

WELCOME to CAUx Local India 2018





Flange Design In Detail

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Some Typical Flange Images



Aller of



with tongue



Some Typical Gasket Images





R Type Ring

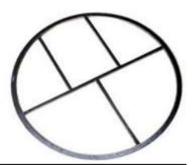














Flange Design As Per ASME Sec.VIII Div.1



Mandatory Apendix.2 -

•Scope:-

➤ The rules apply specifically to the design of bolted flange connections with gaskets that are entirely within the circle enclosed by the bolt holes and with no contact outside this circle, and are to be used in conjunction with the applicable requirements in Subsections A, B, and C of this Division.

≻Non Circular Flanges can be done as per 2-10 for circular bores only.

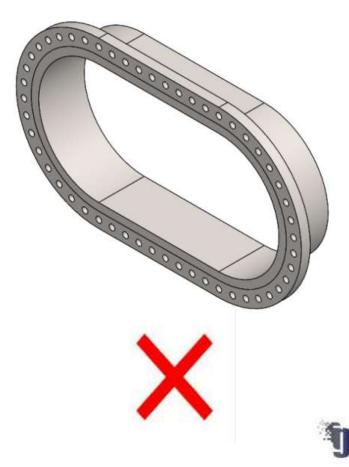




ImageGrafix







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•We can Use standards listed in UG-44 like B16.5, B16.47

•One can use other types of flanged connections provided they are **designed in accordance with good engineering practice** and **method of design is acceptable to the Inspector.**

- ➢ Flanged covers as shown in Figure 1-6;
- ➢Bolted flanges using full-face gaskets
- flanges using means other than bolting to restrain the flange assembly against pressure





Edge of weld shall not overlap Hemispherical head Hemispherical head _Toriconical head knuckle) -Toriconical head See Note (1) Ellipsoidal or Not less than Ellipsoidal or torispherical torispherical 2t and in no case head head less than Knuckle See Note (1) *с*і Knuckle 1/2 in. (13 mm) radius radius Tangent line Tangent line <--Skirt -Skirt Gasket Flange Gasket Flange Loose Flange Type Integral Flange Type (a) [Notes (2) and (3)]

Figure 1-6 Dished Covers With Bolting Flanges

Full Face Gasketed Flanges





Some Important Considerations as per Appendix.2



- Flanges made from ferritic steel shall be full-annealed, normalized, normalized and tempered, or quenched and tempered when the thickness of the flange section exceeds 3 in. (75 mm).
- It is recommended that bolts and studs have a nominal diameter of not less than 1/2 in. (13 mm)



Types Of Flanges



<u>(1) Loose Type Flanges.</u>

This type covers those designs in which the *flange has no direct connection to the nozzle neck, vessel, or pipe wall*, and designs where the method of attachment is not considered to give the mechanical strength equivalent of integral attachment.

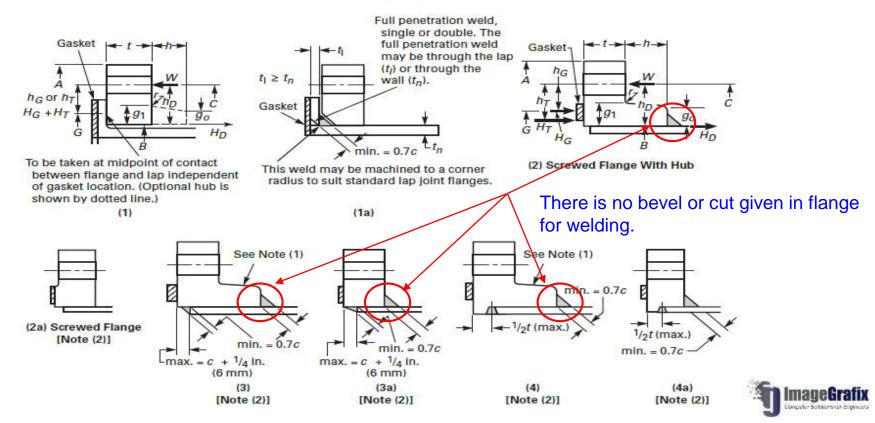
See Figure 2-4 sketches (1), (1a), (2), (2a), (3), (3a), (4), (4a), (4b), and (4c) for typical loose type flanges and the location of the loads and moments



(1) Loose Type Flanges.



Figure 2-4 Types of Flanges



Types Of Flanges



(2) Integral Type Flanges.

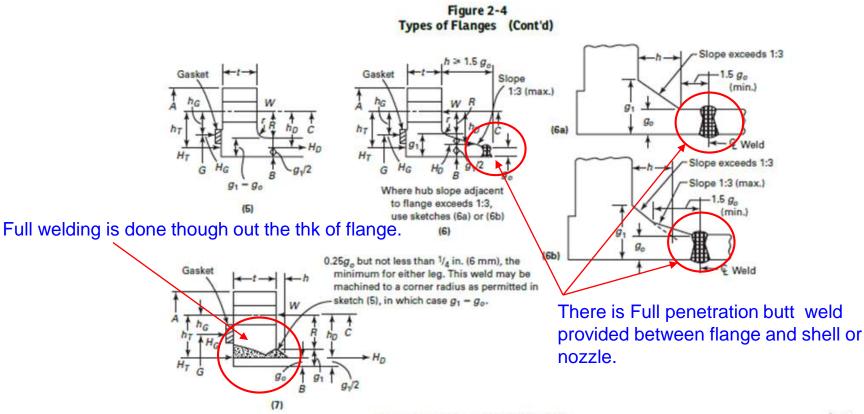
This type covers designs where the flange is cast or forged integrally with the nozzle neck, vessel or pipe wall, butt welded there to or attached by other forms of arc or gas welding of such a nature that <u>the flange and nozzle neck</u>, <u>vessel or pipe wall is considered to be the equivalent of an integral structure</u>.

See Figure 2-4 sketches (5), (6), (6a), (6b), and (7) for typical integral type flanges



(2) Integral Type Flanges.





Integral-Type Flanges [Notes (3) and (4)]



Types Of Flanges



(3) <u>Optional Type Flanges.</u>

This type covers designs where the attachment of the flange to the nozzle neck, vessel, or pipe wall is such that <u>the assembly is considered to act as a unit, which</u> <u>shall be calculated as an integral flange.</u>

• For simplicity the designer may calculate the construction as a loose type flange provided none of the following values is exceeded

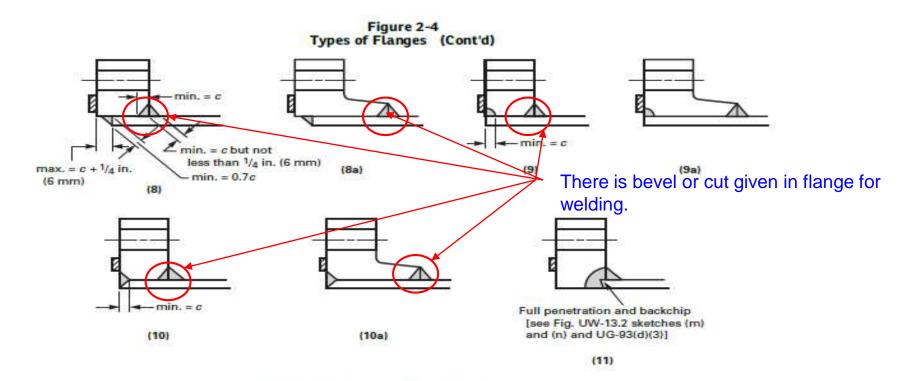
$$g_o = \frac{5}{8}$$
 in.(16 mm)
 $B/g_o = 300$
 $P = 300$ psi (2 MPa)
operating temperature = 700°F (370°C)

Figure 2-4 sketches (8), (8a), (9), (9a), (10),(10a), and (11) for typical optional type flanges.



(3) Optional Type Of Flanges.





Optional-Type Flanges [Notes (5), (6), and (7)]





Design Conditions

(1) **Operating Conditions.**

•The conditions required **to resist** the hydrostatic end force of the design pressure tending to part the joint and to maintain on the gasket or joint-contact surface sufficient compression to assure a tight joint, all at the design temperature.

The minimum load is a function of the design pressure, the gasket material and the effective gasket or contact area to be kept tight under pressure, per eq. (c)(1)(1) sufficient compression to assure a tight joint all at the design temperature.





Design Conditions

(2) Gasket Seating Condition.

•The conditions existing when the gasket or joint-contact surface is seated by applying an initial load with the bolts when assembling the joint, at atmospheric temperature and pressure.

• The minimum initial load considered to be adequate for proper seating is a function of the gasket material, and the effective gasket or contact area to be seated, per eq. (c)(2)(2)





STEP 1: - Calculation of required bolt loads

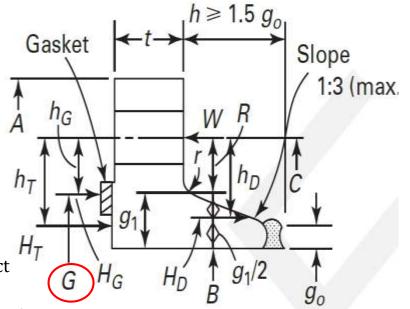
Calculation of required Bolt load for operating condition = Wm1

$$W_{m1} = H + H_p = 0.785G^2P + (2b \times 3.14GmP)$$
(1)

- H = total hydrostatic end force.
- Hp = total joint-contact surface compression load
- G = diameter at location of gasket load reaction.
- G is defined as follows (see Table 2-5.2):

```
(a) when bo \leq 1/4 in. (6 mm), G = mean diameter of gasket contact face
```

- (b) when bo > 1/4 in. (6 mm), G = outside diameter of gasket contact face less 2b
- b = effective gasket or joint-contact-surface seating width







	Basic Gasket Seating Width, b.		
Facing Sketch (Exaggerated)	Column 1	Colomn II	
b) (1) (1) (1) (1) (1) (1) (1) (1) (1) (1	<u>N</u> 2	N/I	
c) $w = 1$ w = N $w \le N$	$\frac{w+T}{2}$: $\left(\frac{w+N}{4}\max\right)$	$\frac{w+T}{2} \cdot \left[\frac{w+R}{4}\right]$ max	
ld)	· • • • • • • • • • •	5. 4 77 X (1 6777-5	
2) ¹ / ₅₄ in, i0.4 mml nubbin ^{-¹/2} ¹ / ₅₅ in (1.5 mml nubbin ^{-¹/2}) ¹ / ₅₅ in (<u>w + N</u>	<u>w + 38</u> 8	
3) 1/64 in. 10.4 mm) nubtin 1/000000000000000000000000000000000000	<u>N</u> 4	<u>3.W</u> <u>H</u>	
4)	3 .W H	7 <u>N</u> 36	
5) See Note (1)	<u>N</u> 4	<u>3M</u> 8	





STEP 1: - Calculation of required bolt loads

Calculation of required Bolt load for Gasket Seating Condition = Wm2

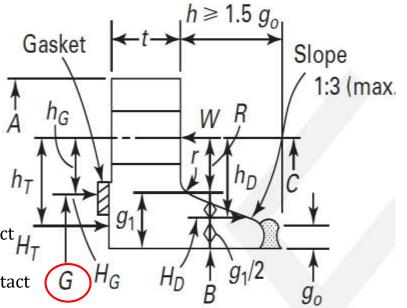
 $W_{m2} = 3.14 bGy$ (2)

- y = Gasket seating Stress.
- G = diameter at location of gasket load reaction.
- G is defined as follows (see Table 2-5.2):

(a) when bo $\leq 1/4$ in. (6 mm), G = mean diameter of gasket contact H_T face

(b) when bo > 1/4 in. (6 mm), G = outside diameter of gasket contact face less 2b

b = effective gasket or joint-contact-surface seating width







STEP 2: - Calculation of required bolt Areas

 Calculation of required Required and Actual Bolt Area (Am and Ab)

Total Required cross sectional area of bolt Am =

 $A_{\rm m} = \max \left(Am_1, Am_2 \right)$

Required bolt area for operating condition Am1 =

 $Am_1 = Wm_1/Sb$

Required bolt area for Gasket seating condition Am2 =

 $Am_2 = Wm_2/Sa.$

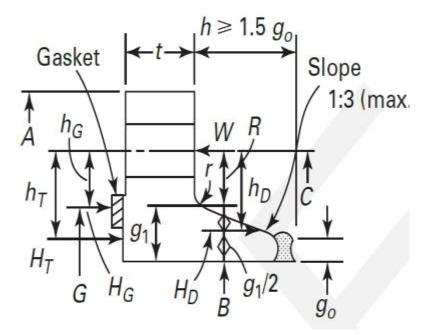
Where,

Wm1 = Required Bolt load for operating condition

Wm2 = Required Bolt load for Gasket seating condition

Sa = allowable bolt stress at atmospheric temperature(see UG-23)

Sb = allowable bolt stress at design temperature (seeUG-23)







STEP 3: - Maximum Bolt Spacing Between Bolts

For vessels in lethal service or when specified by the user or his designated agent, the maximum bolt spacing shall not exceed the value calculated in accordance with eq. (3).

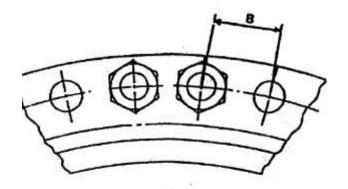
$$B_{s\max} = 2a + \frac{6t}{m+0.5} \tag{3}$$

Where,

a = Bolt diameter

t = Flange thickness

m = Gasket factor





STEP 4: - Calculation of Flange Design Bolt Load(W)

For operating conditions,

$$W = W_{m1} \tag{4}$$

For Gasket Seating conditions,

$$W = \frac{\left(A_m + A_b\right)S_a}{2} \tag{5}$$

By taking avg area instead of only required area Am ,we are increasing W and hence the thickness to take care of over tightening of flange bolts.

For critical applications where lethal service is present full bolt load is considered i.e W = Sa x Ab, And hence designing flange for full strength of bolts .









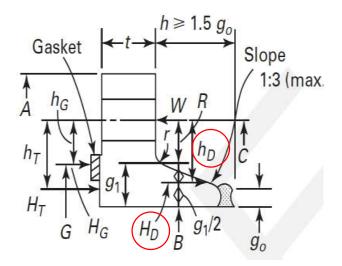
STEP 5: - Calculation of Flange Moment(Mo)

For operating conditions,

 $\mathbf{Mo} = \mathbf{M}_{\mathbf{D}} + \mathbf{M}_{\mathbf{T}} + \mathbf{M}_{\mathbf{G}}$

Where,

- M_D = component of moment due to H_D , = $H_D h_D$
- H_D = hydrostatic end force on area inside of flange = $(\pi/4)xB^2P$
- $h_{\rm D}$ = radial distance from the bolt circle, to the circle on which $H_{\rm D}$ acts, as prescribed in Table 2-6







	h _D	h _T	h _G
Integral-type flanges [see Figure 2-4 sketches (5), (6), (6a), (6b), and (7)] and optional type flanges calculated as integral type [see Figure 2-4 sketches (8), (8a), (9), (9a), (10), (10a), and (11)]	$R + 0.5g_1$	$\frac{R+g_1+h_G}{2}$	$\frac{C-G}{2}$
Loose type, except lap-joint flanges [see Figure 2-4 sketches (2), (2a), (3), (3a), (4), and (4a)]; and optional type flanges calculated as loose type [see Figure 2-4 sketches (8), (8a), (9), (9a), (10), (10a), and (11)]	$\frac{C-B}{2}$	$\frac{h_D + h_G}{2}$	$\frac{C-G}{2}$
Lap-type flanges [see Figure 2-4 sketches (1) and (1a)]	$\frac{C-B}{2}$	$\frac{C-G}{2}$	C-G





STEP 5: - <u>Calculation of Flange Moment(Mo)</u>

For operating conditions,

 $\mathbf{Mo} = \mathbf{M}_{\mathsf{D}} + \mathbf{M}_{\mathsf{T}} + \mathbf{M}_{\mathsf{G}}$

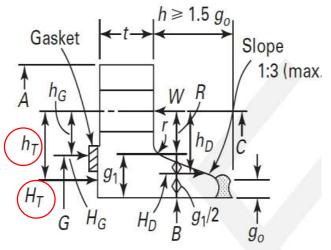
Where,

 M_T = component of moment due to H_T = $H_T h_T$

 H_T = difference between total hydrostatic end force and the hydrostatic end force on area inside of flange, acting between gasket diameter G and ID of flange B.

 $= H - H_D$

 h_T = radial distance from the bolt circle to the circle on which H_T acts as prescribed in Table 2-6







	h _D	h _T	h _G
Integral-type flanges [see Figure 2-4 sketches (5), (6), (6a), (6b), and (7)] and optional type flanges calculated as integral type [see Figure 2-4 sketches (8), (8a), (9), (9a), (10), (10a), and (11)]	$R + 0.5g_1$	$\frac{R+g_1+h_G}{2}$	$\frac{C-G}{2}$
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Lap-type flanges [see Figure 2-4 sketches (1) and (1a)]	C-B	$\frac{C-G}{2}$	C-G





STEP 5: - <u>Calculation of Flange Moment(Mo)</u>

For operating conditions,

 $\mathbf{Mo} = \mathbf{M}_{\mathsf{D}} + \mathbf{M}_{\mathsf{T}} + \mathbf{M}_{\mathsf{G}}$

Where,

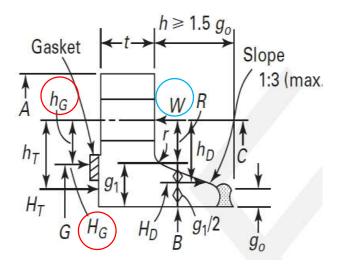
 M_G = component of moment due to H_G , = $H_G h_G$

 H_G = gasket load (difference between flange design bolt load and total hydrostatic end force)

= W – H

For operating condition

 h_G = radial distance from gasket load reaction to the bolt circle = (C - G)/2





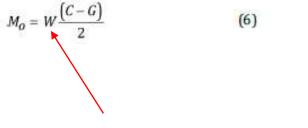


	h _D	h _T	h _G
Integral-type flanges [see Figure 2-4 sketches (5), (6), (6a), (6b), and (7)] and optional type flanges calculated as integral type [see Figure 2-4 sketches (8), (8a), (9), (9a), (10), (10a), and (11)]	$R + 0.5g_1$	$\frac{R+g_1+h_G}{2}$	$\frac{C-G}{2}$
Loose type, except lap-joint flanges [see Figure 2-4 sketches (2), (2a), (3), (3a), (4), and (4a)]; and optional type flanges calculated as loose type [see Figure 2-4 sketches (8), (8a), (9), (9a), (10), (10a), and (11)]	$\frac{C-B}{2}$	$\frac{h_D + h_G}{2}$	$\frac{C-G}{2}$
Lap-type flanges [see Figure 2-4 sketches (1) and (1a)]	C-B	$\frac{C-G}{2}$	$\frac{C-G}{2}$



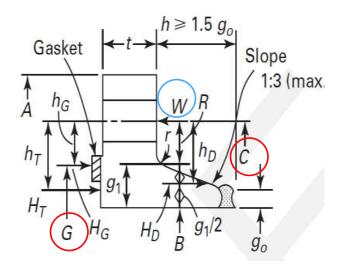


For Gasket Seating conditions,



For Gasket Seating condition









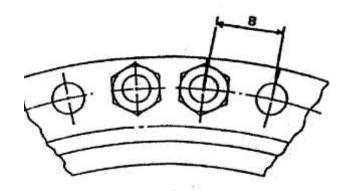
STEP 6: - <u>Calculation of Bolt Space correction Factor</u>

When the bolt spacing exceeds 2a + t,

Multiply ${\bf M_0}$ by the bolt spacing correction factor ${\bf B}_{\rm SC}$ If Bolt spacing exceeds 2a+t

$$B_{SC} = \sqrt{\frac{B_S}{2a+t}}$$

(7)





STEP 7: - <u>Calculation of Flange Stresses</u>

For Integral Type Flanges

1) Longitudinal hub stress - S_H

$$S_H = \frac{f M_0}{L g_1^2 B} \tag{8}$$

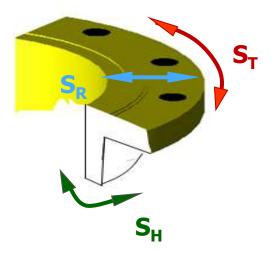
2) Radial Flange stress - S_R

$$S_R = \frac{(1.33te + 1)M_o}{Lt^2 B}$$
(9)

3) Tangential Flange stress - ${\rm S}_{\rm T}$

$$S_T = \frac{YM_o}{t^2B} - ZS_R \tag{10}$$





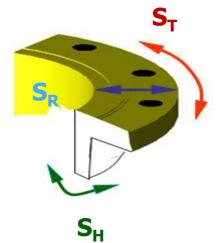




1.5 x S_f

STEP 7: - <u>Calculation of Flange Stresses</u>

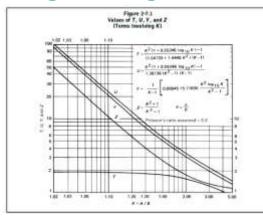
For Integral Type Flanges PvElite Report

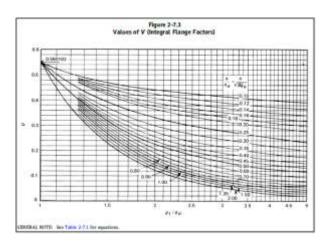


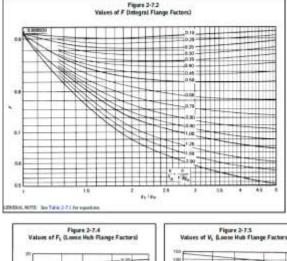
Stress Computation	Results: O	perating	Gasket S	eating	
	Actual	Allowed	Actual	Allowed	
Longitudinal Hub	2952.	30000.	7651.	30000.	psi
Radial Flange	3242.	20000.	8402.	20000.	psi
Tangential Flange	1161.	20000.	3009.	20000.	psi
			X		
			S		
			U t		



Flange Design....Various Factors For Flange Stresses







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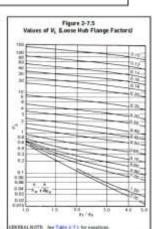
6.1

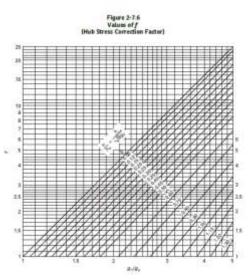
1.4

1.8.

CRIVERAL MOTE: the Table 1/71 for equations

\$21.00











STEP 7: - <u>Calculation of Flange Stresses</u>

Allowable Stresses For Flange

1) Longitudinal hub stress - S_H

•For Cast iron, $S_{all} = S_f$

Where,

Sf = Allowable flange stress at design or ambient temperature as applicable.

•Other than cast iron material

- For optional type of flanges designed as integral [Figure 2-4 sketches (8), (8a), (9), (9a), (10), (10a), and (11)], also integral type sketch(7)]
 S_{all}= Smaller (1.5S_f, 1.5S_n)
- For integral type flanges with hub welded to the neck, pipe or vessel wall sketches (6), (6a), and (6b)

 S_{all} = Smaller (1.5 S_{f_1} 2.5 S_n)

2) Radial Flange stress - S_R

 $S_{all} = S_f$

3) Tangential Flange stress - S_T

 $S_{all} = S_f$

4) Combined stresses

$$\frac{S_{\rm H}+S_{\rm R}}{2} <= S_{\rm f} \quad , \quad \frac{S_{\rm H}+S_{\rm T}}{2} <= S_{\rm f}$$





STEP 7: - <u>Calculation of Flange Stresses</u>

For Loose Ring Type Flanges

1) Longitudinal hub stress - S_H

 $S_H = 0$

2) Radial Flange stress - S_R

 $S_R = 0$

3) Tangential Flange stress - S_T

$$S_T = \frac{YM_o}{t^2B}$$

Where,

 M_o = total moment acting upon the flange, for the operating conditions or gasket seating as may apply

- t = flange thickness
- B = inside diameter of flange
- g1 = thickness of hub at back of flange

f,L,e,Y,Z = Factors.

f = hub stress correction factor for integral flangesfrom Figure 2-7.6



Flange Rigidity



- •Flanges that have been designed based on allowable stress limits alone may not be sufficiently rigid to control leakage.
- •The rigidity factors provided in Table 2-14 have been proven through extensive user experience for a wide variety of joint design and service conditions.
- The use of the rigidity index does not guarantee a leakage rate within established limits but it should be considered as one of factors for joint design.
- Successful service experience may be used as an alternative to the flange rigidity rules for fluid services that are nonlethal and non-flammable without exceeding following conditions.

The temperature range of -20°F (-29°C) to 366°F (186°C)
Design pressures of 150 psi (1 035 kPa).



Flange Rigidity.....



Table 2-14 Flange Rigidity Factors

Flange Type	Rigidity Criterion
Integral-type flanges and optional type flanges designed as integral-type flanges	$J = \frac{52.14VM_o}{LEg_o^2 K_l h_o} \le 1.0$
Loose-type flanges with hubs	$J = \frac{52.14 V_L M_o}{LE g_o^2 K_L h_o} \le 1.0$
Loose-type flanges without hubs and optional flanges designed as loose-type flanges	$J = \frac{109.4M_o}{Et^3 K_L(\ln K)} \le 1.0$

E = modulus of elasticity for the flange material at design temperature (operating condition) or at atmospheric temperature (gasket seating condition), psi J = rigidity index ≤ 1 KI = rigidity factor for integral or optional flange types = 0.3 KL = rigidity factor for loose-type flanges = 0.2



How to define Flange Geometry



For Integral Type Flanges

- Select Flange I.D = Shell I.D
- Assume Flange thickness
- \bullet Take ${\bf g}_{{\bf o}}$ as equal to shell thickness
- Assume g1 such a way that 1:3 taper requirement satisfies , give hub length as at least as (g1- go)*3
- Select Size of bolt
- From TEMA table D-5M give the minimum Hub to bolt dimension and hence finalize P.C.D of bolt.
- From TEMA table D-5M give the minimum Bolt to Edge dimension and hence finalize O.D of Flange
- Define this as gasket O.D
- Consider gasket width and decide gasket I.D
- Specify gasket m and Y factors
- Check bolt area requirement and give no of bolts
- If bolt area is sufficient then check minimum and maximum bolt spacing requirements.
- If required fine tune the dimensions.
- Don't use bolt below M16 size.
- Check required thickness and give thickness more than this.
- Check and provide if needed counter flange bolt loads.
- Check for moments and axial loads and apply them if applicable.
- Always keep rigidity index check box on.
- If corrosion is there check on the corrosion check box as well.





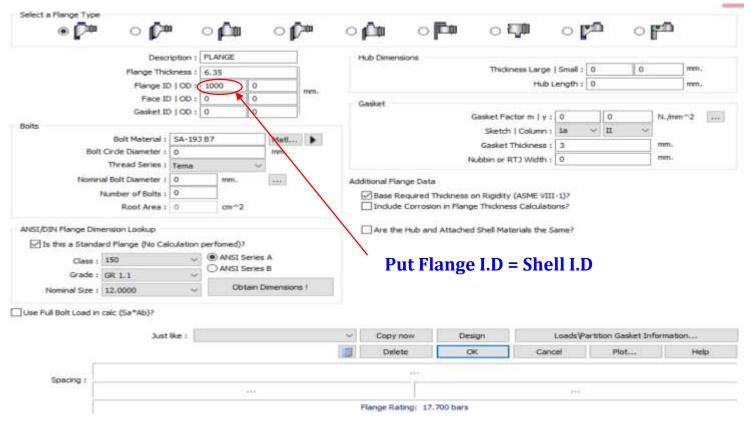
Select Flange Type

	Desc	ription :	FLANGE	3			Hub Dimensions							
	Flange This	- 12 - 2 - 30						Thick	vess Large Small :	0 0	mm.			
	Flance II	S	1000	0			Hub Length : 0 mm.							
		:00:	algebra in the second	0	mm.				1144000107310	No. and Adv				
	Gasket II	1.22.11	0 0				Gasket	100000000000000000000000000000000000000		11.2	1			
ts		11							ctor m y : 0	0	N.,mm^2			
	Bolt Material :	SA-193	sadora da la constante de la constante		Mati >				Column : 1a	~ 11 ~	12 C			
Bo	It Circle Diameter :	0			mm.				Thickness : 3		mm.			
	Thread Series : Tem			~			Nubbin or RTJ Width : 0 mm.							
Nomi	nal Bolt Diameter 1	0	mm.	5	***	Ac	dditional Flange Data							
	Number of Bolts :	Ð					Rase Required T	hickness on Rigidity	(ASME VIII-1)?					
	Root Area :	0	cm-	2			Indude Corrosio	n in Flange Thicknes						
SI/DIN Flange Di		0	cm-	2					ss Calculations?					
	mension Lookup						Indude Corrosio		ss Calculations?					
Is this a Stand	mension Lookup lard Flange (No Ca		performed	02	A		Indude Corrosio		ss Calculations?					
⊡ Is this a Stand Class	mension Lookup lard Flange (No Ca ; 150	lculation ~	performed	()? I Series			Indude Corrosio		ss Calculations?					
Is this a Stand Class Grade	mension Lookup lard Flange (No Ca : 150 : GR 1.1	lculation ~ ~	erfomed ANSI ANSI	()? I Series I Series			Indude Corrosio		ss Calculations?					
Is this a Stand	mension Lookup lard Flange (No Ca : 150 : GR 1.1	lculation ~	erfomed ANSI ANSI	()? I Series I Series	: B		Indude Corrosio		ss Calculations?					
Is this a Stand Class Grade Nominal Size	mension Lookup lard Flange (No Cal : 150 : GR 1.1 : 12.0000	lculation ~ ~	erfomed ANSI ANSI	()? I Series I Series	: B		Indude Corrosio		ss Calculations?					
Class Grade	mension Lookup lard Flange (No Cal : 150 : GR 1.1 : 12.0000 n calc (Sa*Ab)?	lculation ~ ~	erfomed ANSI ANSI	()? I Series I Series	: B		Indude Corrosio		ss Calculations? erials the Same?	Partition Gasket I	nformation			
Is this a Stand Class Grade Nominal Size	mension Lookup lard Flange (No Cal : 150 : GR 1.1 : 12.0000 n calc (Sa*Ab)?	iculation ~ ~	erfomed ANSI ANSI	()? I Series I Series	: B		Include Corrosio Are the Hub and	Attached Shell Mat	ss Calculations? erials the Same?	Partition Gasket In Plot	nformation			
Is this a Stand Class Grade Nominal Size	mension Lookup lard Flange (No Cal : 150 : GR 1.1 : 12.0000 n calc (Sa*Ab)?	iculation ~ ~	erfomed ANSI ANSI	()? I Series I Series	: B	×	Copy now	Attached Shell Mat Design	ss Calculations? erials the Same? Loads¥					





Define Flange I.D







Assume Flange Thickness

Spacing (

	Flange This	10.00	+0		14	ib Dimension	s	Thidmess Lar	ge Smail	1000		0	mm.
	Face I	0100:0	2 0	i interest i	Gi	isket		n	to Length	10			inn.
olts	Gasioet II	100:0						Gasket Factor m (y: 0		0	N./mm	1^2
015	Bolt Material :	SA-193 F	12	Mati >				Sketch Colum		¥	11	~	
Bo	it Circle Diameter :	adapterio and include		mm.				Gasket Thicknes				men.	
	Thread Series ;	Tema		~				Nubbin or RTJ Widt	h: Q			mm.	
Nom	nal Bolt Diameter :	0	mm.		Add	tional Flange	Data						
	Number of Bolts :	0			E	Base Requ	ired Thidnes	ss on Rigidity (ASME	/111-1)?				
	Root Area :	0	cm^2		0	Indude Co	rrosion in Fla	nge Thickness Calcu	ations?				
NSI/DIN Flange De	mension Lookup					Are the H	ib and Attack	hed Shell Materials th	e Same?				
Is this a Stand	fand Flange (No Ca	culation pe	erfomed)?										
Class	150	-	ANSI Sen	es A									
	I OR L.I	4	C ANSI Seri	es.0									
				Dimensions (

Flange Rating: 17,700 bars





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Desc	iption : FLAN	GE		Hub Dimension	ns		Mer Service			
Flange This	kness : 40				Thickness Large Small : 0 8 mm.					
Flange II	and weat of the local division of the local	0	mm.			Hu	b Length : 0		mm.	
		0	1200000	Gasket						
Gasket II	0 00 1	0				Gasket Pactor m 1	100000000000000000000000000000000000000	1666	m^2	
Bolt Material :	SA-193 B7		Mati >			Sketch Column			`	
Bolt Material : 5A-19 Bolt Circle Diameter : 0			mm.			Gasket Thickness	No.	mm.	\mathbf{A}	
Thread Series :	Tema Metric	÷				Nubbin or RTJ Width	1: 2			
Nominal Bolt Diameter :	0 n	wn.	11.	Additional Flange	e Data					
Number of Bolts :	100					on Rigidity (ASME V				
Root Area :	0 0	m^2		M Include Co	orrosion in Flan	ge Thickness Calcula	ations?			
/DIN Flange Dimension Lookup				Are the H	ub and Attache	d Shell Materials the	r Same?		\setminus	
Is this a Standard Flange (No Ca	culation perfor	ned)?							N	
Class : 150		NSI Series				Put	g0 = Shc	ell nomir	nal thk pro	
Grade : GR 1.1	(@) A	NSI Series	B			1 40	B0 0 1		iui uni pi o	
Nominal Size : 12.0000	~	Obtain D	mensions I							
Full Bolt Load in calc (Sa*Ab)?										
				< Copy nov	v De	sign	Loads Partitic	on Gasket Informat	tion	
Just	like :									

Insufficient Bolt Area or Geometry Error [Failed]





Defining Flange Geometry- Integral Flange Define g1 and hub length

- 17	escription :	and the second second]	Hub Dimensions	Thick	ness Large Small	17 8	mm.	
	Thickness :					mod	Hub Length			
	e ID OD :	1000	0	mm.			hub Length	21	mm.	
	e ID OD :	and the second s	0		Gasket					
	al : SA-19	3 87	RECOVERNMENT			Sketch	ctor m y : 0 Column : 1a Thickness : 3	~ п ~	4./mm ×	
Bolt Circle Diamet		2010/02/07	mm.			Nubbin or R	RTJ Width :		nm.	\sim
Thread Serie			~							
Nominal Bolt Diamet		mm.			Additional Flange Data			Put g1 =	= g0 + 8 to	10 mm.
Number of Bol	To a source				Base Required T			_	-	
Root An	a: 0	cm^2			S Incode Corrosio	nin nange micknes	ss caculations?	nere tai	ken as 9m	m
NSI/DIN Flange Dimension Lookup	,				Are the Hub and	Attached Shell Mat	terials the Same?			
Is this a Standard Flange (No	Calculation	perfomed)?								
Class: 150		C ANSI Se	ries A		H	ib length	$= (g_1 - g_0)$	*3 = (17 - 1)	8)*3 = 27	
Grade : GR 1.1		@ ANSI Se	eries Bl				(8 - 8 °,	, , , , , , , , , , , , , , , , , , , ,	c , c - .	
		Obt	sin Dimensio	ns t						
Nominal Size : 12.0000										
Nominal Size : 12.0000 Ise Full Bolt Load in calc (Sa"Ab)?										
ise Full Bolt Load in calc (Sa*Ab)?	lust like :				Copy now	Design	Loads	artition Gasket Infor	mation	
ise Full Bolt Load in calc (Sa*Ab)?	-				Copy now	Design OK	Loads \P Cancel	artition Gasket Infor Plot	mation Help	
ise Full Bolt Load in calc (Sa*Ab)?	-									



Define bolt type, size and numbers

Description	FLANGE		Hub Dimensions				
	10		Hub binensions	Thick	ness Large Small :	17 8	mm.
Flange Thickness	and the second s				Hub Length :	(and a second se	mm.
Flange ID OD : Face ID OD :	stangen it with a second second second	mm.			Hub Lenger :	61]
Gasket ID OD	and and an and a second		Gasket		0 N 44-		
dasker to 100				Gasket Fa	ctor m y : 0	0	N./mm^2
Bolt Material : SA-19	22.87	Mati		Sketch	Column : 1a	~ II ~	
Bolt Circle Diameter : 0	93.67	mm.		Gasket	Thickness :		mm.
Thread Series: Tema	Metric ~	00//542		Nubbin or R	TJ Width : 0		mm.
SI/DIN Flange Dimension Lookup	cm^2		Are the Hub and	h in Flange Thicknes			
Is this a Standard Flange (No Calculation Class : 150 Grade : GR 1 Nominal Size : 12,000	n perfomed)? ANSI Series		Are the Hub and		erials the Same?		
Grade : GR 1.	n perfomed)? ANSI Series	B	Are the Hub and	Attached Shell Mat	erials the Same?		
Is this a Standard Flange (No Calculation Class : 150 Grade : GR 1. Nominal Size : 12,000 se Full Bolt Load in cric (Sa "Ab)? Just like :	n perfomed)? ANSI Series	B Imensiona 1	Are the Hub and	Attached Shell Mat	erials the Same? It type DIt	artition Gasket In	formation
Is this a Standard Flange (No Calculation Class : 150 Grade : GR 1. Nominal Size : 12,000 e Full Bolt Load in cylic (Sa "Ab)? Just like :	n perfomed)? ANSI Series	B Imensiona 1	Are the Hub and	Attached Shell Mat	erials the Same? It type DIt	artition Gasket In Plot	formation
Is this a Standard Flange (No Calculation Class : 150 Grade : GR 1 Nominal Size : 12,000 se Full Bolt Load in cric (Sa®Ab)?	n perfomed)? ANSI Series	B Imensiona 1	Are the Hub and Give	Attached Shell Mat Select Bol Size of bo Design	terials the Same? It type DIt Loads PA		New Constantion

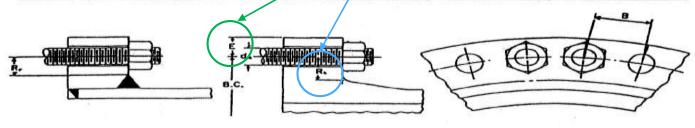
Defining Flange Geometry- Integral Flange Define Bolt PCD and Flange 0.D



METRIC BOLTING DATA - RECOMMENDED MINIMUM

(All Dimensions in Millimeters Unless Noted)

	Th	reads	Nut Dime	ensions					
Bolt Size dB	Pitch	Root Area (mm²)	Across Flats	Across Corners	Bolt Spacing B	Radial Distance Rh	Radial Distance Rr	Edge Distance E	Bolt Size
M12	1.75	72.398	21.00	24.25	31.75	20.64	15.88	15.88	M12
M16	2.00	138.324	27.00	31.18	44.45	28.58	20.64	20.64	M16
M20	2.50	217.051	34.00	39.26	52.39	31.75	23.81	23.81	M20
M22	2.50	272.419	36.00	41.57	53.98	33.34	25.40	25.40	M22
M24	3.00	312.748	41.00	47.34	58.74	36.51	28.58	28.58	M24
M27	3.00	413.852	46.00	53.12	63.50	38.10	29.00	29.00	M27
M30	3.50	502.965	50.00	57.74	73.03	46.04	33.34	33.34	M30
M36	4.00	738.015	60.00	69.28	84.14	53.97	39.69	39.69	M36
M42	4.50	1018.218	70.00	80.83	100.00	61.91		49.21	M42
M48	5.00	1342.959	80.08	92.38	112,71	68.26		55.56	M48
M56	5.50	1862.725	90.00	103.92	127.00	76.20		63.50	M56
M64	6.00	2467.150	100.00	115.47	129.70	84.14		66.68	M64
M72	6.00	3221.775	110.00	127.02	155.58	88.90		69.85	M72
MBO	6.00	4076.831	120.00	138.55	166.69	93.66		74.61	MBO
M90	6.00	5287.085	135.00	155.88	188.91	107.95		84.14	M90
M100	6.00	6651.528	150.00	173.21	207.96	119.06		93.66	M100

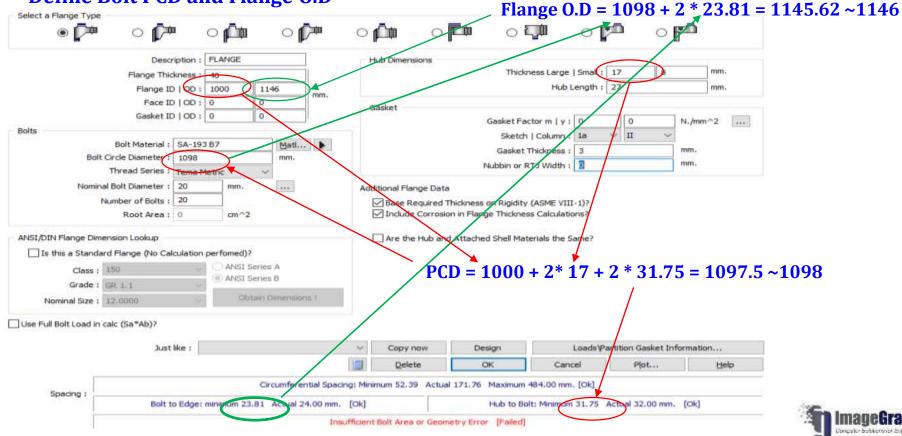






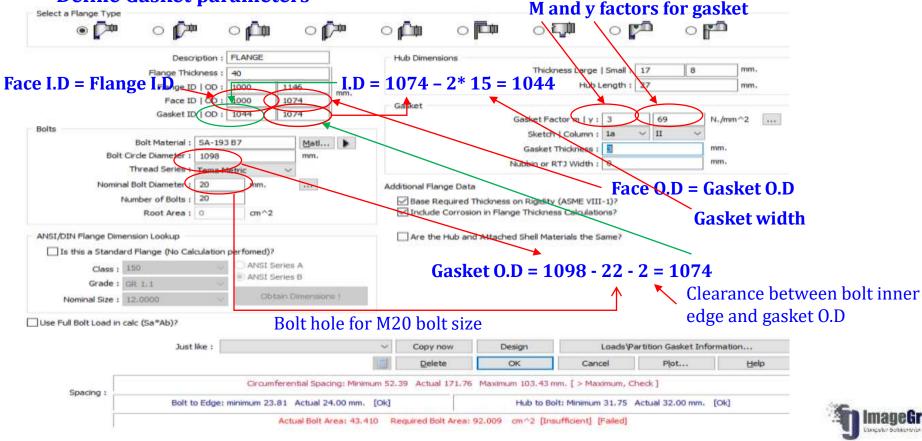


Define Bolt PCD and Flange O.D





Define Gasket parameters





Checking Bolt Area 0 🏴 0 n data 0 ① Ⅲ □ 0 0 0 Description : FLANGE Hub Dimensions mm. Thickness Large | Small : 17 8 Flange Thickness : 40 Hub Length : 27 mm. Flange ID | OD 1000 1146 mm. Face ID | OD 1000 1074 Gasket Gasket ID | OD : 1044 1074 Gasket Factor m | y : N./mm^2 69 444 Bolts Sketch | Column : 1a ~ II Bolt Material : SA-193 B7 Mati... > Gasket Thickness : 3 mm. Bolt Circle Diameter : 1098 mm. Nubbin or RTJ Width : 0 mm. Thread Series : Tema Metric Nominal Bolt Diameter : 20 mm. Additional Flange Data Number of Bolts : 20 Base Required Thickness on Rigidity (ASME VIII-1)? Root Area: 0 Include Corrosion in Flange Thickness Calculations? m^2 ANSI/DIN Flange Dimension Lookup Are the Hub and Attached Shell Materials the Same? Is this a Standard Flange (No Calculation perfored)? ANSI Series A Class : 150 ANSI Series 8 Grade : GR 1.1 Nominal Size : 12.0000 **Increase no of bolts to satisfy bolt area** Use Full Bolt Load in calc (Sa*Ab)? Just like : 14 Copy now Design Loads Partition Gasket Information... Delete OK Cancel Plot... Help Circumferential Spacing: Minimum 52,39 Actual 171,76 Maximum 103,43 mm, [> Maximum, Check] Spacing : Bolt to Edge: minimum 23.81 Actual 24.00 mm. [Ok] Hub to Bolt: Minimum 31.75 Actual 32.00 mm. [Ok] Actual Bolt Area: 43,410 Required Bolt Area: 92,009 cm^2 [Insufficient] [Failed] **Bolt Area is insufficient**





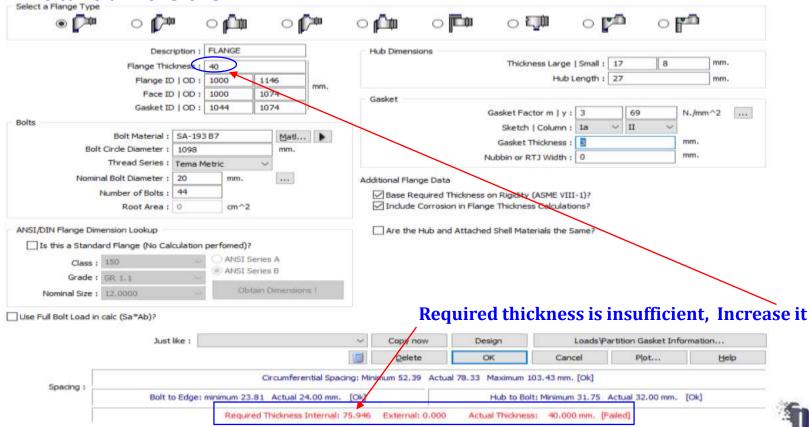
Checking Bolt Area

Spacing :				Circu	umferen	tial Spacin	ng: Mini	num 52.39 Actua	78.33 Maximum	103.43 mm.	[Ok]			
								Delete	ОК	Cano	1000	Plot	t	jelp
	Just	like :					~	Copy now	Design		Loads Partit	ion Gasket In	1.2	
lse Full Bolt Load ir	n caic (Sa*Ab)?							No c	of bolts ir	icreas	sed to	satisfy	v bolt	are
Nominal Size :	12.0000		Ot	btain Dim	vensions	El .								
Grade	GR 1.1													
Class	150			Series A Series B		\sim								
Is this a Stand	lard Flange (No Cal	culation												
NSI/DIN Flange Dir	mension Lookup						C	Are the Hub and	Attached Shell Ma	terials the S	ame?			
	Root Area :	0	640.43	2			E	Include Corrosio	n in Flange Thickne	ss Calculatio	ons?			
	Number of Bolts :	44					Б	Base Required T	hickness on Rigidity	ASME VIII	-1)?			
Nomi	nal Bolt Diameter :	20	mm.	5	***		Add	tional Flange Data						
20		Tema N	letric	letric \checkmark					Nubbin or RTJ Width :	0				
Bol	Bolt Material : It Circle Diameter :	SA-193 1098	387 Matl					Gasket Thickness :		:		mm.		
olts	1.1.2.1.1.1.1.1.1.1			87 84-44		(ingen)			Sketch	n Column :	1a 🗸	п ~		
	Gasket II) OD :	1044 1074		é –				Gasket Fa	ctor m y :	3	69	N./mm^2	
	Face II	OD:	1000	1074		mm.	G	Gasket						
	Flange ID		1000	1146			Hub Length : 27 mm.							
	Flange Thic		FLANGE				1	up Dimensions	Thick	ness Large	Small : 17	8	m	n.
			EL ANICE				1.4.	b Dimensions						



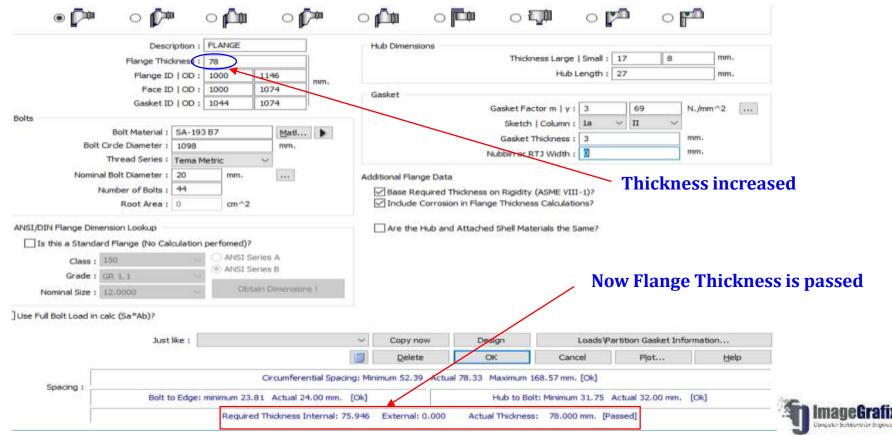


Fine tune dimensions





Fine tune dimensions



Defining Flange Geometry- Integral Flange Plot of Flange

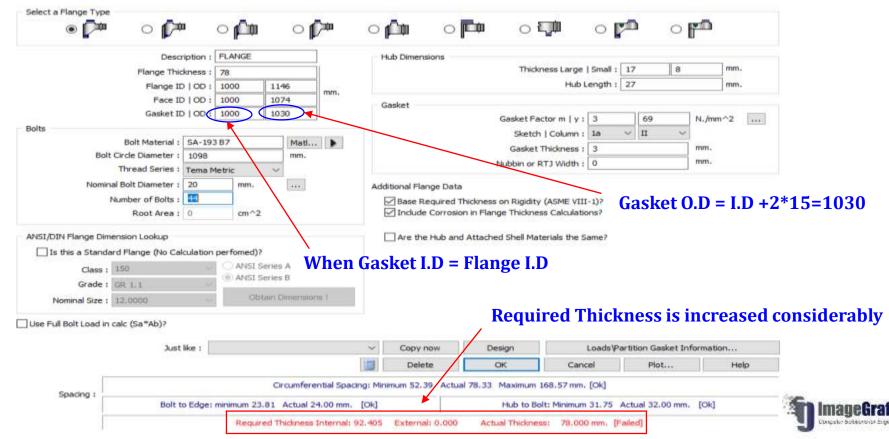


Flange Type 1 (Integral Weld Neck) : FLANGE Flange Material: SA-516 70 Bolt Material: SA-193 B7 Number of Bolts: 44 @ 1098.000 mm. BCD 78.000 -K 不 1146.000 不 -20.000 [Bolt Diameter Dim, NOT the hole 不 $\mathbf{1}$ 1098.00 小 1074.00 < 27.000 个 \mathbf{V} 17.000 V 8.000 不 1044.00 1000.00 1000.000





If gasket is defined from flange I.D



Defining Gasket Width



As Per ASME Section VIII Div.1

Table 2-4 Recommended Minimum Gasket Contact Widths for Sheet and Composite Gaskets

Flange ID	Gasket Contact Width
24 in. (600 mm) < ID ≤ 36 in. (900 mm)	1 in. (25 mm)
36 in. (900 mm) < ID < 60 in. (1500 mm)	1 ¹ / ₄ in. (32 mm)
ID ≥ 60 in. (1500 mm)	$1\frac{1}{2}$ (38 mm)

As Per TEMA

RCB-6.3 PERIPHERAL GASKETS

RC-6.31

The minimum width of peripheral ring gaskets for external joints shall be 3/8" (9.5 mm) for shell sizes through 23 in. (584 mm) nominal diameter and 1/2" (12.7 mm) for all larger shell sizes.

B-6.31

The minimum width of peripheral ring gaskets for external joints shall be 3/8" (9.5 mm) for shell sizes through 23 in. (584 mm) nominal diameter and 1/2" (12.7 mm) for all larger shell sizes. Full face gaskets shall be used for all cast iron flanges.



Defining Gasket Width



As Per ASME Section VIII Div.2

Table 4.16.2 Recommended Minimum Gasket Contact Width										
	Gasket Co	ntact Width, N								
	Gasket Outside Diameter									
Gasket Type	<150 mm	<300 mm	<600 mm	<900 mm	900 mm (36 in.)					
	(6 in.)	(12 in.)	(24 in.)	(36 in.)	and Over					
Sheet gaskets including laminated sheets gaskets	9 mm	12 mm	16 mm	16 mm	19 mm					
with or without a metal core	(0.375 in.)	(0.5 in.)	(0.625 in.)	(0.625 in.)	(0.75 in.)					
Preformed composite gaskets including spiral	6 mm	9 mm	12 mm	16 mm	16 mm					
wound, jacketed, and solid flat metal gaskets	(0.25 in.)	(0.375 in.)	(0.5 in.)	(0.625 in.)	(0.625 in.)					

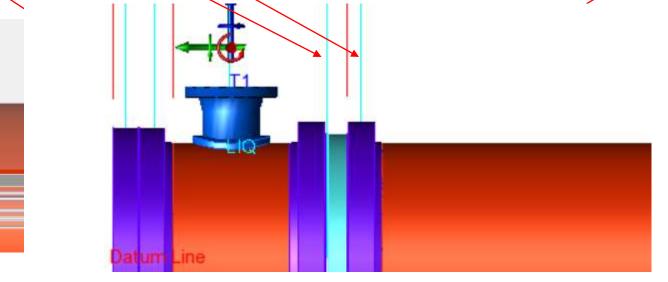


Transferring Bolt loads, forces and moments on flange



When Bolt Loads are different on Flanges?

- When Flanges on both sides of tubesheet are having different pressure, temperature or gaskets.
- In case of TEMA AES type of construction shell side bonnet flanges are having different diameters.





Transferring Bolt loads, forces and moments on flange



How to apply Forces and Moments on Flanges?

• When there are external forces and moments present on the flange joint its effect will be considered according to Kellogg's Equation

$$P_e = \frac{4.F}{\pi.G^2} + \frac{16.M}{\pi.G^3}$$

- This $\mathbf{P}_{\mathbf{e}}$ is simply added to the design pressure \mathbf{P}
- \bullet Where , ${\bf F}$ is external axial force on flange.

• According to Div 2 equation this axial force will have to be considered if it is tensile i.e. pulling force, in other case the value to be taken as zero.

 F_A = value of the external tensile net-section axial force. Compressive net-section forces are to be neglected and for that case, FA should be taken as equal to zero.





Thank You!

Have a great conversation!

