ITEM : SAMPLE
SERVICE :SAMPLE
N1 Nozzle

Date :
Rev. : 0
By :
Sheet : 1/3

ALLOWABLE EXTERNAL LOADS ON TANK SHELL OPENING - APP. P

Input:

Tank Nominal Mean Radius	R :	23775	(mm) - D/2	Design Pressure Pd :	0	kPa
Max. Design Liquid Level	H :	12920	(mm)			
Product Specific Gravity	G :	0.8				
Design Temperature	T :	70	^{0}C	ΔT:	50	^{0}C
Shell Thickness	t :	18	(mm)			
Nozzle Outside Radius	a :	406.4	(mm)			
Nozzle Elevation	L :	550	(mm)			

Calculation:

Modulus of Elasticity from Table P-1a, E	:	200,260	(MPa)
Thermal Expansion Coeff. from Table P-1a, α	:	0.000012	(mmx10^{-6}/mm ^{0}C)

$\frac{R}{t_1}$ = 1320.8 $\frac{a}{R}$ = 0.0171 $\frac{L}{2a}$ = 0.6767 ⇒ 1.0

For the radial load (from Fig. P-2A) $\frac{K_R}{E(2a)}$ = 5.91E-05 K_R= 9.61E+03 N/mm

For the longitudinal mement (from Fig. P-2B) $\frac{K_L}{E(2a)3}$ = 7.77E-05 K_L= 8.356E+09 N-mm/rad

For the longitudinal mement (from Fig. P-2C) $\frac{K_C}{E(2a)3}$ = 5.30E-05 K_C= 5.696E+09 N-mm/rad

Calculation of unrestrained shell deflection and rotation at the nozzle centerline resulting from product:

$\beta = \frac{1.285}{\sqrt{(Rt)}}$ = 0.002 /mm βL = 1.0804 rad

$$W = \frac{9.8\times10^{-6}GHR^2}{Et}\times\left[1-e^{-\beta L}\cos(\beta L)-\frac{L}{H}\right]+\alpha R\Delta T = 26.93 \text{ mm}$$

$$\theta = \frac{9.8\times10^{-6}GHR^2}{Et}\times\left\{\frac{1}{H}-\beta e^{-\beta L}[\cos(\beta L)+\sin(\beta L)]\right\} = -0.013 \text{ rad}$$

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The Allowable Loads for Shell Opening :

X_A : 956.4 mm X_B : 143.6 mm X_C : 550 mm

Nondimensional Quantities :

$\frac{X_A}{(Rt)^{0.5}}$ = 1.462 $\frac{X_B}{(Rt)^{0.5}}$ = 0.2195 $\frac{X_C}{(Rt)^{0.5}}$ = 0.8407 $\lambda = \frac{a}{(Rt)^{0.5}}$ = 0.6212

From Figures P-4A and P-4B; Y_F: 1.3023 /N Y_L: 3.7142 /N-mm Y_C: 2.5057 /N-mm

Pressure and Load on Opening :

P = 9.8*SG*(H-L) + Pd*1000 = 96,981 Pa $F_P = P\pi a^2$ = 50,320 N

Nomogram : $1.0-0.75\{(X_B/(Rt)^{0.5}\}$ = 0.84

$1.0-0.75\{(X_A/(Rt)^{0.5}\}$ = 0.10

$1.0-0.75\{(X_C/(Rt)^{0.5}\}$ = 0.37

For M_L = 0 and M_C = 0; Since $\frac{\lambda F_R}{2Y_F F_P} \leq 0.10$ $F_{r\,max}$ = **21,098** N

[Tension at A Controls]

For M_L = 0 and F_R = 0; Since $\frac{\lambda M_C}{aY_C F_P} \leq 0.37$ $M_{c\,max}$ = **3.05E+07** N-mm

[Tension at C/C' Controls]

M_L UP,
For F_R = 0 and M_C = 0; Since $\frac{\lambda M_L}{aY_L F_P} \leq 0.84$ $M_{L\,max}$ = **1.02E+08** N-mm

[Tension at B Controls]

M_L DOWN,
For F_R = 0 and M_C = 0; Since $\frac{\lambda M_L}{aY_L F_P} \leq 0.10$ $M_{L\,max}$ = **-1.22E+07**

[Tension at A Controls]

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NOMOGRAMS :