CALCULATION OF FIXATION OF CYLINDRICAL CONTAINER

FUNDAMENTALS:

-mass of container (100L): m=82.5 kg (including 80% LPG)
-diameter of container: d=360 mm
-dimension between the bolts on the headside of the containerframe: l = 180 mm
-dimension of bolts : 4 x M8 (8.8)
-dimension of clamping band: 19x1 mm
-dimension of triangle-bolt: M8 (8.8)
-gravitation : g=9.8 m/s²

MECHANICAL PROPERTIES: tensile stress (σ_t) & shear stress (τ_s)

-Bracket (ST 37-2)	σ_t = 240 N/mm²	τ_s = 138 N/mm²
-Bolt (M8 x 8)	σ_t = 640 N/mm²	τ_s = 369 N/mm²
-Tankframe (ST 37-2)	σ_t = 240 N/mm²	τ_s = 138 N/mm²
-Triangle-Bolt (4.6)	σ_t = 240 N/mm²	τ_s = 138 N/mm²
-Clamping Band (AISI 301 or AISI 304)	σ_t = 500/700 N/mm²	τ_s = 287/402 N/mm²

CALCULATION FORCE IN DRIVE DIRECTION (F_d) AND UPWARD DIRECTION (F_u)

Requirement: The fastening has to withstand a force of 20 times the mass of the container
In driving direction.

$$F_d = 20 \times m \times g = 20 \times 85.5 \times 9.8 = 16.8KN$$

$$M_{w.r.t A} = 0$$

$$F_d \times \frac{d}{2} = F_u \times l \Rightarrow F_u = \frac{16.8 \times 180}{175} = 17.3KN$$

CALCULATION SHEAR STRESS AT 4 BOLTS (TANKFRAME)

$$\tau_s = \frac{F_d}{4 \times A} = \frac{16.8}{4 \times \frac{\pi}{4} \times 6.83^2} = 120N/mm^2$$

CALCULATION TENSILE STRESS AT 2 BOLTS (TANKFRAME / VEHICLE)

$$\sigma_t = \frac{F_u}{2 \times A} = \frac{17.3}{2 \times \frac{\pi}{4} \times d_s^2} = \frac{17.3}{2 \times \frac{\pi}{4} \times 6.83^2} = 236 N/mm^2$$

CALCULATION TENSILE STRESS AT CLAMPING BAND

Requirement: minimum 3 Clamping Bands
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$$\sigma_t = \frac{F_u}{3 \times A} = \frac{17.3}{3 \times 19 \times 1} = 303 N/mm^2 \qquad (3 \text{ Clamping Bands})$$

$$\sigma_t = \frac{F_u}{4 \times A} = \frac{17.3}{4 \times 19 \times 1} = 228 N/mm^2 \qquad (4 \text{ Clamping Bands})$$

CALCULATION TENSILE STRESS AT TRIANGLE BOLT

1 Triangle Bolt per Clamping Band

$$\sigma_t = \frac{F_u}{3 \times A} = \frac{17.3}{3 \times \frac{\pi}{4} \times 6.83^2} = 157 N/mm^2 \qquad (3 \text{ Triangle Bolts})$$

$$\sigma_t = \frac{F_u}{4 \times A} = \frac{17.3}{4 \times \frac{\pi}{4} \times 6.83^2} = 118 N/mm^2 \qquad (4 \text{ Triangle Bolts})$$

CALCULATION SHEAR STRESS AT BRACKET

1 Bracket per Clamping Band

$$\tau_s = \frac{F_u}{3 \times A} = \frac{17.3}{3 \times 2 \times 3.3 \times 10} = 87 N/mm^2 \qquad (3 \text{ Brackets})$$

$$\tau_s = \frac{F_u}{4 \times A} = \frac{17.3}{4 \times 2 \times 3.3 \times 10} = 66 N/mm^2$$ (4 Brackets)

CALCULATION SHEAR STRESS AT TANKFRAME (CLAMPING BAND)

$$\tau_s = \frac{F_u}{3 \times A} = \frac{17.3}{3 \times 2 \times 9.5 \times 3.3} = 92 N/mm^2$$ (3 Clamping Bands)

$$\tau_s = \frac{F_u}{4 \times A} = \frac{17.3}{4 \times 2 \times 9.5 \times 3.3} = 69 N/mm^2$$ (4 Clamping Bands)

DRAWING OF CYLINDRICAL CONTAINER