Fire Tube Flange

BS5500 Methodology

Description: Fire Tube Flange

Design Conditions:

100	**P** [psi] - interior design pressure
0.125	**c** [in] - corrosion allowance
0.25	**Cf** - factor of attachement per figure UG-34

Flange Data:

SA-516 70N	Material
20000	**Sp** [psi] - allowable stess at design temp
1	**tn** [in] - nominal thickness of slip on flange
1.5	**tb** [in] - nominal thickness of blind flange
20.5	**Di** [in] - short side inside diameter
20.5	**B** [in] - loose type inside diameter
25	**L** [in] - distance CL to CL
1	**E** - flange material efficiency
0.625	**g0** [in] - nozzle neck thickness
0.375	**Leg0** [in] - outside fillet weld size
0.375	**Legl** [in] - inside fillet weld size

Gasket Data:

26.5	**God** [in] - gasket outside diameter on the short side
0.125	**gt** [in] - gasket thickness
4.2	**m** - gasket multiplication factor
2931	**y** [psi] - gasket seating stress

Bolt Data:

SA-193 B7	Material
25000	**Sb** [psi] - allowable stess at design temp
28800000	**Emi** [psi] - modulus of elasticity
52	**n** - number of bolts
0.875	**Db** [in] - bolt diameter
1	**Bd** [in] - bolt hole diameter
23.5	**BCDs** [in] - small bolt circle diameter
49	**BCDl** [in] - large bolt circle diameter

Variables:

1	**2b'** [in] =	effective gasket contact width taken as 0.2 per BS 5500		0.2
2	**A** [in^2] =	bolt cross sectional area		0.419
3	**Z** [in] =	3.4-(2.4*(BCDs/BCDl))	3.4-(2.4*(23.5/49)) =	2.249

Hydrostatic End Forces:

4	**bp** [in] =	4/SQRT(25.4)*SQRT(God-BCDs)	4/SQRT(25.4)*SQRT(26.5-23.5) =	1.3747
5	**H** [lb-in] =	P*((PI()*((BCDs-Bd)^2)/4)+(BCDs-Bd)*L)		
6			100*((3.1415*((23.5-1)^2)/4)+(23.5-1)*25) =	96009.6094
7	**Hd** [lb-in] =	P*(PI()*(B^2)/4+(B*L))	100*(3.1415*(20.5^2)/4+(20.5*25)) =	84255.3844
8	**Ht** [lb-in] =	H-Hd	96009.609-84255.384 =	11754.225

Compression Load On Gasket To Ensure Tight Joint:

9	**hp** [in] =	(Bd+2b')/2	(1+0.2)/2 =	0.6
10	**Dg** [in] =	BCDs-(2*hp)	23.5-(2*0.6) =	22.3

Hp [lb-in] =	2b'*(PI()*Dg+2*L)*m*P	0.2*(3.1415*22.3+2*25)*4.2*100 =	10084.6578	
Hr [lb-in] =	Hd+Hp+Ht	84255.384+10084.658+11754.225 =	106094.2672	
g1 [in] =	Leg0	0.375 =	0.375	
hd [in] =	(BCDs-B)/2	(23.5-20.5)/2 =	1.5	
ht [in] =	(BCDs+Bd+2b'-B)/4	(23.5+1+0.2-20.5)/4 =	1.05	
hr [in] =	(God-BCDs+Bd)/4	(26.5-23.5+1)/4 =	1.0	
HR [lb-in] =	(Hd*hd+Ht*ht+ Hp*hp)/hr			
		(84255.384*1.5+11754.225*1.05+10084.658*0.6)/1 =	144775.8075	

Number Of Bolts Required:

Wm1 [lb] =	H+Hp+HR	96009.609+10084.658+144775.807 =	250870.0747	
Am1 [in^2] =	Wm1/Sb	250870.075/25000 =	10.0348	
Wm2 [lb] =	(PI()*BCDs+2*L)*bp*y	(3.1415*23.5+2*25)*1.375*2931 =	498917.563	
Am2 [in^2] =	Wm2/Sb	498917.563/25000 =	19.9567	
Am [in^2] =	MAX(Am1, Am2)	MAX(10.035,19.957) =	19.9567	
Ba [in^2] =	Am/A	19.957/0.419 =	47.6294	
CheckBa	Ba<=n	47.629<=52 =	**Ok**	

Mating Flange Thickness:

tm [in] =	SQRT((6*HR*hr)/(Sp*((PI()*BCDs)+(2*L) - (n*Bd))))+c			
		SQRT((6*144775.807*1)/(20000*((3.1415*23.5)+(2*25)-(52*1))))+0.125 =	0.9026	
Checktm	tm<=tn	0.903<=1 =	**Ok**	

Oblong Blind Flange Thickness:

tr [in] =	BCDs*SQRT((Z*Cf*P)/(Sp*E))+c			
		23.5*SQRT((2.249*0.25*100)/(20000*1))+0.125 =	1.371	
Checktr	tr<=tb	1.371<=1.5 =	**Ok**	

Maxium Bolt Pitch:

Pitchmax [in] =	2*Db+(6*tm/(m+0.5)*0.996513022)			
		2*0.875+(6*0.903/(4.2+0.5)*0.996513022) =	2.8983	
Pitch [in] =	(BCDs*PI()+2*L)/n	(23.5*3.1415+2*25)/52 =	2.3813	
CheckPitch =	Pitch<=Pitchmax	2.381<=2.898 =	**Ok**	