilation system in cargo area.

.12 details of the cargo tank instrumentation including gauging/sounding devices, level/overflow alarms and pressure and temperature indicating equipment;
.13 pressure drop calculation of the vent system based on the maximum loading/unloading rates;
.14 arrangement drawing of the various fire bulkheads and decks with standard fire test reports for the various arrangements, surface coverings, paints and similar;
.15 details of fire extinguishing appliances and systems in cargo area;
.16 drawings of the bilge and ballast water systems within the cargo area;
.17 details of the gas-freeing arrangements for cargo tanks including inert gas system;
.18 details of the gas detection system;
.19 gas return system;
.20 schematic electrical wiring diagrams in cargo area.

NOTE: Items 1, 2 and 3 shall be submitted for information only. Others shall be submitted for approval.

5.3 Vessel arrangement

5.3.1 Hold spaces

5.3.1.1 The cargo tanks shall be separated by cofferdams of at least 0.6 m in width from the accommodation, engine rooms and service spaces outside the cargo area below deck or, if there are no such accommodation, engine rooms and service spaces, from the vessel’s end. Where the cargo tanks are installed in hold space, a space of not less than 0.5 m shall be provided between such tanks and the end bulkheads of the hold space. In this case an end bulkhead meeting at least the definition for Class “A-60” (see the Rules, Part 3 – Machinery, Systems and Electricity, Chapter III, 1.2.6), shall be deemed equivalent to a cofferdam.

For pressure cargo tanks, the 0.5 m distance may be reduced to 0.2 m.

5.3.1.2 Hold spaces and cargo tanks shall be capable of being inspected.

5.3.1.3 All spaces in the cargo area shall be capable of being ventilated. Means for checking their gas-free condition shall be provided.

5.3.1.4 The bulkheads bounding the cargo tanks, cofferdams and hold spaces shall be watertight. The cargo tanks and the bulkheads bounding the cargo area shall have no openings or penetrations below deck.

The bulkhead between the engine room and the service spaces in the cargo area or between the engine room and a hold space may be fitted with penetrations provided that they conform to the provisions of 5.3.3.5.

The bulkhead between the cargo tank and the cargo pump-room below deck may be fitted with penetrations provided that they conform to the provisions of 5.3.6.2.

The bulkheads between the cargo tanks may be fitted with penetrations provided that the loading or unloading piping are fitted with shut-off devices in the cargo tank from which they come. These pipes shall be fitted at least 0.6 m above the bottom.
These shut-off devices shall be operable from the deck.

5.3.1.5 Double-hull spaces and double bottoms in the cargo area shall be arranged for being filled with ballast water only. Double bottoms may, however, be used as fuel oil tanks, provided they comply with the requirements of 5.3.8.

5.3.1.6 A cofferdam, the centre part of a cofferdam or another space below deck in the cargo area may be arranged as a service space, provided the bulkheads bounding the service space extend vertically to the bottom. This service space shall only be accessible from the deck.

The service space shall be watertight with the exception of its access hatches and ventilation inlets.

5.3.1.7 No piping for loading and unloading shall be fitted within the service space referred to in 5.3.1.4. Piping for loading and unloading may be fitted in the cargo pump-rooms below deck only when they conform to the provisions of 5.3.6.2. This does not apply to Type N open.

5.3.1.8 Where service spaces are located in the cargo area under deck, they shall be arranged so as to be easily accessible and to permit persons wearing protective clothing and breathing apparatus to safely operate the service equipment contained therein. They shall be designed so as to allow injured or unconscious personnel to be removed from such spaces without difficulties, if necessary by means of fixed equipment.

5.3.1.9 Cofferdams, double-hull spaces, double bottoms, cargo tanks, hold spaces and other accessible spaces within the cargo area shall be arranged so that they may be completely inspected and cleaned in an appropriate manner. The dimensions of openings except for those of double-hull spaces and double bottoms which do not have a wall adjoining the cargo tanks shall be in compliance with the Rules, Part 2 – Hull and Hull Equipment, Chapter II, 4.2.

5.3.2 Arrangement of cofferdams

5.3.2.1 Cofferdams or cofferdam compartments remaining once a service space has been arranged in accordance with 5.3.1.6 shall be accessible through an access hatch.

5.3.2.2 Cofferdams shall be capable of being filled with water and emptied by means of a pump. Filling shall be affected within 30 minutes. These requirements are not applicable when the bulkhead between the engine room and the cofferdam comprises fire-protection insulation “A-60” in accordance with the Rules, Part 3 – Machinery, Systems and Electricity, Chapter III, 1.2.6 or has been fitted out as a service space.

The cofferdams shall not be fitted with inlet valves.

5.3.2.3 No fixed pipe shall permit connection between a cofferdam and other piping of the vessel outside the cargo area.

5.3.2.4 When the list of substances on the vessel according to 1.7.2.2 contains substances for which protection against explosion is required in column (17) of Table C of Chapter 3.2, Part 3 of ADN, the ventilation openings of cofferdams shall be fitted with a flame arrester capable of withstanding a deflagration. This does not apply to Type N open.

5.3.3 Protection against the penetration of gases – Type N closed and Type N open with flame arresters only

5.3.3.1 The vessel shall be designed so as to prevent gases from penetrating into the accommodation and the service spaces.

5.3.3.2 Outside the cargo area, the lower edges of door openings in the sidewalls of superstructures and the coamings of access hatches to under-deck spaces shall have a height of not less than 0,5 m above the deck.

This requirement need not be complied with if the wall of the superstructures facing the cargo area extends from one side of the vessel to the other and has doors the sills of which have a height of not less than 0,5 m.

The height of this wall shall not be less than 2,0 m. In this case, the lower edges of door-openings in the sidewalls of superstructures and the coamings of access hatches behind this wall shall have a height of not less than 0,1 m. The sills of engine room doors and the coamings of its access hatches shall, however, always have a height of not less than 0,5 m.

5.3.3.3 In the cargo area, the lower edges of door-openings in the sidewalls of superstructures shall have a height of not less than 0,5 m above the deck and the sills of hatches and ventilation openings of premises located under the deck shall have a height of not less than 0,5 m above the deck.

This requirement does not apply to access openings to double-hull and double bottom spaces.

5.3.3.4 The bulwarks, foot-rails, etc. shall be provided with sufficiently large openings which are located directly above the deck.

5.3.3.5 5.3.3 does not apply to Type N open.

5.3.4 Engine rooms

Internal combustion engines for the vessel’s propulsion as well as internal combustion engines for auxiliary machinery shall be located outside the cargo area.

Entrances and other openings of engine rooms shall be at a distance of not less than 2,0 m from the cargo area.

The engine room shall be accessible from the deck; the entrances shall not face the cargo area. Where the doors are not located in a recess whose depth is at least equal to the door width, the hinges shall face the cargo area.

5.3.5 Accommodation and service spaces

5.3.5.1 Accommodation spaces and the wheelhouse shall be located outside the cargo area forward of the fore vertical plane or abaft the aft vertical plane bounding the part of cargo area below deck. Windows of the wheelhouse which are located not less than 1,0 m above the bottom of the wheelhouse may tilt forward.

5.3.5.2 Entrances to spaces and openings of superstructures shall not face the cargo area. Doors opening outward and not located in a recess the depth of which is at least equal to the width of the doors shall have their hinges facing the cargo area.

5.3.5.3 Entrances from the deck and openings of spaces facing the weather shall be capable of being closed.
Chapter II - TRANSPORT OF DANGEROUS GOODS

The following instruction shall be displayed at the entrance of such spaces:

Do not open during loading and unloading without the permission of the master. Close immediately.

5.3.5.4 Entrance and windows of superstructures and accommodation spaces which can be opened as well as other openings of these spaces shall be located not less than 2,0 m from the cargo area. No wheelhouse doors and windows shall be located within 2,0 m from the cargo area, except where there is no direct connection between the wheelhouse and the accommodation.

5.3.5.5
a) Driving shafts of the bilge or ballast pumps may penetrate through the bulkhead between the service space and the engine room, provided the arrangement of the service space is in compliance with 5.3.1.4;
b) the penetration of the shaft through the bulkhead shall be gastight and shall have been approved by the Register;
c) penetrations through the bulkhead between the engine room and the service space in the cargo area, and the bulkhead between the engine room and the hold spaces may be provided for electrical cables, hydraulic lines and piping for measuring, control and alarm systems, provided that the penetrations have been approved by the Register. The penetrations shall be gastight. Penetrations through a bulkhead with a “A -60” fire protection insulation (see the Rules, Part 3 – Machinery, Systems and Electricity, Chapter III, 1.2.6), shall have an equivalent fire protection;
d) pipes may penetrate through the bulkhead between the engine room and the service space in the cargo area provided that these are pipes between the mechanical equipment in the engine room and the service space which do not have any openings within the service space and which are provided with shut-off devices at the bulkhead in the engine room;
e) notwithstanding 5.3.1.4, pipes from the engine room may pass through the service space in the cargo area or a cofferdam or a hold space or a double-hull space to the outside provided that within the service space or cofferdam or hold space or double hull space they are of the thick-walled type and have no flanges or openings.

5.3.6 Accommodation and service spaces – additional requirements for Type N closed and Type N open with flame arresters

5.3.6.1 Where a driving shaft of auxiliary machinery penetrates through a wall located above the deck the penetration shall be gastight.

5.3.6.2 A service space located within the cargo area below deck shall not be used as a cargo pump room for the vessel’s own gas discharging system, e.g. compressors or the compressor/heat exchanger/pump combination, except where:

- the pump room is separated from the engine room or from service spaces outside the cargo area by a cofferdam or a bulkhead with an “A-60” fire protection insulation (see the Rules, Part 3 – Machinery, Systems and Electricity, Chapter III, 1.2.6), or by a service space or a hold space;
- the “A-60” bulkhead required above does not include penetrations referred to in 5.3.3.3, a);
- ventilation exhaust outlets are located not less than 6,0 m from entrances and openings of the accommodation and service spaces;
- the access hatches and ventilation inlets can be closed from the outside;
- all pipes for loading and unloading as well as those of stripping systems are provided with shut-off devices at the pump suction side in the cargo pump-room immediately at the bulkhead. The necessary operation of the control devices in the pump-room, starting of pumps and necessary control of the liquid flow rate shall be effected from the deck;
- the bilge of the cargo pump-room is equipped with a gauging device for measuring the filling level which activates a visual and audible alarm in the wheelhouse when a liquid is accumulating in the cargo pump-room bilge;
- the cargo pump-room is provided with a permanent gas detection system which automatically indicates the presence of explosive gases or lack of oxygen by means of direct-measuring sensors and which actuates a visual and audible alarm when the gas concentration has reached 20% of the lower explosive limit. The sensors of this system shall be placed at suitable positions at the bottom and directly below the deck. Measurement shall be continuous;
- the audible and visual alarms are installed in the wheelhouse and in the cargo pump-room and, when the alarm is actuated, the loading and unloading system is shut down. Failure of the gas detection system shall be immediately signalled in the wheelhouse and on deck by means of audible and visual alarms;
- the ventilation system prescribed in 5.3.11.3 has a capacity of not less than 30 changes of air per hour based on the total volume of the service space.

5.3.7 Engines

5.3.7.1 Only internal combustion engines running on fuel with a flashpoint of more than 55°C are permitted.

5.3.7.2 Ventilation inlets of the engine room and, when the engines do not take in air directly from the engine room, the air intakes of the engines shall be located not less than 2,0 m from the cargo area.

5.3.7.3 Sparking shall not be possible within the cargo area.

5.3.8 Oil fuel tanks

5.3.8.1 When the vessel is fitted with hold spaces and double bottoms, double bottoms within these spaces may be arranged as a liquid oil fuel tanks, provided their depth is not less than 0,6 m.

Oil fuel pipes and openings of such tanks are not permitted in the hold space.
5.3.8.2 The open ends of air pipes of all oil fuel tanks shall extend to not less than 0.5 m above the open deck. The open ends and the open ends of overflow pipes leading on the deck shall be fitted with a protective device consisting of a gauze diaphragm or a perforated plate.

5.3.9 Exhaust pipes

5.3.9.1 Exhausts shall be evacuated from the vessel into the open air either upwards through an exhaust pipe or through the shell plating. The exhaust outlet shall be located not less than 2.0 m from the cargo area. The exhaust pipes of engines shall be arranged so that the exhausts are led away from the vessel. The exhaust pipes shall not be located within the cargo area.

5.3.9.2 Exhaust pipes shall be provided with a device preventing the escape of sparks, e.g. spark arresters.

5.3.10 Bilge pumping and ballasting arrangements

5.3.10.1 Bilge and ballast pumps for spaces within the cargo area shall be installed within such areas.

This provision does not apply to:
- double-hull spaces and double bottoms which do not have a common boundary wall with the cargo tanks;
- cofferdams and hold spaces where ballasting is carried out using the piping of the firefighting system in the cargo area and bilge-pumping is performed using eductors.

5.3.10.2 Where the double bottom is used as a liquid oil fuel tank, it shall not be connected to the bilge piping system.

5.3.10.3 Where the ballast pump is installed in the cargo area, the standpipe and its outboard connection for suction of ballast water shall be located within the cargo area but outside the cargo tanks.

5.3.10.4 A cargo pump-room below deck shall be capable of being drained in an emergency by an installation located in the cargo area and independent from any other installation. This installation shall be provided outside the cargo pump-room.

5.3.11 Ventilation

5.3.11.1 Each hold space shall have two openings the dimensions and location of which shall be such as to permit effective ventilation of any part of the hold space. If there are no such openings, it shall be possible to fill the hold spaces with inert gas or dry air.

5.3.11.2 Double-hull spaces and double bottoms within the cargo area which are not arranged for being filled with ballast water and cofferdams between engine rooms and pump-rooms, if they exist, shall be provided with ventilation systems.

5.3.11.3 Any service spaces located in the cargo area below deck shall be provided with a system of forced ventilation with sufficient power for ensuring at least 20 changes of air per hour based on the volume of the space.

The ventilation exhaust ducts shall extend down to 50.0 mm above the bottom of the service space. The air shall be supplied through a duct at the top of the service space. The air inlet shall be located not less than 2.0 m above the deck, at a distance of not less than 2.0 m from tank openings and 6.0 m from the outlets of safety valves.

The extension pipes, which may be necessary, may be of the hinged type.

On board Type N open vessels, other suitable installations without ventilator fans shall be sufficient.

5.3.11.4 Ventilation of accommodation and service spaces shall be possible.

5.3.11.5 Ventilation inlets of service spaces in the cargo area may be located within such area.

5.3.12 Ventilation – additional requirements for Type N closed and Type N open with flame arresters

5.3.12.1 Ventilators used in the cargo area shall be designed so that no sparks may be emitted on contact of the impeller blades with the housing and no static electricity may be generated.

5.3.12.2 All ventilation inlets of accommodation and service spaces leading outside shall be fitted with fire flaps. Such ventilation inlets shall be located not less than 2.0 m from the cargo area.

5.3.12.3 The flame arresters prescribed in 5.3.2.4, 5.4.7, 5.4.9 and 5.7.4 shall be of a type approved for this purpose by the Register.

5.3.12.4 5.3.12 does not apply to Type N open.

5.3.13 Ventilation of cargo pump rooms

5.3.13.1 Cargo pump rooms shall be provided with extraction type ventilation systems, independent of other vessel's spaces, providing at least 30 changes of air per hour based on total volume of the service space.

5.3.13.2 The following instruction shall be displayed at the entrance of the cargo pump-room:

Before entering the cargo pump-room check whether it is free from gases and contains sufficient oxygen. Do not open doors and entrance openings without the permission of the master. Leave immediately in the event of alarm.

5.3.13.3 Portable means shall be provided for gas-freeing of cargo tanks and other spaces not equipped with fixed ventilation.

5.3.13.4 5.3.13 does not apply to Type N open.

5.4 Cargo containment

5.4.1 General

5.4.1.1 The tanker Type N may be constructed as a single or double-hull tank vessel or as a tank vessel with independent cargo tanks and may be arranged in three different designs in respect of cargo tank venting system due to regard to the products as specified in the list of substances permitted to be carried of Table C of Chapter 3.2, Part 3 of ADN:
Chapter II - TRANSPORT OF DANGEROUS GOODS

– Type N with open venting;
– Type N with open venting and with flame arresters;
– Type N closed.

5.4.1.2 The scantlings and structural arrangements shall be in compliance with applicable requirements of the present Rules, Chapter I, Section 3.

5.4.1.3 Testing pressures

Cargo tanks, residual cargo tanks, cofferdams, piping for loading and unloading shall be capable of withstanding testing pressures in accordance with the Rules, Part 2 – Hull and Hull Equipment, Chapter III, 5.8.

In addition, the testing pressure for the cargo tanks and residual cargo tanks shall not be less than 1,3 times the construction pressure. The testing pressure for the cofferdams and open cargo tanks shall not be less than 10,0 kPa (0,1 bar) gauge pressure.

The testing pressure for piping for loading and unloading shall not be less than 1000,0 kPa (10,0 bar) gauge pressure.

5.4.2 Cargo area hull design

Where independent cargo tanks are used, or for double-hull construction where the cargo tanks are integrated in the vessel’s structure, the space between the wall of the vessel and wall of the cargo tanks shall not be less than 0,6 m.

The space between the bottom of the vessel and the bottom of the cargo tanks shall not be less than 0,5 m. The space may be reduced to 0,4 m under the pump sumps.

The vertical space between the suction well of a cargo tank and the bottom structures shall not be less than 0,1 m.

When a hull is constructed in the cargo area as a double hull with independent cargo tanks located in hold spaces, the above values are applicable to the double hull. If in this case the minimum values for inspections of independent tanks referred to in 5.3.1.9 are not feasible, it must be possible to remove the cargo tanks easily for inspection.

5.4.3 Cargo tank arrangements

5.4.3.1 For vessels with a length of not more than 50,0 m, the length of a cargo tank shall not exceed 10,0 m.

5.4.3.2 For vessels with a length of more than 50,0 m, the length of a cargo tank shall not exceed 0,2 ∙ L.

5.4.3.3 Provisions in 5.4.3.1 and 5.4.3.2 do not apply to vessels with independent built-in cylindrical tanks having a length to diameter ratio ≤ 7.

5.4.3.4 The cargo tanks independent of the vessel’s hull shall be fixed so that they cannot float.

5.4.3.5 The capacity of a suction well shall be limited to not more than 0,1 m³.

5.4.4 Integrated tank scantlings

5.4.4.1 The scantlings of the integrated tank structure shall be determined in accordance with the present Rules, Chapter I, 3.3.3.

5.4.5 Independent cargo tank scantling

5.4.5.1 The scantlings of the independent tank structure shall be determined in accordance with the present Rules, Chapter I, 3.3.4.

When the vessel is provided with pressure cargo tanks, these tanks shall be designed in compliance with the Rules, Part 3 – Machinery, Systems and Electricity, Chapter I, Section 5, for a working pressure of 400,0 kPa.

5.4.5.2 The scantlings of the tank supports and fastenings shall be in compliance with the present Rules, Chapter I, 3.3.4.

5.4.6 Cargo tank openings

5.4.6.1 Cargo tank openings shall be located on deck in the cargo area.

5.4.6.2 Cargo tank openings with a cross-section of more than 0,1 m² and openings of safety devices for preventing overpressures shall be located not less than 0,5 m above deck.

5.4.6.3 For tanker Type N closed, cargo tank openings shall be fitted with gastight closures capable of withstanding the test pressure in accordance with Rules, Part 2 – Hull and Hull Equipment, Chapter III, 5.8.

5.4.6.4 Closures which are normally used during loading or unloading operations shall not cause sparking when operated.

This item does not apply to Type N open.

5.4.7 Safety devices

Each cargo tank or group of cargo tanks connected to a common venting pipe shall be fitted with safety devices for preventing unacceptable overpressures or vacuums:

For the Type N open:
– safety devices designed to prevent any accumulation of water and its penetration into the cargo tanks;

For the Type N open with flame arresters:
– safety equipment fitted with flame arresters capable of withstanding steady burning and designed to prevent any accumulation of water and its penetration into the cargo tank;

For the Type N closed:
– safety devices for preventing unacceptable overpressure or vacuum. Where anti-explosion protection is required in column (17) of Table C of Chapter 3.2 of ADN, the vacuum valve shall be fitted with a flame arrester capable of withstanding a deflagration and the pressure relief valve with a high-velocity vent valve acting as a flame arrester capable of withstanding steady burning. Gases shall be discharged upwards. The opening pressure of the high-velocity vent valve and the opening pressure of the vacuum valve shall be permanently marked on the valves.
– a connection for the safe return ashore of gases expelled during loading;
– a device for the safe depressurization of the tanks. When the list of substances on the vessel according 1.7.2.2 contains substances for which protection against explosion is required in column (17) of Table C of Chapter 3.2 of ADN, this device shall include at least a...
5.4.8 Safety devices fitted on Type N closed – Additional arrangements

The outlets of high-velocity vent valves shall be located not less than 2,0 m above the deck and at a distance of not less than 6,0 m from the accommodation and from the service spaces outside the cargo area.

This height may be reduced when within a radius of 1,0 m round the outlet of the high-velocity vent valve, there is no equipment, no work is being carried out and signs indicate the area. The setting of the high-velocity vent valves shall be such that during the transport operation they do not blow off until the maximum permissible working pressure of the cargo tanks is reached.

5.5.1 Cargo piping system

5.5.1.1 General

The requirements 5.5.1.2, 5.5.1.4, 5.5.2.2, 5.5.2.5, 5.5.2.8 and 5.5.4 do not apply to Type N open unless the substance carried has corrosive properties. See column (5) of Table C of Chapter 3.2, hazard 8) of ADN.

5.5.1.2 Pumps and accessory loading and unloading piping shall be placed in an area between the fore vertical plane and the aft vertical plane bounding the part of the cargo area below deck.

5.5.1.3 Cargo pumps shall be capable of being shut down from the cargo area and from a position outside this area.

5.5.1.4 Cargo pumps situated on deck shall be located not less than 6,0 m from entrances to, or openings of, the accommodation and service spaces outside the cargo area.

5.5.2.1 Arrangement of cargo piping

5.5.2.1 Piping for loading and unloading shall be independent of any other piping of the vessel.

5.5.2.2 No cargo piping shall be located below deck, except those inside the cargo tanks and inside the cargo pump-room.

5.5.2.3 The piping for loading and unloading shall be arranged so that, after loading or unloading operations, the liquid remaining in these pipes may be safely removed and may flow either into the vessel’s tanks or the tanks ashore.

5.5.2.4 Piping for loading and unloading shall be clearly distinguishable from other piping, e.g. by means of colour marking.

5.5.2.5 The shore connections shall be located not less than 6,0 m from the entrances to, or openings of, the accommodation and service spaces outside the cargo area.

5.5.2.6 Each shore connection of the venting piping and shore connections of the piping for loading and unloading, through which the loading or unloading operation is carried out, shall be fitted with a shut-off device. However, each shore connection shall be fitted with a blind flange when it is not in operation.

5.5.2.7 Piping for loading and unloading, and venting piping, shall not have flexible connections fitted with sliding seals.

5.5.2.8 The distance referred to in 5.5.1.4 and 5.5.2.5 may be reduced to 3,0 m if a transverse bulkhead complying with 5.3.3.2 is situated at the end of the cargo area. The openings shall be provided with doors.
The following notice shall be displayed on the doors:

**Do not open during loading and unloading without the permission of the master.** Close immediately.

5.5.2.9 If the vessel is carrying several dangerous substances liable to react dangerously with each other, a separate pump with its own piping for loading and unloading shall be installed for each substance. The piping shall not pass through a cargo tank containing dangerous substances with which the substance in question is liable to react.

5.5.2.10 The piping for loading shall extend down to the bottom of the cargo tanks. This does not apply to **Type N open**.

5.5.3 Control, monitoring and alarm devices

5.5.3.1 The stop valves or other shut-off devices of the piping for loading and unloading shall indicate whether they are open or shut.

5.5.3.2 The piping for loading and unloading shall be fitted with pressure gauges at the outlet of the pumps. The permissible maximum overpressure or vacuum value shall be indicated on each measuring device.

5.5.4 Bonding

Every component of the piping for loading and unloading shall be electrically connected to the hull.

5.5.5 Washing or ballast water supply

5.5.5.1 When piping for loading and unloading are used for supplying the cargo tanks with washing or ballast water, the sections of these pipes shall be located within the cargo area but outside the cargo tanks.

Pumps for tank washing systems with associated connections may be located outside the cargo area, provided the discharge side of the system is arranged in such a way that the suction is not possible through that part.

A spring-loaded non-return valve shall be provided to prevent any gases from being expelled from the cargo area through the tank washing system.

5.5.5.2 A non-return valve shall be fitted at the junction between the water suction pipe and the cargo loading pipe.

5.5.6 Permissible loading and unloading flows

5.5.6.1 The permissible loading and unloading flows shall be calculated. For **Type N open** and **Type N open with flame arrester** the loading and unloading flows depend on the total cross-section of the exhaust ducts.

5.5.6.2 Calculations concern the permissible maximum loading and unloading flow for each cargo tank or each group of cargo tanks, taking into account the design of the ventilation system.

These calculations shall take into consideration the fact that in the event of an unforeseen cut-off of the vapour return piping of the shore facility, the safety devices of the cargo tanks will prevent pressure in the cargo tanks from exceeding the following values:

- over-pressure: 115% of the opening pressure of the high-velocity vent valve;
- vacuum pressure: not more than the construction vacuum pressure but not exceeding 5,0 kPa (0,05 bar).

5.6 Cargo pressure and temperature control

5.6.1 Regulation of cargo pressure and temperature

5.6.1.1 Unless the entire cargo system is designed to resist the full effective vapour pressure of the cargo at the upper limits of the ambient design temperatures, the pressure of the tanks shall be kept below the permissible maximum set pressure of the safety valves, by one or more of the following means:

- a system for the regulation of cargo tank pressure using mechanical refrigeration;
- a system ensuring safety in the event of the heating or increase in pressure of the cargo. The insulation or the design pressure of the cargo tank, or the combination of these two elements, shall be such as to leave an adequate margin for the operating period and the temperatures expected; in each case the system shall be deemed acceptable by the Register and shall ensure safety for a minimum time of three times the operation period;
- other systems deemed acceptable by the Register.

5.6.1.2 The systems prescribed in **5.6.1.1** shall be constructed, installed and tested to the satisfaction of the Register. The materials used in their construction shall be compatible with the cargoes to be carried. For normal service, the upper ambient design temperature limits shall be:

- air: +30°C
- water: +20°C.

5.6.2 Refrigeration system

5.6.2.1 The refrigeration system referred to in **5.6.1.1** shall be composed of one or more units capable of keeping the pressure and temperature of the cargo at the upper limits of the ambient design temperatures at the prescribed level. Unless another means of regulating cargo pressure and temperature deemed satisfactory by the Register is provided, provision shall be made for one or more stand-by units with an output at least equal to that of the largest prescribed unit. Provision shall be made for a stand-by heat-exchanger unless the system’s normal heat-exchanger has a surplus capacity equal to at least 25 % of the largest prescribed capacity.

Cargo tanks, piping and accessories shall be insulated so that, in the event of a failure of all cargo refrigeration systems, the entire cargo remains for at least 52 hours in a condition not causing the safety valves to open.

5.6.2.2 When several refrigerated cargoes with a potentially dangerous chemical reaction are carried simultaneously, particular care shall be given to the refrigeration systems so as to prevent any mixing of the cargoes. For the carriage of such cargoes, separate refrigeration systems, each including the full stand-by unit referred to in **5.6.2.1**, shall be provided for each cargo.
5.6.2.3 When several refrigerated cargoes are not soluble in each other under conditions of carriage such that their vapour pressures are added together in the event of mixing, particular care shall be given to the refrigeration systems to prevent any mixing of the cargoes.

5.6.2.4 All primary and secondary coolant fluids shall be compatible with each other and with the cargo with which they may come into contact.

5.6.2.5 When the refrigeration system is installed in a separate service space, this service space shall meet the requirements of 5.3.6.2.

5.6.3 Cargo tank heating

5.6.3.1 Boilers which are used for heating the cargo shall be fuelled with a liquid fuel having a flashpoint of more than 55°C. They shall be placed either in the engine room or in another separate space below deck and outside the cargo area, which is accessible from the deck or from the engine room.

5.6.3.2 The cargo heating system shall be designed so that the cargo cannot penetrate into the boiler in the case of a leak in the heating coils. A cargo heating system with artificial draught shall be ignited electrically.

5.6.3.3 The ventilation system of the engine room shall be designed taking into account the air required for the boiler.

5.6.3.4 Where the cargo heating system is used during loading, unloading or gas-freeing, the service space which contains this system shall fully comply with the requirements of 5.9.4.6.

This requirement does not apply to the inlets of the ventilation system. These inlets shall be located at a minimum distance of 2,0 m from the cargo area and 6 m from the openings of cargo tanks or residual cargo tanks, loading pumps situated on deck, openings of high velocity vent valves, pressure relief devices and shore connections of loading and unloading piping and must be located not less than 2 m above the deck.

5.6.3.5 The requirements of 5.9.4.6 are not applicable to the unloading of substances having a flashpoint of 60 °C or more when the temperature of the product is at least 15 K lower at the flash point.

5.6.4 Water spray system

5.6.4.1 When water spraying is required in column (9) of Table C of Chapter 3.2, Part 3 of ADN, a water spray system shall be installed in the cargo area on deck to enable gas emissions from loading to be precipitated and to cool the tops of cargo tanks by spraying water over the whole surface so as to avoid safely the activation of the high velocity vent valve at 10,0 kPa (0,1 bar).

5.6.4.2 The spray nozzles shall be so installed that the entire cargo deck area is covered and the gases released are precipitated safely.

5.6.4.3 The system shall be capable of being put into operation from the wheelhouse and from the deck. Its capacity shall be such that when all the spray nozzles are in operation, the outflow is not less than 50,0 l per square metre of deck area and per hour.

5.7 Tanks and receptacles for residual products and receptacles for slops

5.7.1 If vessels are provided with a tank for residual products, it shall comply with the provisions of 5.7.3 and 5.7.4. Receptacles for residual products and receptacles for slops shall be located only in the cargo area. During the filling of the receptacles for residual products, means for collecting any leakage shall be placed under the filling connections.

5.7.2 Receptacles for slops shall be fire resistant and shall be capable of being closed with lids. The receptacles for slops shall be marked and be easy to handle.

5.7.3 The maximum capacity of a tank for residual products is 30,0 m³.

5.7.4 The tank for residual products shall be equipped with:

   a) in the case of an open system:
      – a device for ensuring pressure equilibrium;
      – an ullage opening;
      – connections, with stop valves, for pipes and hose assemblies;
   b) in the case of a protected system:
      – a device for ensuring pressure equilibrium, fitted with a flame arrester capable of withstanding steady burning;
      – an ullage opening;
      – connections, with stop valves, for pipes and hose assemblies;
   c) in the case of a closed system:
      – a vacuum valve and a high-velocity vent valve.

   The high-velocity vent valve shall be so regulated that it does not open during carriage. This condition is met when the opening pressure of the valve meets the conditions required in column (10) of Table C of Chapter 3.2 of ADN, for the substance to be carried. When anti-explosion protection is required in column (17) of Table C of Chapter 3.2 of ADN, the vacuum valve shall be capable of withstanding deflagrations and the high-velocity vent valve steady burning;

   – a device for measuring the degree of filling;
   – connections, with stop valves, for pipes and hose assemblies.

5.7.5 Receptacles for residual products shall be equipped with:

   – a connection enabling gases released during filling to be evacuated safely;
   – a possibility of indicating the degree of filling;
   – connections with shut-off devices, for pipes and hose assemblies.

5.7.6 Receptacles for residual products shall be connected to the venting piping of cargo tanks only for the time necessary to fill them.

5.7.7 Receptacles for residual products and receptacles for slops placed on the deck shall be located at a minimum
distance from the hull equal to one quarter of the vessel’s breadth.

5.8 Inerting facility

5.8.1 In cases in which inerting or blanketing of the cargo is prescribed, the vessel shall be equipped with an inerting system.

5.8.2 This system shall be capable of maintaining a permanent minimum pressure of 7.0 kPa (0.07 bar) in the spaces to be inerted. In addition, the inerting system shall not increase the pressure in the cargo tank to a pressure greater than that at which the pressure valve is regulated. The set pressure of the vacuum-relief valve shall be 3.5 kPa (0.035 bar).

5.8.3 The premises to be inerted shall be equipped with connections for introducing the inert gas and monitoring systems so as to ensure the correct atmosphere on a permanent basis.

5.9 Electrical installations

5.9.1 Only distribution systems without return connection to the hull are permitted. This provision does not apply to:
- active cathodic corrosion protection;
- local installations outside the cargo area (e.g. connections of starters of diesel engines);
- device for checking the insulation level referred to in 5.9.2.

5.9.2 Every insulated distribution network shall be fitted with an automatic device with a visual and audible alarm for checking the insulation level.

5.9.3 For the selection of electrical equipment to be used in zones presenting an explosion risk, the explosion groups and temperature classes assigned to the substances carried in the list of substances shall be taken into consideration (see columns (15) and (16) of Table C of Chapter 3.2, Part 3 of ADN).

5.9.4 Type and location of electrical equipment

5.9.4.1 Only the following equipment may be installed in cargo tanks, residual cargo tanks and piping for loading and unloading (comparable to zone 0):
- measuring, regulation and alarm devices of the EEx (ia) type of protection.

5.9.4.2 Only the following equipment may be installed in the cofferdams, double hull spaces, double bottoms and hold spaces (comparable to zone 1):
- measuring, regulation and alarm devices of the certified safe type;
- lighting appliances of the “flame-proof enclosure” or “apparatus protected by pressurization” type of protection;
- hermetically sealed echo sounding devices the cables of which are led through thick-walled steel tubes with gastight connections up to the main deck;
- cables for the active cathodic protection of the shell plating in protective steel tubes such as those provided for echo sounding devices.

The following equipment may be installed only in double hull spaces and double bottom if used for ballasting:
- permanently fixed submerged pumps with temperature monitoring, of the certified safe type.

5.9.4.3 Only the following equipment may be installed in the service spaces in the cargo area below deck (comparable to zone 1):
- measuring, regulation and alarm devices of the certified safe type;
- lighting appliances of the “flame-proof enclosure” or “apparatus protected by pressurization” type of protection;
- motors driving essential equipment such as ballast pumps; they shall be of the certified safe type.

5.9.4.4 The control and protective equipment of the electrical equipment referred to in 5.9.4.1 to 5.9.4.3 above shall be located outside the cargo area if they are not intrinsically safe.

5.9.4.5 The electrical equipment in the cargo area on deck (comparable to zone 1) shall be of the certified safe type.

5.9.4.6 Electrical equipment used during loading, unloading and gas-freeing during berthing and which are located outside the cargo area (comparable to zone 2) shall be at least of the “limited explosion risk” type.

This provision does not apply to:
.1 lighting installations in the accommodation, except for switches near entrances to accommodation
.2 radiotelephone installations in the accommodation or the wheelhouse
.3 mobile and fixed telephone installations in the accommodation or the wheelhouse
.4 electrical installations in the accommodation, the wheelhouse or the service spaces, if:
- these spaces are fitted with a ventilation system ensuring an overpressure of 0.1 kPa (0.001 bar) and none of the windows is capable of being opened; the air intakes of the ventilation system located as far away as possible, however, not less than 6.0 m from the cargo area and not less than 2.0 m above the deck;
- the spaces are fitted with a gas detection system with sensors at the suction inlets of the ventilation system and directly at the top edge of the sill of the entrance doors of the accommodation and service;
- the gas concentration measurement is continuous;
- when the gas concentration reaches 20% of the lower explosive limit, the ventilators shall be switched off. In such a case and when the overpressure is not maintained or in the event of failure of the gas detection system, the electrical installations which do not comply with item .4 above, shall be switched off. These operations shall be performed immediately and automatically and activate the emergency lighting in the accommodation, the wheelhouse and the service spaces, which shall comply at least with the “limited explosion risk” type. The switching-off shall be
indicated in the accommodation and wheelhouse by visual and audible signals;
- the ventilation system, the gas detection system and the alarm of the switch-off device fully comply with the requirements of item 5.9.4.6 above;
- the automatic switch-off device is set so that no automatic switching-off may occur while the vessel is under way.

5.9.4.7 The electrical equipment which does not meet the requirements set out in 5.9.4.6 together with its switches shall be marked in red. The disconnection of such equipment shall be operated from a centralized location on board.

5.9.4.8 An electric generator which is permanently driven by an engine and which does not meet the requirements of 5.9.4.6, shall be fitted with a switch capable of shutting down the excitation of the generator. A notice board with the operating instructions shall be displayed near the switch.

5.9.4.9 Sockets for the connection of signal lights and gangway lighting shall be permanently fitted to the vessel close to the signal mast or the gangway. Connecting and disconnecting shall not be possible except when the sockets are not live.

5.9.4.10 The failure of the power supply for the safety and control equipment shall be immediately indicated by visual and audible signals at the locations where the alarms are usually actuated.

5.9.5 Earthing

5.9.5.1 The metal parts of electrical appliances in the cargo area which are not live as well as protective metal tubes or metal sheaths of cables in normal service shall be earthed, unless they are so arranged that they are automatically earthed by bonding to the metal structure of the vessel.

5.9.5.2 The provisions of 5.9.5.1 apply also to equipment having service voltages of less than 50,0 V.

5.9.5.3 Independent cargo tanks, metal intermediate bulk containers and tank-containers shall be earthed.

5.9.5.4 Receptacles for residual products shall be capable of being earthed.

5.9.6 Electric cables

5.9.6.1 All cables in the cargo area shall have a metallic sheath.

5.9.6.2 Cables and sockets in cargo area shall be protected against mechanical damage.

5.9.6.3 Movable cables are prohibited in the cargo area, except for intrinsically safe electric circuits or for the supply of signal lights and gangway lighting.

5.9.6.4 Cables of intrinsically safe circuits shall only be used for such circuits and shall be separated from other cables not intended for being used in such circuits (e.g. they shall not be installed together in the same string of cables and they shall not be fixed by the same cable clamps).

5.9.6.5 For movable cables intended for signal lights and gangway lighting, only sheathed cables of type H 07 RN-F in accordance with standard IEC 60 245-4:1994 or cables of at least equivalent design having conductors with a cross-section of not less than 1,5 mm² shall be used.

These cables shall be as short as possible and installed so that damage is not likely to occur.

5.9.6.6 The cables required for the electrical equipment referred to in 5.9.4.2 and 5.9.4.3 are accepted in cofferdams, double hull spaces, double bottoms, hold spaces and service spaces below deck.

5.9.7 Accumulators

Accumulators shall be located outside the cargo area.

5.10 Fire protection and fire-extinguishing

5.10.1 Fire and naked light

5.10.1.1 The outlets of funnels shall be located not less than 2,0 m from the hatchway openings. Arrangements shall be provided to prevent the escape of sparks and the entry of water.

5.10.1.2 Heating, cooking and refrigerating appliances shall not be fuelled with liquid fuels, liquid gas or solid fuels.

The installation in the engine room or in another separate space of heating appliances fuelled with liquid fuel having a flashpoint above 55 °C is, however, permitted.

Cooking and refrigerating appliances are permitted only in wheelhouses with metal floor and in the accommodation.

5.10.1.3 Only electrical lighting appliances are permitted.

5.10.2 Fire extinguishing systems

In addition to the requirements of the Rules, Part 3 – Machinery, Systems and Electricity, Chapter III, Section 5, the fire extinguishing arrangements in 5.10.4 and 5.10.3 shall be complied with.

5.10.3 Portable fire extinguishers

In addition to the fire extinguishing appliances prescribed in the Rules, Part 3 – Machinery, Systems and Electricity, Chapter III, 5.5.2 and 5.5.3, each vessel shall be equipped with at least two additional portable fire extinguishers having the same capacity.

These additional portable fire extinguishers shall be suitable for fighting fires involving the dangerous goods carried.

These two portable fire extinguishers shall be located in the protected area or in proximity to it.

5.10.4 Fire-extinguishing system

A fire-extinguishing system shall be installed on the vessel. This system shall comply with the following requirements:
- it shall be supplied by two independent fire or ballast pumps, one of which shall be ready for use at any time.

These pumps and their means of propulsion and electrical equipment shall not be installed in the same space;
Chapter II - TRANSPORT OF DANGEROUS GOODS

5.11.1 General

Cargo tanks shall be provided with the following equipment:

a) a mark inside the tank indicating the liquid level of 97%;

b) a level gauge;

c) a level alarm device which is activated at the latest when a degree of filling of 90% is reached;

d) a high level sensor for actuating the facility against overflowing when a degree of filling of 97.5% is reached;

e) an instrument for measuring the pressure of the vapour phase inside the cargo tank;

f) an instrument for measuring the temperature of the cargo, if in column (9) of Table C of Chapter 3.2, Part 3 of ADN a heating installation is required, or if maximum temperature is indicated in column (20) of that list;

g) a connection for a closed-type or partly closed-type sampling device, and/or at least one sample opening as required in column (13) of Table C of Chapter 3.2, Part 3 of ADN.

5.11.2 Cargo tank level indicators

Each cargo tank shall be equipped with a closed gauging device approved by the Register. The level gauge shall allow readings from the control position of the shut-off devices of the particular cargo tank. The maximum permissible maximum filling levels of 95% and 97%, as given in the list of substances, shall be marked on each level gauge.

5.11.3 Level alarm device

Cargo tank shall be provided with a level alarm device which is activated at the latest when a degree of filling of 90% is reached.

The level alarm device shall give a visual and audible warning on board when actuated. The level alarm device shall be independent of the level gauge.

5.11.4 High level sensor

Cargo tank shall be provided with a high level sensor for actuating the facility against overflowing at the latest when a degree of filling of 97.5% is reached.

The high level sensor referred to above shall give a visual and audible alarm on board and at the same time actuate an electrical contact which in the form of a binary signal interrupts the electric current loop provided and fed by the shore facility, thus initiating measures at the shore facility against overflowing during loading operations.

The signal shall be transmitted to the shore facility via a watertight two-pin plug of a connector device in accordance with standard EN 60309-2:1999 + A1:2007 + A2:2012 for direct current of 40,0 to 50,0 volts, identification colour white, position of the nose 10 h.

The plug shall be permanently fitted to the vessel close to the shore connections of the loading and unloading piping.

The high level sensor shall also be capable of switching off the vessel's own discharging pump.

The high level sensor shall be independent of the level alarm device, but it may be connected to the level gauge.

5.11.5 Cargo tank pressure monitoring – Type N closed

When the pressure or temperature exceeds a set value, instruments for measuring the vacuum or overpressure of the gaseous phase in the cargo tank or the temperature of the cargo, shall activate a visual and audible alarm in the wheelhouse. When the wheelhouse is unoccupied the alarm shall also be perceptible in a location occupied by a crew member.

When the pressure exceeds the set value during loading and unloading, the instrument for measuring the pressure shall, initiate immediately an electrical contact which shall put into effect measures to interrupt the loading or unloading operation.

If the vessel’s own discharge pump is used, it shall be switched off automatically.

The instrument for measuring the overpressure or vacuum shall activate the alarm at latest when an overpressure is reached equal to 1,15 times the opening pressure of the pressure relief device, or a vacuum pressure equal to the construction vacuum pressure but not exceeding 5.0 kPa (0.05 bar).
5.11.6 Cargo temperature monitoring

An instrument for measuring the temperature of the cargo shall be provided, if in column (9) of Table C of Chapter 3.2, Part 3 of ADN a heating installation is required or if in column (20) a possibility of heating the cargo is required or if a maximum temperature is indicated.

5.11.7 Cargo tank sampling equipment

Each cargo tank shall be equipped with a connection for a sampling device, closed or partially closed, and/or at least one sampling opening as required in column (13) of Table C of Chapter 3.2, Part 3 of ADN.

5.12 Buoyancy and stability

5.12.1 General

General requirements of the Rules, Part 2 – Hull and Hull Equipment, Chapter II, Section 11 shall be complied with.

1. Proof of sufficient stability shall be furnished. This proof is not required for single hull vessels with cargo tanks the width of which is not more than 0.7 \( B \);

2. The basic values for the stability calculation - the vessel’s lightweight and the location of the centre of gravity - shall be determined either by means of an inclining experiment or by detailed mass and moment calculation. In the latter case the lightweight shall be checked by means of a lightweight test with a tolerance limit of ± 5% between the mass determined by the calculation and the displacement determined by the draught readings;

3. Proof of sufficient intact stability shall be furnished for all stages of loading and unloading and for the final loading condition for all the relative densities of the substances transported contained in the vessel substance list according to 1.7.2.2;

4. For every loading case, taking account of the actual fillings and floating position of cargo tanks, ballast tanks and compartments, drinking water and sewage tanks and tanks containing products for the operation of the vessel, the vessel shall comply with the intact and damage stability requirements. Intermediate stages during operations shall also be taken into consideration;

5. Floatability after damage shall be proved for the most unfavourable loading condition. For this purpose calculated proof of sufficient stability shall be established for critical intermediate stages of flooding and for the final stage of flooding.

5.12.2 Intact stability

5.12.2.1 For vessels with independent cargo tanks and for double-hull constructions with cargo tanks integrated in the frames of the vessel, the requirements for intact stability resulting from the damage stability calculation shall be fully complied with.

5.12.2.2 For vessels with cargo tanks of more than 0.7 \( B \) in width, proof shall be furnished that the following stability requirements have been complied with:

a) in the positive area of the righting lever curve up to immersion of the first unprotected (non-weathertight) opening there shall be a righting lever \((GZ)\) of not less than 0.1 m;

b) the surface of the positive area of the righting lever curve up to immersion of the first unprotected (non-weathertight) opening and in any event up to an angle of heel ≤ 27° shall not be less than 0.024 m rad;

c) the metacentric height \( GM \) shall not be less than 0.1 m.

These conditions shall be met bearing in mind the influence of all free surfaces in tanks for all stages of loading and unloading.

5.12.3 Damage stability

5.12.3.1 For vessels with independent cargo tanks and for double-hull vessels with cargo tanks integrated in the construction of the vessel, the following assumptions shall be taken into consideration for the damaged condition:

a) The extent of side damage is as follows:

   - longitudinal extent: at least 0.1 \( L \), but not less than 5.0 m;
   - transverse extent: 0.59 m inboard from the vessel’s side at right angles to the centreline at the level corresponding to the maximum draught, or when applicable, \( B_{sz} - 0.01 \) m, where \( B_{sz} \) is the width of the side compartment (double side);
   - vertical extent: from the baseline upwards without limit;

b) The extent of bottom damage is as follows:

   - longitudinal extent: at least 0.1 \( L \), but not less than 5.0 m;
   - transverse extent: 3.0 m;
   - vertical extent: from the base 0.49 m upwards, the sump excepted;

c) Any bulkheads within the damaged area shall be assumed damaged, which means that the location of bulkheads shall be chosen so as to ensure that the vessel remains afloat after the flooding of two or more adjacent compartments in the longitudinal direction.

The following provisions are applicable:

- for bottom damage also two adjacent athwartship compartments shall also be assumed flooded;
- the lower edge of any non-weathertight openings (e.g. doors, windows, access hatches) shall, at the final stage of flooding, be not less than 0.1 m above the damage waterline;
- in general, permeability shall be assumed to be 95%. Where an average permeability of less than 95% is calculated for any compartment, this calculated value may be used.

However, the following minimum values shall be used:

- engine rooms: 85%;
- accommodation: 95%;
- double bottoms, fuel oil tanks, ballast tanks, etc., depending on whether, according to their function, they have to be assumed as full or empty for the vessel floating at the maximum permissible draught: 0% or 95%.

For the main engine room only the one-compartment standard needs to be taken into account, i.e. the end
bulkheads of the engine room shall be assumed as not damaged.

5.12.3.2 For critical intermediate stages of flooding, beyond the equilibrium stage, the following criteria for righting lever curve have to be fulfilled:

- Righting lever \((GZ) \geq 0.03\ m\);
- Range of positive \(GZ\): 5°.

5.12.3.3 At the stage of equilibrium (final stage of flooding), the angle of heel shall not exceed 12° (see Figure 5.12-1).

Non-watertight openings shall not be flooded before reaching the stage of equilibrium. If such openings are immersed before that stage, the corresponding spaces shall be considered as flooded for the purpose of stability calculation.

The positive range of the righting lever curve beyond the position of equilibrium shall have a righting lever of \(\geq 0.05\ m\) in association with an area under the curve of \(\geq 0.0065\ m\cdot\text{rad}\).

The minimum values of stability shall be satisfied up to immersion of the first unprotected (non-watertight) opening and in any event up to an angle of heel \(\leq 27°\). If non-watertight openings are immersed before the requirements for minimum values of stability are complied with, the corresponding spaces shall be considered as flooded for the purposes of stability calculation.

If openings through which undamaged compartments may become additionally flooded are capable of being closed watertight, the closing appliances shall be marked accordingly.

Where cross- or down-flooding openings are provided for reduction of unsymmetrical flooding, the time for equalization shall not exceed 15 minutes, provided during the intermediate stages of flooding sufficient stability has been proved.

![Figure 5.12-1](image)

**Figure 5.12-1**

5.13 Notice boards

The notice boards displaying the prohibition of admittance on board including prohibition of smoking, fire and naked light shall be clearly legible from either side of the vessel.

6 OIL SEPARATOR VESSEL

6.1 General

6.1.1 The following requirements of this Section apply to Type N open tankers with deadweight of up to 300 tonnes, built and equipped to accept and carry oily and greasy wastes from other vessels assigned with additional Character of class Oil separator vessel, as defined in the Rules, Part 1 – Classification and Surveys, Chapter I, 3.6.2.

6.1.2 Vessels considered in this Section shall comply with the applicable requirements of the Rules, Part 1 – Classification and Surveys, Part 2 – Hull and Hull Equipment and Part 3 – Machinery, Systems and Electricity, as applicable, and with the specific requirements from Section 1 and the present Rules, Chapter I, Section 3.

6.1.3 Vessels without cargo tanks are considered to be subject to Section 2.

6.2 Documentation to be submitted

In addition to the documentation required in the other applicable Parts of the Rules for the parts of the vessel not affected by the cargo, the following documentation shall be submitted, as applicable:

1. list of substances intended to be carried with their UN numbers including all design characteristics of substances and other important design conditions;
2. general arrangement plan, showing location of cargo tanks and fuel oil, ballast and other tanks, void spaces, etc.;
3. loading and unloading operation description, including cargo tank filling limits;
4. cargo area plan, location of the electrical equipment installed in these areas and list of the electrical equipment installed in cargo tank and cargo area (comparable to zone 0 and 1), including the following equipment particulars: location, type of protection, type of protection against explosion, testing body and approval number;
5. list of equipment installed in cargo area (comparable to zone 2) which may be used during loading, unloading and gas-freeing and red equipment;
6. details of hull structure in way of cargo tanks, including support arrangement for tanks, saddles, anti-floating and anti-lifting devices, deck sealing arrangements, independent cargo tanks, etc.;
7. intact and damage stability calculations;
8. scantlings, material and arrangement of the cargo containment system;
9. details of cargo handling and venting system, including arrangements and details of piping and fitting;
10. locations and details of cargo pumps including their driving machinery;
11. ventilation duct arrangement in gas-dangerous spaces and adjacent zones including schemes and calculations of ventilation system in cargo area;
12. details of the cargo tank instrumentation including gauging/sounding devices, level/overfill alarms and pressure and temperature indicating equipment;
.13 arrangement drawing of the various fire bulkheads and decks with standard fire test reports for the various arrangements, surface coverings, paints and similar;
.14 details of fire extinguishing appliances and systems in cargo area;
.15 drawings of the bilge and ballast water systems within the cargo area;
.16 details of the gas-freeing arrangements for cargo tanks including inert gas system;
.17 details of the gas detection system;
.18 schematic electrical wiring diagrams in cargo area.

NOTE: Items 1, 2 and 3 shall be submitted for information only. Others shall be submitted for approval.

6.3 Vessel arrangement

6.3.1 Hold spaces

6.3.1.1 The cargo tanks shall be separated by cofferdams of at least 0.6 m in width from the accommodation, engine rooms and service spaces outside the cargo area below deck or, if there are no such accommodation, engine rooms and service spaces, from the vessel's end. Where the cargo tanks are installed in hold space, a space of not less than 0.5 m shall be provided between such tanks and the end bulkheads of the hold space. In this case an end bulkhead meeting at least the definition for Class "A-60" (see the Rules, Part 3 – Machinery, Systems and Electricity, Chapter III, 1.2.6), shall be deemed equivalent to a cofferdam.

For pressure cargo tanks, the 0.5 m distance may be reduced to 0.2 m.

6.3.1.2 Hold spaces and cargo tanks shall be capable of being inspected.

6.3.1.3 All spaces in the cargo area shall be capable of being ventilated. Means for checking their gas-free condition shall be provided.

6.3.1.4 The bulkheads bounding the cargo tanks, cofferdams and hold spaces shall be watertight. The cargo tanks and the bulkheads bounding the cargo area shall have no openings or penetrations below deck.

The bulkhead between the engine room and the service spaces in the cargo area or between the engine room and a hold space may be fitted with penetrations provided that they conform to the provisions of 6.3.4.4.

The bulkheads between the cargo tanks may be fitted with penetrations provided that the loading or unloading piping are fitted with shut-off devices in the cargo tank from which they come. These pipes shall be fitted at least 0.60 m above the bottom.

These shut-off devices shall be operable from the deck.

6.3.1.5 Double-hull spaces and double bottoms in the cargo area shall be arranged for being filled with ballast water only. Double bottoms may, however, be used as fuel oil tanks, provided they comply with the requirements of 6.3.6.

6.3.1.6 A cofferdam, the centre part of a cofferdam or another space below deck in the cargo area may be arranged as a service space, provided the bulkheads bounding the service space extend vertically to the bottom. This service space shall only be accessible from the deck.

The service space shall be watertight with the exception of its access hatches and ventilation inlets.

6.3.1.7 Where service spaces are located in the cargo area under deck, they shall be arranged so as to be easily accessible and to permit persons wearing protective clothing and breathing apparatus to safely operate the service equipment contained therein. They shall be designed so as to allow injured or unconscious personnel to be removed from such spaces without difficulties, if necessary by means of fixed equipment.

6.3.1.8 Cofferdams, double-hull spaces, double bottoms, cargo tanks, hold spaces and other accessible spaces within the cargo area shall be arranged so that they may be completely inspected and cleaned in an appropriate manner. The dimensions of openings except for those of double-hull spaces and double bottoms which do not have a wall adjoining the cargo tanks shall be in compliance with the Rules, Part 2 – Hull and Hull Equipment, Chapter II, 4.2.

6.3.2 Arrangement of cofferdams

6.3.2.1 Cofferdams or cofferdam compartments remaining once a service space has been arranged in accordance with 6.3.1.6 shall be accessible through an access hatch.

6.3.2.2 No fixed pipe shall permit connection between a cofferdam and other piping of the vessel outside the cargo area.

6.3.3 Engine rooms

Internal combustion engines for the vessel’s propulsion as well as internal combustion engines for auxiliary machinery shall be located outside the cargo area.

Entrances and other openings of engine rooms shall be at a distance of not less than 2.0 m from the cargo area.

The engine room shall be accessible from the deck; the entrances shall not face the cargo area.

6.3.4 Accommodation and service spaces

6.3.4.1 Accommodation spaces and the wheelhouse shall be located outside the cargo area forward of the fore vertical plane or abaft the aft vertical plane bounding the part of cargo area below deck. Windows of the wheelhouse which are located not less than 1.0 m above the bottom of the wheelhouse may tilt forward.

6.3.4.2 Entrances to spaces and openings of superstructures shall not face the cargo area.

6.3.4.3 Entrances from the deck and openings of spaces facing the weather shall be capable of being closed.

6.3.4.4 a) Driving shafts of the bilge or ballast pumps may penetrate through the bulkhead between the service space and the engine room, provided the arrangement of the service space is in compliance with 6.3.1.6.
b) The penetration of the shaft through the bulkhead shall be gastight and shall have been approved by the Register.

c) Penetrations through the bulkhead between the engine room and the service space in the cargo area, and the bulkhead between the engine room and the hold spaces may be provided for electrical cables, hydraulic lines and piping for measuring, control and alarm systems, provided that the penetrations have been approved by the Register. The penetrations shall be gastight. Penetrations through a bulkhead with a “A-60” fire protection insulation (see the Rules, Part 3 – Machinery, Systems and Electricity, Chapter III, 1.2.6), shall have an equivalent fire protection.

d) Pipes may penetrate through the bulkhead between the engine room and the service space in the cargo area provided that these are pipes between the mechanical equipment in the engine room and the service space which do not have any openings within the service space and which are provided with shut-off devices at the bulkhead in the engine room.

e) Notwithstanding 6.3.1.4, pipes from the engine room may pass through the service space in the cargo area or a cofferdam or a hold space or a double-hull space to the outside provided that within the service space or cofferdam or hold space or double hull space they are of the thick-walled type and have no flanges or openings.

6.3.5 Engines

Sparking shall not be possible within the cargo area.

6.3.6 Oil fuel tanks

6.3.6.1 When the vessel is fitted with hold spaces and double bottoms, double bottoms within these spaces may be arranged as a liquid oil fuel tanks, provided their depth is not less than 0.6 m.

Oil fuel pipes and openings of such tanks are not permitted in the hold space.

6.3.6.2 The open ends of air pipes of all oil fuel tanks shall extend to not less than 0.5 m above the open deck. The open ends and the open ends of overflow pipes leading on the deck shall be fitted with a protective device consisting of a gauze diaphragm or a perforated plate.

6.3.7 Exhaust pipes

6.3.7.1 Exhaussts shall be evacuated from the vessel into the open air either upwards through an exhaust pipe or through the shell plating. The exhaust outlet shall be located not less than 2.0 m from the cargo area. The exhaust pipes of engines shall be arranged so that the exhausts are led away from the vessel. The exhaust pipes shall not be located within the cargo area.

6.3.7.2 Exhaust pipes shall be provided with a device preventing the escape of sparks, e.g. spark arresters.

6.3.8 Bilge pumping and ballasting arrangements

6.3.8.1 Bilge and ballast pumps for spaces within the cargo area shall be installed within such area.

This provision does not apply to:

- double-hull spaces and double bottoms which do not have a common boundary wall with the cargo tanks;
- cofferdams and hold spaces where ballasting is carried out using the piping of the firefighting system in the cargo area and bilge-pumping is performed using eductors.

6.3.8.2 Where the double bottom is used as a liquid oil fuel tank, it shall not be connected to the bilge piping system.

6.3.8.3 Where the ballast pump is installed in the cargo area, the standpipe and its outboard connection for suction of ballast water shall be located within the cargo area but outside the cargo tanks.

6.3.8.4 A cargo pump-room below deck shall be capable of being drained in an emergency by an installation located in the cargo area and independent from any other installation. This installation shall be provided outside the cargo pump-room.

6.3.9 Ventilation

6.3.9.1 Each hold space shall have two openings the dimensions and location of which shall be such as to permit effective ventilation of any part of the hold space.

6.3.9.2 Double-hull spaces and double bottoms within the cargo area which are not arranged for being filled with ballast water and cofferdams between engine rooms and pump-rooms, if they exist, shall be provided with ventilation systems.

6.3.9.3 Any service spaces located in the cargo area below deck shall be provided with suitable ventilation installations.

6.3.9.4 Ventilation of accommodation and service spaces shall be possible.

6.3.10 Ventilation of cargo pump rooms

6.3.10.1 Cargo pump rooms shall be provided with extraction type ventilation systems, independent of other vessel's spaces, providing at least 30 changes of air per hour based on total volume of the service space.

6.3.10.2 The following instruction shall be displayed at the entrance of the cargo pump-room:

Before entering the cargo pump-room check whether it is free from gases and contains sufficient oxygen.

Do not open doors and entrance openings without the permission of the master.

Leave immediately in the event of alarm.

6.3.10.3 Portable means shall be provided for gas-freeing of cargo tanks and other spaces not equipped with fixed ventilation.

6.4 Cargo containment

6.4.1 General

The scantlings and structural arrangements shall be in compliance with applicable requirements of the present Rules, Chapter I, Section 3.
6.4.2 Cargo area hull design

Where independent cargo tanks are used, or for double-hull construction where the cargo tanks are integrated in the vessel’s structure, the space between the wall of the vessel and wall of the cargo tanks shall not be less than 0.6 m.

The space between the bottom of the vessel and the bottom of the cargo tanks shall not be less than 0.5 m. The space may be reduced to 0.4 m under the pump sumps.

The vertical space between the suction well of a cargo tank and the bottom structures shall not be less than 0.1 m.

When a hull is constructed in the cargo area as a double hull with independent cargo tanks located in hold spaces, the above values are applicable to the double hull. If in this case the minimum values for inspections of independent tanks referred to in 6.3.1.8 are not feasible, it must be possible to remove the cargo tanks easily for inspection.

6.4.3 Cargo tank arrangements

6.4.3.1 For vessels with a length of not more than 50.0 m, the length of a cargo tank shall not exceed 10.0 m.

6.4.3.2 For vessels with a length of not more than 50.0 m, the length of a cargo tank shall not exceed 0.2 L.

6.4.3.3 Provisions in 6.4.3.1 and 6.4.3.2 do not apply to vessels with independent built-in cylindrical tanks having a length to diameter ratio ≤ 7.

6.4.3.4 The cargo tanks independent of the vessel’s hull shall be fixed so that they cannot float.

6.4.3.5 The capacity of a suction well shall be limited to not more than 0.1 m³.

6.4.4 Integrated tank scantlings

The scantlings of the integrated tank structure shall be determined in accordance with the present Rules, Chapter I, 3.3.4.

6.4.5 Independent cargo tank scantling

6.4.5.1 The scantlings of the independent tank structure shall be determined in accordance with the present Rules, Chapter I, 3.3.4.

When the vessel is provided with pressure cargo tanks, these tanks shall be designed in compliance with the Rules, Part 3 – Machinery, Systems and Electricity, Chapter I, Section 5, for a working pressure of 400.0 kPa.

6.4.5.2 The scantlings of the tank supports and fastenings shall be in compliance with the present Rules, Chapter I, 3.3.4.

6.4.6 Cargo tank openings

6.4.6.1 Cargo tank openings shall be located on deck in the cargo area.

6.4.6.2 Cargo tank openings with a cross-section of more than 0.1 m² and openings of safety devices for preventing overpressures shall be located not less than 0.5 m above deck.

6.4.7 Safety devices

Each cargo tank or group of cargo tanks connected to a common venting pipe shall be fitted with safety devices for preventing any accumulation of water and its penetration into cargo tanks.

6.5 Cargo piping system

6.5.1 General

Cargo pumps shall be capable of being shut down from the cargo area from a position outside this area.

6.5.2 Arrangement of cargo piping

6.5.2.1 Piping for loading and unloading shall be independent of any other piping of the vessel.

6.5.2.2 The piping for loading and unloading shall be arranged so that, after loading or unloading operations, the liquid remaining in these pipes may be safely removed and may flow either into the vessel’s tanks or the tanks ashore.

6.5.2.3 Piping for loading and unloading shall be clearly distinguishable from other piping, e.g. by means of colour marking.

6.5.2.4 Each shore connections shall be located not less than 6.0 m from the entrances to, or openings of, the accommodation and service spaces outside the cargo area.

6.5.2.5 Each shore connection of the venting piping and shore connections of the piping for loading and unloading, through which the loading or unloading operation is carried out, shall be fitted with a shut-off device.

6.5.2.6 Piping for loading and unloading, and venting piping, shall not have flexible connections fitted with sliding seals.

6.5.3 Control, monitoring and alarm devices

The stop valves or other shut-off devices of the piping for loading and unloading shall indicate whether they are open or shut.

6.5.4 Washing or ballast water supply

6.5.4.1 When piping for loading and unloading are used for supplying the cargo tanks with washing or ballast water, the suctions of these pipes shall be located within the cargo area but outside the cargo tanks.

Pumps for tank washing systems with associated connections may be located outside the cargo area, provided the discharge side of the system is arranged in such a way that the suction is not possible through that part.

6.5.4.2 A non-return valve shall be fitted at the junction between the water suction pipe and the cargo loading pipe.

6.6 Cargo pressure and temperature control

6.6.1 Cargo tank heating

6.6.1.1 Boilers which are used for heating the cargo shall be fuelled with a liquid fuel having a flashpoint of more than 55°C. They shall be placed either in the engine room or in another separate space below deck and outside the cargo area, which is accessible from the deck or from the engine room.
Chapter II - TRANSPORT OF DANGEROUS GOODS

6.6.1.2 The cargo heating system shall be designed so that the cargo cannot penetrate into the boiler in the case of a leak in the heating coils. A cargo heating system with artificial draught shall be ignited electrically.

6.6.1.3 The ventilation system of the engine room shall be designed taking into account the air required for the boiler.

6.7 Receptacles for residual products and receptacles for slops

Receptacles for slops shall be fire resistant and shall be capable of being closed with lids. The receptacles for slops shall be marked and be easy to handle.

6.8 Electrical installations

6.8.1 Only distribution systems without return connection to the hull are permitted. This provision does not apply to:

- active cathodic corrosion protection.
- local installations outside the cargo area (e.g. connections of starters of diesel engines)
- device for checking the insulation level referred to in 6.8.2.

6.8.2 Every insulated distribution network shall be fitted with an automatic device with a visual and audible alarm for checking the insulation level.

6.8.3 For the selection of electrical equipment to be used in zones presenting an explosion risk, the explosion groups and temperature classes assigned to the substances carried in the list of substances shall be taken into consideration (see columns (15) and (16) of Table C of Chapter 3.2, Part 3 of ADN).

6.8.4 Type and location of electrical equipment

6.8.4.1 Only the following equipment may be installed in cargo tanks, residual cargo tanks and piping for loading and unloading (comparable to zone 0):

- measuring, regulation and alarm devices of the EEx (ia) type of protection.

6.8.4.2 Only the following equipment may be installed in the cofferdams, double hull spaces, double bottoms and hold spaces (comparable to zone 1):

- measuring, regulation and alarm devices of the certified safe type;
- lighting appliances of the "flame-proof enclosure" or "apparatus protected by pressurization" type of protection;
- hermetically sealed echo sounding devices the cables of which are led through thick-walled steel tubes with gastight connections up to the main deck;
- cables for the active cathodic protection of the shell plating in protective steel tubes such as those provided for echo sounding devices.

The following equipment may be installed only in double hull spaces and double bottom if used for ballasting:

- permanently fixed submerged pumps with temperature monitoring, of the certified safe type.

6.8.4.3 Only the following equipment may be installed in the service spaces in the cargo area below deck (comparable to zone 1):

- measuring, regulation and alarm devices of the certified safe type;
- lighting appliances of the "flame-proof enclosure" or "apparatus protected by pressurization" type of protection;
- motors driving essential equipment such as ballast pumps; they shall be of the certified safe type.

6.8.4.4 The control and protective equipment of the electrical equipment referred to in 6.8.4.1 to 6.8.4.3 above shall be located outside the cargo area if they are not intrinsically safe.

6.8.4.5 The electrical equipment in the cargo area on deck (comparable to zone 1) shall be of the certified safe type.

6.8.4.6 Electrical equipment used during loading, unloading and gas-freeing during berthing and which are located outside the cargo area (comparable to zone 2) shall be at least of the "limited explosion risk" type.

This provision does not apply to:

1. lighting installations in the accommodation, except for switches near entrances to accommodation;
2. radiotelephone installations in the accommodation or the wheelhouse;
3. mobile and fixed telephone installations in the accommodation or the wheelhouse;
4. electrical installations in the accommodation, the wheelhouse or the service spaces, if:

- these spaces are fitted with a ventilation system ensuring an overpressure of 0,1 kPa (0,001 bar) and none of the windows is capable of being opened; the air intakes of the ventilation system located as far away as possible, however, not less than 6,0 m from the cargo area and not less than 2,0 m above the deck;
- the spaces are fitted with a gas detection system with sensors at the suction inlets of the ventilation system and directly at the top edge of the sill of the entrance doors of the accommodation and service;
- the gas concentration measurement is continuous;
- when the gas concentration reaches 20% of the lower explosive limit, the ventilators shall be switched off. In such a case and when the overpressure is not maintained or in the event of failure of the gas detection system, the electrical installations which do not comply with item .1 above, shall be switched off. These operations shall be performed immediately and automatically and activate the emergency lighting in the accommodation, the wheelhouse and the service spaces, which shall comply at least with the “limited explosion risk” type. The switching-off shall be indicated in the accommodation and wheelhouse by visual and audible signals;
- the ventilation system, the gas detection system and the alarm of the switch-off device fully comply with the requirements of item .1 above;
- the automatic switch-off device is set so that no automatic switching-off may occur while the vessel is under way.
6.8.4.7 The electrical equipment which does not meet the requirements set out in 6.5.4.6 together with its switches shall be marked in red. The disconnection of such equipment shall be operated from a centralized location on board.

6.8.4.8 An electric generator which is permanently driven by an engine and which does not meet the requirements of 6.8.4.6, shall be fitted with a switch capable of shutting down the excitation of the generator. A notice board with the operating instructions shall be displayed near the switch.

6.8.4.9 Sockets for the connection of signal lights and gangway lighting shall be permanently fitted to the vessel close to the signal mast or the gangway. Connecting and disconnecting shall not be possible except when the sockets are not live.

6.8.4.10 The failure of the power supply for the safety and control equipment shall be immediately indicated by visual and audible signals at the locations where the alarms are usually actuated.

6.8.5 Earthing

6.8.5.1 The metal parts of electrical appliances in the cargo area which are not live as well as protective metal tubes or metal sheaths of cables in normal service shall be earthed, unless they are so arranged that they are automatically earthed by bonding to the metal structure of the vessel.

6.8.5.2 The provisions of 6.8.5.1 apply also to equipment having service voltages of less than 50,0 V.

6.8.5.3 Independent cargo tanks, metal intermediate bulk containers and tank-containers shall be earthed.

6.8.5.4 Receptacles for residual products shall be capable of being earthed.

6.8.6 Electric cables

6.8.6.1 All cables in the cargo area shall have a metallic sheath.

6.8.6.2 Cables and sockets in cargo area shall be protected against mechanical damage.

6.8.6.3 Movable cables are prohibited in the cargo area, except for intrinsically safe electric circuits or for the supply of signal lights and gangway lighting.

6.8.6.4 Cables of intrinsically safe circuits shall only be used for such circuits and shall be separated from other cables not intended for being used in such circuits (e.g. they shall not be installed together in the same string of cables and they shall not be fixed by the same cable clamps).

6.8.6.5 For movable cables intended for signal lights and gangway lighting, only sheathed cables of type H 07 RN-F in accordance with standard IEC 60 245-4:1994 or cables of at least equivalent design having conductors with a cross-section of not less than 1,5 mm² shall be used.

These cables shall be as short as possible and installed so that damage is not likely to occur.

6.8.6.6 The cables required for the electrical equipment referred to in 6.5.4.2 and 6.8.4.3 are accepted in cofferdams, double hull spaces, double bottoms, hold spaces and service spaces below deck.

6.8.7 Accumulators

Accumulators shall be located outside the cargo area.

6.9 Fire protection and fire-extinguishing

6.9.1 Fire and naked light

6.9.1.1 The outlets of funnels shall be located not less than 2,0 m from the hatchway openings. Arrangements shall be provided to prevent the escape of sparks and the entry of water.

6.9.1.2 Heating, cooking and refrigerating appliances shall not be fuelled with liquid fuels, liquid gas or solid fuels.

The installation in the engine room or in another separate space of heating appliances fuelled with liquid fuel having a flashpoint above 55°C is, however, permitted.

Cooking and refrigerating appliances are permitted only in wheelhouses with metal floor and in the accommodation.

6.9.1.3 Only electrical lighting appliances are permitted.

6.9.2 Portable fire extinguishers

In addition to the fire extinguishing appliances prescribed in the Rules, Part 3 – Machinery, Systems and Electricity, Chapter III, 5.5.2 and 5.5.3, each vessel shall be equipped with at least two additional portable fire extinguishers having the same capacity.

These additional portable fire extinguishers shall be suitable for fighting fires involving the dangerous goods carried.

These two portable fire extinguishers shall be located in the protected area or in proximity to it.

6.10 Safety and control installations

6.10.1 General

Cargo tanks shall be provided with the following equipment:

a) a mark inside the tank indicating the liquid level of 97%;

b) a high level sensor for actuating the facility against overflowing when a degree of filling of 97,5% is reached;

c) an instrument for measuring the temperature of the cargo, if in column (9) of Table C of Chapter 3.2, Part 3 of ADN a heating installation is required, or if maximum temperature is indicated in column (20) of that list.

6.10.2 High level sensor

The high level sensor shall activate a visual and audible alarm and switch off the pump used to evacuate bilge water.

6.10.3 Cargo temperature monitoring

An instrument for measuring the temperature of the cargo shall be provided, if in column (9) of Table C of Chapter 3.2, Part 3 of ADN a heating installation is required or if in column (20) a possibility of heating the cargo is required or if a maximum temperature is indicated.
6.11 Buoyancy and stability

6.11.1 General

General requirements of the Rules, Part 2 – Hull and Hull Equipment, Chapter II, Section 11 shall be complied with.

1 proof of sufficient stability shall be furnished. This proof is not required for single hull vessels with cargo tanks the width of which is not more than 0,7·B;

2 the basic values for the stability calculation - the vessel’s lightweight and the location of the centre of gravity - shall be determined either by means of an inclining experiment or by detailed mass and moment calculation. In the latter case the lightweight shall be checked by means of a lightweight test with a tolerance limit of ± 5% between the mass determined by the calculation and the displacement determined by the draught readings;

3 proof of sufficient intact stability shall be furnished for all stages of loading and unloading and for the final loading condition for all the relative densities of the substances transported contained in the vessel substance list according 1.7.2.2;

4 for every loading case, taking account of the actual fillings and floating position of cargo tanks, ballast tanks and compartments, drinking water and sewage tanks and tanks containing products for the operation of the vessel, the vessel shall comply with the intact and damage stability requirements.

Intermediate stages during operations shall also be taken into consideration;

5 floatability after damage shall be proved for the most unfavourable loading condition. For this purpose calculated proof of sufficient stability shall be established for critical intermediate stages of flooding and for the final stage of flooding.

6.11.2 Intact stability

6.11.2.1 For vessels with independent cargo tanks and for double-hull constructions with cargo tanks integrated in the frames of the vessel, the requirements for intact stability resulting from the damage stability calculation shall be fully complied with.

6.11.2.2 For vessels with cargo tanks of more than 0,7·B in width, proof shall be furnished that the following stability requirements have been complied with:

a) in the positive area of the righting lever curve up to immersion of the first unprotected (non-weathertight) opening there shall be a righting lever (GZ) of not less than 0,1 m;

b) the surface of the positive area of the righting lever curve up to immersion of the first unprotected (non-weathertight) opening and in any event up to an angle of heel ≤ 27° shall not be less than 0,024 m rad;

c) the metacentric height GM shall not be less than 0,1 m.

These conditions shall be met bearing in mind the influence of all free surfaces in tanks for all stages of loading and unloading.

6.11.3 Damage stability

6.11.3.1 For vessels with independent cargo tanks and for double-hull vessels with cargo tanks integrated in the construction of the vessel, the following assumptions shall be taken into consideration for the damaged condition:

a) the extent of side damage is as follows:

- longitudinal extent: at least 0,1·L, but not less than 5,0 m;
- transverse extent: 0,59 m inboard from the vessel’s side at right angles to the centreline at the level corresponding to the maximum draught, or when applicable, B_{ST} -0,01 m, where B_{ST} is the width of the side compartment (double side);
- vertical extent: from the baseline upwards without limit;

b) the extent of bottom damage is as follows:

- longitudinal extent: at least 0,1·L, but not less than 5,0 m;
- transverse extent: 3,0 m;
- vertical extent: from the base 0,49 m upwards, the sump excepted;

c) any bulkheads within the damaged area shall be assumed damaged, which means that the location of bulkheads shall be chosen so as to ensure that the vessel remains afloat after the flooding of two or more adjacent compartments in the longitudinal direction.

The following provisions are applicable:

- for bottom damage also two adjacent athwartship compartments shall also be assumed flooded;
- the lower edge of any non-watertight openings (e.g. doors, windows, access hatchways) shall, at the final stage of flooding, be not less than 0,1 m above the damage waterline;
- in general, permeability shall be assumed to be 95%. Where an average permeability of less than 95% is calculated for any compartment, this calculated value may be used.

However, the following minimum values shall be used:

- engine rooms: 85%;
- accommodation: 95%;
- double bottoms, fuel oil tanks, ballast tanks, etc., depending on whether, according to their function, they have to be assumed as full or empty for the vessel floating at the maximum permissible draught: 0% or 95%.

For the main engine room only the one-compartment standard needs to be taken into account, i.e. the end bulkheads of the engine room shall be assumed as not damaged.

6.11.3.2 For critical intermediate stage of flooding, beyond the equilibrium stage, the following criteria have to be fulfilled:

Righting lever (GZ) ≥ 0,03 m;
Range of positive GZ: 5°.

6.11.3.3 At the stage of equilibrium (final stage of flooding), the angle of heel shall not exceed 12° (see Figure 6.11-1).
Non-watertight openings shall not be flooded before reaching the stage of equilibrium. If such openings are immersed before that stage, the corresponding spaces shall be considered as flooded for the purpose of stability calculation.

The positive range of the righting lever curve beyond the position of equilibrium shall have a righting lever of $\geq 0.0065 \text{ m} \cdot \text{rad}$. The minimum values of stability shall be satisfied up to immersion of the first unprotected (non-watertight) opening and in any event up to an angle of heel $\leq 27^\circ$. If non-watertight openings are immersed before the requirements for minimum values of stability are complied with, the corresponding spaces shall be considered as flooded for the purposes of stability calculation.

If openings through which undamaged compartments may become additionally flooded are capable of being closed watertight, the closing appliances shall be marked accordingly.

Where cross- or down-flooding openings are provided for reduction of unsymmetrical flooding, the time for equalization shall not exceed 15 minutes, provided during the intermediate stages of flooding sufficient stability has been proved.

![Diagram](Figure 6.11-1)

6.12 Notice boards

The notice boards displaying the prohibition of admittance on board including prohibition of smoking, fire and naked light shall be clearly legible from either side of the vessel.

7 SUPPLY VESSEL

7.1 General

7.1.1 The following requirements of this Section apply to Type N open tankers with a deadweight of up to 300 tonnes, built and equipped to carry and delivery to other vessels of products intended for the operation of vessels assigned with additional Character of class Supply vessel, as defined in the Rules, Part 1 – Classification and Surveys, Chapter I, 3.6.2.

7.1.2 Vessels considered in this Section shall comply with the applicable requirements of the Rules, Part 1 – Classification and Surveys, Part 2 – Hull and Hull Equipment and Part 3 – Machinery, Systems and Electricity, as applicable, and with the specific requirements from Section 1 and the present Rules, Chapter I, Section 3.

7.2 Documentation to be submitted

In addition to the documentation required in the other applicable Parts of the Rules for the parts of the vessel not affected by the cargo, the following documentation shall be submitted, as applicable:

1. list of substances intended to be carried with their UN numbers including all design characteristics of substances and other important design conditions;
2. general arrangement plan, showing location of cargo tanks and fuel oil, ballast and other tanks, void spaces, etc.;
3. loading and unloading operation description, including cargo tank filling limits;
4. cargo area plan, location of the electrical equipment installed in these areas and list of the electrical equipment installed in cargo tank and cargo area (comparable to zone 0 and 1), including the following equipment particulars: location, type of protection, type of protection against explosion, testing body and approval number;
5. list of equipment installed in cargo area (comparable to zone 2) which may be used during loading, unloading and gas-freeing and red equipment;
6. details of hull structure in way of cargo tanks, including support arrangement for tanks, saddles, anti-floating and anti-lifting devices, deck sealing arrangements, independent cargo tanks, etc.;
7. intact and damage stability calculations;
8. scantlings, material and arrangement of the cargo containment system;
9. details of cargo handling and venting system, including arrangements and details of piping and fitting;
10. locations and details of cargo pumps including their driving machinery;
11. Ventilation duct arrangement in gas-dangerous spaces and adjacent zones including schemes and calculations of ventilation system in cargo area;
12. details of the cargo tank instrumentation including gauging/sounding devices, level/overfill alarms and pressure and temperature indicating equipment;
13. pressure drop calculation of the vent system based on the maximum loading/unloading rates;
Chapter II - TRANSPORT OF DANGEROUS GOODS

7.3 Vessel arrangement

7.3.1 Hold spaces

7.3.1.1 The cargo tanks shall be separated by cofferdams of at least 0,6 m in width from the accommodation, engine rooms and service spaces outside the cargo area below deck or, if there are no such accommodation, engine rooms and service spaces, from the vessel’s end. Where the cargo tanks are installed in hold space, a space of not less than 0,5 m shall be provided between such tanks and the end bulkheads of the hold space. In this case an end bulkhead meeting at least the definition for Class “A-60” (see the Rules, Part 3 – Machinery, Systems and Electricity, Chapter III, 1.2.6), shall be deemed equivalent to a cofferdam.

For pressure cargo tanks, the 0,5 m distance may be reduced to 0,2 m.

7.3.1.2 Hold spaces and cargo tanks shall be capable of being inspected.

7.3.1.3 All spaces in the cargo area shall be capable of being ventilated. Means for checking their gas-free condition shall be provided.

7.3.1.4 The bulkheads bounding the cargo tanks, cofferdams and hold spaces shall be watertight. The cargo tanks and the bulkheads bounding the cargo area shall have no openings or penetrations below deck.

The bulkhead between the engine room and the service spaces in the cargo area or between the engine room and a hold space may be fitted with penetrations provided that they conform to the provisions of 7.3.4.4.

The bulkheads between the cargo tanks may be fitted with penetrations provided that the loading or unloading piping are fitted with shut-off devices in the cargo tank from which they come. These pipes shall be fitted at least 0,60 m above the bottom.

These shut-off devices shall be operable from the deck.

7.3.1.5 Double-hull spaces and double bottoms in the cargo area shall be arranged for being filled with ballast water only. Double bottoms may, however, be used as fuel oil tanks, provided they comply with the requirements of 7.3.6.

7.3.1.6 A cofferdam, the centre part of a cofferdam or another space below deck in the cargo area may be arranged as a service space, provided the bulkheads bounding the service space extend vertically to the bottom. This service space shall only be accessible from the deck.

The service space shall be watertight with the exception of its access hatches and ventilation inlets.

7.3.1.7 Where service spaces are located in the cargo area under deck, they shall be arranged so as to be easily accessible and to permit persons wearing protective clothing and breathing apparatus to safely operate the service equipment contained therein. They shall be designed so as to allow injured or unconscious personnel to be removed from such spaces without difficulties, if necessary by means of fixed equipment.

7.3.1.8 Cofferdams, double-hull spaces, double bottoms, cargo tanks, hold spaces and other accessible spaces within the cargo area shall be arranged so that they may be completely inspected and cleaned in an appropriate manner. The dimensions of openings except for those of double-hull spaces and double bottoms which do not have a wall adjoining the cargo tanks shall be in compliance the Rules, Part 2 – Hull and Hull Equipment, Chapter II, 4.2.

7.3.2 Arrangement of cofferdams

7.3.2.1 Cofferdams or cofferdam compartments remaining once a service space has been arranged in accordance with 7.3.1.6 shall be accessible through an access hatch.

7.3.2.2 No fixed pipe shall permit connection between a cofferdam and other piping of the vessel outside the cargo area.

7.3.3 Engine rooms

Internal combustion engines for the vessel’s propulsion as well as internal combustion engines for auxiliary machinery shall be located outside the cargo area.

Entrances and other openings of engine rooms shall be at a distance of not less than 2,0 m from the cargo area.

The engine room shall be accessible from the deck; the entrances shall not face the cargo area.

7.3.4 Accommodation and service spaces

7.3.4.1 Accommodation spaces and the wheelhouse shall be located outside the cargo area forward of the fore vertical plane or abaft the aft vertical plane bounding the part of cargo area below deck. Windows of the wheelhouse which are located not less than 1,0 m above the bottom of the wheelhouse may tilt forward.

7.3.4.2 Entrances to spaces and openings of superstructures shall not face the cargo area.

7.3.4.3 Entrances from the deck and openings of spaces facing the weather shall be capable of being closed.

7.3.4.4 a) Driving shafts of the bilge or ballast pumps may penetrate through the bulkhead between the service space and the engine room, provided the arrangement of the service space is in compliance with 7.3.1.6.
b) the penetration of the shaft through the bulkhead shall be gastight and shall have been approved by the Register;

c) penetrations through the bulkhead between the engine room and the service space in the cargo area, and the bulkhead between the engine room and the hold spaces may be provided for electrical cables, hydraulic lines and piping for measuring, control and alarm systems, provided that the penetrations have been approved by the Register. The penetrations shall be gastight. Penetrations through a bulkhead with a “A-60” fire protection insulation (see the Rules, Part 3 – Machinery, Systems and Electricity, Chapter III, 1.2.6), shall have an equivalent fire protection;

d) pipes may penetrate through the bulkhead between the engine room and the service space in the cargo area provided that these are pipes between the mechanical equipment in the engine room and the service room which do not have any openings within the service space and which are provided with shut-off devices at the bulkhead in the engine room;

e) notwithstanding 7.3.1.4, pipes from the engine room may pass through the service space in the cargo area or a cofferdam or a hold space or a double-hull space to the outside provided that within the service space or cofferdam or hold space or double hull space they are of the thick-walled type and have no flanges or openings.

7.3.5 Engines

Sparking shall not be possible within the cargo area.

7.3.6 Oil fuel tanks

7.3.6.1 When the vessel is fitted with hold spaces and double bottoms, double bottoms within these spaces may be arranged as a liquid oil fuel tanks, provided their depth is not less than 0,6 m.

Oil fuel pipes and openings of such tanks are not permitted in the hold space.

7.3.6.2 The open ends of air pipes of all oil fuel tanks shall extend to not less than 0,5 m above the open deck. The open ends and the open ends of overflow pipes leading on the deck shall be fitted with a protective device consisting of a gauze diaphragm or a perforated plate.

7.3.7 Exhaust pipes

7.3.7.1 Exhausts shall be evacuated from the vessel into the open air either upwards through an exhaust pipe or through the shell plating. The exhaust outlet shall be located not less than 2,0 m from the cargo area. The exhaust pipes of engines shall be arranged so that the exhausts are led away from the vessel. The exhaust pipes shall not be located within the cargo area.

7.3.7.2 Exhaust pipes shall be provided with a device preventing the escape of sparks, e.g. spark arresters.

7.3.8 Bilge pumping and ballasting arrangements

7.3.8.1 Bilge and ballast pumps for spaces within the cargo area shall be installed within such area.

This provision does not apply to:

- double-hull spaces and double bottoms which do not have a common boundary wall with the cargo tanks;
- cofferdams and hold spaces where ballasting is carried out using the piping of the firefighting system in the cargo area and bilge-pumping is performed using eductors.

7.3.8.2 Where the double bottom is used as a liquid oil fuel tank, it shall not be connected to the bilge piping system.

7.3.8.3 Where the ballast pump is installed in the cargo area, the standpipe and its outboard connection for suction of ballast water shall be located within the cargo area but outside the cargo tanks.

7.3.8.4 A cargo pump-room below deck shall be capable of being drained in an emergency by an installation located in the cargo area and independent from any other installation. This installation shall be provided outside the cargo pump-room.

7.3.9 Ventilation

7.3.9.1 Each hold space shall have two openings the dimensions and location of which shall be such as to permit effective ventilation of any part of the hold space.

7.3.9.2 Double-hull spaces and double bottoms within the cargo area which are not arranged for being filled with ballast water and cofferdams between engine rooms and pump-rooms, if they exist, shall be provided with ventilation systems.

7.3.9.3 Any service spaces located in the cargo area below deck shall be provided with suitable ventilation installations.

7.3.9.4 Ventilation of accommodation and service spaces shall be possible.

7.3.10 Ventilation of cargo pump rooms

7.3.10.1 Cargo pump rooms shall be provided with extraction type ventilation systems, independent of other vessel's spaces, providing at least 30 changes of air per hour based on total volume of the service space.

7.3.10.2 The following instruction shall be displayed at the entrance of the cargo pump-room:

Before entering the cargo pump-room check whether it is free from gases and contains sufficient oxygen.

Do not open doors and entrance openings without the permission of the master.

Leave immediately in the event of alarm.

7.3.10.3 Portable means shall be provided for gas-freeing of cargo tanks and other spaces not equipped with fixed ventilation.

7.4 Cargo containment

7.4.1 General

The scantlings and structural arrangements shall be in compliance with applicable requirements of the present Rules, Chapter I, Section 3.
Chapter II - TRANSPORT OF DANGEROUS GOODS

7.4.2 Cargo area hull design

Where independent cargo tanks are used, or for double-hull construction where the cargo tanks are integrated in the vessel’s structure, the space between the wall of the vessel and wall of the cargo tanks shall not be less than 0.6 m.

The space between the bottom of the vessel and the bottom of the cargo tanks shall not be less than 0.5 m. The space may be reduced to 0.4 m under the pump sumps.

The vertical space between the suction well of a cargo tank and the bottom structures shall not be less than 0.1 m.

When a hull is constructed in the cargo area as a double hull with independent cargo tanks located in hold spaces, the above values are applicable to the double hull. If in this case the minimum values for inspections of independent tanks referred to in 7.3.1.8 are not feasible, it must be possible to remove the cargo tanks easily for inspection.

7.4.3 Cargo tank arrangements

7.4.3.1 For vessels with a length of not more than 50.0 m, the length of a cargo tank shall not exceed 10,0 m.

7.4.3.2 For vessels with a length of more than 50.0 m, the length of a cargo tank shall not exceed 0,2 ∙ L.

7.4.3.3 Provisions in 7.4.3.1 and 7.4.3.2 do not apply to vessels with independent built-in cylindrical tanks having a length to diameter ratio ≤ 7.

7.4.3.4 The cargo tanks independent of the vessel’s hull shall be fixed so that they cannot float.

7.4.3.5 The capacity of a suction well shall be limited to not more than 0,1 m³.

7.4.4 Integrated tank scantlings

The scantlings of the integrated tank structure shall be determined in accordance with the present Rules, Chapter 1, 3.3.3.

7.4.5 Independent cargo tank scantling

7.4.5.1 The scantlings of the independent tank structure shall be determined in accordance with the present Rules, Chapter 1, 3.3.4.

When the vessel is provided with pressure cargo tanks, these tanks shall be designed in compliance with the Rules, Part 3 – Machinery, Systems and Electricity, Chapter 1, Section 5, for a working pressure of 400.0 kPa.

7.4.5.2 The scantlings of the tank supports and fastenings shall be in compliance with the present Rules, Chapter 1, 3.3.4.

7.4.6 Cargo tank openings

7.4.6.1 Cargo tank openings shall be located on deck in the cargo area.

7.4.6.2 Cargo tank openings with a cross-section of more than 0,1 m² and openings of safety devices for preventing overpressures shall be located not less than 0,50 m above deck.

7.4.7 Safety devices

Each cargo tank or group of cargo tanks connected to a common venting pipe shall be fitted with safety devices for preventing any accumulation of water and its penetration into cargo tanks.

7.5 Cargo piping system

7.5.1 General

Cargo pumps shall be capable of being shut down from the cargo area from a position outside this area.

7.5.2 Arrangement of cargo piping

7.5.2.1 Piping for loading and unloading shall be independent of any other piping of the vessel.

7.5.2.2 The piping for loading and unloading shall be arranged so that, after loading or unloading operations, the liquid remaining in these pipes may be safely removed and may flow either into the vessel’s tanks or the tanks ashore.

7.5.2.3 Piping for loading and unloading shall be clearly distinguishable from other piping, e.g. by means of colour marking.

7.5.2.4 Each shore connections shall be located not less than 6,0 m from the entrances to, or openings of, the accommodation and service spaces outside the cargo area.

7.5.2.5 Each shore connection of the venting piping and shore connections of the piping for loading and unloading, through which the loading or unloading operation is carried out, shall be fitted with a shut-off device.

7.5.3 Control, monitoring and alarm devices

The stop valves or other shut-off devices of the piping for loading and unloading shall indicate whether they are open or shut.

7.5.4 Washing or ballast water supply

7.5.4.1 When piping for loading and unloading are used for supplying the cargo tanks with washing or ballast water, the suctions of these pipes shall be located within the cargo area but outside the cargo tanks.

Pumps for tank washing systems with associated connections may be located outside the cargo area, provided the discharge side of the system is arranged in such a way that the suction is not possible through that part.

7.5.4.2 A non-return valve shall be fitted at the junction between the water suction pipe and the cargo loading pipe.

7.5.5 Permissible loading and unloading flows

7.5.5.1 The permissible loading and unloading flows shall be calculated. For Type N open and Type N open with flame arrester the loading and unloading flows depend on the total cross-section of the exhaust ducts.

7.5.5.2 Calculations concern the permissible maximum loading and unloading flow for each cargo tank or each group of cargo tanks, taking into account the design of the ventilation system.

These calculations shall take into consideration the fact that in the event of an unforeseen cut-off of the vapour.
return piping of the shore facility, the safety devices of the cargo tanks will prevent pressure in the cargo tanks from exceeding the following values:

- over-pressure: 115% of the opening pressure of the high-velocity vent valve;
- vacuum pressure: not more than the construction vacuum pressure but not exceeding 5,0 kPa (0,05 bar).

7.6 Cargo pressure and temperature control

7.6.1 Cargo tank heating

7.6.1.1 Boilers which are used for heating the cargo shall be fuelled with a liquid fuel having a flashpoint of more than 55°C. They shall be placed either in the engine room or in another separate space below deck and outside the cargo area, which is accessible from the deck or from the engine room.

7.6.1.2 The cargo heating system shall be designed so that the cargo cannot penetrate into the boiler in the case of a leak in the heating coils. A cargo heating system with artificial draught shall be ignited electrically.

7.6.1.3 The ventilation system of the engine room shall be designed taking into account the air required for the boiler.

7.7 Receptacles for residual products and receptacles for slops

7.7.1 If vessels are provided with a tank for residual products, it shall comply with the provisions of 7.7.3 and 7.7.4. Receptacles for residual products and receptacles for slops shall be located only in the cargo area. During the filling of the receptacles for residual products, means for collecting any leakage shall be placed under the filling connections.

7.7.2 Receptacles for slops shall be fire resistant and shall be capable of being closed with lids. The receptacles for slops shall be marked and be easy to handle.

7.7.3 The maximum capacity of a tank for residual products is 30,0 m³.

7.7.4 The tank for residual products shall be equipped with:

- a device for ensuring pressure equilibrium;
- an ullage opening;
- connections, with stop valves, for pipes and hose assemblies.

7.7.5 Receptacles for residual products shall be equipped with:

- a connection enabling gases released during filling to be evacuated safely;
- a possibility of indicating the degree of filling;
- connections with shut-off devices, for pipes and hose assemblies.

7.7.6 Receptacles for residual products and receptacles for slops placed on the deck shall be located at a minimum distance from the hull equal to one quarter of the vessel’s breadth.

7.8 Electrical installations

7.8.1 Only distribution systems without return connection to the hull are permitted. This provision does not apply to:

- active cathodic corrosion protection;
- local installations outside the cargo area (e.g. connections of starters of diesel engines);
- device for checking the insulation level referred to in 7.8.2.

7.8.2 Every insulated distribution network shall be fitted with an automatic device with a visual and audible alarm for checking the insulation level.

7.8.3 For the selection of electrical equipment to be used in zones presenting an explosion risk, the explosion groups and temperature classes assigned to the substances carried in the list of substances shall be taken into consideration (see columns (15) and (16) of Table C of Chapter 3.2, Part 3 of ADN).

7.8.4 Type and location of electrical equipment

7.8.4.1 Only the following equipment may be installed in cargo tanks, residual cargo tanks and piping for loading and unloading (comparable to zone 0):

- measuring, regulation and alarm devices of the EE (ia) type of protection.

7.8.4.2 Only the following equipment may be installed in the cofferdams, double hull spaces, double bottoms and hold spaces (comparable to zone 1):

- measuring, regulation and alarm devices of the certified safe type;
- lighting appliances of the “flame-proof enclosure” or “apparatus protected by pressurization” type of protection;
- hermetically sealed echo sounding devices the cables of which are led through thick-walled steel tubes with gastight connections up to the main deck;
- cables for the active cathodic protection of the shell plating in protective steel tubes such as those provided for echo sounding devices.

7.8.4.3 Only the following equipment may be installed in the service spaces in the cargo area below deck (comparable to zone 1):

- measuring, regulation and alarm devices of the certified safe type;
- lighting appliances of the “flame-proof enclosure” or “apparatus protected by pressurization” type of protection;
- motors driving essential equipment such as ballast pumps; they shall be of the certified safe type.

7.8.4.4 The control and protective equipment of the electrical equipment referred to in 7.8.4.1 to 7.8.4.3 above shall be located outside the cargo area if they are not intrinsically safe.

7.8.4.5 The electrical equipment in the cargo area on deck (comparable to zone 1) shall be of the certified safe type.
Chapter II - TRANSPORT OF DANGEROUS GOODS

7.8.4.6 Electrical equipment used during loading, unloading and gas-freeing during berthing and which are located outside the cargo area (comparable to zone 2) shall be at least of the “limited explosion risk” type.

This provision does not apply to:

.1 lighting installations in the accommodation, except for switches near entrances to accommodation;
.2 radiotelephone installations in the accommodation or the wheelhouse;
.3 mobile and fixed telephone installations in the accommodation or the wheelhouse;
.4 electrical installations in the accommodation, the wheelhouse or the service spaces, if:
  – these spaces are fitted with a ventilation system ensuring an overpressure of 0,1 kPa (0,001 bar) and none of the windows is capable of being opened; the air intakes of the ventilation system located as far away as possible, however, not less than 6,0 m from the cargo area and not less than 2,0 m above the deck;
  – the spaces are fitted with a gas detection system with sensors at the suction inlets of the ventilation system and directly at the top edge of the sill of the entrance doors of the accommodation and service;
  – the gas concentration measurement is continuous when the gas concentration reaches 20% of the lower explosive limit, the ventilators shall be switched off. In such a case and when the overpressure is not maintained or in the event of failure of the gas detection system, the electrical installations which do not comply with item .1 above, shall be switched off. These operations shall be performed immediately and automatically and activate the emergency lighting in the accommodation, the wheelhouse and the service spaces, which shall comply at least with the “limited explosion risk” type. The switching-off shall be indicated in the accommodation and wheelhouse by visual and audible signals;
  – the ventilation system, the gas detection system and the alarm of the switch-off device fully comply with the requirements of item .1 above;
  – the automatic switch-off device is set so that no automatic switching-off may occur while the vessel is under way.

7.8.4.7 The electrical equipment which does not meet the requirements set out in 7.8.4.6 together with its switches shall be marked in red. The disconnection of such equipment shall be operated from a centralized location on board.

7.8.4.8 An electric generator which is permanently driven by an engine and which does not meet the requirements of 7.8.4.6, shall be fitted with a switch capable of shutting down the excitation of the generator. A notice board with the operating instructions shall be displayed near the switch.

7.8.4.9 Sockets for the connection of signal lights and gangway lighting shall be permanently fitted to the vessel close to the signal mast or the gangway. Connecting and disconnecting shall not be possible except when the sockets are not live.

7.8.4.10 The failure of the power supply for the safety and control equipment shall be immediately indicated by visual and audible signals at the locations where the alarms are usually actuated.

7.8.5 Earthing

7.8.5.1 The metal parts of electrical appliances in the cargo area which are not live as well as protective metal tubes or metal sheaths of cables in normal service shall be earthed, unless they are so arranged that they are automatically earthed by bonding to the metal structure of the vessel.

7.8.5.2 The provisions of 7.8.5.1 apply also to equipment having service voltages of less than 50,0 V.

7.8.5.3 Independent cargo tanks, metal intermediate bulk containers and tank-containers shall be earthed.

7.8.5.4 Receptacles for residual products shall be capable of being earthed.

7.8.6 Electric cables

7.8.6.1 All cables in the cargo area shall have a metallic sheath.

7.8.6.2 Cables and sockets in cargo area shall be protected against mechanical damage.

7.8.6.3 Movable cables are prohibited in the cargo area, except for intrinsically safe electric circuits or for the supply of signal lights and gangway lighting.

7.8.6.4 Cables of intrinsically safe circuits shall be used for such circuits and shall be separated from other cables not intended for being used in such circuits (e.g. they shall not be installed together in the same string of cables and they shall not be fixed by the same cable clamps).

7.8.6.5 For movable cables intended for signal lights and gangway lighting, only sheathed cables of type H 07 RN-F in accordance with standard IEC 60 245-4:1994 or cables of at least equivalent design having conductors with a cross-section of not less than 1,5 mm² shall be used. These cables shall be as short as possible and installed so that damage is not likely to occur.

7.8.7 Accumulators

Accumulators shall be located outside the cargo area.

7.9 Fire protection and fire-extinguishing

7.9.1 Fire and naked light

7.9.1.1 The outlets of funnels shall be located not less than 2,0 m from the hatchway openings. Arrangements shall be provided to prevent the escape of sparks and the entry of water.

7.9.1.2 Heating, cooking and refrigerating appliances shall not be fuelled with liquid fuels, liquid gas or solid fuels.

The installation in the engine room or in another separate space of heating appliances fuelled with liquid fuel having a flashpoint above 55°C is, however, permitted.

Cooking and refrigerating appliances are permitted only in wheelhouses with metal floor and in the accommodation.
7.9.1.3 Only electrical lighting appliances are permitted.

7.9.2 Portable fire extinguishers

In addition to the fire extinguishing appliances prescribed in the Rules, Part 3 – Machinery, Systems and Electricity, Chapter III, 5.5.2 and 5.5.3, each vessel shall be equipped with at least two additional portable fire extinguishers having the same capacity.

These additional portable fire extinguishers shall be suitable for fighting fires involving the dangerous goods carried.

These two portable fire extinguishers shall be located in the protected area or in proximity to it.

7.10 Safety and control installations

7.10.1 General

7.10.1.1 Cargo tanks shall be provided with the following equipment:

a) a mark inside the tank indicating the liquid level of 97%;
b) a high level sensor for actuating the facility against overflowing when a degree of filling of 97,5% is reached.

7.10.1.2 In addition to above supply vessels and other vessels which may be delivering products required for operation shall be equipped with a transhipment facility compatible with European standard EN 12 827:1996 and a rapid closing device enabling refuelling to be interrupted. It shall be possible to actuate this rapid closing device by means of an electrical signal from the overflow prevention system.

The electrical circuits actuating the rapid closing device shall be secured according to the quiescent current principle or other appropriate error detection measures. The state of operation of electrical circuits which cannot be controlled using the quiescent current principle shall be capable of being easily checked.

It shall be possible to actuate the rapid closing device independently of the electrical signal.

The rapid closing device shall actuate a visual and an audible alarm on board.

7.10.2 High level sensor

Cargo tank shall be provided with a high level sensor for actuating the facility against overflowing at the latest when a degree of filling of 97,5% is reached.

The high level sensor shall activate a visual and audible alarm and switch off the pump used to evacuate bilge water.

The high level sensor referred to above shall give a visual and audible alarm on board and at the same time actuate an electrical contact which in the form of a binary signal interrupts the electric current loop provided and fed by the shore facility, thus initiating measures at the shore facility against overflowing during loading operations. The signal shall be transmitted to the shore facility via a watertight two-pin plug of a connector device in accordance with standard EN 60309-2:1999 + A1:2007 + A2:2012 for direct current of 40,0 to 50,0 volts, identification colour white, position of the nose 10 h.

7.11 Buoyancy and stability

7.11.1 General

General requirements of the Rules, Part 2 – Hull and Hull Equipment, Chapter II, Section 11 shall be complied with.

1. proof of sufficient stability shall be furnished. This proof is not required for single hull vessels with cargo tanks the width of which is not more than 0,70 B;

2. the basic values for the stability calculation - the vessel’s lightweight and the location of the centre of gravity - shall be determined either by means of an inclining experiment or by detailed mass and moment calculation. In the latter case the lightweight shall be checked by means of a lightweight test with a tolerance limit of ± 5% between the mass determined by the calculation and the displacement determined by the draught readings;

3. proof of sufficient intact stability shall be furnished for all stages of loading and unloading and for the final loading condition for all the relative densities of the substances transported contained in the vessel substance list according to 1.7.2.2;

4. for every loading case, taking account of the actual fillings and floating position of cargo tanks, ballast tanks and compartments, drinking water and sewage tanks and tanks containing products for the operation of the vessel, the vessel shall comply with the intact and damage stability requirements.

Intermediate stages during operations shall also be taken into consideration;

5. floatability after damage shall be proved for the most unfavourable loading condition. For this purpose calculated proof of sufficient stability shall be established for critical intermediate stages of flooding and for the final stage of flooding.

7.11.2 Intact stability

7.11.2.1 For vessels with independent cargo tanks and for double-hull constructions with cargo tanks integrated in the frames of the vessel, the requirements for intact stability resulting from the damage stability calculation shall be fully complied with.

7.11.2.2 For vessels with cargo tanks of more than 0,70 B in width, proof shall be furnished that the following stability requirements have been complied with:

a) In the positive area of the righting lever curve up to immersion of the first unprotected (non-weathertight) opening there shall be a righting lever (GZ) of not less than 0,1 m

b) The surface of the positive area of the righting lever curve up to immersion of the first unprotected (non-
Chapter II - TRANSPORT OF DANGEROUS GOODS

weathertight) opening and in any event up to an angle of heel ≤ 27° shall not be less than 0.024 rad.

c) The metacentric height \( GM \) shall not be less than 0.10 m.

These conditions shall be met bearing in mind the influence of all free surfaces in tanks for all stages of loading and unloading.

7.11.3 Damage stability

7.11.3.1 For vessels with independent cargo tanks and for double-hull vessels with cargo tanks integrated in the construction of the vessel, the following assumptions shall be taken into consideration for the damaged condition:

a) the extent of side damage is as follows:
   - longitudinal extent: at least 0,1 \( L \), but not less than 5,0 m;
   - transverse extent: 0.59 m inboard from the vessel’s side at right angles to the centreline at the level corresponding to the maximum draught, or when applicable, \( B_{TT} - 0.01 \) m, where \( B_{TT} \) is the width of the side compartment (double side);
   - vertical extent: from the baseline upwards without limit;

b) the extent of bottom damage is as follows:
   - longitudinal extent: at least 0,1 \( L \), but not less than 5,0 m;
   - transverse extent: 3,0 m;
   - vertical extent: from the base 0.49 m upwards, the sump excepted;

c) any bulkheads within the damaged area shall be assumed damaged, which means that the location of bulkheads shall be chosen so as to ensure that the vessel remains afloat after the flooding of two or more adjacent compartments in the longitudinal direction.

The following provisions are applicable:
   - for bottom damage also two adjacent athwartship compartments shall also be assumed as flooded;
   - the lower edge of any non-watertight openings (e.g. doors, windows, access hatchways) shall, at the final stage of flooding, be not less than 0.10 m above the damage waterline;
   - in general, permeability shall be assumed to be 95%.

Where an average permeability of less than 95% is calculated for any compartment, this calculated value may be used. However, the following minimum values shall be used:
   - engine rooms: 85%;
   - accommodation: 95%;
   - double bottoms, fuel oil tanks, ballast tanks, etc., depending on whether, according to their function, they have to be assumed as full or empty for the vessel floating at the maximum permissible draught: 0% or 95%.

For the main engine room only the one-compartment standard needs to be taken into account, i.e. the end bulkheads of the engine room shall be assumed as not damaged.

7.11.3.2 For critical intermediate stage of flooding, beyond the equilibrium stage, the following criteria for righting lever curve have to be fulfilled:

Righting lever \( (GZ) \geq 0.03 \) m;

Range of positive \( GZ \): 5°.

7.11.3.3 At the stage of equilibrium (final stage of flooding), the angle of heel shall not exceed 12°. If non-watertight openings are immersed before that stage, the corresponding spaces shall be considered as flooded for the purpose of stability calculation.

The positive range of the righting lever curve beyond the position of equilibrium shall have a righting lever of \( \geq 0.05 \) m in association with an area under the curve of \( \geq 0.0065 \) rad.

The minimum values of stability shall be satisfied up to immersion of the first unprotected (non-weathertight) opening and in any event up to an angle of heel ≤ 27°. If non-weathertight openings are immersed before the requirements for minimum values of stability are complied with, the corresponding spaces shall be considered as flooded for the purposes of stability calculation.

If openings through which undamaged compartments may become additionally flooded are capable of being closed watertight, the closing appliances shall be marked accordingly.

Where cross- or down-flooding openings are provided for reduction of unsymmetrical flooding, the time for equalization shall not exceed 15 minutes, provided during the intermediate stages of flooding sufficient stability has been proved.

\[ \text{Equilibrium position} \]
\[ \text{First floodable non-weathertight opening, however} \leq 27° \]

Figure 7.11-1

7.12 Notice boards

The notice boards displaying the prohibition of admittance on board including prohibition of smoking, fire and naked light shall be clearly legible from either side of the vessel.
8 VESSELS USED FOR PROPULSION OF A PUSHED CONVOY

8.1 General

8.1.1 The following requirements of this Section apply to vessels used for propulsion of a pushed convoy or a side-by-side formation comprising a tank vessel carrying dangerous substances, assigned with descriptive notation, as defined in the Rules, Part 1 – Classification and Surveys, Chapter 1, 3.7.7.

8.1.2 Vessels considered in this Section shall comply with the applicable requirements of the Rules, Part 1 – Classification and Surveys, Part 2 – Hull and Hull Equipment and Part 3 – Machinery, Systems and Electricity, as applicable, and with the specific requirements from the present Rules.

8.1.3 Other vessels involved in the convoy or in the side-by-side formation not carrying dangerous goods shall comply with requirements of Section 9.

8.1.4 Vessels moving only Type N open tank vessels do not have to meet requirements of 8.2.2.1, 8.2.2.2 and 8.5.

8.2 Vessel arrangement

8.2.1 Ventilation

8.2.1.1 Ventilation of accommodation and service spaces shall be possible.

8.2.1.2 Any ventilation inlets of accommodation and service spaces leading outside shall be fitted with fire flaps. Such ventilation inlets shall be located not less than 2.00 m from the cargo area.

8.2.2 Protection against the penetration of gases

8.2.2.1 The vessel shall be designed so as to prevent gases from penetrating into the accommodation and the service spaces.

8.2.2.2 Outside the cargo area, the lower edges of door openings in the sidewalls of superstructures and the coamings of access hatches to under-deck spaces shall have a height of not less than 0.5 m above the deck.

This requirement need not be complied with if the wall of the superstructures facing the cargo area extends from one side of the vessel to the other and has doors the sills of which have a height of not less than 0.5 m.

The height of this wall shall not be less than 2.0 m. In this case, the lower edges of door-openings in the sidewalls of superstructures and the coamings of access hatches behind this wall shall have a height of not less than 0.1 m. The sills of engine room doors and the coamings of its access hatches shall, however, always have a height of not less than 0.5 m.

8.2.3 Engine rooms

Internal combustion engines for the vessel’s propulsion as well as internal combustion engines for auxiliary machinery shall be located outside the cargo area.

Chapter II - TRANSPORT OF DANGEROUS GOODS

Entrances and other openings of engine rooms shall be at a distance of not less than 2.0 m from the cargo area.

The engine room shall be accessible from the deck; the entrances shall not face the cargo area. Where the doors are not located in a recess whose depth is at least equal to the door width, the hinges shall face the cargo area.

8.2.4 Accommodation and service spaces

8.2.4.1 Accommodation spaces and the wheelhouse shall be located outside the cargo area forward of the fore vertical plane or abaft the aft vertical plane bounding the part of cargo area below deck. Windows of the wheelhouse which are located not less than 1.0 m above the bottom of the wheelhouse may tilt forward.

8.2.4.2 Entrances to spaces and openings of superstructures shall not face the cargo area. Doors opening outward and not located in a recess the depth of which is at least equal to the width of the doors shall have their hinges facing the cargo area.

8.2.4.3 Entrances from the deck and openings of spaces facing the weather shall be capable of being closed.

The following instruction shall be displayed at the entrance of such spaces:

Do not open during loading and unloading without the permission of the master.

Close immediately.

8.2.4.4 Entrances and windows of superstructures and accommodation spaces which can be opened as well as other openings of these spaces shall be located not less than 2.0 m from the cargo area. No wheelhouse doors and windows shall be located within 2.0 m from the cargo area, except where there is no direct connection between the wheelhouse and the accommodation.

8.2.5 Engines

8.2.5.1 Only internal combustion engines running on fuel with a flashpoint of more than 55 °C are permitted.

8.2.5.2 Ventilation inlets of the engine room and, when the engines do not take in air directly from the engine room, the air intakes of the engines shall be located not less than 2.0 m from the cargo area.

8.2.5.3 Sparking shall not be possible within the cargo area.

8.2.6 Oil fuel tanks

The open ends of air pipes of all oil fuel tanks shall extend to not less than 0.50 m above the open deck. The open ends and the open ends of overflow pipes leading on the deck shall be fitted with a protective device consisting of a gauze diaphragm or a perforated plate.
Chapter II - TRANSPORT OF DANGEROUS GOODS

8.2.7 Exhaust pipes

8.2.7.1 Exhausts shall be evacuated from the vessel into the open air either upwards through an exhaust pipe or through the shell plating. The exhaust outlet shall be located not less than 2,0 m from the cargo area. The exhaust pipes of engines shall be arranged so that the exhausts are led away from the vessel. The exhaust pipes shall not be located within the cargo area.

8.2.7.2 Exhaust pipes shall be provided with a device preventing the escape of sparks, e.g. spark arresters.

8.3 Electrical installations

8.3.1 Only distribution systems without return connection to the hull are permitted. This provision does not apply to:

- active cathodic corrosion protection;
- local installations outside the cargo area (e.g. connections of starters of diesel engines);
- device for checking the insulation level referred to in 8.3.2.

8.3.2 Every insulated distribution network shall be fitted with an automatic device with a visual and audible alarm for checking the insulation level.

8.3.3 For the selection of electrical equipment to be used in zones presenting an explosion risk, the explosion groups and temperature classes assigned to the substances carried in the list of substances shall be taken into consideration (see columns (15) and (16) of Table C of Chapter 3.2, Part 3 of ADN).

8.3.4 Type and location of electrical equipment

8.3.4.1 Electrical equipment used during loading, unloading and gas-freeing during berthing and which are located outside the cargo area (comparable to zone 2) shall be at least of the "limited explosion risk" type.

This provision does not apply to:

.1 lighting installations in the accommodation, except for switches near entrances to accommodation
.2 radiotelephone installations in the accommodation or the wheelhouse
.3 mobile and fixed telephone installations in the accommodation or the wheelhouse
.4 electrical installations in the accommodation, the wheelhouse or the service spaces, if:

these spaces are fitted with a ventilation system ensuring

- an overpressure of 0,1 kPa (0,001 bar) and none of the windows is capable of being opened; the air intakes of the ventilation system located as far away as possible, however, not less than 6,0 m from the cargo area and not less than 2,0 m above the deck;
- the spaces are fitted with a gas detection system with sensors at the suction inlets of the ventilation system and directly at the top edge of the sill of the entrance doors of the accommodation and service;
- the gas concentration measurement is continuous;
- when the gas concentration reaches 20% of the lower explosive limit, the ventilators shall be switched off.

In such a case and when the overpressure is not maintained or in the event of failure of the gas detection system, the electrical installations which do not comply with item a) above, shall be switched off. These operations shall be performed immediately and automatically and activate the emergency lighting in the accommodation, the wheelhouse and the service spaces, which shall comply at least with the “limited explosion risk” type. The switching-off shall be indicated in the accommodation and wheelhouse by visual and audible signals;

- the ventilation system, the gas detection system and the alarm of the switch-off device fully comply with the requirements of item a) above;
- the automatic switch-off device is set so that no automatic switching-off may occur while the vessel is under way.

8.3.4.2 The electrical equipment which does not meet the requirements set out in 8.3.4.1 together with its switches shall be marked in red. The disconnection of such equipment shall be operated from a centralized location on board.

8.3.4.3 An electric generator which is permanently driven by an engine and which does not meet the requirements of 8.3.4.1, shall be fitted with a switch capable of shutting down the excitation of the generator. A notice board with the operating instructions shall be displayed near the switch.

8.3.4.4 Sockets for the connection of signal lights and gangway lighting shall be permanently fitted to the vessel close to the signal mast or the gangway. Connecting and disconnecting shall not be possible except when the sockets are not live.

8.3.5 Electric cables

For movable cables intended for signal lights and gangway lighting, only sheathed cables of type H 07 RN-F in accordance with standard IEC 60 245-4:1994 or cables of at least equivalent design having conductors with a cross-section of not less than 1,5 mm² shall be used.

These cables shall be as short as possible and installed so that damage is not likely to occur.

8.4 Fire protection and fire-extinguishing

8.4.1 Fire and naked light

8.4.1.1 The outlets of funnels shall be located not less than 2,0 m from the hatchway openings. Arrangements shall be provided to prevent the escape of sparks and the entry of water.

8.4.1.2 Heating, cooking and refrigerating appliances shall not be fuelled with liquid fuels, liquid gas or solid fuels.

The installation in the engine room or in another separate space of heating appliances fuelled with liquid fuel having a flashpoint above 55°C is, however, permitted.

Cooking and refrigerating appliances are permitted only in wheelhouses with metal floor and in the accommodation.

8.4.1.3 Only electrical lighting appliances are permitted.
8.4.2 Fire extinguishing systems

In addition to the requirements of the Rules, Part 3 – Machinery, Systems and Electricity, Chapter III, Section 5, the fire extinguishing arrangements in 8.4.4 and 8.4.5 shall be complied with.

8.4.3 Portable fire extinguishers

In addition to the fire extinguishing appliances prescribed in the Rules, Part 3 – Machinery, Systems and Electricity, Chapter III, 5.5.2 and 5.5.3, each vessel shall be equipped with at least two additional portable fire extinguishers having the same capacity.

These additional portable fire extinguishers shall be suitable for fighting fires involving the dangerous goods carried.

These two portable fire extinguishers shall be located in the protected area or in proximity to it.

8.4.4 Fire-extinguishing system

A fire-extinguishing system shall be installed on the vessel. This system shall comply with the following requirements:

- it shall be supplied by one independent fire or ballast pumps, one of which shall be ready for use at any time;
- it shall be provided with a water main fitted with at least three hydrants in the protected area above deck. Three suitable and sufficiently long hoses with jet/spray nozzles having a diameter of not less than 12,0 mm shall be provided. Alternatively, one or more of the hose assemblies may be substituted by directable jet/spray nozzles having a diameter of not less than 12,0 mm. It shall be possible to reach any point of the deck in the protected area simultaneously with at least two jets of water which do not emanate from the same hydrant.
- A spring-loaded non-return valve shall be fitted to ensure that no gases can escape through the fire-extinguishing system into the accommodation or service spaces outside the cargo area;
- the capacity of the system shall be at least sufficient for a jet of water to reach a distance of not less than the vessel’s breadth from any location on board with two spray nozzles being used at the same time;
- the water supply system shall be capable of being put into operation from the wheelhouse and from the deck;
- measures shall be taken to prevent the freezing of fire-mains and hydrants.

8.4.5 Fixed fire-extinguishing system

In addition, the engine room, the pump room and all spaces containing essential equipment (switchboards, compressors, etc.) for the refrigeration equipment, if any, shall be provided with a fixed fire-extinguishing system meeting the requirements of the Rules, Part 3 – Machinery, Systems and Electricity, Chapter III, 5.3.

8.5 Notice boards

Notice boards shall be fitted at the ventilation inlets indicating the conditions under which they shall be closed. Any ventilation inlets of accommodation and service spaces leading outside shall be fitted with fire flaps. Such ventilation inlets shall be located not less than 2,0 m from the cargo area.

Ventilation inlets of service spaces in the cargo area below deck may be located within such area.
Chapter II - TRANSPORT OF DANGEROUS GOODS

9 VESSELS BEING THE PART OF A PUSHED CONVOY

9.1 General

9.1.1 The following requirements of this Section apply to vessels (not carrying dangerous goods, other than propulsion vessels) involved in a pushed convoy or a side-by-side formation comprising a dry cargo vessel or a tank vessel carrying dangerous substances, assigned with descriptive notation, as defined in the Rules, Part 1 – Classification and Surveys, Chapter I, 3.7.4 and 3.7.5.

9.1.2 However, this descriptive note may be used in addition to type notation Tug, Pusher or Cargo vessel used for propulsion of a pushed convoy or a side-by-side formation comprising a cargo vessel carrying dangerous substances and complies with the Rule requirements.

9.1.3 Vessels considered in this Section shall comply with the applicable requirements of the Rules, Part 1 – Classification and Surveys, Part 2 – Hull and Hall Equipment and Part 3 – Machinery, Systems and Electricity, as applicable, and with the specific requirements from the present Rules.

9.2 Vessel arrangement

9.2.1 Ventilation

Ventilation shall be provided for the accommodation and for service spaces.

9.2.2 Accommodation and service spaces

9.2.2.1 Gastight closing appliances shall be provided for openings in the accommodation and wheelhouse facing the holds.

9.2.2.2 No entrances or openings of the engine rooms and service spaces shall face the protected area.

9.2.3 Engines

9.2.3.1 Only internal combustion engines running on fuel with a flashpoint of more than 55°C are permitted.

9.2.3.2 The air vents of the engine rooms and the air intakes of the engines which do not take air in directly from the engine room shall be located not less than 2,0 m from the hatchway openings.

9.2.3.3 Sparking shall not be possible within the cargo area.

9.2.4 Oil fuel tanks

9.2.4.1 Double bottoms within the hold area may be arranged as fuel oil tanks provided their depth is not less than 0,6 m. Oil fuel pipes and openings to such tanks are not permitted in the holds.

9.2.4.2 The air pipes of all oil fuel tanks shall be led to 0,5 m above the open deck. Their open ends and the open ends of the overflow pipes leaking to the deck shall be fitted with a protective device consisting of a gauze gird or a perforated plate.

9.2.5 Exhaust pipes

9.2.5.1 Exhaust shall be evacuated from the vessel into the open air either upwards through an exhaust pipe or through the shell plating. The exhaust outlet shall be located not less than 2,0 m from the hatchway openings.

The exhaust pipes of engines shall be arranged so that the exhausts are led away from the vessel. The exhaust pipes shall not be located within the protected area.

9.2.5.2 Exhaust pipes shall be provided with a device preventing the escape of sparks, e.g. spark arresters.

9.3 Electrical installations

9.3.1 Type and location of electrical equipment

9.3.1.1 Electric motors for hold ventilators which are arranged in the air flow shall be of the certified safe type.

9.3.1.2 Sockets for the connection of signal lights, and gangway lighting shall be solidly fitted to the vessel close to the signal mast or the gangway. Sockets intended to supply the submerged pumps and hold ventilators shall be permanently fitted to the vessel in the vicinity of the hatches.

9.3.2 Electric cables

9.3.2.1 Cables and sockets in the protected area shall be protected against mechanical damage.

9.3.2.2 Movable cables are prohibited in the protected area, except for intrinsically safe electric circuits or for the supply of signal lights and gangway lighting, for containers, for submerged pumps, hold ventilators and for electrically operated cover gantries.

9.3.2.3 For movable cables permitted in accordance with 9.3.2.2 above, only rubber-sheathed cables of type H07 RN-F in accordance with standard IEC-60 245-4:1994 or cables of at least equivalent design having conductors with a cross-section of not less than 1,5 mm², shall be used. These cables shall be as short as possible and installed so that damage is not likely to occur.

9.4 Fire protection and fire-extinguishing

9.4.1 Fire and naked light

9.4.1.1 The outlets of funnels shall be located not less than 2,0 m from the hatchway openings. Arrangements shall be provided to prevent the escape of sparks and the entry of water.

9.4.1.2 Heating, cooking and refrigerating appliances shall not be fuelled with liquid fuels, liquid gas or solid fuels.

The installation in the engine room or in another separate space of heating appliances fuelled with liquid fuel having a flashpoint above 55°C is, however, permitted.

Cooking and refrigerating appliances are permitted only in wheelhouses with metal floor and in the accommodation.

9.4.1.3 Electric lighting appliances are only permitted outside the accommodation and the wheelhouse.
9.5 Notice boards

The notice boards displaying the prohibition of admittance on board including prohibition of smoking, fire and naked light shall be clearly legible from either side of the vessel.
**III ADDITIONAL CHARACTERS OF CLASS**

**1 SYMBOLS**

- $B_F = \text{breadth of the vessel on the transverse section considered, measured on top of the floor, [mm];}$
- $d_{FP} = \text{minimum required diameter of fitting pin of propeller connection, [mm];}$
- $d_P = \text{diameter of propeller, [mm];}$
- $M_a = \text{righting moment, [kNm];}$
- $M_{ICE} = \text{calculated/estimated ice torque generated by the propeller working in ice, [kNm];}$
- $M_{MCR} = \text{nominal mean torque delivered by the engine (referred to installed MCR of engine), [Nm];}$
- $M_{max} = \text{maximal permissible peak torque, [Nm];}$
- $p = \text{required mean pressure, [N/mm}^2\text{];}$
- $p_C = \text{design lateral cargo load according to the Rules, Part 2 – Hull and Hull Equipment, Chapter III, 5.2, [kN/m}^2\text{];}$
- $p_{ICE} = \text{ice pressure, [N/mm}^2\text{];}$
- $R_m = \text{tensile strength, [N/mm}^2\text{];}$
- $w = \text{net section modulus, [cm}^3\text{];}$
- $\gamma = \text{angle of repose of the dry bulk cargo, [°];}$
- $\rho_C = \text{density of dry bulk cargo, [t/m}^3\text{];}$
- $\sigma_F = \text{calculated tooth root bending stress, [N/mm}^2\text{];}$
- $\sigma_H = \text{calculated tooth flank contact (Hertzian) stress, [N/mm}^2\text{].}$

Other symbols in this Chapter, if not otherwise specified, are defined in the present Rules, Chapter I – Type notations.

**2 STRENGTHENED CONSTRUCTION**

**2.1 General**

**2.1.1 Application**

Vessels complying with the requirements of this Section may be assigned one of the following additional Characters of class, as defined the Rules, Part 1 – Classification and Surveys, Chapter I, 3.6.3 and 3.6.1 respectively:

- **Ice**, for vessels complying with 2.2;
- **GRAB**, for vessels complying with 2.3.

**2.1.2 Documentation to be submitted**

**2.1.2.1 Navigation in ice**

In addition to the documentation required in the Rules, Part 1 – Classification and Surveys, Chapter II, Table 3.2-1, for vessels navigating in ice, the following documentation shall be submitted:

- shell expansion as well as transverse and longitudinal sections showing the ice belt zone, light ballast waterline and load waterline.

Those plans shall clearly indicate the reinforced scantlings as well as details of transitional structures ensuring adequate strength continuity.

**2.1.2.2 Grab loading**

In addition to the documentation required in the Rules, Part 1 – Classification and Surveys, Chapter II, Table 3.2-1, for vessels loaded and unloaded by means of grabs or buckets, the following documentation shall be submitted:

- transverse and longitudinal sections showing strengthened structural members within the cargo hold.

Those plans shall clearly indicate the reinforced scantlings as well as other relevant structural details.

**2.2 Navigation in ice**

**2.2.1 General**

**2.2.1.1 Application**

The following requirements for Ice strengthened vessels apply to vessels operate in inland navigation conditions corresponding to a low ice level, i.e. brash ice with a thickness not exceeding 0,2 m.

The present Rules are not applicable to vessels intended for ice breaking.

For vessels intended to operate under more severe ice conditions, Rules for the Classification of Ships, Part 29 – Polar Class Ships and Ice Class Ships shall be applied for the corresponding ice class. In any case, it is the owner’s responsibility to determine which ice class notation shall be the most suitable for the intended operating conditions of the vessel.

These requirements shall not be assumed as neither substituting, equivalent nor complementing to national requirements and ice or polar ice classes as defined and introduced by specific administrations or specific ice Rules.
2.2.1.2 Definitions

1 Ice belt zone

The ice belt zone is a zone of the side structures in which plating and supporting members shall be strengthened.

2 Ice belt depth

For side plating, ice belt zone shall extend between 300,0 mm below the light ballast waterline (i.e. the lowest ballast waterline) and 300,0 mm above the load waterline.

For side supporting members, ice belt zone shall extend from deck to the bilge turn.

3 Ice belt length

The side plating and supporting members shall be strengthened fore, from stem, over a length equal to the vessel breadth \( B \), or up to the transverse section with the breadth \( B \) closest to the fore end, whichever is greater.

2.2.2 Structure strengthening

2.2.2.1 General

When navigating in ice, the vessel shall always be loaded to at least the light ballast waterline.

In regard to this, attention shall also be paid to ensure the propeller is fully submerged, if possible entirely below the ice.

Any ballast tank which is a part of structures above the light ballast waterline and exposed to air, and which is expected to be used to load the vessel to the light ballast waterline, shall be equipped with adequate devices to prevent the water from freezing.

General provisions given in the *Rules, Part 2 – Hull and Hull Equipment, Chapter V, Section 3 and Section 6* shall be complied with, as applicable.

To ensure continuity of structure, supporting members within ice belt zone shall be arranged in line with those of adjacent structures. Where such design is not possible, strength continuity shall be ensured by means of wide tapering brackets or other adequate transitional structures. The details of connection shall be considered by the *Register* on a case by case basis.

Where brackets are fitted, their net scantlings shall not be less than the values obtained from the formulae given in the *Rules, Part 2 – Hull and Hull Equipment, Chapter II, 5.4.2*.

A curved bracket shall be considered as the largest bracket contained in the curved bracket as defined in the *Rules, Part 2 – Hull and Hull Equipment, Chapter II, 5.4.2* and Figure 5.2.2-1.

Ordinary stiffeners shall, in general, be continuous through the supporting structures, as indicated in the *Rules, Part 2 – Hull and Hull Equipment, Chapter II, 6.2*.

2.2.2.2 Plating

The plating net thickness in ice belt zone shall not be less than 1,5 times the shell plating thickness in the midship region.

The gross thickness shall be obtained using an addition for corrosion and abrasion not less than 2,0 mm.

A lower value of addition for corrosion and abrasion may be accepted by the *Register* on a case by case basis, where an evidence is provided that the special protective coating, highly resistant to the abrasion of ice, is applied.

2.2.2.3 Supporting members

1 General

These requirements apply ice belt zones of transversely framed side structures.

Strengthening of longitudinally framed side structures shall be considered on a case-by-case basis.

2 Side frames

If the actual spacing between side frames, measured on the planing, is quite greater than the frame spacing (due to the hull geometry), one of the following applies:

– the actual spacing shall be reduced;

– in scantlings formulae spacing of supporting members shall be taken equal to actual spacing.

In any case, provisions given in the *Rules, Part 2 – Hull and Hull Equipment, Chapter II, 5.3.1* and *5.3.2* shall be complied with.

3 Intermediate side frames

Within the ice belt zone, intermediate side frames shall be fitted extending from the deck to the bilge turn.

The net section moduli of intermediate side frames shall not be less than 0,75 times the section moduli of the side frames.

In way of these frames, intermediate floors shall also be fitted. Their scantlings shall be determined taking their span equal to \( 0,5B \), assuming the centreline bulkhead or bottom centre girder is fitted.

3 Side stringer

Depending on the hull geometry and arrangement, one or more adequately spaced side stringers shall be fitted at each side.

Where one stringer is provided, it shall be fitted in the area of mid-depth of strengthened side plating.

Where two stringers are provided, they shall be fitted on strengthened side plating, close to its upper and lower ends.

The net section modulus of the side stringer shall not be less than its rule value or twice the value of rule section modulus of side frames, whichever is greater.

2.2.2.4 Stem

1 General

A sharp edged stem improves the manoeuvrability of the vessel in ice.

Adequate continuity of strength shall be ensured at the connection of stems to the adjacent structure. Abrupt changes in sections shall be avoided.

2 Plate stem

General provisions given in the *Rules, Part 2 – Hull and Hull Equipment, Chapter V, 6.6.6* shall be complied with, as applicable.
The net thickness, \( t \), in [mm], of the plate stem shall not be less than 1.3 times the value of its rule thickness. A horizontal supporting brackets shall be provided, following provisions given in the Rules, Part 2 – Hull and Hull Equipment, Chapter V, 6.6.6.

A centreline stiffener shall be fitted to provide additional support, extending to a horizontal supporting bracket located at least 0.5 m above the load waterline. The strength check of centreline stiffener shall be carried out by direct calculation in accordance with provisions given in the Rules, Part 2 – Hull and Hull Equipment, Chapter V, 1.8. In no case its web net thickness and depth may be less than 0.7\( t \) and 10\( t \), respectively, where \( t \) is the stem plating net thickness.

### Solid bar stem

General provisions given in the Rules, Part 2 – Hull and Hull Equipment, Chapter V, 6.6.6 shall be complied with, as applicable.

### Stern frame

In case of twin-screw vessels, shafting and stern tubes of side propellers shall, in general, be enclosed within plate bossings. Where shaft brackets are fitted, their scantlings determined by applying formulae of the Rules.
.3 Connecting bolts
The diameter of fitted and plain bolts determined by applying formulae given in the Rules, Part 3 – Machinery, Systems and Electricity, shall be proportionally increased.

2.2.3.5 Gears and couplings

.1 Gears
a) Bending strength of tooth root
For adequate bending strength of the tooth root, the following condition shall be satisfied:

\[ c_E \cdot \sigma_F \leq \sigma_{FP}, \quad \left[ \text{N/mm}^2 \right] \] (2.2.3-2)

where:
- \( c_E \) = strengthening factor for gears and couplings, equal to 1.08;
- \( \sigma_F \) = calculated tooth root bending stress without ice load, \([\text{N/mm}^2]\);
- \( \sigma_{FP} \) = maximal permissible tooth root bending stress depending on material’s properties, \([\text{N/mm}^2]\).

b) Contact stress of tooth flanks
For adequate contact stress of the tooth flanks or Hertzian pressure, the following condition shall be satisfied:

\[ \sqrt{c_E} \cdot \sigma_H \leq \sigma_{HP}, \quad \left[ \text{N/mm}^2 \right] \] (2.2.3-3)

where:
- \( c_E \) = strengthening factor for gears and couplings, equal to 1.08;
- \( \sigma_H \) = calculated tooth flank contact (Hertzian) stress without ice load, \([\text{N/mm}^2]\);
- \( \sigma_{HP} \) = maximal permissible contact (Hertzian) stress depending on material’s properties, \([\text{N/mm}^2]\).

.2 Gear shafts
The diameter of gear shafts defined in the Rules, Part 3 – Machinery, Systems and Electricity, shall be increased as required by the relevant operating considerations.

.3 Flexible couplings
Flexible couplings in main propulsion installation shall be designed for a torque capacity in accordance to the following condition:

\[ M_{t,MCB} \leq M_{t, nom,C}, \quad \left[ \text{Nm} \right] \] (2.2.3-4)

where:
- \( M_{t,MCB} \) = nominal mean torque delivered by the engine (referred to installed MCR of engine), \([\text{Nm}]\);
- \( M_{t, nom,C} \) = proven nominal torque for coupling for continuous operation including an allowance of at least 30 % for dynamical superimposed torques (catalogue’s nominal torque), \([\text{Nm}]\).

Further the coupling shall be designed to withstand torque shocks of magnitude equal to the following value:

\[ M_{t,ICE,C} \leq c_E \cdot c_A \cdot M_{t,MCB} \leq M_{t, max,C}, \quad \left[ \text{Nm} \right] \] (2.2.3-5)

where:
- \( c_E \) = assumed peak torque which the elastic coupling shall transmit safely, including the influence of ice operation, \([\text{Nm}]\);
- \( M_{t, max,C} \) = maximal permissible peak torque for elastic coupling excluding reduction due to thermal loading (catalogue’s permissible repetitive peak torque), \([\text{Nm}]\);
- \( c_A \) = application factor for gear, defined in the Rules, Part 3 – Machinery, Systems and Electricity, Chapter I, 6.1.5.

2.2.3.6 Propellers

.1 Thickness of propeller blade sections
The minimum thickness of propeller blade shall not be less than 1.15 times its rule value, defined in the Rules, Part 3 – Machinery, Systems and Electricity, Chapter I, 4.5.

.2 Thickness of blade tips
The thickness, \( t_{ICE} \), of blade tips at 95% radius shall not be less than the following value:

\[ t_{ICE} = \frac{45 \cdot (0.01 \cdot d_P + 6)}{\sqrt{R_{mPR}}}, \quad \left[ \text{mm} \right] \] (2.2.3-6)

where:
- \( d_P \) = diameter of propeller, \([\text{mm}]\);
- \( R_{mPR} \) = tensile strength of the propeller’s material, \([\text{N/mm}^2]\).

.3 Propeller mounting
Where the propeller is mounted on the propeller shaft by the oil shrink fit method, the necessary pressure, in \( \left[ \text{N/mm}^2 \right] \), between propeller hub and propeller shaft in the area of the mean taper diameter shall not be less than 1.1 times the value for un-strengthened machinery installations.

In the case of flanged propellers, the required strengthened diameter of the fitting pins, \( d_{PPC,E} \), shall not be less than the following value:

\[ d_{PPC,E} = 1.15 \cdot d_{PP}, \quad \left[ \text{mm} \right] \] (2.2.3-8)

where:
- \( d_{PP} \) = minimum required diameter \([\text{mm}]\) of fitting pin of propeller connection for un-strengthened machinery installations, \([\text{mm}]\).

2.2.3.7 Transverse thrusters
The tunnels of transverse thrusters shall be fitted with grids for protection against ice impacts.

2.2.3.8 Steering gear
The steering gear components shall be adequately specified, taking into account the increased diameter of rudder stock, as given in 2.2.3.1.

Adequate relief valves shall be fitted to provide the protection of the steering gear against hydraulic overpressure.
Chapter III - ADDITIONAL CHARACTERS OF CLASS

2.2.3.9 Cooling water system and river water inlets

The following requirements shall be complied with:

1. the cooling water system shall be arranged to ensure the supply of cooling water when navigating in ice also;

2. for this purpose, at least one river water inlet chest shall
be designed and arranged as follows:

- a) the river water inlet shall be located near the
centreline of the vessel and as aft as possible;
- b) the chest shall be sufficiently high to allow ice to
accumulate above the inlet pipe;
- c) the area of the strum holes shall not be less than 4
times the inlet pipe sectional area;
- d) a pipe for discharging the cooling water, having the
same diameter of the main overboard discharge line,
shall be connected to the inlet chest;

3. where there are difficulties in satisfying the requirements
of .2, d) above, two smaller chests may be accepted,
alternatively, provided that they are located and arranged
as stated in the other provisions above;

4. heating coils may be installed in the upper part of the
chests;

5. arrangements for using ballast water for cooling purposes
may be accepted as a reserve in ballast conditions but are
not acceptable as a substitute for the river inlet chests as
described above.

2.3 Grab loading

In case of loading and unloading of dry bulk
cargoes by means of grabs or buckets, the scantlings of
structural members within the cargo hold shall be reinforced
as follows:

- a) plating: \( t_{GL} = t + 1.5, \) [mm], where \( t \) is the net
thickness in case of no grab loading;
- b) plating: \( t_{GL} = t + 2.0, \) [mm], where \( t \) is the net
thickness in case of no grab loading;

Above 1.5 m from inner bottom (top of floors), the net
scantlings of structural members may be gradually
tapered to the rule scantlings, determined by applying
relevant formulae given in the Rules, Part 2 – Hull and
Hull Equipment, Chapter V – Hull scantlings;

- a) ordinary stiffeners: \( w_{GL} = 1.4 \times w, \) [cm²], where \( w \)
is the net section modulus in case of no grab loading.

- b) unit cargo arrangement in cargo holds, on decks and/or
on hatch covers, indicating size and total weight of
cargoes;
- c) that documentation shall, where applicable, be
supported by direct calculations and shall clearly indicate the
design loads of structural members subjected to load
concentrations as well as relevant details of transitional
structures ensuring adequate strength continuity.

3 HEAVY CARGO TRANSPORT

3.1 General

3.1.1 Application

Vessels complying with the requirements of this
Section may be assigned one of the following additional
Characters of class, as defined the Rules, Part 1 –
Classification and Surveys, Chapter I, 3.6.1:

- to vessels intended to carry heavy unit cargoes:
  \( HVCG \) (\( \text{AREA}_i \times X_i \) \{kN/m²\});
- to vessel intended to carry heavy dry bulk cargoes:
  \( HVCG. \)

3.1.2 Direct calculation

Direct calculation may be adopted for the yielding
and buckling checks of hull structural members instead of the
Rules scantling formulae as well as for the analysis of
structural members not covered by the Rules or for type of
loading not covered by the Rules (e.g. heavy concentrated
loads, unevenly distributed loads etc.), in accordance with the
Rules, Part 2 – Hull and Hull Equipment, Chapter V, 1.8.

The following strength checks shall be carried out, as
applicable:

- level of normal stresses and shear stresses in way of
  significant structural discontinuities (e.g. considerable
  changes in structural arrangement and scantlings);
- level of normal stresses and shear stresses in welds in
  way of highly stressed areas;
- column buckling and local buckling of primary
  supporting members, plane or corrugated bulkheads etc.,
subjected to significant compressive loads.

All calculation documents shall be submitted to the
Register.

3.1.3 Documentation to be submitted

3.1.3.1 Vessels intended to carry heavy unit cargoes

In addition to the documentation required in the
Rules, Part 1 – Classification and Surveys, Chapter II, Table
3.2-1, the following information shall be submitted to the
Register:

- unit cargo arrangement in cargo holds, on decks and/or
  on hatch covers, indicating size and total weight of
cargoes;
- transverse and longitudinal sections showing
  strengthened structural members subjected to heavy
cargo loads.

That documentation shall, where applicable, be
supported by direct calculations and shall clearly indicate the
design loads of structural members subjected to load
concentrations as well as relevant details of transitional
structures ensuring adequate strength continuity.

3.1.3.2 Vessels intended to carry heavy dry bulk
cargoes

In addition to the documentation required in the
Rules, Part 1 – Classification and Surveys, Chapter II, Table
3.2-1, the following information shall be submitted to the
Register:
– unit cargo arrangement in cargo holds, on decks and/or on hatch covers, indicating size and total weight of cargoes;
– transverse and longitudinal sections showing strengthened structural members subjected to heavy cargo loads.

Those plans shall clearly indicate the design loads of those structural members as well as relevant details of transitional structures ensuring adequate strength continuity.

3.2 Vessels intended to carry heavy unit cargoes

3.2.1 Design loads

The value of design lateral cargo load \( p_C \), for each \( \text{Area} \), shall be specified by the Designer according to 3.1.1 (following provisions given in the Rules, Part 2 – Hull and Hull Equipment, Chapter III, 5.3 and 5.4, as applicable) and indicated as \( X_i \) value, in kN/m².

Bending and shear strength of hull girder transverse sections shall comply with the requirements of the Rules, Part 2 – Hull and Hull Equipment, Chapter V, Section 3 and Section 4, respectively, taking into account indicated cargo distribution.

3.2.2 Hull scantlings

The hull scantlings shall, in general, not be less than required in the Rules, Part 2 – Hull and Hull Equipment, Chapter V – Hull scantlings, taking into account indicated cargo distribution.

3.3 Vessels intended to carry heavy dry bulk cargoes

3.3.1 Design loads

The design lateral cargo load, \( p_C \), shall be determined according to the Rules, Part 2 – Hull and Hull Equipment, Chapter III, 5.2, taking into account the exact values of density and angle of repose of the bulk cargo.

In no case these cargo properties shall be taken less than:

– density of cargo, \([\text{t/m}^3]\):
  \[ \rho_C \geq 2.5; \]
– angle of repose of the dry bulk cargo, \([\text{°}]\):
  \[ \gamma \geq 35. \]

Bending and shear strength of hull girder transverse sections shall comply with the requirements of the Rules, Part 2 – Hull and Hull Equipment, Chapter V, Section 3 and Section 4, respectively, taking the cargo properties as specified above.

3.3.2 Hull scantlings

3.3.2.1 General

The hull scantlings shall, in general, not be less than required in the Rules, Part 2 – Hull and Hull Equipment, Chapter V – Hull scantlings, taking into account indicated cargo distribution.

3.3.2.2 Bottom or inner bottom plating thickness

The net thickness, \( t_i \), of bottom or inner bottom plating subjected to heavy dry bulk cargo, shall not be less than the following value:

\[
t_i = 0.038 \cdot L \cdot \sqrt{k} + 3.5 \cdot s + 5.3, \quad [\text{mm}]
\]  

(3.3.2-1)

where:

\( k \) = material factor defined in the Rules, Part 2 – Hull and Hull Equipment, Chapter II, Section 2;

\( s \) = spacing of ordinary stiffeners defined in the Rules, Part 2 – Hull and Hull Equipment, Chapter II, 5.3.2, [m].

3.3.2.3 Strengthening of cargo hold structures for grab loading/unloading

In case of loading and unloading cargoes by means of grabs or buckets, the scantlings of structural elements within the cargo hold, where no continuous wooden ceiling is fitted, shall be increased according to 2.3.
4 STABILITY

4.1 General

4.1.1 Application

4.1.1.1 Vessels complying with the requirements of this Section may be assigned one of the following additional Characters of class, as defined in the Rules, Part 1 – Classification and Surveys, Chapter I, 3.6.3:

- Intact stability;
- Damage stability.

4.1.1.2 General requirements

.1 General

For any vessel for which a stability investigation is requested in order to comply with the class requirements, adequate stability shall be demonstrated.

General provisions given in the Rules, Part 2 – Hull and Hull Equipment, Chapter II, 11.1 and 11.2 shall be complied with.

.2 Inclining test and lightweight check

Vessel for which a stability investigation is requested shall be initially subjected to an inclining test or a lightweight check, so that the stability data can be determined.

General provisions given in the Rules, Part 2 – Hull and Hull Equipment, Chapter II, 11.4 shall be complied with.

4.1.2 Documentation to be submitted

The documentation to be submitted are listed in the Rules, Part 2 – Hull and Hull Equipment, Chapter II, 11.2.1.

The Register may require any other necessary guidance for the safe operation of the vessel.

4.2 Cargo vessels

4.2.1 Application

Vessels complying with the requirements of this Head may be assigned the additional Characters of class Intact stability or Damage stability, as defined in the Rules, Part 1 – Classification and Surveys, Chapter I, 3.6.3.

4.2.2 Intact stability

4.2.2.1 Proof of sufficient intact stability shall be provided for all intended loading conditions (i.e. design loading conditions), for all loading/unloading stages, up to the final loading stage.

4.2.2.2 Proof of sufficient intact stability shall be provided according to the Rules, Part 2 – Hull and Hull Equipment, Chapter II, 11.3.

4.2.2.3 The stability reducing free surface effect shall be taken into account, as applicable, according to the Rules, Part 2 – Hull and Hull Equipment, Chapter II, 11.2.3.

4.2.2.4 Additional intact stability requirements for dry bulk cargo vessels

.1 Intact stability criteria

The intact stability characteristics of any vessel carrying dry bulk cargo shall meet at least the following criteria after taking into account heeling moment due to shift of cargo and the total heeling moment, as defined in 4.2.2.5 (see also Figure 4.2.2-1):

a) in each of the following two cases the heeling angle \( \varphi_1 \) shall not exceed 12°:
   - in application of the heeling moment due to shift of cargo and wind according to 4.2.2.5.3 and 4.2.2.5.1 respectively;
   - in application of the heeling moment due to shift of cargo and turning according to 4.2.2.5.3 and 4.2.2.5.2 respectively;

b) the remaining or residual area between the heeling arm curve due to shift of cargo and the righting arm curve in static stability diagram, up to heel angle \( \varphi_2 \), in all loading conditions, shall not be less than 0.024 m-rad;

c) the remaining or residual area between the heeling arm curve due to total heeling moment and the righting arm curve in static stability diagram, up to heel angle \( \varphi_2 \), in all loading conditions, shall not be less than 0.0065 m-rad

\( \varphi_2 = \text{heel angle of maximum difference between the ordinates of the righting lever arm curve and the heeling lever arm curve, or 27° or the angle at which the first unprotected (non-weathertight) opening immerses, whichever is less;} \)

d) the initial metacentric height, after correction for the free surface effects of liquids in tanks, as specified in 4.2.2.3, shall not be less than 0.15 m.

e) the initial metacentric height, after correction for the free surface effects of liquids in tanks, as specified in 4.2.2.3, shall not be less than 0.15 m.

4.2.2.5 Heeling moments

Total heeling moment is the sum of the following heeling moments.

.1 Moment due to lateral wind pressure

The heeling moment due to wind pressure, \( M_{WD} \), shall be calculated as follows:

\[
M_{WD} = \rho_{WD} \cdot A_{WD} \left( \delta_{WD} + \frac{T_{WD}}{2} \right) \quad [\text{kNm}] \quad (4.2.2-1)
\]
where:

\[ p_{\text{WD}} \] = wind pressure defined in the *Rules, Part 2 – Hull and Hull Equipment, Chapter III, 4.1.2, [kN/m^2]*;

\[ A_{\text{WD}} \] = lateral area of the vessel above the plane of draught, \( T_{\text{LC}} \), associated with the loading condition considered, [m^2];

\[ \delta_{\text{WD}} \] = distance of the centre of gravity of the lateral plane, \( A_{\text{WD}} \), from the plane of draught, \( T_{\text{LC}} \), associated with the loading condition considered, [m];

\[ T_{\text{LC}} \] = draught associated with each cargo and ballast distribution defined in the *Rules, Part 2 – Hull and Hull Equipment, Chapter III – Design load principles*, [m].

**.2 Turning circle moment**

The moment due to centrifugal force, \( M_{\text{CF}} \), caused by the turning of the vessel, shall be calculated as follows:

\[
M_{\text{CF}} = c_{\text{CF}} \cdot v^2 \cdot \frac{\Delta}{L_{\text{WL}}} \left( KG - \frac{T_{\text{LC}}}{2} \right), \text{[kNm]} \quad (4.2.2-2)
\]

where:

\[ c_{\text{CF}} \] = a coefficient equal to 0,0347;

\[ L_{\text{WL}} \] = length of waterline, [m];

\[ v \] = maximum speed of the vessel, [km/h];

\[ \Delta \] = displacement, [t];

\[ KG \] = vertical centre of gravity (VCG) corresponding to the loading condition considered and the base line, [m].

**.3 Heeling moment due to shift of cargo**

For dry bulk cargo likely to redistribute itself if the vessel’s heel angle is greater than its angle of repose (such as grain or cement), the heeling moment due to shift of cargo shall be also taken into account.

The value of that moment shall be determined in relation with the cargo hold geometry, assuming an angle to the horizontal of the resulting cargo surface after shifting of \( 12^\circ \).

**4.2.3 Damage stability**

Buoyancy of the vessel in the event of flooding shall be proven for all intended loading conditions.

**4.2.3.1 Assumption**

Cargo vessels shall comply with the two-compartment status.

The following assumptions concerning the extent of damage given in Table 4.2.3-1 shall be taken into account in the event of flooding:

a) for side damage and bottom damage, each bulkhead within the extent of damage will be assumed to be damaged. This means that the position of the bulkheads shall be selected in such a way as to ensure that the vessel remains buoyant after flooding of two or more adjacent compartments in the longitudinal direction;

b) the lowest point of each non-watertight opening (e.g. doors, windows, access hatchways) shall lie at least 0,1 m above the damaged waterline;

c) permeability is assumed to be 95%. If it is proven by a calculation that the average permeability of any compartment is less than 95%, the calculated value may be used instead.

The values to be adopted shall not be less than those given in Table 4.2.3-2;

d) if damage of a smaller dimension than specified above produces more detrimental effects with respect to heeling or loss of metacentric height, such damage shall be taken into account for calculation purposes.

---

**Figure 4.2.2-1**

Stability curve
### Table 4.2.3-1

<table>
<thead>
<tr>
<th>Dimension of the side damage</th>
<th>Longitudinal $l_D$, [m]</th>
<th>Transverse $b_D$, [m]</th>
<th>Vertical $h_D$, [m]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extent of damage</td>
<td>$0,1 \cdot L_{WL}$, however not less than 5,0 m</td>
<td>$0,59$</td>
<td>from vessel bottom to top without delimitation</td>
</tr>
</tbody>
</table>

### Table 4.2.3-2

<table>
<thead>
<tr>
<th>Accommodation spaces</th>
<th>Permeability values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine and boiler rooms</td>
<td>95%</td>
</tr>
<tr>
<td>Double bottoms, fuel bunkers,</td>
<td>85%</td>
</tr>
<tr>
<td>ballast and other tanks,</td>
<td>0% to 95%</td>
</tr>
<tr>
<td>depending on whether, according to their intended purpose, they shall be assumed to be full or empty for the vessel floating at the plane of maximum draught</td>
<td></td>
</tr>
</tbody>
</table>

### Figure 4.2.3-1

Proof of damage stability (final stage of flooding)

These minimum values for stability shall be met until the immersion of the first unprotected (non-weathertight) opening or in any case before reaching a heeling angle of $27^\circ$. If non-weathertight openings are immersed before the requirements for minimum values of stability are complied with, the corresponding spaces shall be considered as flooded for the purposes of stability calculation.

4.2.3.3 The shut-off devices of openings capable of being closed watertight, through which undamaged compartments may additionally become flooded, shall be marked accordingly.

4.2.3.4 If cross-flood openings to reduce asymmetrical flooding are provided, they shall meet the following conditions:

a) the total time permitted for compensation shall not exceed 15 minutes;

b) during the intermediate stages of flooding, proof of sufficient stability shall be provided.
4.3 Tankers

4.3.1 Application

4.3.1.1 Vessels complying with the requirements of this Section may be assigned the additional Characters of class Intact stability, as defined in the Rules, Part 1 – Classification and Surveys, Chapter I, 3.6.3.

4.3.1.2 As a rule, centre longitudinal bulkhead shall be fitted. The Register may waive this requirement if proof of sufficient stability is provided.

4.3.2 Intact stability

4.3.2.1 Proof of sufficient intact stability shall be provided for all intended loading conditions, for all loading/unloading stages, up to the final loading stage.

4.3.2.2 Proof of sufficient intact stability shall be provided according to the Rules, Part 2 – Hull and Hull Equipment, Chapter II, 11.3.

4.3.2.3 The stability reducing free surface effect shall be taken into account, as applicable, according to the Rules, Part 2 – Hull and Hull Equipment, Chapter II, 11.23.

4.4 Tugs and pushers

4.4.1 Application

Vessels complying with the requirements of this Section may be assigned the additional Characters of class Intact stability, as defined in the Rules, Part 1 – Classification and Surveys, Chapter I, 3.6.3.

4.4.2 Intact stability

4.4.2.1 Proof of sufficient intact stability shall be provided for all intended service conditions.

4.4.2.2 Proof of sufficient intact stability shall be provided according to the Rules, Part 2 – Hull and Hull Equipment, Chapter II, 11.3.

4.4.2.3 The stability reducing free surface effect shall be taken into account, as applicable, according to the Rules, Part 2 – Hull and Hull Equipment, Chapter II, 11.23.

4.5 Pontoons and dredgers

4.5.1 Application

Vessels complying with the requirements of this Section may be assigned the additional Characters of class Intact stability, as defined in the Rules, Part 1 – Classification and Surveys, Chapter I, 3.6.3.

4.5.2 Intact stability

4.5.2.1 Proof of sufficient intact stability shall be provided for all intended loading conditions, for all loading/unloading stages.

4.5.2.2 Proof of sufficient intact stability shall be provided based at least on the following load data:

a) Density of dredged material:

- mixture of sand and water in the ducts: 1.3 t/m³;
- sands and gravels: 1.5 t/m³;
- very wet sands: 2.0 t/m³;

b) Clamshell dredgers:
the values given in (a) shall be increased by 15%.

c) Hydraulic dredgers:
the maximum lifting power shall be considered.

4.5.2.3 The stability reducing free surface effect shall be taken into account, as applicable, according to the Rules, Part 2 – Hull and Hull Equipment, Chapter II, 11.23.

4.5.2.4 Heeling moments

.1 Moment due to lateral wind pressure

The heeling moment due to wind pressure, \( M_{WD} \), shall be calculated as follows:

\[
M_{WD} = c_{WD} \cdot p_{WD} \cdot A_{WD} \cdot \left( \delta_{WD} + \frac{T_{LC}}{2} \right), \quad \text{[kNm]} \quad (4.5.2-1)
\]

where:

- \( c_{WD} \) = wind drag coefficient of structural shapes, taking into account the wind gusts;
- \( = 1.2 \) for frameworks;
- \( = 1.6 \) for solid section beam;
- \( p_{WD} \) = wind pressure defined in the Rules, Part 2 – Hull and Hull Equipment, Chapter III, 4.1.2, [kN/m²];
- \( A_{WD} \) = lateral area of the vessel above the plane of draught, \( T_{LC} \), associated with the loading condition considered, [m²];
- \( \delta_{WD} \) = distance of the centre of gravity of the lateral plane, \( A_{WD} \), from the plane of draught, \( T_{LC} \), associated with the loading condition considered, [m];
- \( T_{LC} \) = draught associated with each cargo and ballast distribution defined in the Rules, Part 2 – Hull and Hull Equipment, Chapter III – Design load principles, [m].

.2 Turning circle moment

The moment due to centrifugal force, \( M_{CF} \), caused by the turning of the vessel, shall be calculated as follows:

\[
M_{CF} = c_{CF} \cdot v^2 \cdot \frac{\Delta}{L_{WL}} \left( KG - \frac{T_{LC}}{2} \right), \quad \text{[kNm]} \quad (4.5.2-2)
\]

where:

- \( c_{CF} \) = a coefficient equal to 0.0347;
- \( L_{WL} \) = length of waterline, [m];
- \( v \) = maximum speed of the vessel, [km/h];
- \( \Delta \) = displacement, [t];
- \( KG \) = vertical centre of gravity (VCG) corresponding to the loading condition considered and the base line, [m].

.3 Asymmetric structure induced moment

The asymmetric structure induced moment shall be defined by the Designer, as applicable.

.4 Load induced moment

The load induced moment shall be defined by the Designer.

.5 Ballast and supplies induced moment
Chapter III - ADDITIONAL CHARACTERS OF CLASS

The least favourable extent of tank filling from the point of view of stability shall be determined and the corresponding moment introduced into the calculation when calculating the moments resulting from the liquid ballast and the liquid provisions.

6. Moment due to inertia forces

The moment resulting from the inertia forces shall be taken into account if the movements of the load and the working gear are likely to affect vessel’s stability.

7. Moment due to other mechanical equipment

The moment due to other mechanical equipment shall be defined by the Designer.

8. Cross current induced moment

The moment resulting from the cross current shall be taken into account for a vessel which is anchored or moored across the current while operating.

4.5.2.5 Righting moments

The righting moments, $M_a$, for floating installations with vertical side walls may be calculated by the following formula:

$$M_a = 10 \cdot \Delta \cdot GM \cdot \sin \varphi \quad \text{[kNm]} \quad (4.5.2-3)$$

where:

$\Delta = \text{displacement, [t]}$;

$GM = \text{metacentric height, [m]}$;

$\varphi = \text{heel angle, [°]}$.

This formula shall apply up to heel angle of 10° or up to a heel angle corresponding to immersion of the edge of the deck or emergence of the edge of the bottom. In this instance the smallest angle shall be decisive.

This formula may be applied to oblique side walls up to heel angle of 5°.

If the particular geometry of the vessel does allow such simplification, the righting lever arm curves shall be provided.

4.5.2.6 Intact stability criteria

1. when heeling moments in accordance with 4.5.2.4 are applied during the operation of the working gear (in a way that the moments which may act simultaneously are added up), the following requirements shall be complied with:

a) the residual safety clearance shall not be less than:
   - 0,4 m for unprotected (non-weathertight) openings;
   - 0,3 m for weathertight and watertight openings;

b) the residual freeboard shall not be less than 0,3 m.

The residual freeboard may be reduced if the requirements in 4.5.2.7 are complied with;

2. the heel angle shall not exceed 10° and the edge of the bottom (base of the hull) shall not emerge.

4.5.2.7 Intact stability criteria in case of reduced residual freeboard

If a reduced residual freeboard is taken into account, it shall be checked, for all intended loading and working conditions, that:

a) after correction for the free surface effect, the metacentric height $GM$ shall not be less than 0,15 m;

b) the heel angle shall not exceed 10°;

c) for heel angles between 0° and 30°, a righting lever arm, $GZ$, shall not be less than:

$$GZ = 0,3 - 0,28 \cdot \varphi_{an} \quad \text{[m]} \quad (4.5.2-4)$$

where:

$\varphi_{an} = \text{heel angle of vanishing stability (i.e. heel angle from which the righting lever arm curve has negative values, [rad])};$

$= \text{it shall not be less than 20° (0,349 rad) and shall not be taken greater than 30° (0,349 rad).}$

d) for heel angles between 0° and 30°, the remaining righting lever arm shall not be less than:

$$GZ = 0,2 - 0,23 \cdot \varphi_{an} \quad \text{[m]} \quad (4.5.2-5)$$

where:

$\varphi_{an} = \text{heel angle of vanishing stability (i.e. heel angle from which the righting lever arm curve has negative values, [rad])};$

$= \text{it shall not be taken greater than 30°.}$

The remaining or residual righting lever arm means the maximum difference existing between 0° and 30° heel, between the ordinates of the righting lever arm curve and the heeling lever arm curve. If an unprotected (non-weathertight) opening is immersed at a heel angle less than the one corresponding to the maximum difference between the lever arm curves, the lever arm corresponding to that heel angle shall be taken into account.

c) the residual safety clearance is not less than:
   - 0,4 m for unprotected (non-weathertight) openings;
   - 0,3 m for weathertight and watertight openings;

f) the residual freeboard is not less than 0,05 m.

4.6 Floating installations without confirmation of stability

The following floating installations may be exempted from requirements of 4.5.2.5 and 4.5.2.6:

- those whose working gear may in no case change their list or trim;
- those where there can in no case be any displacement of the position of centre of gravity.

Those floating installations shall comply with the following requirements:

- at maximum load, the safety clearance shall be at least 0,3 m and the freeboard shall be at least 0,15 m;
- for openings which cannot be closed in such a way as to exclude spray and bad weather, the safety clearance shall be at least 0,5 m.