GC8 Permissible stresses in way of supports of type C cargo tanks

(1986)
(Rev.1
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Section 4.23.3.1 of the IMO INTERNATIONAL CODE FOR THE CONSTRUCTION AND EQUIPMENT OF SHIPS CARRYING LIQUEFIED GASES IN BULK (MSC.370(93)) reads:

"4.23.3.1 Plastic deformation

For type C independent tanks, the allowable stresses shall not exceed:

$\sigma_m \leq f$
$\sigma_L \leq 1.5f$
$\sigma_b \leq 1.5f$
$\sigma_L + \sigma_b \leq 1.5f$
$\sigma_m + \sigma_b \leq 1.5f$
$\sigma_m + \sigma_b + \sigma_g \leq 3.0f$
$\sigma_L + \sigma_b + \sigma_g \leq 3.0f$,

where:

σ_m = *equivalent primary general membrane stress;*
σ_L = *equivalent primary local membrane stress;*
σ_b = *equivalent primary bending stress;*
σ_g = *equivalent secondary stress; and*
f = *the lesser of R_m/A or R_e/B,*

with R_m and R_e as defined in 4.18.1.3. With regard to the stresses σ_m, σ_L, σ_b and σ_g, the definition of stress categories in 4.28.3 are referred. The values A and B shall be shown on the International Certificate of Fitness for the Carriage of Liquefied Gases in Bulk and shall have at least the following minimum values:

	Nickel steels and carbon-manganese steels	***Austenitic steels***	***Aluminium alloys***
A	*3*	*3.5*	*4*
B	*1.5*	*1.5*	*1.5*

"

Note:

1. Rev.1 of this UI is to be uniformly implemented by IACS Societies on ships the keels of which are laid or which are at a similar stage of construction on or after 1 July 2016.

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Interpretation

The circumferential stresses at supports shall be calculated by a procedure acceptable to the Classification Society for a sufficient number of load cases.

1. Permissible stresses in stiffening rings:

For horizontal cylindrical tanks made of C-Mn steel supported in saddles, the equivalent stress in the stiffening rings shall not exceed the following values if calculated using finite element method:

$$\sigma_e \leq \sigma_{all}$$

where:

$$\sigma_{all} = \min(0.57R_m; 0.85R_e)$$

$$\sigma_e = \sqrt{(\sigma_n + \sigma_b)^2 + 3\tau^2}$$

σ_e = von Mises equivalent stress in N/mm^2

σ_n = normal stress in N/mm^2 in the circumferential direction of the stiffening ring

σ_b = bending stress in N/mm^2 in the circumferential direction of the stiffening ring

τ = shear stress in N/mm^2 in the stiffening ring

R_m and R_e as defined in 4.18.1.3 of the Code.

Equivalent stress values σ_e should be calculated over the full extent of the stiffening ring by a procedure acceptable to the Classification Society, for a sufficient number of load cases.

2. The following assumptions should be made for the stiffening rings:

2.1 The stiffening ring should be considered as a circumferential beam formed by web, face plate, doubler plate, if any, and associated shell plating.

The effective width of the associated plating should be taken as:

.1 For cylindrical shells:
an effective width (mm) not greater than 0.78 $\sqrt{rt}$ on each side of the web. A doubler plate, if any, may be included within that distance.

where:

r = mean radius of the cylindrical shell (mm)

t = shell thickness (mm)

.2 For longitudinal bulkheads (in the case of lobe tanks):

the effective width should be determined according to established standards. A value of 20 t_b on each side of the web may be taken as a guidance value.

where:

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t_b = bulkhead thickness (mm).

2.2 The stiffening ring should be loaded with circumferential forces, on each side of the ring, due to the shear stress, determined by the bi-dimensional shear flow theory from the shear force of the tank.

3. For calculation of reaction forces at the supports, the following factors should be taken into account:

3.1 Elasticity of support material (intermediate layer of wood or similar material).
3.2 Change in contact surface between tank and support, and of the relevant reactions, due to:

– thermal shrinkage of tank.

– elastic deformations of tank and support material.

The final distribution of the reaction forces at the supports should not show any tensile forces.

4. The buckling strength of the stiffening rings should be examined.

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