RULES FOR CLASSIFICATION

High speed and light craft

Edition December 2015

Part 5 Ship types

Chapter 2 Car ferry
FOREWORD

DNV GL rules for classification contain procedural and technical requirements related to obtaining and retaining a class certificate. The rules represent all requirements adopted by the Society as basis for classification.

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CURRENT – CHANGES

This is a new document.
The rules enter into force 1 July 2016.
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SECTION 1 GENERAL

1 Classification

1.1 Class notation

1.1.1 High speed and light craft built in compliance with the requirements for the notation Passenger craft and in addition to the relevant requirements in this chapter may be given one of the following class notations:

Ferry A, (or B), (or C).

Ch.1 Sec.2 [1.2.1] and Ch.1 Sec.2 [2.2.1] are not applicable to craft with notation Ferry C.

Guidance note:
Ch.1 Sec.2 [1.2.1] reads:
The number of passengers used for the maximum loading condition of the craft shall be established from the number of permanent seats on board.

Ch.1 Sec.2 [2.2.1] reads:
On board high speed craft safety belts shall be provided for all seats from which the craft can be operated.

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

1.1.2 Craft arranged for carriage of vehicles in enclosed spaces and built in accordance with the relevant requirements as specified may be given the class notation Ferry A.

1.1.3 Craft arranged for carriage of vehicles on weather deck or in open ro-ro spaces built in accordance with relevant requirements for open ro-ro cargo space may be given the class notation Ferry B.

1.1.4 Craft with an operational speed of less than 25 knots, and arranged for carriage of vehicles on weather deck, may be given the class notation Ferry C.

1.1.5 For craft with a ferry class notation a statement of the total effective deck area for cars will be entered in the "Appendix to the classification certificate", e.g. 850 m²cardk.

1.1.6 For the application of these rules, wherever the term Administration is quoted, this shall be read as Society.

1.2 Definitions

1.2.1 Special category spaces are those enclosed spaces intended for the carriage of motor vehicles with fuel in their tanks for their own propulsion, into and from which such vehicles can be driven and to which passengers have access, including spaces intended for the carriage of cargo vehicles.

(HSC Code 1.4.45)

1.2.2 Ro-ro cargo spaces are spaces not normally subdivided in any way and extending to either a substantial length or the entire length of the ship in which goods (packaged or in bulk, in or on rail or road cars, vehicles (including road or rail tankers), trailers, containers, pallets, demountable tanks or in or on similar stowage units or others receptacles) can be loaded and unloaded normally in a horizontal direction.

1.2.3 Open ro-ro cargo spaces are ro-ro cargo spaces either open at both ends, or open at one end and provided with adequate natural ventilation effective over their entire length through permanent openings in the side plating or deckhead.
1.2.4 Closed ro-ro cargo spaces are ro-ro cargo spaces which are neither open ro-ro cargo spaces nor weather decks.

1.2.5 Weather deck is a deck which is completely exposed to the weather from above and from at least two sides.

1.2.6 Car Ferry A: Car ferries with special category spaces.

1.2.7 Car Ferry B: Car ferries with cars in open ro-ro cargo spaces or on weather deck.

1.2.8 Car Ferry C: Car ferries with cars on weather deck.

1.2.9 Open vehicle spaces are spaces:
1) to which any passengers carried have access;
2) intended for carriage of motor vehicles with fuel in their tanks for their own propulsion; and
3) either open at both ends or open at one end and provided with adequate natural ventilation effective over their entire length through permanent openings in the side plating or deckhead or from above.
   (HSC Code 1.4.34)

2 Application

2.1 2000 HSC code

2.1.1 The requirements of this chapter apply to craft which may be defined within the International Code of Safety for High-Speed Craft, 2000, but also to craft which may be operated under equivalent certificates.

2.1.2 The requirements in this chapter apply to craft intended for regular transport of passengers and vehicles. Requirements listed in Ch.1 for Passenger craft notation are also to be complied with.

2.1.3 The notation Ferry A is applicable to car ferries with a totally enclosed car deck.

2.1.4 The notation Ferry B is applicable to car ferries with car deck open for free ventilation in at least two ends, i.e. fore and aft or port and starboard.

2.1.5 The notation Ferry C is applicable to car ferries where the car deck is an open weather deck.

2.2 Cars

2.2.1 Ferries may be designed for vehicles of various weight classes and limitations on the weight of the cars shall be clearly marked and given in the “Appendix to the classification certificate”.

3 Safety for persons onboard

3.1 General

3.1.1 Safety measures for craft with Ferry C notation will be handled on a case by case basis, but are in general to comply with the 2000 HSC Code. Measures shall be taken to ensure that there is enough space between the vehicles to allow for easy access to the muster stations in order to evacuate.
4 Service restrictions

4.1 General

4.1.1 The requirements for Ferry B and Ferry C are normally based on the craft operating on a national certificate with service restriction of 20 nautical miles or less.

4.1.2 For craft built under this edition of the rules based on the 2000 HSC Code, Ferry A and Ferry B will be given the same maximum service restrictions.

Guidance note:
The 2000 HSC Code allows for this principle as the open vehicle space is defined without any other restrictions than for craft with special category space.

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

4.1.3 The requirements for Ferry C are based on a more restricted service than the 2000 HSC Code and equivalent requirements are given without exemption from the safety level of the code. Craft with the notation Ferry C will be given service restrictions R3 or R4.

5 Documentation

5.1 General

5.1.1 Documentation shall be submitted as required by Table 1.

Table 1 Documentation Requirements

<table>
<thead>
<tr>
<th>Object</th>
<th>Documentation type</th>
<th>Additional description</th>
<th>Info</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moveable car deck arrangements</td>
<td>Z030 – Arrangement plan</td>
<td>Arrangement, scantlings and supports for movable car decks and ramps, if any.</td>
<td>AP</td>
</tr>
<tr>
<td>Shell doors</td>
<td>C030 – Detailed drawing</td>
<td>Showing arrangement, scantlings and closing appliances for doors and/or ramps.</td>
<td>AP</td>
</tr>
<tr>
<td></td>
<td>H020 – Design load plan</td>
<td></td>
<td>AP</td>
</tr>
<tr>
<td></td>
<td>Z030 – Arrangement plan</td>
<td>Showing doors from vehicle decks</td>
<td>AP</td>
</tr>
<tr>
<td>Shell doors control and monitoring system</td>
<td>I200 - Control and monitoring system documentation</td>
<td></td>
<td>AP</td>
</tr>
<tr>
<td>Shell doors television monitoring system</td>
<td>I200 - Control and monitoring system documentation</td>
<td></td>
<td>AP</td>
</tr>
<tr>
<td>Cargo securing arrangements</td>
<td>H180 – Cargo securing manual</td>
<td>Securing plan for vehicles with fastening and securing devices.</td>
<td>AP</td>
</tr>
<tr>
<td>Ventilation systems</td>
<td>S012 – Ducting diagram (DD)</td>
<td>Including number of air changes/hour</td>
<td>AP</td>
</tr>
<tr>
<td>Damage stability</td>
<td>B030 – Internal watertight integrity plan</td>
<td></td>
<td>FI</td>
</tr>
<tr>
<td></td>
<td>B070 – Preliminary damage stability calculation</td>
<td></td>
<td>AP</td>
</tr>
<tr>
<td>Object</td>
<td>Documentation type</td>
<td>Additional description</td>
<td>Info</td>
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<td>--------</td>
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<td>------------------------</td>
<td>------</td>
</tr>
<tr>
<td>Ship hull structure</td>
<td>B130 – Final damage stability calculation</td>
<td></td>
<td>AP</td>
</tr>
<tr>
<td></td>
<td>H080 – Strength analysis</td>
<td>Calculation of transverse strength</td>
<td>AP</td>
</tr>
<tr>
<td></td>
<td>H110 – Loading manual</td>
<td></td>
<td>AP</td>
</tr>
<tr>
<td>Vehicle, special category and ro-ro spaces fire extinguishing system</td>
<td>G200 – Fixed fire extinguishing system documentation</td>
<td></td>
<td>AP</td>
</tr>
<tr>
<td>Fire doors control and monitoring system</td>
<td>I200 - Control and monitoring system documentation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cargo storing arrangements</td>
<td>Z030 - Arrangement plan</td>
<td>For vehicle, special category and ro-ro spaces: — drainage openings or freeing ports — arrangement of boundary bulkheads — means of escape — precautions against ignition of inflammable vapours.</td>
<td></td>
</tr>
<tr>
<td>Fire extinguishing equipment, mobile</td>
<td>Z090 – Equipment list</td>
<td>Portable fire extinguishers.</td>
<td>AP</td>
</tr>
<tr>
<td></td>
<td>Z030 – Arrangement plan</td>
<td>— water- or fog applicators . — portable foam applicators .</td>
<td>AP</td>
</tr>
<tr>
<td>Propulsion and steering arrangements, general</td>
<td>Z071 – Failure mode and effect analysis</td>
<td>The FMEA should follow guidelines in HSC Code Annex 4 and should include at least: machinery systems and associated controls directional control system stabilization system integrated control and monitoring system electrical system. For Category B Passenger Craft, the FMEA shall take into consideration fire and flooding in one compartment (except in bridge) as a single failure scenario.</td>
<td>AP</td>
</tr>
<tr>
<td></td>
<td>Z030 - Arrangement plan</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

AP = For approval; FI = For information
ACO = As carried out; L = Local handling; R = On request; TA = Covered by type approval; VS = Vessel specific

For general requirements to documentation, including definition of the Info Codes, see SHIP Pt.1 Ch.3 Sec.2. For a full definition of documentation types, see SHIP Pt.1 Ch.3 Sec.3.
SECTION 2 ARRANGEMENT

1 Hull arrangement

1.1 General

1.1.1 Special category spaces shall be structurally separated from the operating compartment, passenger accommodation and evacuation routes as effectively as practical. If the adjacent arrangement of these spaces is permitted, provision shall be made for easy evacuation of the passenger accommodation away from the special category space.

1.2 Collision bulkheads

1.2.1 Collision bulkhead shall be arranged in accordance with Pt.3 Ch.1 Sec.2 [1].

1.3 Doors and access openings

1.3.1 Arrangements and scantlings of doors in ship’s side and ends are in general to satisfy the requirements given for the main class, with relevant additions as given below.

1.3.2 For ferries with the class notation Ferry A warning indicator lights for open or locked doors shall be arranged also on the bridge.

1.3.3 For ferries with the class notation Ferry B or Ferry C openings in sides and ends leading to the vehicle deck need not have closing appliances.

1.3.4 Doors and sill heights are in general to satisfy the requirements given for the main class.

1.3.5 Doors leading from vehicle deck to engine room shall have sill heights not less than 380 mm. Other doors leading from vehicle deck within a closed superstructure to spaces below freeboard deck, are in no case to have sill heights less than 230 mm. Access hatches for inspection of void spaces do not require any sill heights.

1.3.6 Ramps used for embarkation or disembarkation of passengers to be fitted with suitable portable handrails.

1.3.7 External vehicle ramps to comply with requirements as stipulated in Sec.3 [5].

1.4 Signboards

1.4.1 NO SMOKING signs shall be posted at all entries to vehicle space. Such signs are also to be prominently displayed in the vehicle space.

2 Bow arrangement

2.1 Bow ramp arrangement

2.1.1 Bow doors shall be situated above the freeboard deck.
2.1.2 Where bow doors are leading to a complete or long forward enclosed superstructure, an inner door shall be fitted. The inner door shall be part of the collision bulkhead. A vehicle ramp may be arranged for this purpose, provided the regulations concerning the position of the collision bulkhead are fulfilled. See [1.2.1]. If this is not possible a separate inner door shall be installed.

2.1.3 Bow doors shall be so fitted as to ensure tightness consistent with operational conditions and to give effective protection to inner doors. Inner doors shall be weathertight, and shall be arranged with supports on the aft side of the doors.

2.2 Structural arrangement

2.2.1 In general the strength of bow doors shall be equivalent to the strength of the surrounding structure. Impact strengthening shall be considered.

2.2.2 Bow doors of the visor or hinged opening type shall be adequately stiffened, and means shall be provided to prevent lateral or vertical movement of the doors when closed. Adequate strength shall be provided in the connections of the lifting arms to the door structure and to the ship structure.

2.3 Closing and securing arrangement

2.3.1 Bow doors shall be fitted with adequate means of closing and securing, commensurate with the strength of the surrounding structure.

2.3.2 Closing devices shall be simple to operate and easily accessible.

2.3.3 Bow doors with clear opening area ≥ 12 m² shall be provided with closing devices with an arrangement for remote control from a convenient position and with indication of the open/closed position of every closing device. The operating panel for remote controlled bow doors shall be inaccessible to unauthorized persons.

2.3.4 Notice plates, giving instructions to the effect that the doors (inner and outer) shall be closed and all closing devices locked before leaving quay side (or terminal), shall be placed at the operating panel (or for small doors at the door when no operating panel) and on the bridge.

2.3.5 Where hydraulic cleating is applied, the system shall be mechanically lockable in closed position. This shall be understood to mean that, in the event of failure of the hydraulic system, the cleating will remain locked.

2.3.6 Indicators shall be provided on the operating panel and on the navigation bridge for all shell doors, loading doors and other closing appliances which, if left open or not properly secured, could lead to major flooding of a special category space or ro-ro cargo space. The indicator system shall be designed on the fail to safe principle and shall show if the door is not fully closed or not secured. The power supply for the indicator system shall be independent of the power supply for operating and securing the doors.

2.3.7 Means shall be arranged, such as television surveillance or a water leakage system, to provide an indication to the navigation bridge of any leakage through bow doors, stern doors or any other cargo or vehicle loading doors which could lead to major flooding of special category spaces or ro-ro cargo spaces.
2.3.8 Special category spaces and ro-ro cargo spaces are either to be patrolled or monitored by effective means, such as television surveillance, so that movement of vehicles in adverse weather and unauthorized access by passengers can be observed whilst the ship is underway.

Guidance note:
Items [2.3.6], [2.3.7] and [2.3.8] apply to all passenger ships with Ro-Ro cargo spaces or special category spaces as defined in SOLAS regulation II-2/3.

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

2.3.9 Devices shall be arranged for the doors to be secured in open position.
SECTION 3 STRUCTURES, EQUIPMENT

1 Wheel loadings and car deck structure

1.1 Design loads

1.1.1 For individual vehicles with specified arrangement and dimensions of footprints, the design pressure is in general to be taken as:

\[ p = \frac{Q}{n_0 a b} (9.81 + 0.5 a_v) \ (kN/m^2) \]

- \( Q \) = maximum axle load in t
- \( n_0 \) = number of loads areas on the axle
- \( a \) = extent in m of the load area parallel to the stiffeners (see Figure 1)
- \( b \) = extent in m of the load area perpendicular to the stiffeners (see Figure 1)
- \( a_v \) = \( 6/\sqrt{Q} \) for moving cargo handling vehicles, harbour conditions
  = vertical design acceleration for the craft.

The load area as indicated in Figure 1 are defined as:
— the footprint area of individual wheels or
— the rectangular enveloped area of footprints of a wheel group.

In general the scantlings shall be checked according to both definitions. If, however, the distance \( e \) between individual footprints is less than the breadth \( b_1 \) of the prints, the load area may normally be calculated for the group of wheels only.
### Figure 1 Definition of load area

1.1.2 If the arrangement and dimensions of footprints are not available for vehicles with pneumatic tyres the design pressure may normally be taken as:

\[
p = \frac{p_s(9.81 + 0.5a_y)}{9.81w} \text{ (kN/m}^2)\]
\[ p_0 = \text{maximum tyre pressure in kN/m}^2 \]
\[ = 1\,000 \text{ for cargo handling vehicles unless otherwise specified} \]
\[ = 120/Q + 3 \text{ for road transporters unless otherwise specified} \]
\[ w = 1.0 \text{ in general} \]
\[ = 1.20 \text{ when double wheels are specified} \]
\[ = 1.27 \text{ when triple wheels are specified} \]
\[ a_v = \text{as given in [1.1.1].} \]

The load area dimensions are in general to be taken as:
\[ a = \sqrt{A} \text{ (m)} \]
\[ b = \sqrt{A/k} \text{ (m)} \]
\[ k = k_1 \text{ in general} \]
\[ = k_2 \text{ for plating when } k_2 < k_1 \text{ and} \]
\[ \frac{wQ}{n_0 s^2} \sim 100 \]
\[ k_1 = 2.0 \text{ for single wheel} \]
\[ = 2.0 \text{ for multiple wheels with axle parallel to stiffeners} \]
\[ = 0.8 \text{ for double wheels with axle perpendicular to stiffeners} \]
\[ = 0.5 \text{ for triple wheels with axle perpendicular to stiffeners} \]
\[ k_2 = \frac{\sqrt{A}}{2s} \]
\[ A = \frac{9.81 wQ}{n_0 p_0} \text{ (m}^2) \]
\[ Q \text{ and } n_0 = \text{as defined in [1.1.1]} \]
\[ n_0 = 2 \text{ unless otherwise specified.} \]

1.1.3 For heavy vehicles where the stowing and lashing arrangement may significantly affect the load distribution at sea, the design pressure for individual load areas will be specially considered.

1.1.4 Deck areas for wheel loads from cargo handling vehicles, which are frequently operating in all directions, shall be checked for design loads with axle parallel and perpendicular to stiffeners.

1.2 Steel plating

1.2.1 The thickness of steel deck plating subjected to wheel loading shall not be less than:

\[ t = \frac{77.4 k_{a} - k_{w} c s p}{\sqrt{mk}} + t_k \text{ (mm)} \]

\[ k_{a} = 1.1 - 0.25 s/l \]
\[
\begin{align*}
    k_w &= 1.3 - \frac{4.2}{(\frac{a}{s} + 1.8)^2}, \text{ maximum } 1.0 \text{ for } a \geq 1.94s \\
    c &= b \text{ for } b < s \\
    &= s \text{ for } b > s \\
    p, a \text{ and } b &= \text{ as given in [1.1]} \\
    m &= \frac{38}{b/s - 4.7\frac{b}{s} + 6.5}, \text{ for } b/s \leq 1.0 \\
    m &= 13.57 \text{ for } b/s \text{ larger than } 1.0.
\end{align*}
\]

Between specified values of b/s the m-value may be varied linearly. The m-value may also be obtained from Figure 2.

\[
\sigma = 320 \, f_1 \, \text{N/mm}^2 \text{ (maximum) in general for seagoing conditions} \\
= 370 \, f_1 \, \text{N/mm}^2 \text{ (maximum) in general for harbour conditions} \\
= \text{as given in Table 1, but not exceeding the above general maximum values, for upper deck within 0.4 L amidships.}
\]

For upper deck between 0.4 L amidships and 0.1 L from the perpendiculars \(\sigma\) shall be varied linearly.

For tween decks \(\sigma\) shall be found by linear interpolation between upper deck value and general maximum value taken at the neutral axis.

### Table 1 Allowable bending stress for upper deck plating within 0.4 L amidships

<table>
<thead>
<tr>
<th>Arrangement</th>
<th>Condition</th>
<th>(\sigma) in N/mm(^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Longitudinally stiffened</td>
<td>Seagoing R1-R3</td>
<td>(280 , f_1 + 60 , (f_1 - f_2))</td>
</tr>
<tr>
<td>Longitudinally stiffened</td>
<td>Harbour R4-R5</td>
<td>(355 , f_1 + 20 , (f_1 - f_2))</td>
</tr>
<tr>
<td>Transversely stiffened</td>
<td>Seagoing R1-R3</td>
<td>(185 , f_1 + 135 , (f_1 - f_2))</td>
</tr>
<tr>
<td>Transversely stiffened</td>
<td>Harbour R4-R5</td>
<td>(285 , f_1 + 85 , (f_1 - f_2))</td>
</tr>
</tbody>
</table>
Figure 2 Bending moment factor (m-values)

\[ x = \frac{b}{s}, \text{ not greater than } 1.0 \text{ for plating} \]
\[ x = \frac{a}{l} \text{ for stiffeners} \]

1.2.2 In Figure 3, a – d the general thickness requirements of deck plating subjected to various wheel loading from pneumatic tyres are given. The following parameter values have been assumed:

- tyre pressure: \( p_o = 800 \text{ kN/m}^2 \)
- aspect ratio of plate field: \( l/s \geq 2.5 \)
- allowable stress: \( \sigma = 370 \text{ N/mm}^2 \)
- corrosion addition: \( t_k = 0 \text{ mm} \).
a) SINGLE WHEEL, GENERAL

b) DOUBLE WHEELS, AXLE PARALLEL TO STIFFENERS
c) DOUBLE WHEELS, AXLE PERPENDICULAR TO STIFFENERS

\[ \text{Figure 3 Steel plate thickness for wheel loadings} \]
1.3 Stiffeners of steel

1.3.1 The section modulus for deck beams and longitudinals subjected to wheel loading shall not be less than:

\[
Z = \frac{1000k_2 c d p}{m a} + Z_k \text{ (cm}^3\text{)}
\]

\[
k_2 = \begin{cases} 
1.0 & \text{for } b/s < 0.6 \text{ and } b/s > 3.4 \\
1.15 - 0.25(b/s) & \text{for } 0.6 < b/s < 1.0 \\
1.15 - 0.25(b/s) - b/s & \text{for } 1.0 < b/s < 3.4 
\end{cases}
\]

\[
c = \text{as given in [1.2.1]}
\]

\[
d = \begin{cases} 
a & \text{for } a < l \\
l & \text{for } a > l 
\end{cases}
\]

\[
a, b \text{ and } p = \text{as given in [1.1]}
\]

\[
m = \begin{cases} 
\frac{r}{(\frac{a}{L})^2 - 4.7\frac{a}{L} + 6.5} & , \text{for } a/l \leq 1.0 \\
\frac{87}{(\frac{a}{L})^2 - 6.3\frac{a}{L} + 10.9} & , \text{for } 1.2 < a/l \leq 2.5 \\
12 & , \text{for } a/l \geq 3.5
\end{cases}
\]

\[
r = \text{factor depending on the rigidity of girders supporting continuous stiffeners, taken as 29 unless better support conditions are demonstrated}
\]

\[
r = 38 \text{ when continuous stiffener may be considered as rigidly supported at each girder.}
\]

Between specified values of a/l the m-value may be varied linearly. The m-value may also be obtained from Figure 2.

\[
\sigma = \begin{cases} 
160 f_{y}^2 \text{ N/mm}^2 & \text{(maximum) in general for seagoing conditions} \\
180 f_{y}^2 \text{ N/mm}^2 & \text{(maximum) in general for harbour conditions} \\
\text{as given in Table 2, but not exceeding the general maximum values, for longitudinals within 0.4 L amidships.}
\end{cases}
\]

For longitudinals between 0.4 L amidships and 0.1 L from the perpendiculars shall be varied linearly.

For longitudinals in tween decks s may be found by interpolation as given for plating in [1.2.1].

Table 2 Allowable bending stresses for deck longitudinals

<table>
<thead>
<tr>
<th>Condition</th>
<th>( \sigma ) in N/mm(^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seagoing</td>
<td>[225f_1 - 135f_2\frac{z_n - z_a}{z_n}]</td>
</tr>
<tr>
<td>R1-R3</td>
<td></td>
</tr>
<tr>
<td>Harbour</td>
<td>[225f_1 - 18f_2\frac{z_n - z_a}{z_n}]</td>
</tr>
<tr>
<td>R4-R5</td>
<td></td>
</tr>
</tbody>
</table>
1.3.2 If more than one load area can be positioned simultaneously on the same stiffener span or adjacent spans, the sections modulus will be specially considered, based on direct stress analysis.

1.4 Steel girders

1.4.1 The scantlings of girders will be especially considered based on the most severe condition of moving or stowed vehicles.

The vehicle loads shall be taken as:

\[ P_v = Q_w (9.81 + 0.5 a_v) \] (kN)

\[ a_v = \text{vertical design acceleration for the craft} \]

\[ Q_w = \text{load on wheel group or single wheel in tonnes}. \]

1.4.2 The scantlings of girders being part of a complex system are normally to be based on a direct stress analysis.

1.4.3 Girders and stiffeners shall not be scalloped. Double continuous fillet welds are normally to be used between the plating and the strength member. Chain welds may be accepted after special consideration when vehicles are fitted with pneumatic or solid rubber tyres.

1.4.4 The necessary connection areas between stiffeners and girders will be specially considered. The shear stresses shall not exceed 100 N/mm² in the members to be joined and 115 N/mm² in the weld material.

1.5 Aluminium plating

1.5.1 The thickness of aluminium deck plating for wheel loading shall not be less than as given in [1.2.1] with the allowable stress \( \sigma \), given as:

\[ \sigma = \sigma_0 \cdot f_1 \]

\[ \sigma_0 = 180 \text{ N/mm}^2 \text{ (maximum) in general for seagoing conditions} \]

\[ = 210 \text{ N/mm}^2 \text{ (maximum) in general for harbour conditions} \]

\[ f_1 = \text{as given in Pt.3 Ch.3 Sec.1 [1.3] with respect to plate material yield stress given in Pt.3 Ch.3 Sec.2 Table 1, Pt.3 Ch.3 Sec.2 Table 2, Pt.3 Ch.3 Sec.2 Table 3 and Pt.3 Ch.3 Sec.2 Table 4.} \]

1.6 Aluminium stiffeners

1.6.1 The section modulus of aluminium deck stiffeners for wheel loading shall not be less than as given in [1.3] with the allowable stress \( \sigma \), given as:

\[ \sigma = \sigma_0 \cdot f_1 \]

\[ \sigma_0 = 160 \text{ N/mm}^2 \text{(maximum) in general for seagoing conditions R1-R3} \]

\[ = 180 \text{ N/mm}^2 \text{(maximum) in general for harbour conditions R1-R3} \]

\[ f_1 = \text{as given in Pt.3 Ch.3 Sec.1 [1.3] with respect to stiffener material yield stress given in Pt.3 Ch.3 Sec.2 Table 1, Pt.3 Ch.3 Sec.2 Table 2, Pt.3 Ch.3 Sec.2 Table 3 and Pt.3 Ch.3 Sec.2 Table 4.} \]

\[ a, r = \text{as given in [1.1.1] and [1.3.1], respectively.} \]

1.7 Aluminium girders
1.7.1 The section modulus of transverse deck beams and girders subjected to wheel loading shall not be less than as given for stiffeners in [1.6].

2 Bilge arrangement or drainage

2.1 Drainage

2.1.1 Special category spaces above bulkhead deck to be fitted with scuppers that will ensure that the water is rapidly discharged directly overboard.

2.1.2 Scuppers shall prevent the flow of air into the special category space.

3 Bow door structure

3.1 Design loads

3.1.1 For outer doors the design sea pressure \( p_s \) is in general to be taken as:
\[ p_s = p \] in Pt.3 Ch.1 Sec.3 [3.5].

3.1.2 For outer doors the design bow impact pressure is in general to be taken as:
\[ p_{sl} = p_{sl} \] in Pt.3 Ch.1 Sec.3 [3.3].
with the correction for the factor \( C_h \), and with design load area taken as \( L B_{wl} / 1000 \) (m²).

3.1.3 The design pressures and forces are normally to be calculated at the position \( h/2 \) above the bottom of the door and \( l/2 \) aft of the stem line.
For outer doors of unusual form, proportions or complicated geometry, the areas and angles used for determination of the design values of external forces may require special consideration.

3.1.4 The external design forces on each half of the outer door for support devices, including supporting structural members and surrounding structures, are given by:

- total longitudinal force:
\[ F_x = 0.375 \, p_{sl} \, A_x \] or \( 1.3 \, p_s \, A_x \), if greater

- total transverse force:
\[ F_y = 0.375 \, p_{sl} \, A_y \] or \( 1.3 \, p_s \, A_y \), if greater

- total vertical force:
\[ F_z = 0.375 \, p_{sl} \, A_z \] or \( 1.3 \, p_s \, A_z \), if greater.

The vertical force shall not be taken less than \( 3.3 \, b / h \). \( b \), \( l \) and \( h \) are breadth, length and height of the outer door in m as given in Figure 4.

\[ A_x = \text{area (m}^2\text{)} \) of the vertical front view projection of the outer door at one side of the centre line, between the levels of the bottom of the door and the weather deck or between the bottom of the door and the top of the door, whichever is the lesser.

\[ A_y = \text{area (m}^2\text{)} \) of the vertical side view projection of the outer door, between the levels of the bottom of the door and the weather deck or between the bottom of the door and the top of the door, whichever is the lesser.
\[ A_d = \text{area (m}^2\text{)} \] of the horizontal projection of the outer door at one side of the centre line, between the levels of the bottom of the door and the weather deck or between the bottom of the door and the top of the door, whichever is the lesser.

For outer doors, including bulwark, of unusual form or proportions, the areas and angles used for determination of the design values of external forces may require special consideration.

### Figure 4 Bow doors

#### 3.2 Strength criteria

**3.2.1** Scantlings of primary members and supports of bow doors shall be determined to withstand the design pressures using the allowable stresses in Table 3.

**Table 3 Allowable stresses, outer doors**

<table>
<thead>
<tr>
<th>Material</th>
<th>Design pressure ( p ) (N/mm(^2))</th>
<th>Shear stress ( \tau ) (N/mm(^2))</th>
<th>Bending or normal stress ( \sigma ) (N/mm(^2))</th>
<th>Equivalent stress ( \sigma_e ) (N/mm(^2))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel</td>
<td>( p_s )</td>
<td>80 ( f_1 )</td>
<td>120 ( f_1 )</td>
<td>150 ( f_1 )</td>
</tr>
<tr>
<td></td>
<td>0.375 ( p_{sl} )</td>
<td>105 ( f_1 )</td>
<td>160 ( f_1 )</td>
<td>200 ( f_1 )</td>
</tr>
<tr>
<td>Aluminium</td>
<td>( p_s )</td>
<td>90 ( f_1 )</td>
<td>160 ( f_1 )</td>
<td>180 ( f_1 )</td>
</tr>
<tr>
<td></td>
<td>0.375 ( p_{sl} )</td>
<td>90 ( f_1 )</td>
<td>180 ( f_1 )</td>
<td>200 ( f_1 )</td>
</tr>
</tbody>
</table>

\( f_1 \) = material factors:
Steel, see Pt.3 Ch.2 Sec.2 [2], aluminium, see Pt.3 Ch.3 Sec.2 [2].

**3.2.2** Nominal bearing pressure, determined by dividing the design force by the projected bearing area, shall not exceed 0.8 \( \sigma_f \) (N/mm\(^2\)) for steel materials, where \( \sigma_f \) is the yield stress for the bearing material. For other bearing materials the nominal bearing pressure will be specially considered.

### 3.3 Closing arrangement strength
3.3.1 In general the maximum forces acting on the supports shall be established on the basis of the external force as given in [4.1.4]. The following cases shall be considered:

a) For outer doors of the visor type the forces acting on the supports shall be determined for the following combination of simultaneous design forces:

1) $2 F_x$ and $2 F_z$
2) $1.4 F_x, 0.7 F_y$ and $1.4 F_z$, with $0.7 F_y$ acting alternatively from either side.

Guidance note:
The support forces as determined according to a1) and b1) shall in general give rise to a zero moment in the longitudinal vertical plane about the transverse axis at $h/2$ and $l/2$.

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

3.3.2 For outer doors effective supports including surrounding door and hull structural members are, in the case of failure of any single support, to have sufficient capacity to withstand the total design forces. In this case the allowable stresses given in Table 3 may be increased by 20%.

3.3.3 For outer doors of the visor type, at least two securing devices shall be provided at the bottom of the door, each capable of providing the full reaction force required to prevent opening of the door within the allowable stresses given in Table 3. The opening moment to be balanced by the said reaction force shall not be taken less than:

$$M_0 = 1.3 \left(10 W d + 5 A_x a\right) \text{(kNm)}$$

$$W = \text{mass of the door (t)}$$
$$a = \text{vertical distance (m) from visor hinge to the centroid of the vertical projected area of the bow visor}$$
$$d = \text{vertical distance (m) from hinge axis to the centre of gravity of the door}$$
$$A_x = \text{as defined in [4.1.4].}$$

3.3.4 All load transmitting elements in the design load path, from the door through supports into the ship structure, including welded connections, shall be to the same strength standard as required for the supports.

3.3.5 The lifting arm of a visor type outer door and its connections to the door and hull structure shall be dimensioned for the static and dynamic forces applied during lifting and lowering operations. A minimum wind pressure of 1.5 kN/m² shall be taken into account.

4 External vehicle ramps

4.1 General

4.1.1 Vehicle ramps for shore connection are normally to be built with a grillage system of girders, and local stiffeners in the vehicle’s moving direction. The ramps shall have sufficient strength for the specified design working loads and maximum loads during hoisting operation. After end ramps shall have sufficient flexibility for resting on the quay during loading/unloading operations with a minimum list of 3 degrees. A direct stress analysis may have to be carried out to demonstrate that stresses and flexibility are acceptable.

4.1.2 Plates and stiffeners shall satisfy the strength requirements given in [1].
4.1.3 If the ramp is also acting as a watertight door, relevant requirements given for the main class shall be satisfied.

4.1.4 The support structure for large ramps in stowed position will have to be specially considered based on design loads as given for heavy units Pt.3 Ch.1 Sec.3 [3]. A direct stress analysis may have to be carried out.

4.1.5 Satisfactory functional tests shall be carried out. Control handles for winches or operation devices shall be so arranged that they quickly revert to the neutral (stop) position when released. Provision shall be made to lock handles in the neutral position when the operating gear is unattended.
SECTION 4 CONTROL AND MONITORING

1 General requirements

1.1 General

1.1.1 For instrumentation and automation, including computer based control and monitoring, the requirements of in this chapter are additional to those given in SHIP Pt.4 Ch.9 and SHIP Pt.4 Ch.10.

2 System design

2.1 General

2.1.1 For category B craft, remote control systems for propulsion machinery and directional control should be equipped with back-up systems controllable from the operating compartment.

(HSC Code 11.2.4)

2.1.2 Category B craft should be provided with at least two independent means of propulsion so that the failure of one engine or its support systems would not cause the failure of the other engine or engine systems and with additional machinery controls in or close to the machinery space (local control system).

(HSC Code 9.7)
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