FACTUAL REPORT – ATTACHMENT 2

Structural Analysis Water Tank (extract)

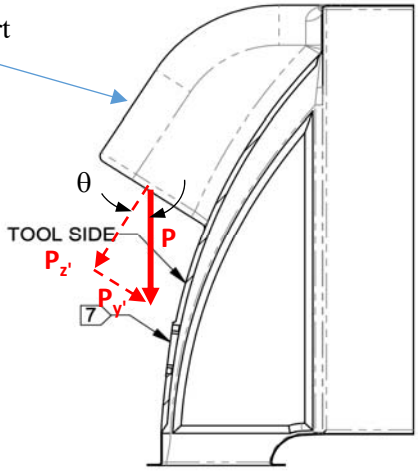
AIRWORTHINESS

ERA21FA233

8. TANK ANALYSIS

8.7 Snorkel Attachment

The LEC180010-1 panel also supports the BME-007-100 tank snorkel, which can be used to fill the tank. Per drawing BME-007-100, the pump motor on the snorkel weighs 50 pounds. The snorkel is 15 feet long, and the hose is 6 inch diameter Tigerflex. Conservatively, the assembly weight will be estimated as 100 pounds. The LECA180003-9 Gate Sealing Flange Assembly attaches the snorkel to the tank.



For the critical 4g down case, the load on the interface is:

W = 100 lb

P=4W = 400 lb

The snorkel interface surface normal makes the angle θ with the global Z-axis.

θ = 30 deg = 0.524 radians

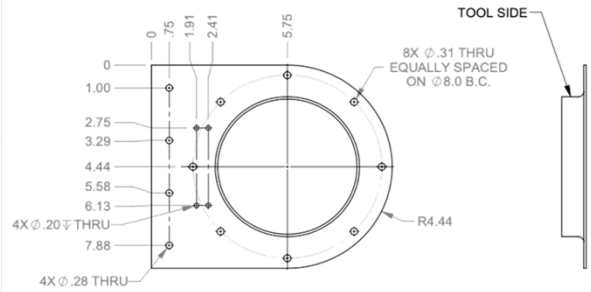
$P_{z'} = P \cos\theta = 400 \times \text{COS}[0.524] =$ 346 lb

$P_{y'} = P \sin\theta = 400 \times \text{SIN}[0.524] =$ 200 lb

There are 8 fasteners attaching the snorkel. The load per fastener is:

$P_t = P_{z'} / 8 =$ 346 / 8 = 43 lb

$P_{shr} = P_{y'} / 8 =$ 200 / 8 = 25 lb



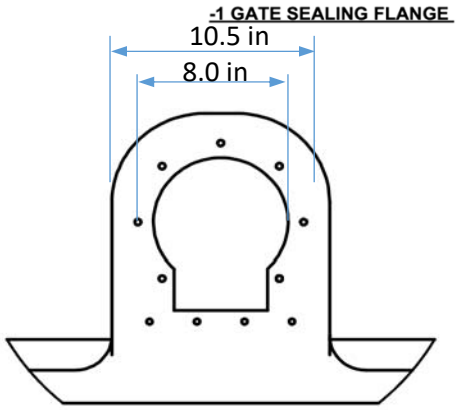
This magnitude of load is good by inspection for the AN4 hardware that attaches the flange. The local bending on the flange is:

$M = P_t L$, where $L = 0.5 \times (10.5 - 8) =$ 1.25

$M =$ 43.3 × 1.25 = 54.1 in-lb

$M' = M / (2L) =$ 54.1 / (2 × 1.25)

$M' =$ 21.7 in-lb/in



This running bending moment (based on 45 degree fanout) is applied to the solid laminate of the flange.

Number of Plies 12 t_{tot} 0.0996 Generate Laminate Props

Ply	Matl	Descr	t	θ (deg)	h_k	h_{k-1}
1	1	CSW Fabric	0.0083	0	-0.0415	-0.0498
2	1	CSW Fabric	0.0083	45	-0.0332	-0.0415
3	1	CSW Fabric	0.0083	0	-0.0249	-0.0332
4	1	CSW Fabric	0.0083	0	-0.0166	-0.0249
5	1	CSW Fabric	0.0083	45	-0.0083	-0.0166
6	1	CSW Fabric	0.0083	0	0.0000	-0.0083
7	1	CSW Fabric	0.0083	0	0.0083	0.0000
8	1	CSW Fabric	0.0083	45	0.0166	0.0083
9	1	CSW Fabric	0.0083	0	0.0249	0.0166
10	1	CSW Fabric	0.0083	0	0.0332	0.0249
11	1	CSW Fabric	0.0083	45	0.0415	0.0332
12	1	CSW Fabric	0.0083	0	0.0498	0.0415

Loads

Nx [lbf/in]	0.0
Ny [lbf/in]	0.0
Nxy [lbf/in]	0.0
Mx [in-lbf/in]	21.7
My [in-lbf/in]	0.0
Mxy [in-lbf/in]	0.0

Extensional A Matrix

895155	184277	0
184277	895155	0
0	0	213078

Coupling B matrix

0.00	0.00	0.00
0.00	0.00	0.00
0.00	0.00	0.00

Bending D Matrix

746.55	145.80	0.00
145.80	746.55	0.00
0.00	0.00	169.61

A' Matrix

1.167E-06	-2.401E-07	1.667E-12
-2.401E-07	1.167E-06	-1.667E-12
1.667E-12	-1.667E-12	4.693E-06

B' Matrix

5.557E-23	-1.441E-22	1.349E-27
-1.441E-22	5.557E-23	-1.349E-27
1.269E-27	-1.269E-27	3.146E-21

D' Matrix

1.393E-03	-2.720E-04	1.934E-09
-2.720E-04	1.393E-03	-1.934E-09
1.934E-09	-1.934E-09	5.896E-03

Number of Plies 12 t_{tot} 0.0996 inch

Ply	Matl	z	$\mu\varepsilon_x$	$\mu\varepsilon_y$	$\mu\varepsilon_{xy}$	σ_x	σ_y	τ_{xy}	Tsai-Hill Failure Index (>1 = fail)
1	1	-0.0498	-1505	294	0	-15553	2428	0	0.444
2	1	-0.0415	-505	-505	750	-5469	-5469	1064	0.118
3	1	-0.0332	-1003	196	0	-10369	1619	0	0.197
4	1	-0.0249	-752	147	0	-7777	1214	0	0.111
5	1	-0.0166	-202	-202	300	-2187	-2187	426	0.019
6	1	-0.0083	-251	49	0	-2592	405	0	0.012
7	1	0.0083	251	-49	0	2592	-405	0	0.012
8	1	0.0166	202	202	-300	2187	2187	-426	0.019
9	1	0.0249	752	-147	0	7777	-1214	0	0.111
10	1	0.0332	1003	-196	0	10369	-1619	0	0.20
11	1	0.0415	505	505	-750	5469	5469	-1064	0.12
12	1	0.0498	1505	-294	0	15553	-2428	0	0.44

$$MS = 1 / K_{Tsai\text{-}Hill} - 1 = \quad 1 / 0.444 - 1 = \quad +1.25 \leftarrow$$