Calculation of fixation of toroidale containers

Declaration:	mass of container [m]:	71.5 [kg]
	Gravitation [g]:	9.8 [m/s²]
	Required acceleration [v]:	20 / 8[-]
	Height of container [h]:	270 [mm]
	Diameter of container [d]:	650 [mm]
	Pitch circle of bolts [d]:	440 [mm]
	Dimension of bolts:	3x M10, kwal. 8.8
	Dimension of clamping band:	30x1.5 [mm], St 37-2
	Dimension of bracket:	40x3 [mm], St 37-2

1. Calculation shear stress: bolts

Load/force:
$$F_G = m * g * v$$
$$F_G = 71.5 * 9.8 * 20 = 14*10^3 \text{ [N]}$$

Shear stress:
$$\tau_s = F_G / A$$
$$\tau_s = 14*10^3 / (3*\pi/4*8.59^2) = 80.52 \text{ [N/mm}^2\text{]}$$

Permissible shear stress:
$$\tau_s = \sigma_t / 2.2 = 291 \text{ [N/mm}^2\text{]}$$

Conclusion: The occured shear stress is allowable.

2. Calculation tensile stress: clamping band/brackets/bolts

Assumption: In worst case situation the container will rotate on the spot of the two bolts at the front side as a result of the mass and deceleration. Because of this all tensile force occurs in the bolt/clamping band combination at the back side.

Load/force:
$$\Sigma M_{t.o.v.A} = 0$$
$$F_G * h/2 = F_t * 330$$
$$F_t = 5.72*10^3 \text{ [N]} \qquad v=8: 2.3*10^3 \text{ [N]}$$

Tensile stress per band:
$$\sigma_t = F_t/2 / A$$
$$\sigma_t = 5.72*10^3/2 / (30*1.5)$$
$$\sigma_t = 63.5 \text{ [N/mm}^2\text{]} \qquad v=8: 25.4 \text{ [N/mm}^2\text{]}$$

Tensile stress per bracket:
$$\sigma_t = F_t/2 / A$$
$$\sigma_t = 5.72*10^3/2 / (40*3)$$
$$\sigma_t = 23.8 \text{ [N/mm}^2\text{]} \qquad v=8: 9.5 \text{ [N/mm}^2\text{]}$$

Tensile stress in the bolt:
$$\sigma_t = F_t / A$$
$$\sigma_t = 5.72*10^3 / (\pi/4*8.59^2)$$
$$\sigma_t = 98.7 \text{ [N/mm}^2\text{]} \qquad v=8: 39.5 \text{ [N/mm}^2\text{]}$$

Permissible tensile stress:
clamping band: $\sigma_t = 240$ [N/mm²]
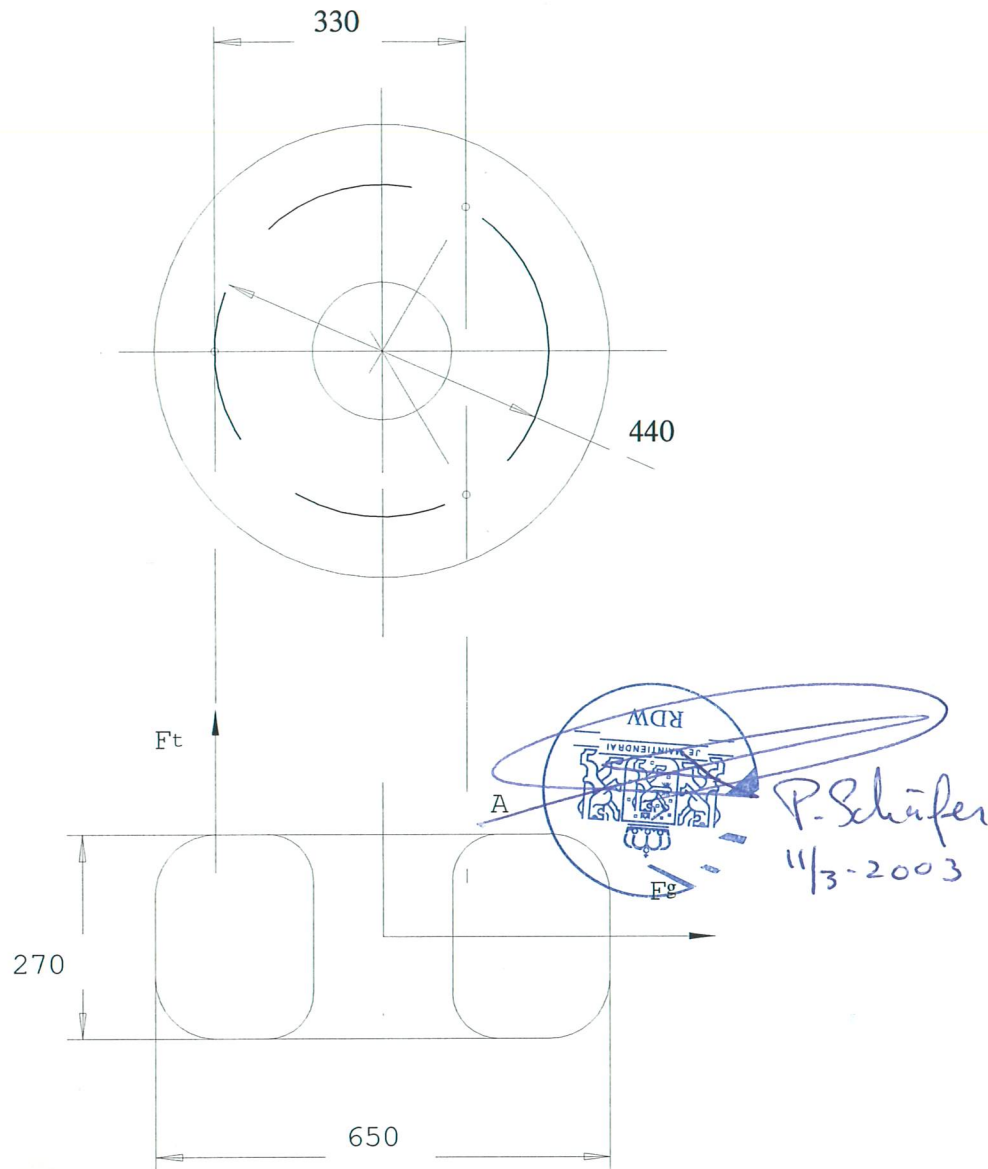bracket: $\sigma_t = 240$ [N/mm²]
bolt: $\sigma_t = 640$ [N/mm²]

Conclusion: In all cases the occured tensile stress is allowable.

Approved by the RDW   Date:
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Drawing of toroidale container

330

440

Ft

270

650

A

Fg

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Fastening metal strap

M8 bolt

M8 washer

M8 spring washer
M8 nut

brace

metal strap

adhesive strip

M10 countersink

67/70 ltr

56 ltr

51/54/58 ltr

46/49 ltr

incase regulation

fill up bush

rail-bearing plate

platework wheel tank

rail-bearing plate

M10 spring washer

M10 nut

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