SECTION 5 INDEPENDENT TANKS

Symbols

L : Rule length as defined in Ch 1, Sec 2, [3.2]

x : Longitudinal position, in m, taken from the aft end AE as defined in Ch 1, Sec 2, [3.4.2].

1 General

1.1 Application

1.1.1 The present section deals with scantlings of independent tanks, in steel, aluminium alloys or composites.

1.2 General

1.2.1 The connections to reinforced hull structures of independent tanks are to be able to withstand the reactions induced by the tank weight.

For that purpose, the dynamic amplification due to behaviour of yacht at sea is to be taken into account for high speed motor yachts as defined in Ch 5, Sec 1, [2] and for monohull sailing yachts. For such yachts, the tank weight is to be taken as W_D, where:

- W_D : Dynamic weight of the tank, taken equal to $(1 + 0,4\ a_V)$

  W : Maximum static weight of the tank

  a_V : Vertical acceleration resulting from effect of heave and pitch, equal to:

  $a_v = 2\ .\ x/L\ .\ a_{CG}$, for high speed motor yacht, without being less than a_{CG} , where a_{CG} is defined in Ch 5, Sec 1, [2.1.7]

  $a_v = a_H + a_P$, for monohull sailing yacht , where a_H and a_P are defined in Ch 5, Sec 1, [2.2].

2 Steel and aluminium tanks

2.1 General

2.1.1 In case of gas-oil or diesel-oil aluminium tanks, it is reminded that careful attention is to be paid to welds, as repairs are made very difficult due to degreasing difficulty.

2.2 Plating

2.2.1 The rule thickness of independent tank plates is given, in mm, by the formulae:

$$t = 22,4 \cdot \mu \cdot s \cdot \sqrt{\frac{p}{\sigma_{ad}}}$$

where:

s : Smaller side, in m, of the elementary plate panel

μ : Aspect ratio coefficient of the elementary plate panel, equal to:

$$\sqrt{1,1 - \left(0,5 \cdot \frac{s^2}{\ell^2}\right)}$$

without being taken more than 1, where:

ℓ : Longer side, in m, of the elementary plate panel

p : Design pressure, or testing pressure, in kN/m², given in Ch 7, Sec 1, [5]

σ_{ad} : Rule admissible stress, in N/mm², defined in Ch 4, Sec 3, Tab 2 or Ch 4, Sec 3, Tab 4 whatever the case

Checking of plate thickness against design pressure is to be performed with admissible local bending stress induced by local hydrodynamic loads.

Checking of plate thickness against testing pressure is to be performed with admissible local bending stress induced by tank testing loads.

2.2.2 A local increase in plating thickness is generally required in way of pipe penetration.

2.3 Stiffeners

2.3.1 As a rule, the design section modulus Z, in cm³, of independent tank ordinary stiffeners is given by the formulae:

$$Z = 1000 \cdot \left(1 - \frac{s}{2 \cdot l}\right) \cdot \frac{p \cdot s \cdot l^2}{m \cdot \sigma_{ad}}$$

where:

ℓ : Span of the siffener, in m, measured as indicated in Ch 4, Sec 4, [3]

s : Spacing between siffeners, in m

p : design pressure, or testing pressure, in kN/m², as given in Ch 7, Sec 1, [5]

σ_{ad} : Rule admissible stresses, in N/mm², defined in Ch 4, Sec 3, Tab 2 or Ch 4, Sec 3, Tab 4 whatever the case

Checking of stiffener section modulus against design pressure is to be performed with admissible local bending stress induced by local hydrodynamic loads.

Checking of stiffener section modulus against testing pressure is to be performed with admissible local bending stress induced by tank testing loads.

m : Coefficient depending on end conditions, equal to 12, 10 or 8, as defined in Ch 4, Sec 4, [3.2.5].

2.3.2 As a rule, the design shear area A_{sh}, in cm^2, of independent tanks stiffeners is given by the formulae:

$$A_{sh} = 10 \cdot \left(1 - \frac{s}{2 \cdot l}\right) \cdot \frac{p \cdot s \cdot l}{\tau_{ad}}$$

where:

p, s, ℓ : As indicated in [2.3.1]

τ_{ad} : Rule admissible shear stress, in N/mm^2, as defined in Ch 4, Sec 3, Tab 2 or Ch 4, Sec 3, Tab 4 as appropriate

Checking of stiffener shear area against design pressure is to be performed with admissible local shear stress induced by local hydrodynamic loads.

Checking of stiffener section modulus against testing pressure is to be performed with admissible local shear stress induced by tank testing loads.

2.3.3 The end connections of stiffeners with supporting structures are also to be carefully checked.

2.3.4 In independent tanks made of steel and intended for fresh water or sea water, the fillet welds connecting the stiffeners to the attached plate are to be double continuous fillet welds, to avoid corrosion.

However, in independent tanks made of steel and intended for gas-oil, it is accepted to have intermittent fillet welds.

3 Composites tanks

3.1 General

3.1.1 The mechanical characteristics of the composite laminates used for the tanks is described in Ch 12, Sec 4.

3.2 Plating

3.2.1 The rule scantlings of independent tank in composites material is to be checked according to Ch 9, Sec 3, [7], with

p : Design pressure, or testing pressure, in kN/m^2, given in Ch 7, Sec 1, [5]

SF : Safety coefficients between the applied stresses (see Ch 12, Sec 4, [4]) and the theoretical breaking stresses (see Ch 12, Sec 3, [5]), to be compared with Rule safety factor defined in Ch 4, Sec 3, [5.4].

3.2.2 A local increase in plating laminate is generally required in way of pipe penetration.

3.3 Stiffeners

3.3.1 The rule flexural modulus and shear areas of independent tank composites stiffeners are is to be checked according to Ch 9, Sec 4, [2], with:

p : Design pressure, or testing pressure, in kN/m^2, given in Ch 7, Sec 1, [5]

SF : Safety coefficients between the applied stresses and (see Ch 12, Sec 4, [6]) and the theoretical breaking stresses (see Ch 12, Sec 3, [5]), to be compared with Rule safety factor defined in Ch 4, Sec 3, [5.4].

3.3.2 The end connections of stiffeners with supporting structures are also to be carefully checked.