



Vessel Bolted Flange Connection

PREPARED: P.G.A.Engineering

CHECKED:

APPROVED:

DATE:

29/04/2014

This calculation is according to ASME VIII Div.1 App.2

Flange Material	A182 F316 (Forgings)		▼
Bolt Material	A193-B7 t < 2" 1/2 (Bolting)		▼
Blind Material	A182 F316 (Forgings)		▼
Flange Type	WELDING NECK CLASS 150 6"		▼
Outside Diameter of Gasket	D_e	168,00	mm ▼
Inside Diameter of Gasket	D_i	146,00	mm ▼
Blind Thickness	t_{BL}	35,0	mm ▼
Grove Dhept	L_G	0,0	mm ▼
Axial Load	F_x	0,0	N ▼
Bendig Moment	M_x	0,0	kN m ▼
Types of Flange	Integral Type Flange		▼
Exthernal Load Evaluation Method	Not Applicable		▼
Gasket Type	Spiral-Wound Metal, Asbestos filled Carbon		▼
Joint Description	Butt joints as attained by double-welding or by other means which		▼
Degree of Radiographic Examination	NONE		▼

CALCULATION

DESCRIPTION	DEF.	Imperial		Metric	
		Values	Unit of Measure	Values	Unit of Measure
INPUT					
Corrosion Allowance	c	0,000	in	0	mm
Outside Diameter of Gasket	D_e	6,614	in	168	mm
Inside Diameter of Gasket	D_i	5,748	in	146	mm
Width of basic gasket seating width	N	0,433	in	11	mm
Minimum Bolt Diameter	$D_{B,MIN}$	0,637	in	16,18742	mm
Minimum Bolt Area	$A_{B,MIN}$	0,319	sq in	205,7999	mm ²
Blind Thiocckness	t_{BL}	1,378	in	35	mm
Grove Depht	L_G	0,000	in	0	mm
Blind Neat Thickness	$t_{BL,NEAT}$	1,378	in	35	mm
Design Pressure	P	51	psi	0,35	MPa
Design Pressure at Test Temperature	P_{TEST}	73	psi	0,50	MPa



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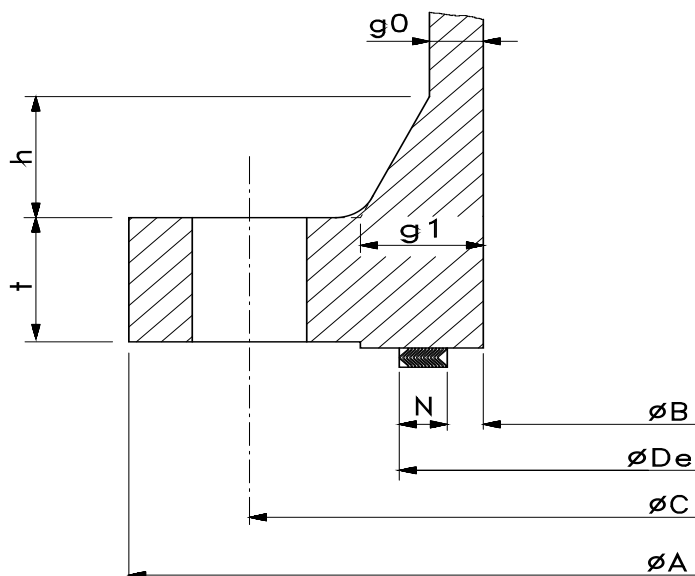
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Equivalent Pressure	P_{eq}	0	psi	0,00	MPa
Maximum Temperature	T_{MAX}	122	°F	50	°C
Minimum Temperature	T_{MIN}	39,2	°F	4	°C
Test Temperature	T_{TEST}	68	°F	20	°C
Gasket Factor	m	2,5	-	3	-
Axial Load	F_X	0	lb	0	N
Bending Moment	M_X	0	in lb	0	N m
Minimum Design Gasket Seating Stress	y	10000	psi	69	MPa
Joint Efficiency Factor	E	1	-	1	-
Allowable Flange Stress at Operating Condition	$S_{F,OP}$	19406	psi	134	MPa
Allowable Flange Stress at Test Temperature	$S_{F,TEST}$	30000	psi	207	MPa
Allowable Bolt Stress at Operating Condition	$S_{B,OP}$	25000	psi	172	MPa
Allowable Bolt Stress at Test Temperature	$S_{B,TEST}$	25000	psi	172	MPa
Allowable Bild Stress at Operating Condition	$S_{BL,OP}$	19406	psi	134	MPa
Allowable Bild Stress at Test Temperature	$S_{BL,TEST}$	30000	psi	207	MPa

DESCRIPTION	DEF.	Imperial		Metric	
		Values	Unit of Measure	Values	Unit of Measure

FLANGE DIMENSION

Outside Diameter of Flange	A	11,024	in	280	mm
Inside Diameter of Flange	B	6,067	in	154,1	mm
Bolt-Circle Diameter	C	9,500	in	241,3	mm
Thickness of Hub at Back of Flange	g_1	0,746	in	18,95	mm
Thickness of Hub at Small End	g_0	0,280	in	7,1	mm
Flange Thickness	t	0,941	in	23,9	mm
Hub Length	h	0,419	in	10,65	mm
Number of Bolt	N_b	8	-	8	-





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OUTPUT

Basic gasket seating width	b_0	0,217	in	5,5	mm
Effective gasket seating width	b	0,217	in	5,50	mm
Diameter at location of gasket load reaction	G	6,18	in	157,0	mm
Req. bolt load in operating conditions	W_{m1}	2590	lb	11520	N
Req. bolt load in Test conditions	$W_{m1,TEST}$	3700	lb	16457	N
Req. bolt load for gasket seating	W_{m2}	42048	lb	187039	N
Total bolts cross sec. area for operating condition	A_{m1}	0,104	sq in	66,8	mm ²
Total bolts cross sec. area for Test condition	$A_{m1,TEST}$	0,148	sq in	95,5	mm ²
Total bolts cross sec. area for gasket seating	A_{m2}	0,400	sq in	258,4	mm ²
Total required cross sectional area of bolts	A_m	0,400	sq in	258,4	mm ²
Total cross sectional area of bolts	A_b	2,552	sq in	1646,4	mm ²
Flange Design bolt load in Operating conditions	W_O	2590	lb	11520	N
Flange Design bolt load in Test conditions	$W_{O,TEST}$	3700	lb	16457	N
Flange Design bolt load for gasket seating	W_G	36905	lb	164160	N
See Par. 2-3	R	0,9705	in	24,65	mm
Moment arm (see Par. 2-6)	hd	1,3435	in	34,13	mm
Moment arm (see Par. 2-6)	hg	1,6594	in	42,15	mm
Moment arm (see Par. 2-6)	ht	1,6880	in	42,88	mm
Total hydrostatic end force	H	1522	lb	6772,3	N
Hydrostatic end force on area inside of flange	Hd	1467	lb	6524,4	N
Gasket load in operating conditions	H_{gO}	1067	lb	4747,3	N
Gasket load in operating conditions	$H_{gO,TEST}$	2177	lb	9684,3	N
Gasket load for gasket seating	H_{gG}	35382	lb	157388,2	N
H-Hd	Ht	56	lb	247,9	N
Moment due Hd	Md	1971	in lb	222,7	Nm
Moment due H_{gO} in operating conditions	M_{gO}	1771	in lb	200,1	Nm
Moment due $H_{gO,TEST}$ in operating conditions	$M_{gO,TEST}$	3613	in lb	408,2	Nm
Moment due H_{gG} for gasket seating	M_{gG}	58715	in lb	6634,2	Nm
Moment Ht	M_t	94	in lb	10,6	Nm
Total moment acting upon the flange in oper. cond.	M_{OO}	3836	in lb	433	Nm
Total moment acting upon the flange in Test cond.	$M_{OO,TEST}$	5677	in lb	641	Nm
Total moment acting upon the flange for gasket seating	M_{OG}	61242	in lb	6920	Nm
Calculated longitudinal stress in hub in oper. cond.	S_{ho}	625	psi	4,3	MPa
Calculated longitudinal stress in hub in Test cond.	$S_{ho,TEST}$	926	psi	6,4	MPa
Calculated longitudinal stress in hub for gasket seating	S_{hG}	9986	psi	68,8	MPa
Calculated radial stress in flange in oper. cond.	S_{rO}	833	psi	5,7	MPa
Calculated radial stress in flange in Test cond.	$S_{rO,TEST}$	1233	psi	8,5	MPa
Calculated radial stress in flange for gasket seating	S_{rG}	13297	psi	91,7	MPa
Calculated tangential stress in flange in oper. cond.	S_{tO}	887	psi	6,1	MPa



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Calculated tangential stress in flange in Test cond.	$S_{tO,TEST}$	2060	psi	14,2	MPa
Calculated tangential stress in flange for gasket seating	S_{tG}	14157	psi	97,6	MPa
Blind Thickness in Operating condition	t_O	0,374	in	9,5	mm
Blind Thickness in Test condition	$t_{O,TEST}$	0,360	in	9,1	mm
Blind Thickness for gasket seating	t_G	0,300	in	7,6	mm
Minimum Blind Thickness Required	$t_{BL,MIN}$	0,374	in	9,5	mm
Blind Neat Thickness in Operating condition	$t_{O,NEAT}$	0,312	in	7,9	mm
Blind Neat Thickness in Test condition	$t_{O,TEST,NEAT}$	0,300	in	7,6	mm
Blind Neat Thickness for gasket seating	$t_{G,NEAT}$	0,300	in	7,6	mm
Minimum Blind Thickness Required	$t_{BL,MIN,NEAT}$	0,312	in	7,9	mm

VERIFICATION

Description	Calculated		Allowed		CHECK
	psi	MPa	psi	MPa	
Cross sectional bolts area $A_m \leq A_b$					VERO
Blind Thickness $t_{BL,MIN} \leq t_{BL}$					VERO
Blind Neat Thickness $t_{BL,MIN,NEAT} \leq t_{BL,NEAT}$					VERO
Longitudinal hub Stress S_{hO} in Operating conditions	625	4,31	29.109	200,70	VERO
Longitudinal hub Stress S_{hO} in Test conditions	926	6,38	45.000	310,26	VERO
Longitudinal hub Stress S_{hG} for gasket seating	9.986	68,85	30.000	206,84	VERO
Radial flange Stress S_{rO} in operating conditions	833	5,74	19.406	133,80	VERO
Radial flange Stress S_{rO} in Test conditions	1233	8,50	30.000	206,84	VERO
Radial flange Stress S_{rG} for gasket seating	13297	91,68	30.000	206,84	VERO
Tangential flange Stress S_{tO} in operating conditions	887	6,11	19.406	133,80	VERO
Tangential flange Stress S_{tO} in Test conditions	2060	14,20	30.000	206,84	VERO
Tangential flange Stress S_{tG} for gasket seating	14157	97,61	30.000	206,84	VERO
Combined Stress ($S_{hO}+S_{rO}$) in operating conditions	729	5,03	19.406	133,80	VERO
Combined Stress ($S_{hO}+S_{rO}$) in Test conditions	1079	5,03	30.000	206,84	VERO
Combined Stress ($S_{hG}+S_{rG}$) for gasket seating	11642	80,27	30.000	206,84	VERO
Combined Stress ($S_{hO}+S_{tO}$) in operating conditions	756	5,21	19.406	133,80	VERO
Combined Stress ($S_{hO}+S_{tO}$) in Test conditions	1493	5,21	30.000	206,84	VERO
Combined Stress ($S_{hG}+S_{tG}$) for gasket seating	12071	83,23	30.000	206,84	VERO