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Layout

Input values:	*1.234*	or	1.234
Calculated values:	***1.234***	or	**1.234**
Critical values:	*1.234*	or	1.234
Estimated values:	*1.234*	or	1.234

Summary

Strength Calculation Software	Program System ATLAS	Version	**8.29.1**
Developed by Lauterbach Verfahrenstechnik GmbH Certified per DIn EN ISO 9001:2015	Certificate Number 01 100 044763		

	LV Soft	**ASME**	**Diff [%]**
Example E4.16.1 - Integral Type Required load W	1.054.672,88 N 237.099,95 lbf	237626,30 lbf	**0,22%**
Example E4.16.1 - Loose Type Required load W	1.703.878,63 N 383.047,25 lbf	387702,50 lbf	**1,20%**

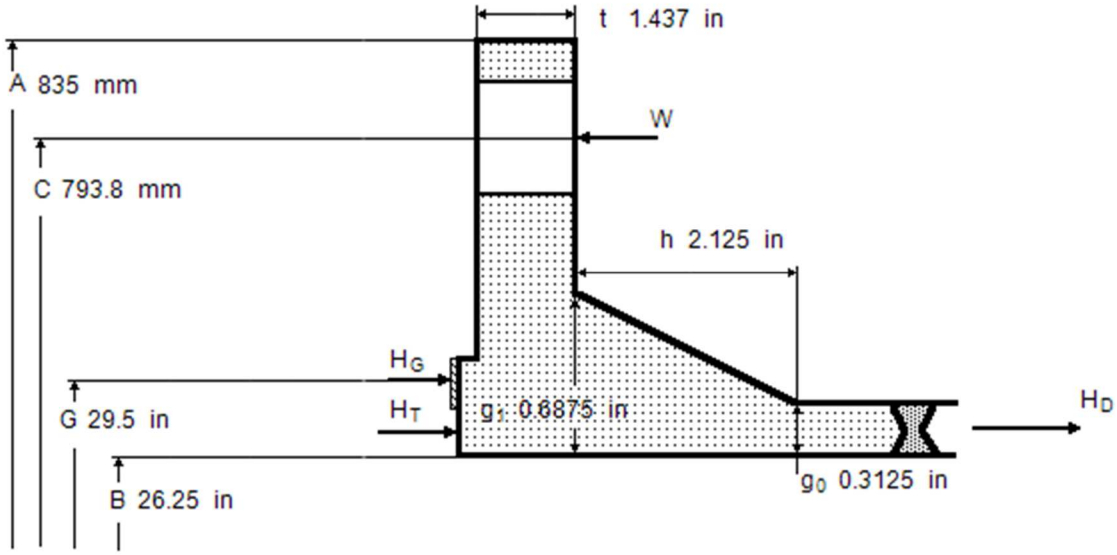
E 4.16.1 - Bolted flanges - ASME BPVC VIII Division 1 App. 2: 2017

Integral Type Flange

Design data

Design pressure	P_D	**9.308** bar	$= p_D$	135	psi
Hydrostatic head	D_P	**0** bar	$= D_p$	0	psi
Calculation pressure	P_0	**9.308** bar	$= p_0$	**135**	psi
Calculation temperature			T_0	650	°F

Flange



Outside diameter	A	835	mm	Inside diameter	B	26.25	in
Bolt circle diameter	C	793.8	mm	Pipe size	B_n	**26.25**	in
Hub length	h	2.125	in	Flange thickness	t	1.437	in
Large hub thickness	g_1	0.6875	in	Small hub thick.	g_0	0.3125	in

Material K03504-SA-105--Class:-Size:

Allowable operating stress	S_{fb}	17811	psi
Allowable installation stress	S_{fa}	20015	psi
Corrosion allowance	c_2	0	in
Modulus of elasticity at operation	E_T	2.591e+7	psi
Modulus of elasticity at test (20°C)	E_{20}	2.92e+7	psi

Gasket

Gasket diameter			G	29.5	in
Effective gasket width	[Table: 2-5.2]		b	0.2031	in
Gasket factor	[Table: 2-5.1]		m	3.75	
Gasket seating load	[Table: 2-5.1]		y	7600	psi

Bolts

Number			n	44	
Root diameter			d_K	0.62	in
Nominal diameter			a	0.75	in
Material	G41400-SA-193-B7-Class:-Size:<=64				
Allowable operating stress			S_b	24946	psi
Allowable installation stress			S_a	24946	psi
Consider bolt spacing correction factor B_{SC} 2-6(7)?			(N=No)	Y	(Y/N)
Required operation bolt load	Eq.(1)		W_{m1}	**111274**	lbf
Minimum initial bolt load	Eq.(2)		W_{m2}	**142982**	lbf
Available cross section of bolts			A_b	**13.28**	in²
Required cross section		W_{m1}/S_b	A_{m1}	**4.46**	in²
Required cross section		W_{m2}/S_a	A_{m2}	**5.732**	in²
Req. bolt load for gasket seating	Eq.(5)	$(A_m+A_b)\cdot S_a/2$	W	**237101**	lbf
Allowable bolt load		$A_b \cdot S_a$	W_{all}	**331221**	lbf
Design (gasket seating =1; max. allowable=2)				1	(1,2)

Moment

	Force			Lever arm			Result	
$M_D = H_D \cdot h_D$	= **324826**	N	·	**54.77**	mm	=	**157458**	lbf·in
$M_G = H_G \cdot h_G$	= **84732**	N	·	**22.23**	mm	=	**16667**	lbf·in
$M_T = H_T \cdot h_T$	= **85412**	N	·	**42.86**	mm	=	**32403**	lbf·in
Total operating moment			M_{01}	= $M_D + M_G + M_T$		=	**206529**	lbf·in
Total gasket seating moment, Eq. (6)			M_{02}	= $W \cdot (C-G)/2$		=	**207464**	lbf·in

Stress

		Operation		Installation		≤ Allowable	
Longitudinal	S_H		psi		psi	≤ $1.5 \cdot S_f$	Eq.(8)
Ratio	S_H/S_f					≤ 1.5	
Allowable stress	S_f	17811	psi	20015	psi		
Radial	S_R		psi		psi	≤ S_f	Eq.(9)
Tangential	S_T		psi		N/mm²	≤ S_f	Eq.(10)
Combination	$(S_H+S_R)/2$ =		psi		psi	≤ S_f	
Combination	$(S_H+S_T)/2$ =		psi		psi	≤ S_f	
Bolt pitch	B_S	**56.67**	mm	≤ **89.63**	mm	= B_{Smax}	Eq.(3)

Remark

Cross-sectional area of bolts	☑
Strength condition flange	☑

Auxiliary values

$K=\frac{A}{B}=1.252$

$T=0$ (Fig. 2-7.1)

$U=0$ (Fig. 2-7.1)

$Y=0$ (Fig. 2-7.1)

$Z=4.518$ (Fig. 2-7.1)

$h_0=\sqrt{B \cdot g_0}=72.75$ mm

$F=0.7677$ (Fig. 2-7.2)

$V=0.1576$ (Fig. 2-7.3)

$f=1$ (Fig. 2-7.6)

$d=\left(\frac{U}{V}\right) \cdot h_0 \cdot g_0^2=0$ mm³

$e=\frac{F}{h_0}=0.01055$ 1/mm

$L=\frac{(t \cdot e+1)}{T}+\frac{t^3}{d}=$ [illegible]

$H=0.785 \cdot G^2 \cdot P \cdot 0.1=410239$ N

$H_D=0.785 \cdot B^2 \cdot P \cdot 0.1=324826$ N

$H_P=2 \cdot b \cdot \pi \cdot G \cdot m \cdot P \cdot 0.1=84732$ N

$H_T=H-H_D=85412$ N

$W_{m1}=H+H_P=494970$ N Eq.(1)

$W_{m2}=\pi \cdot b \cdot g \cdot y=636011$ N Eq.(2)

$H_G=W_{m1}-H=84732$ N

$R=\frac{(C-B)}{2}-g_1=46.04$ mm

$h_D=R+0.5 \cdot g_1=54.77$ mm

$h_G=\frac{(C-G)}{2}=22.23$ mm

$h_T=\frac{(R+g_1+h_G)}{2}=42.86$ mm

Bolt pitch

$B_S=\pi \cdot \frac{C}{n}=56.67$ mm

$B_{Smax}=2 \cdot a+6 \cdot \frac{t}{(m+0.5)}=89.63$ mm Eq.(3)

For $B_S>2 \cdot a+t$

Eq.(7)

$$B_{SC}=\sqrt{\frac{B_S}{(2\cdot a+t)}}=1$$

KI (=0.3 acc. Table 2-14) = **0.3**

Rigidity criterion: J ≤ 1.0

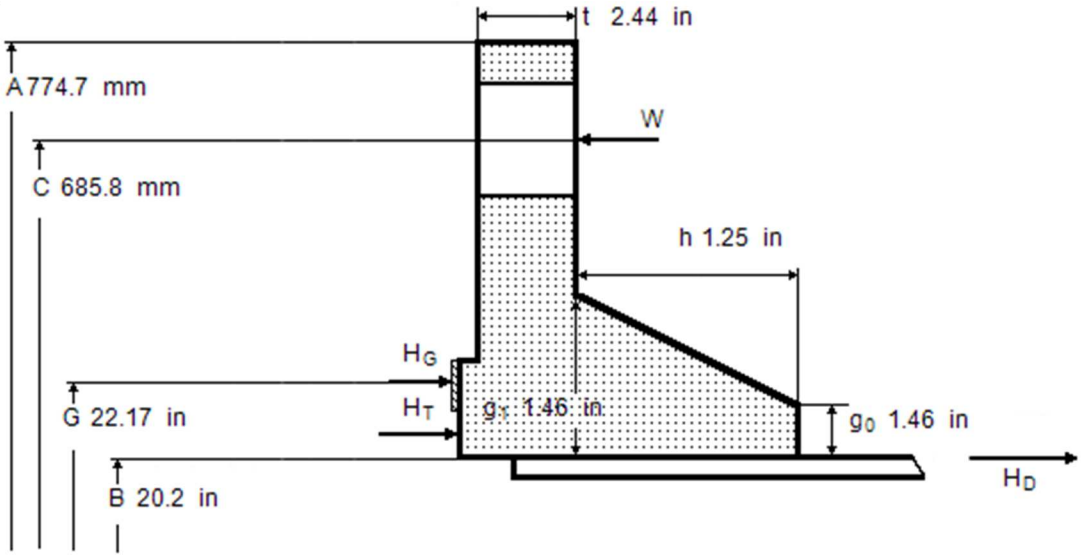
E 4.16.2 - Bolted flanges - ASME BPVC VIII Division 1 App. 2: 2017

Loose Type Flange With Full Neck

Design data

Design pressure	P_D	**31.03** bar	$= p_D$	450	psi
Hydrostatic head	D_P	0 bar	$= D_p$	**0**	psi
Calculation pressure	P_0	**31.03** bar	$= p_0$	**450**	psi
Calculation temperature			T_0	650	°F

Flange



Outside diameter	A	774.7 mm	Inside diameter	B	20.2 in
Bolt circle diameter	C	685.8 mm	Pipe size	B_n	**20.2** in
Hub length	h	1.25 in	Flange thickness	t	2.44 in
Large hub thickness	g_1	1.46 in	Small hub thickness	g_0	1.46 in

Material K03504-SA-105--Class:-Size:

Allowable operating stress	S_{fb}	17811 psi
Allowable installation stress	S_{fa}	20015 psi
Corrosion allowance	c_2	0 in
Modulus of elasticity at operation	E_T	2.591e+7 psi
Modulus of elasticity at test (20°C)	E_{20}	2.92e+7 psi

Gasket

Gasket diameter		G	22.17	in
Effective gasket width	[Table: 2-5.2]	b	0.3536	in
Gasket factor	[Table: 2-5.1]	m	2	
Gasket seating load	[Table: 2-5.1]	y	2500	psi

Bolts

Number			n	24	
Root diameter			d_K	1.08	in
Nominal diameter			a	1.25	in
Material	G41400-SA-193-B7-Class:-Size:<=64				
Allowable operating stress			S_b	24946	psi
Allowable installation stress			S_a	24946	psi
Consider bolt spacing correction factor B_{SC} 2-6(7)?			(N=No) Y		(Y/N)
Required operation bolt load	Eq.(1)		W_{m1}	**217897**	lbf
Minimum initial bolt load	Eq.(2)		W_{m2}	**61533**	lbf
Available cross section of bolts			A_b	**21.97**	in²
Required cross section		W_{m1}/S_b	A_{m1}	**8.735**	in²
Required cross section		W_{m2}/S_a	A_{m2}	**2.467**	in²
Req. bolt load for gasket seating	Eq.(5)	$(A_m+A_b)\cdot S_a/2$	W	**383049**	lbf
Allowable bolt load		$A_b\cdot S_a$	W_{all}	**548201**	lbf
Design (gasket seating =1; max. allowable=2)				1 (1,2)	

Moment

	Force		Lever arm		Result	
$M_D = H_D \cdot h_D$ =	**641171**	N ·	**86.36**	mm =	**490082**	lbf·in
$M_G = H_G \cdot h_G$ =	**197073**	N ·	**61.37**	mm =	**107043**	lbf·in
$M_T = H_T \cdot h_T$ =	**131005**	N ·	**73.86**	mm =	**85646**	lbf·in

Total operating moment	M_{01}	$= M_D + M_G + M_T$ =	**682770**	lbf·in
Total gasket seating moment, Eq. (6)	M_{02}	$= W \cdot (C-G)/2$ =	**925485**	lbf·in

Stress

		Operation		Installation		≤ Allowable	
Longitudinal	S_H		psi		psi	≤ $1.5\cdot S_f$	Eq.(8)
Ratio	S_H/S_f					≤ 1.5	
Allowable stress	S_f	17811	psi	20015	psi		
Radial	S_R		psi		psi	≤ S_f	Eq.(9)
Tangential	S_T		psi		N/mm²	≤ S_f	Eq.(10)
Combination	$(S_H+S_R)/2$ =		psi		psi	≤ S_f	
Combination	$(S_H+S_T)/2$ =		psi		psi	≤ S_f	
Bolt pitch	B_S	**89.77**	mm	≤ **212.2**	mm	= B_{Smax}	Eq.(3)

Remark

Cross-sectional area of bolts	☑
Strength condition flange	☑

Auxiliary values

$K=\frac{A}{B}=1.51$

$T=0$ (Fig. 2-7.1)

$U=0$ (Fig. 2-7.1)

$Y=0$ (Fig. 2-7.1)

$Z=2.563$ (Fig. 2-7.1)

$h_0=\sqrt{B \cdot g_0}=137.9$ mm

$F=3.261$ (Fig. 2-7.4)

$V=11.37$ (Fig. 2-7.5)

$f=1$

$d=\left(\frac{U}{V}\right) \cdot h_0 \cdot g_0^2=0$ mm³

$e=\frac{F}{h_0}=0.02364$ 1/mm

$L=\frac{(t \cdot e+1)}{T}+\frac{t^3}{d}=$ [illegible]

$H=0.785 \cdot G^2 \cdot P \cdot 0.1=772176$ N

$H_D=0.785 \cdot B^2 \cdot P \cdot 0.1=641171$ N

$H_P=2 \cdot b \cdot \pi \cdot G \cdot m \cdot P \cdot 0.1=197073$ N

$H_T=H-H_D=131005$ N

$W_{m1}=H+H_P=969249$ N Eq.(1)

$W_{m2}=\pi \cdot b \cdot g \cdot y=273712$ N Eq.(2)

$H_G=W_{m1}-H=197073$ N

$h_D=\frac{(C-B)}{2}=86.36$ mm

$h_G=\frac{(C-G)}{2}=61.37$ mm

$h_T=\frac{(h_D+h_G)}{2}=73.86$ mm

Bolt pitch

$B_S=\pi \cdot \frac{C}{n}=89.77$ mm

$B_{Smax}=2 \cdot a+6 \cdot \frac{t}{(m+0.5)}=212.2$ mm Eq.(3)

For $B_S>2 \cdot a+t$

$B_{SC}=\sqrt{\frac{B_S}{(2 \cdot a+t)}}=1$ Eq.(7)

KL (=0.2 acc. Table 2-14) = **0.2**

Rigidity criterion: J ≤ 1.0