
# WELCOME to CAUx Local India 2018

# Flange Design In Detail

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HEXAGON
PPM

# Some Typical Flange Images



with tongue

with groove

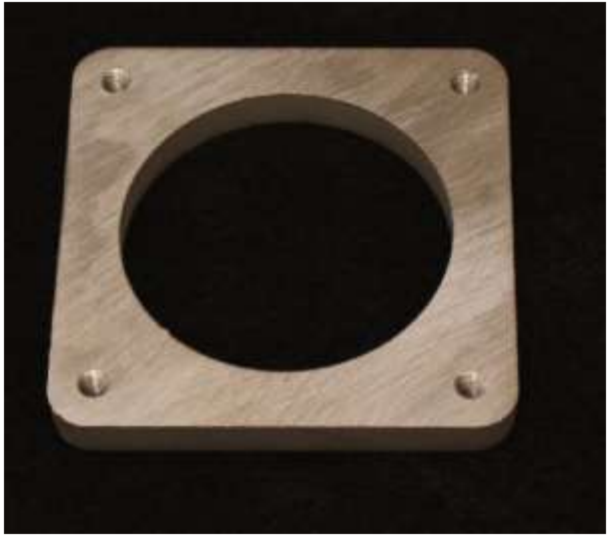
# Some Typical Gasket Images

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.



# Flange Design As Per ASME Sec.VIII Div.1

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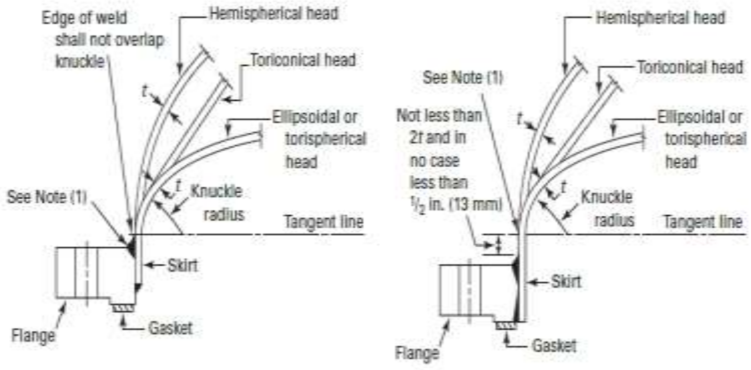
  - The rules apply specifically to the design of bolted flange connections with **gaskets that are entirely within the circle enclosed by the bolt holes and with no contact outside this circle**, and are to be used in conjunction with the applicable requirements in Subsections A, B, and C of this Division.
  - Non Circular Flanges can be done as per 2-10 for circular bores only
- 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

Figure 1-6
Dished Covers With Bolting Flanges




Loose Flange Type

Integral Flange Type

(a) [Notes (2) and (3)]

# 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

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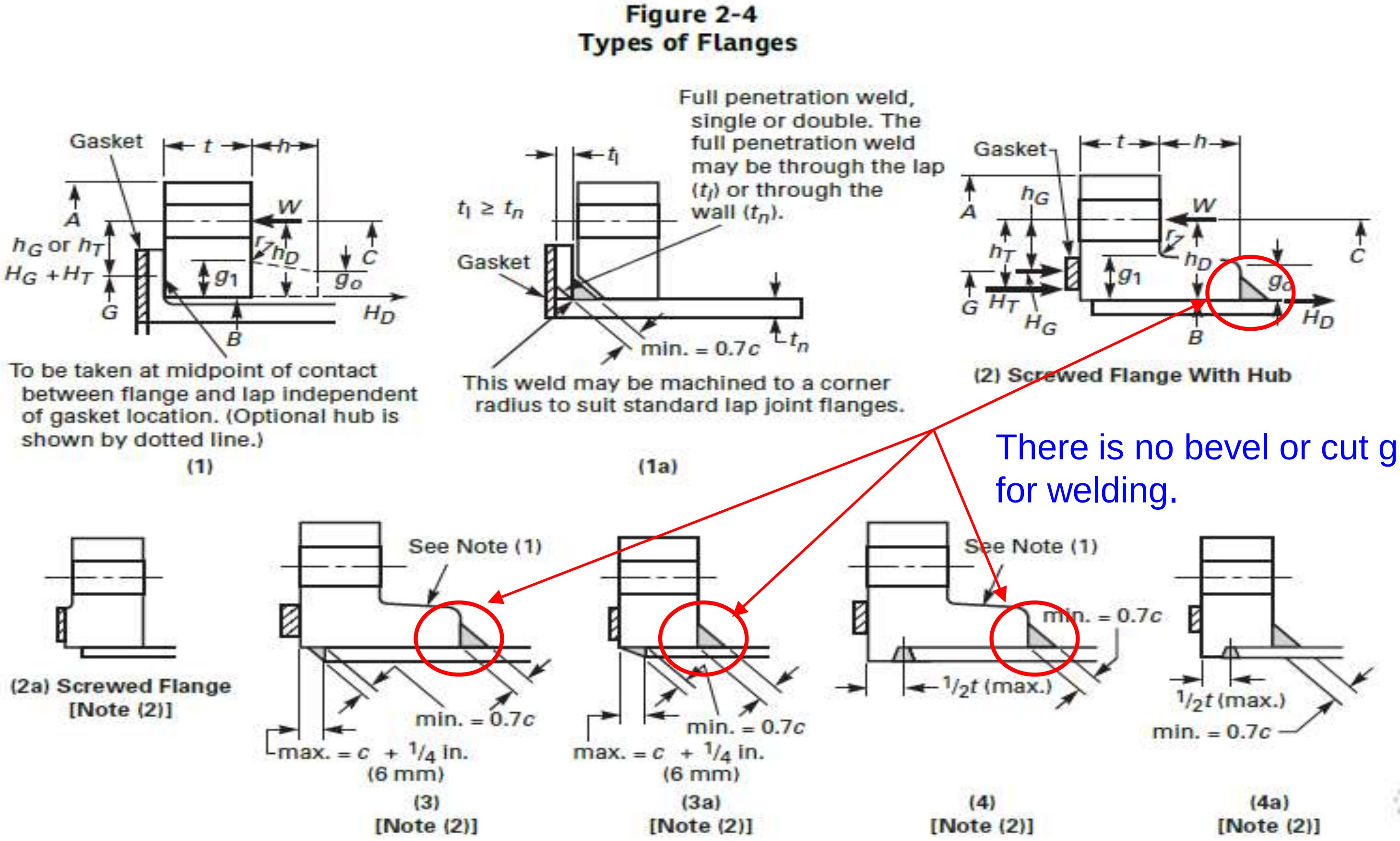
***(1) Loose Type Flanges.***

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.




There is no bevel or cut given in flange for welding.

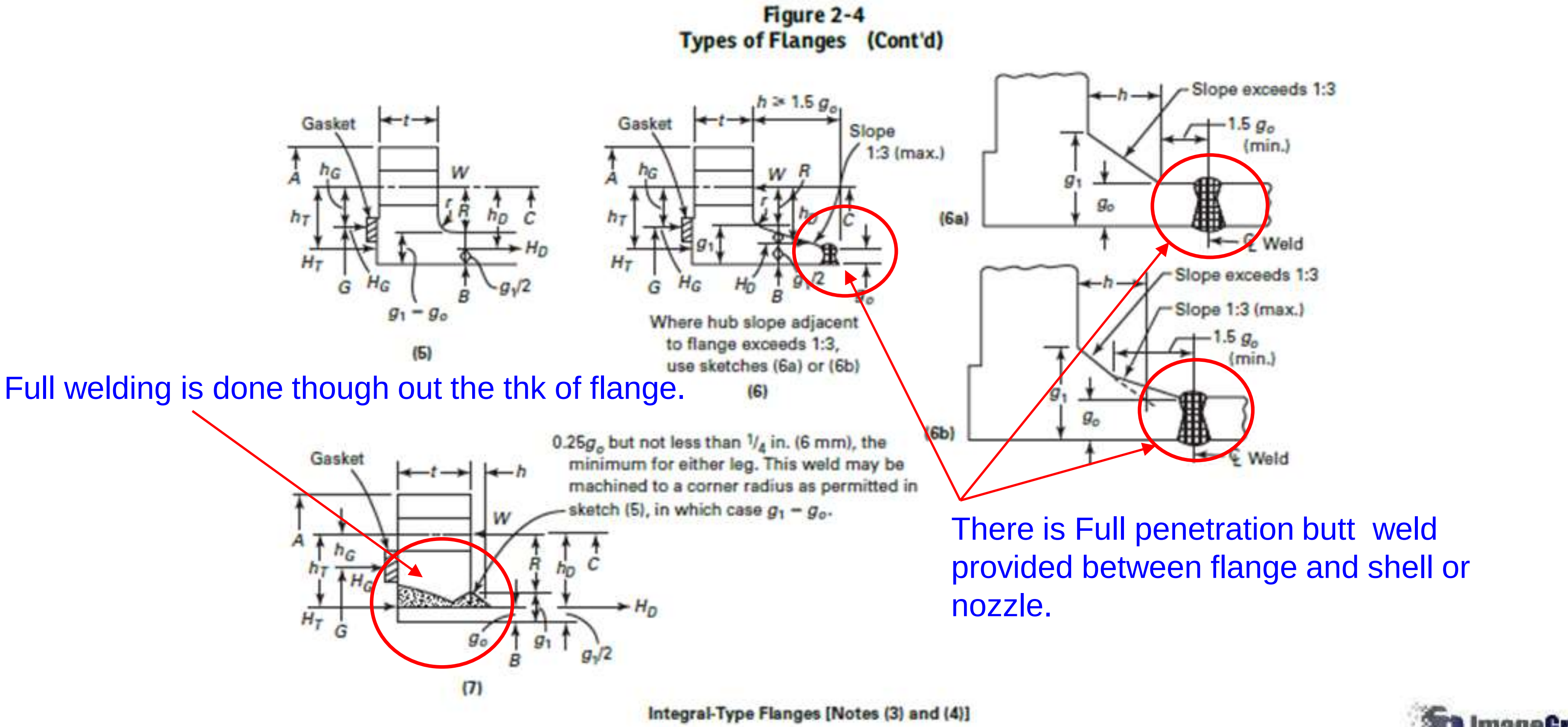
# Types Of Flanges

***(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 *the flange and nozzle neck, vessel or pipe wall is considered to be the equivalent of an integral structure.*

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

# (2) Integral Type Flanges.



# Types Of Flanges

***(3) Optional Type Flanges.***

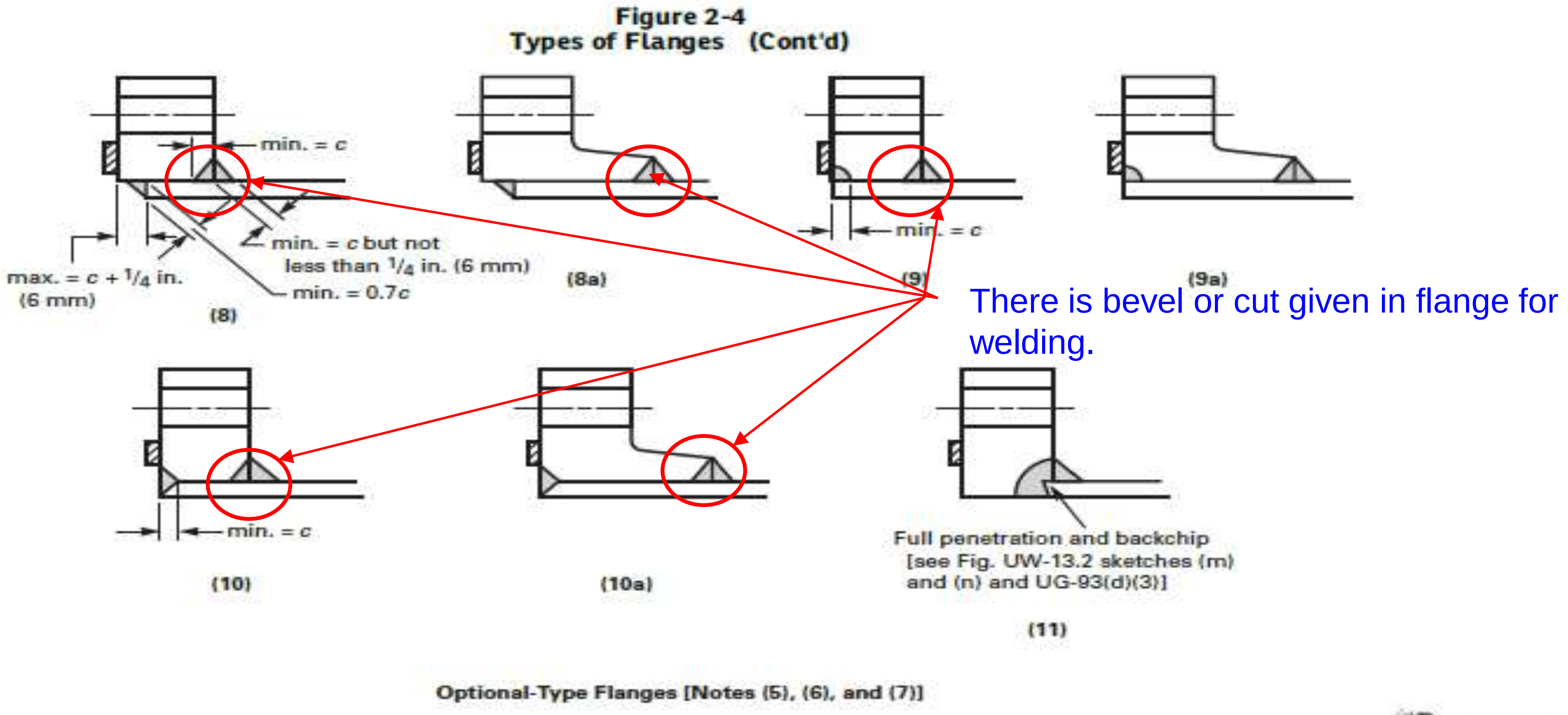
This type covers designs where the attachment of the flange to the nozzle neck, vessel, or pipe wall is such that *the assembly is considered to act as a unit, which shall be calculated as an integral flange.*

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

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

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

# (3) Optional Type Of Flanges.



# Flange Design....

## *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.

# Flange Design....

## *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 seatingis a function of the gasket material, and the effective gasket or contact area to be seated, per eq. (c)(2)(2)

# Flange Design....

## STEP 1: - Calculation of required bolt loads

- **Calculation of required Bolt load for operating condition = Wm1**

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

H = total hydrostatic end force.

Hp = total joint-contact surface compression load

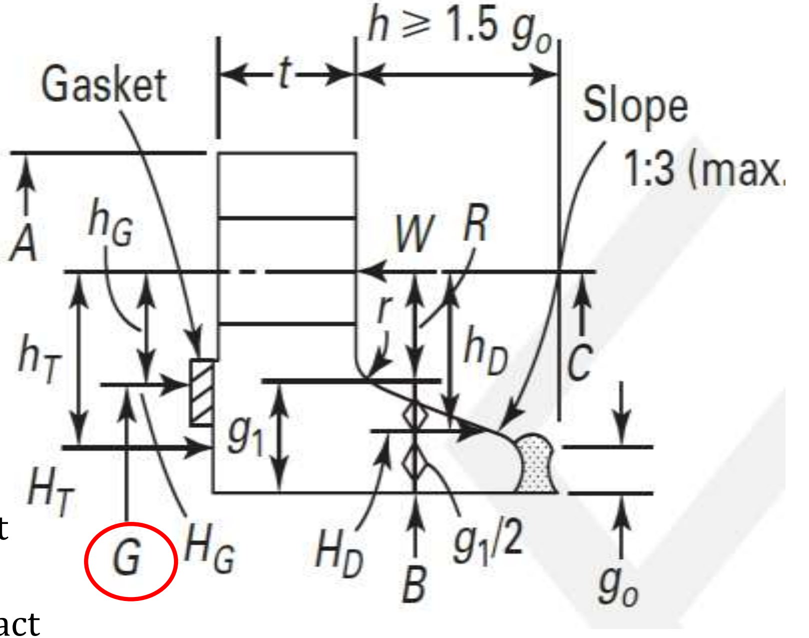
G = diameter at location of gasket load reaction.

G is defined as follows (see Table 2-5.2):

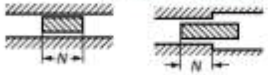
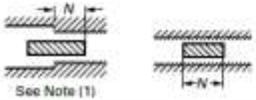
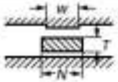
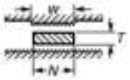
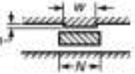
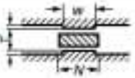
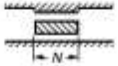
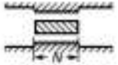
(a) when bo ≤ 1/4 in. (6 mm), G = mean diameter of gasket contact face

(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



## Table 2-5.2
## Effective Gasket Width

| Facing Sketch (Exaggerated) | | Basic Gasket Seating Width, $b_o$ | |
|---|---|---|---|
| | | Column I | Column II |
| (1a) |  | $\frac{N}{2}$ | $\frac{N}{2}$ |
| (1b) |  See Note (1) | $\frac{N}{2}$ | $\frac{N}{2}$ |
| (1c) |  $w \le N$ | $\frac{w+T}{2}; \left(\frac{w+N}{4} \text{max}\right)$ | $\frac{w+T}{2}; \left(\frac{w+N}{4} \text{max}\right)$ |
| (1d) See Note (1) |  $w \le N$ | $\frac{w+T}{2}; \left(\frac{w+N}{4} \text{max}\right)$ | $\frac{w+T}{2}; \left(\frac{w+N}{4} \text{max}\right)$ |
| (2) $^1/_{64}$ in. (0.4 mm) nubbin |  $w \le N/2$ | $\frac{w+N}{4}$ | $\frac{w+3N}{8}$ |
| (3) $^1/_{64}$ in. (0.4 mm) nubbin |  $w \le N/2$ | $\frac{N}{4}$ | $\frac{3N}{8}$ |
| (4) See Note (1) |  | $\frac{3N}{8}$ | $\frac{7N}{16}$ |
| (5) See Note (1) |  | $\frac{N}{4}$ | $\frac{3N}{8}$ |

# Flange Design....

## STEP 1: - Calculation of required bolt loads

➢ **Calculation of required Bolt load for Gasket Seating Condition = Wm2**

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

y = Gasket seating Stress.

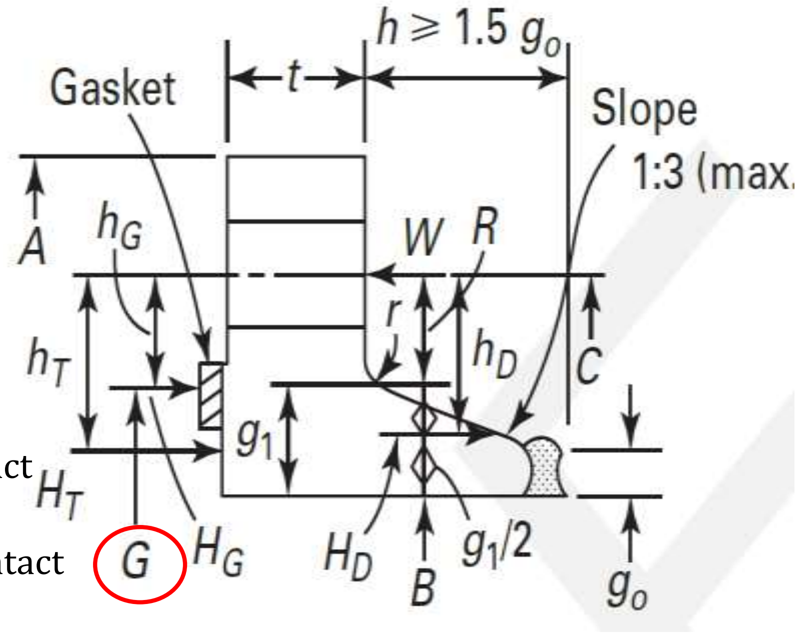
G = diameter at location of gasket load reaction.

G is defined as follows (see Table 2-5.2):

(a) when bo ≤ 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



# Flange Design....

## 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 =**

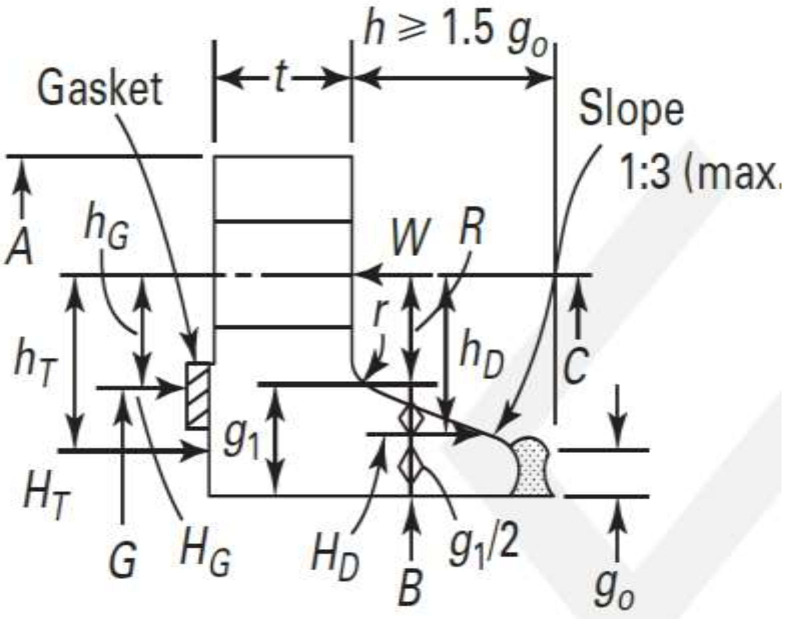
**$A_m$ = max ($Am_1$, $Am_2$)**

Required bolt area for operating condition Am1 =

$Am_1 = Wm_1/Sb$

Required bolt area for Gasket seating condition Am2 =

$Am_2 = Wm_2/Sa.$



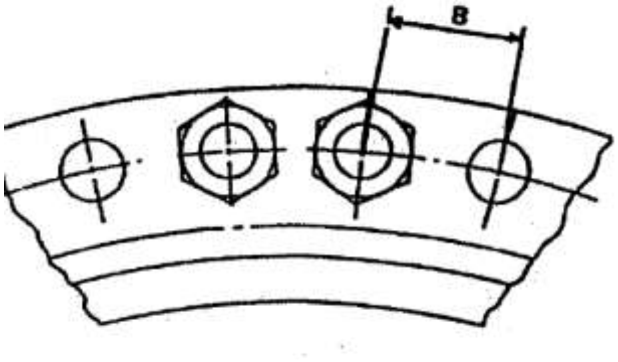

Where,
Wm1 = Required Bolt load for operating condition
Wm2 = Required Bolt load for Gasket seating condition
Sa = allowable bolt stress at atmospheric temperature(see UG-23)
Sb = allowable bolt stress at design temperature (seeUG-23)

# Flange Design....

## 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).

$$B_{S\,max} = 2a + \frac{6t}{m + 0.5} \qquad (3)$$




Where,

a = Bolt diameter

t = Flange thickness

m = Gasket factor

# Flange Design....

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

**For operating conditions,**

$$W = W_{m1} \qquad (4)$$

**For Gasket Seating conditions,**

$$W = \frac{(A_m + A_b)S_a}{2} \qquad (5)$$

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 .

# Flange Design....

## STEP 5: - Calculation of Flange Moment( Mo)

### For operating conditions,

**Mo =** $M_D$ **+** $M_T + M_G$

Where,

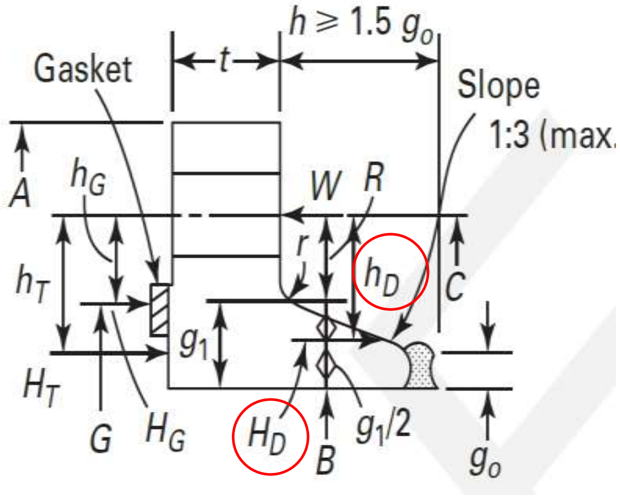
$M_D$ = component of moment due to $H_D$,

= $H_D \cdot h_D$

$H_D$ = hydrostatic end force on area inside of flange

= $(\pi/4) x B^2 P$

$h_D$ = radial distance from the bolt circle, to the circle on which $H_D$ acts, as prescribed in Table 2-6



# Flange Design....

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**Table 2-6**
**Moment Arms for Flange Loads Under Operating Conditions**

| | $h_D$ | $h_T$ | $h_G$ |
|---|---|---|---|
| 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)] | $\frac{C - B}{2}$ | $\frac{C - G}{2}$ | $\frac{C - G}{2}$ |



ImageGrafix

# Flange Design....

## STEP 5: - Calculation of Flange Moment( Mo)

### For operating conditions,

**Mo** = $M_D + M_T + M_G$

Where,

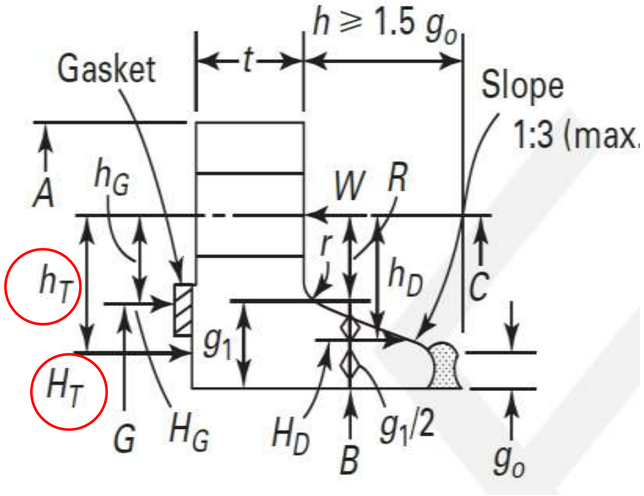
$M_T$ = component of moment due to $H_T$,

= $H_T \cdot h_T$

$H_T$ = 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



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| 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)] | $\frac{C - B}{2}$ | $\frac{C - G}{2}$ | $\frac{C - G}{2}$ |



ImageGrafix

# Flange Design....

## STEP 5: - Calculation of Flange Moment( Mo)

**For operating conditions,**

**Mo** = $M_D + M_T + M_G$

Where,

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

= $H_G \cdot h_G$

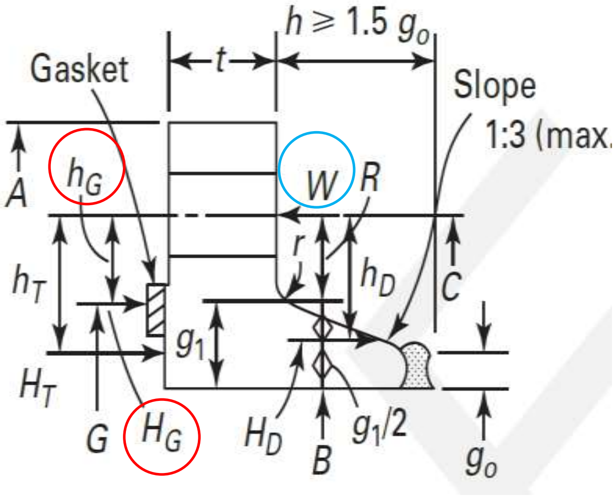
$H_G$ = gasket load (difference between flange design bolt load and total hydrostatic end force)

= W – H

For operating condition

$h_G$ = radial distance from gasket load reaction to the bolt circle

= (C – G)/2



# Flange Design....

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**Moment Arms for Flange Loads Under Operating Conditions**

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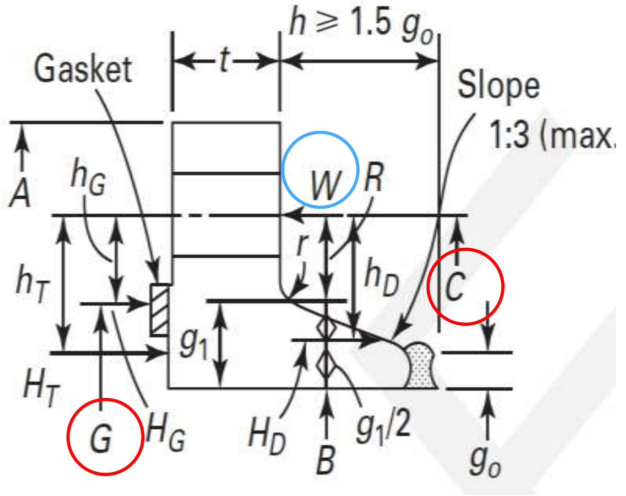
# Flange Design....

## STEP 5: - Calculation of Flange Moment( Mo)

**For Gasket Seating conditions,**

$$M_o = W\frac{(C-G)}{2} \quad (6)$$

For Gasket Seating condition



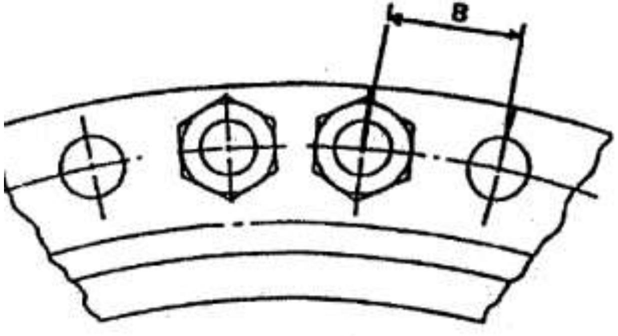
# Flange Design....

## STEP 6: - Calculation of Bolt Space correction Factor

**When the bolt spacing exceeds 2a + t ,**

Multiply $\mathbf{M_O}$ by the bolt spacing correction factor $B_{SC}$ If Bolt spacing exceeds 2a+t

$$B_{SC} = \sqrt{\frac{B_S}{2a + t}} \qquad (7)$$



# Flange Design....

## STEP 7: - Calculation of Flange Stresses

### For Integral Type Flanges

1 ) Longitudinal hub stress - $S_H$

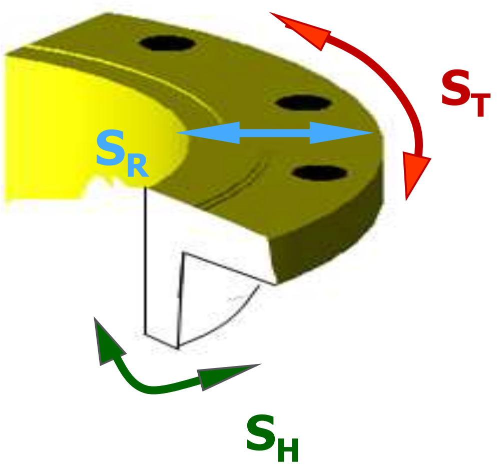
$$S_H = \frac{f M_o}{L g_1^2 B} \qquad (8)$$

2 ) Radial Flange stress - $S_R$

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

3 ) Tangential Flange stress - $S_T$

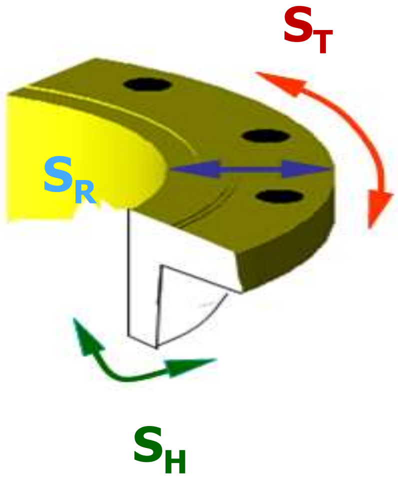
$$S_T = \frac{YM_o}{t^2 B} - ZS_R \qquad (10)$$



# Flange Design....

## STEP 7: - Calculation of Flange Stresses

### For Integral Type Flanges PvElite Report

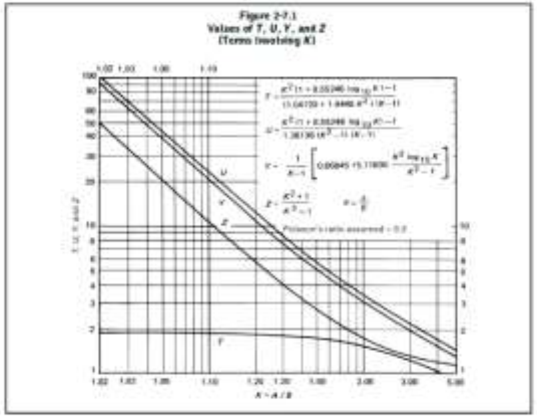


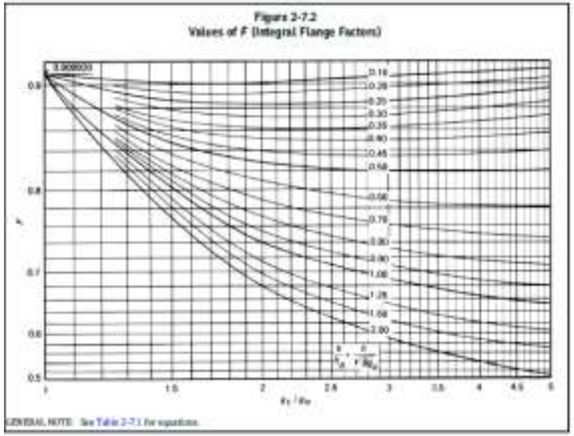

$1.5 \times S_f$

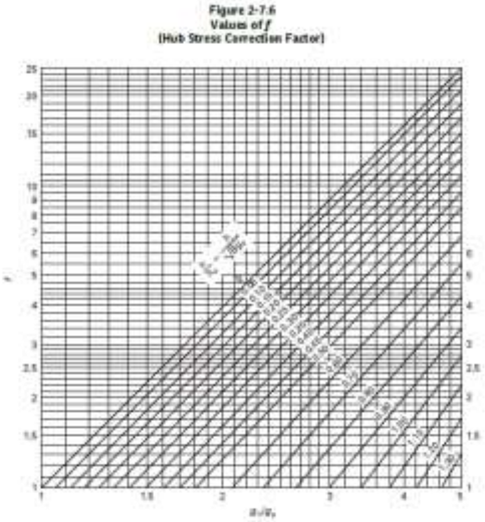
| Stress Computation Results: | Operating Actual | Operating Allowed | Gasket Seating Actual | Gasket Seating Allowed | |
|---|---|---|---|---|---|
| Longitudinal Hub | 2952. | 30000. | 7651. | 30000. | psi |
| Radial Flange | 3242. | 20000. | 8402. | 20000. | psi |
| Tangential Flange | 1161. | 20000. | 3009. | 20000. | psi |

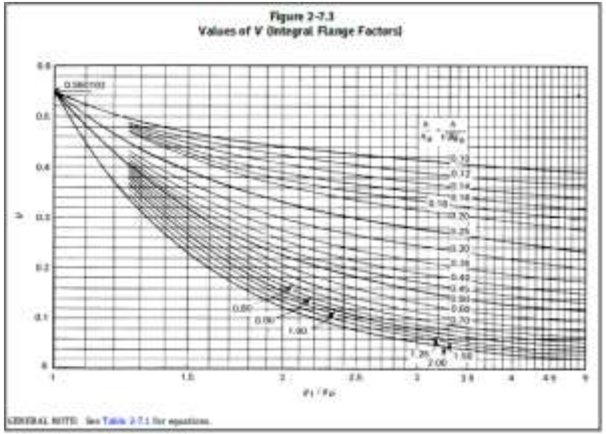
$S_f$

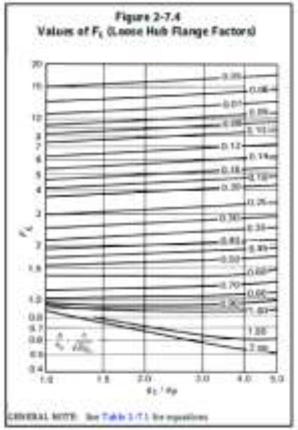
# Flange Design....Various Factors For Flange Stresses

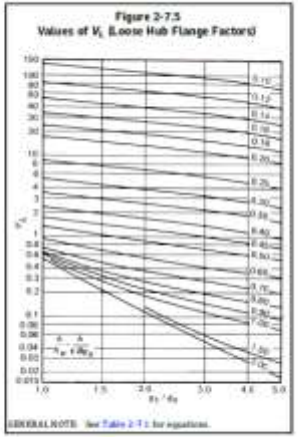


# Flange Design....

## STEP 7: - Calculation of Flange Stresses

### 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)]
  $S_{all} = \text{Smaller}\ (1.5S_f,\ 1.5S_n)$
- For integral type flanges with hub welded to the neck, pipe or vessel wall sketches (6), (6a), and (6b)

$S_{all} = \text{Smaller}\ (1.5S_f,\ 2.5S_n)$

**2 ) Radial Flange stress - $S_R$**

$$S_{all} = S_f$$

**3 ) Tangential Flange stress - $S_T$**

$$S_{all} = S_f$$

**4 ) Combined stresses**

$$\frac{S_H + S_R}{2} \le S_f \quad , \quad \frac{S_H + S_T}{2} \le S_f$$

# Flange Design....

## STEP 7: - Calculation of Flange Stresses

### 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 - $S_T$**

$$S_T = \frac{Y M_o}{t^2 B}$$

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 | $J = \dfrac{52.14 V M_o}{L E g_o^2 K_I h_o} \leq 1.0$ |
| Loose-type flanges with hubs | $J = \dfrac{52.14 V_L M_o}{L E g_o^2 K_L h_o} \leq 1.0$ |
| Loose-type flanges without hubs and optional flanges designed as loose-type flanges | $J = \dfrac{109.4 M_o}{E t^3 K_L (\ln K)} \leq 1.0$ |

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

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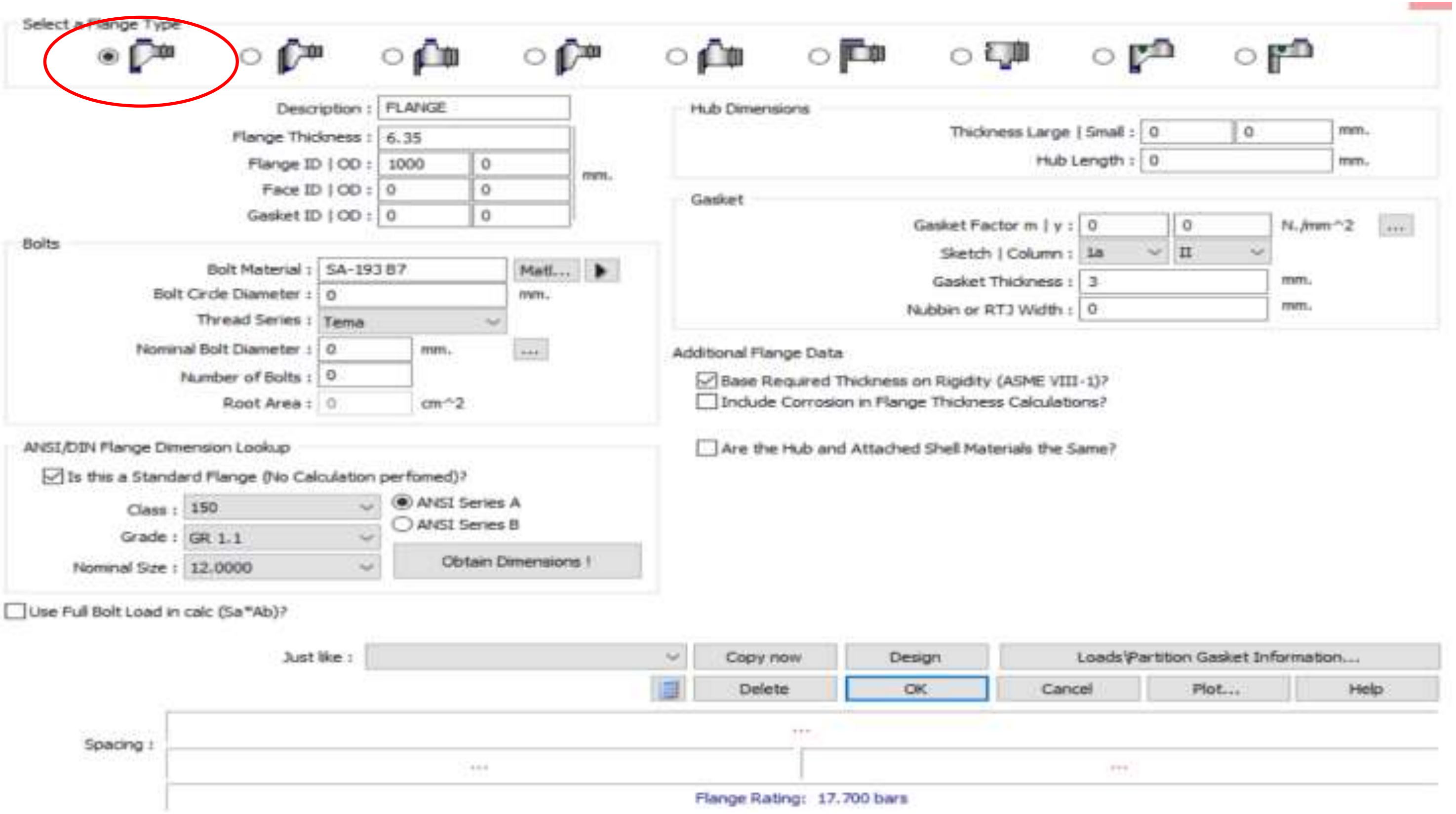
## For Integral Type Flanges

- Select Flange I.D = Shell I.D
- Assume Flange thickness
- Take $\mathbf{g_o}$ 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.

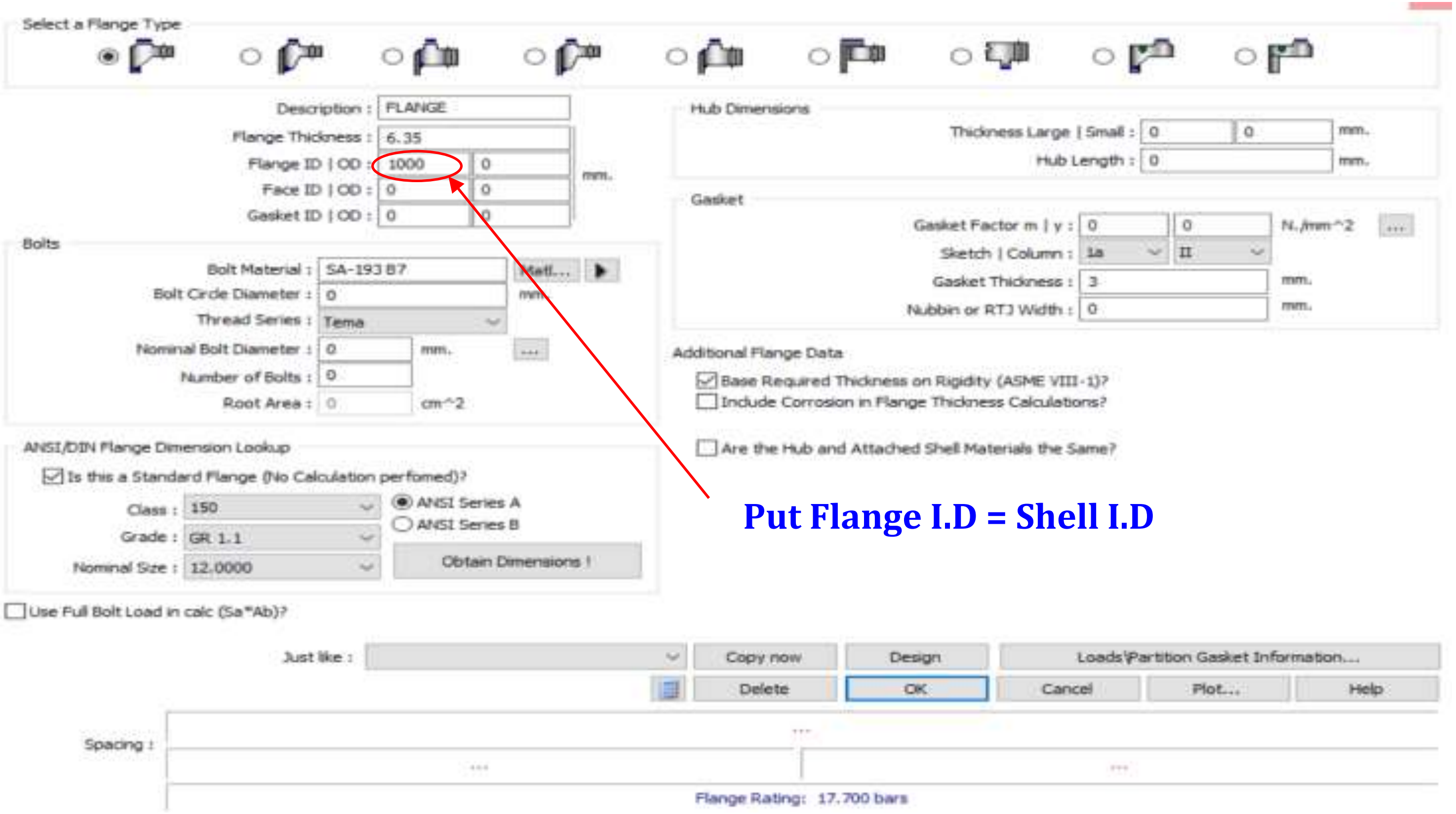
# Defining Flange Geometry- Integral Flange

## Select Flange Type



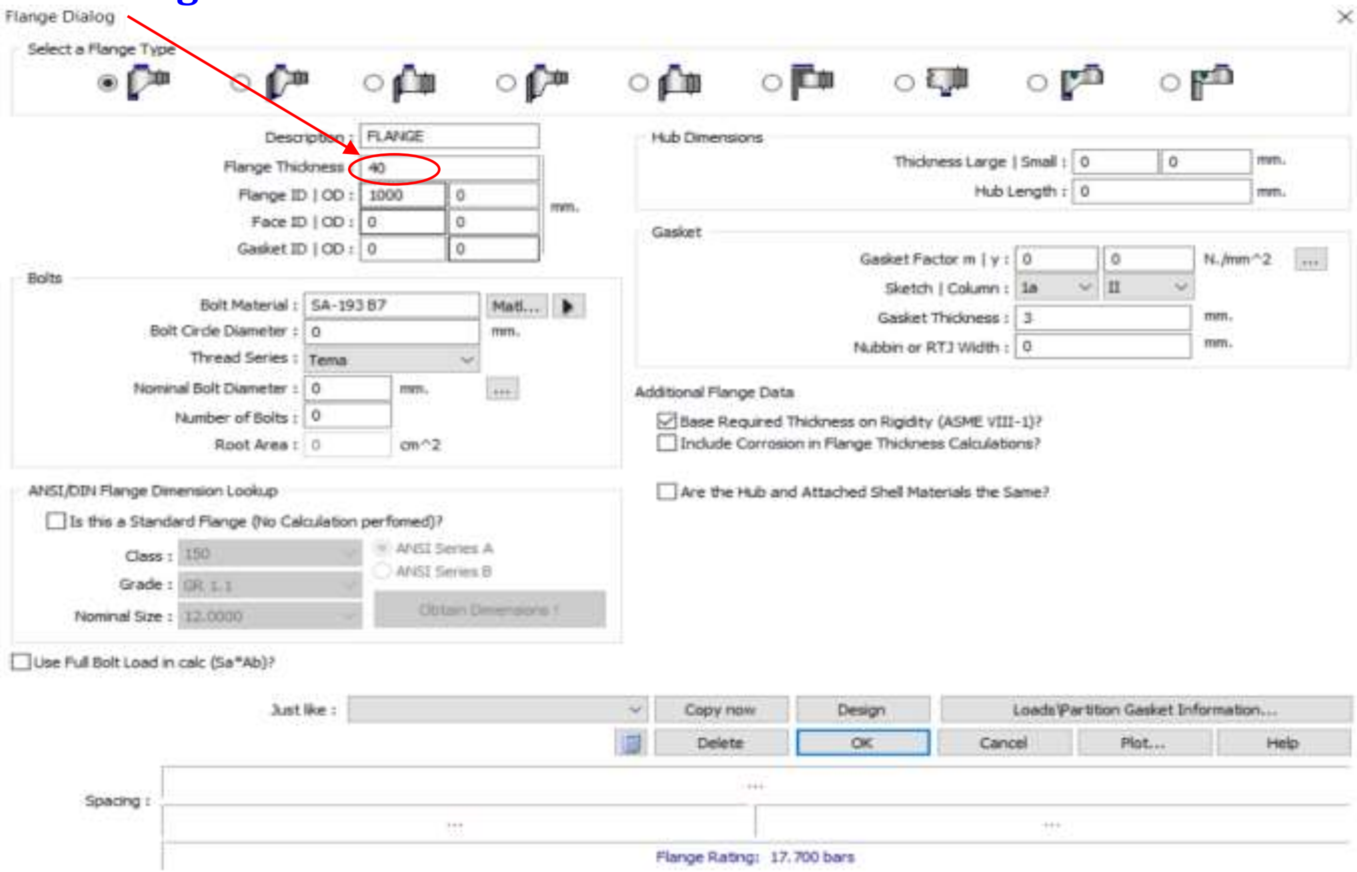
# Defining Flange Geometry- Integral Flange

## Define Flange I.D



# Defining Flange Geometry- Integral Flange

## Assume Flange Thickness



# Defining Flange Geometry- Integral Flange

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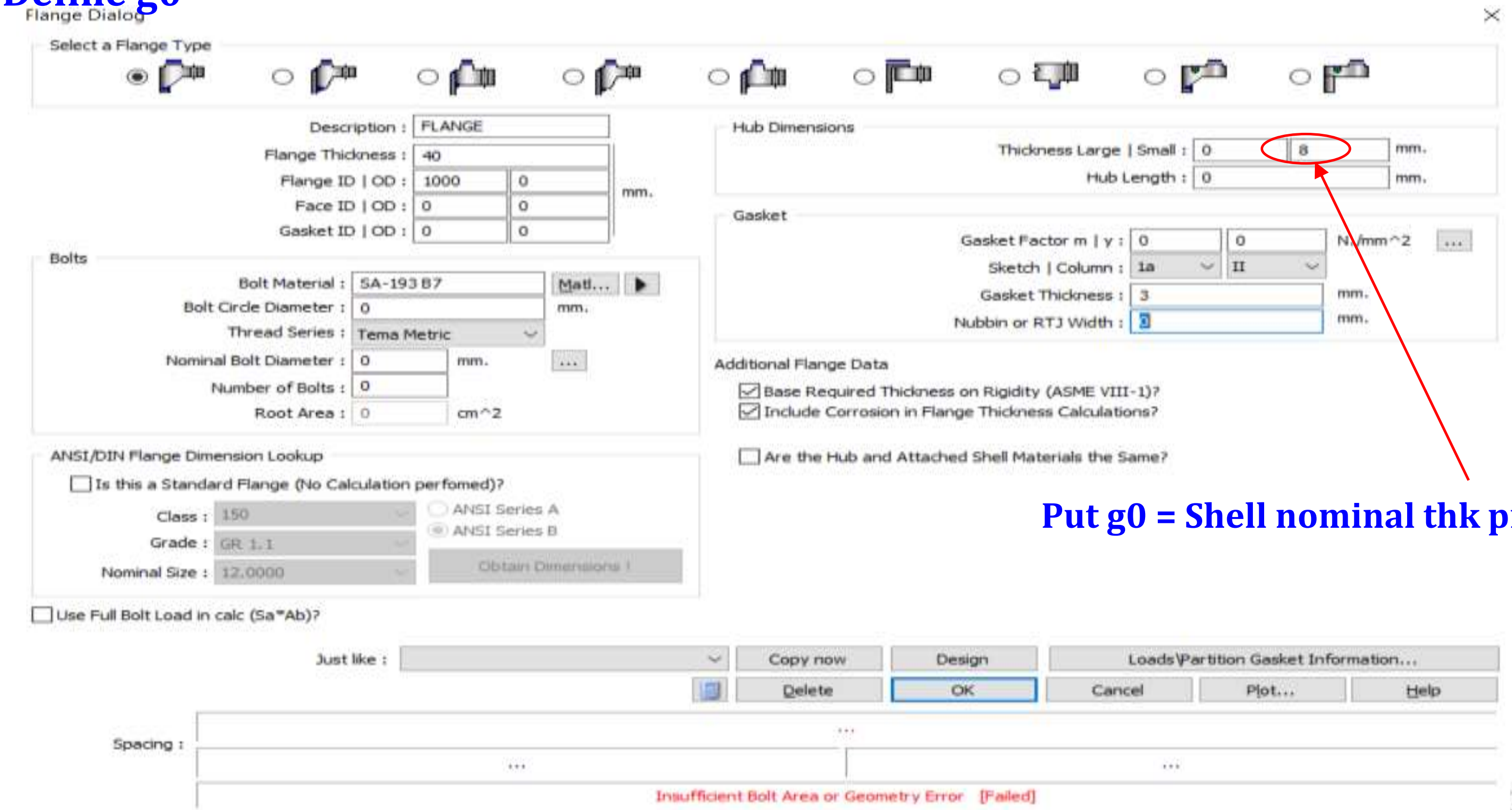
## Define g0




**Put g0 = Shell nominal thk provided**

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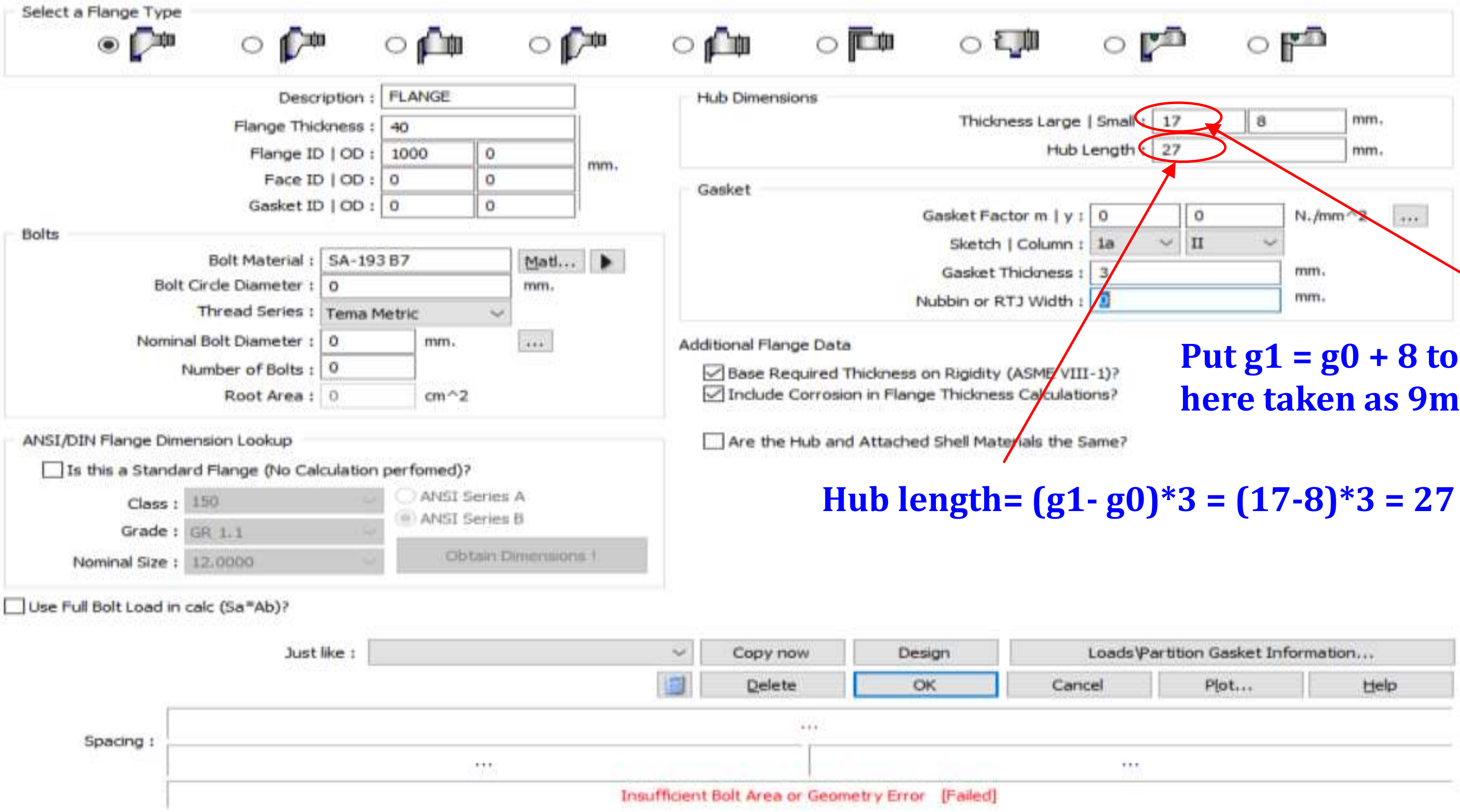
# Defining Flange Geometry- Integral Flange

## Define g1 and hub length

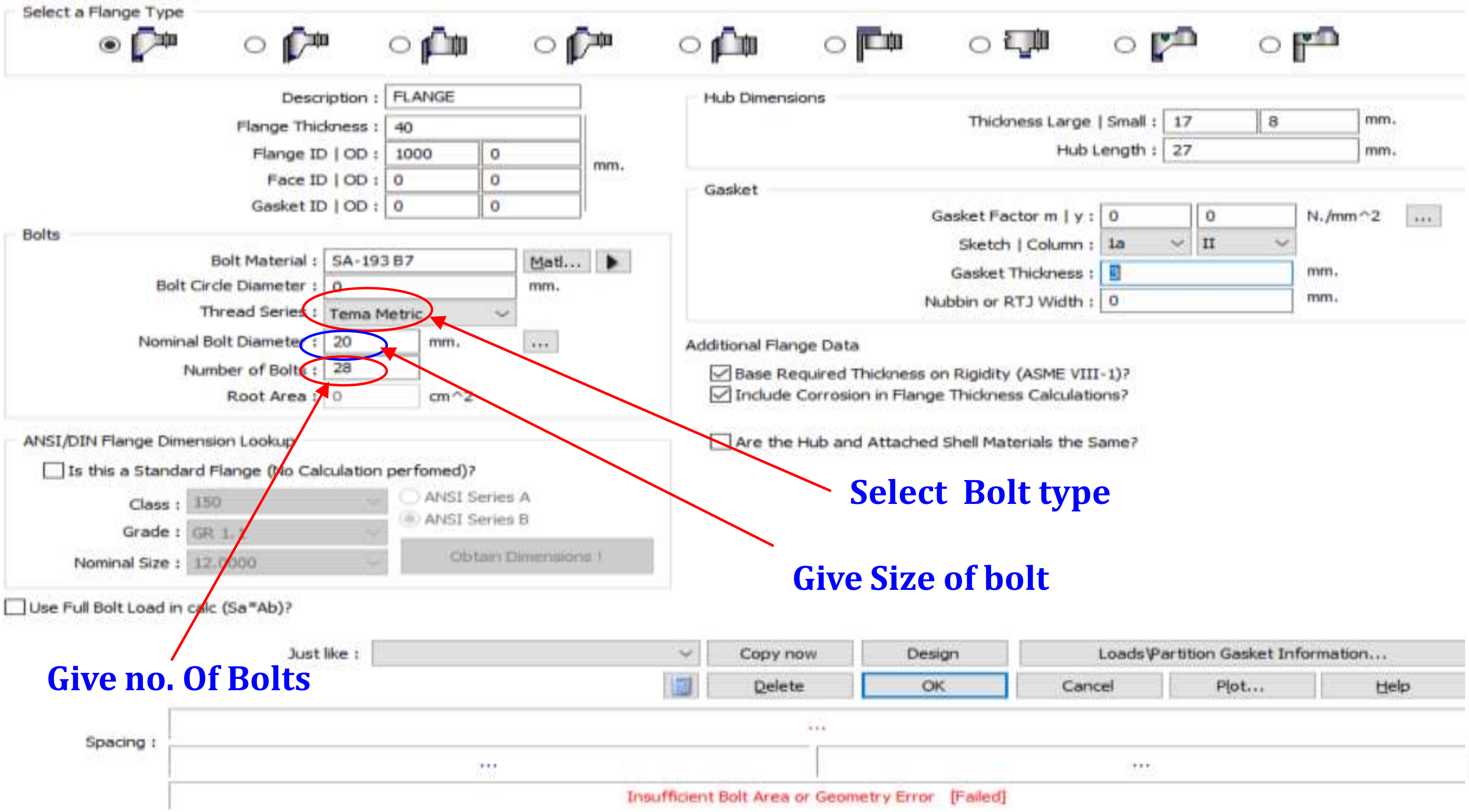



**Put g1 = g0 + 8 to 10 mm, here taken as 9mm**

**Hub length= (g1- g0)*3 = (17-8)*3 = 27**

# Defining Flange Geometry- Integral Flange

## Define bolt type,size and numbers

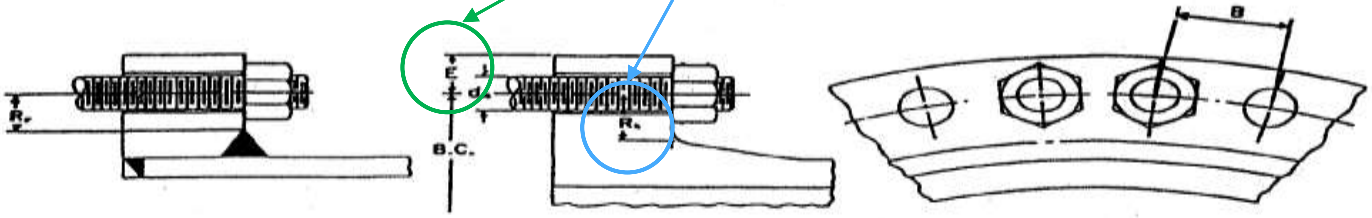


# Defining Flange Geometry- Integral Flange

## Define Bolt PCD and Flange O.D

**TABLE D-5M**
**METRIC BOLTING DATA - RECOMMENDED MINIMUM**
(All Dimensions in Millimeters Unless Noted)

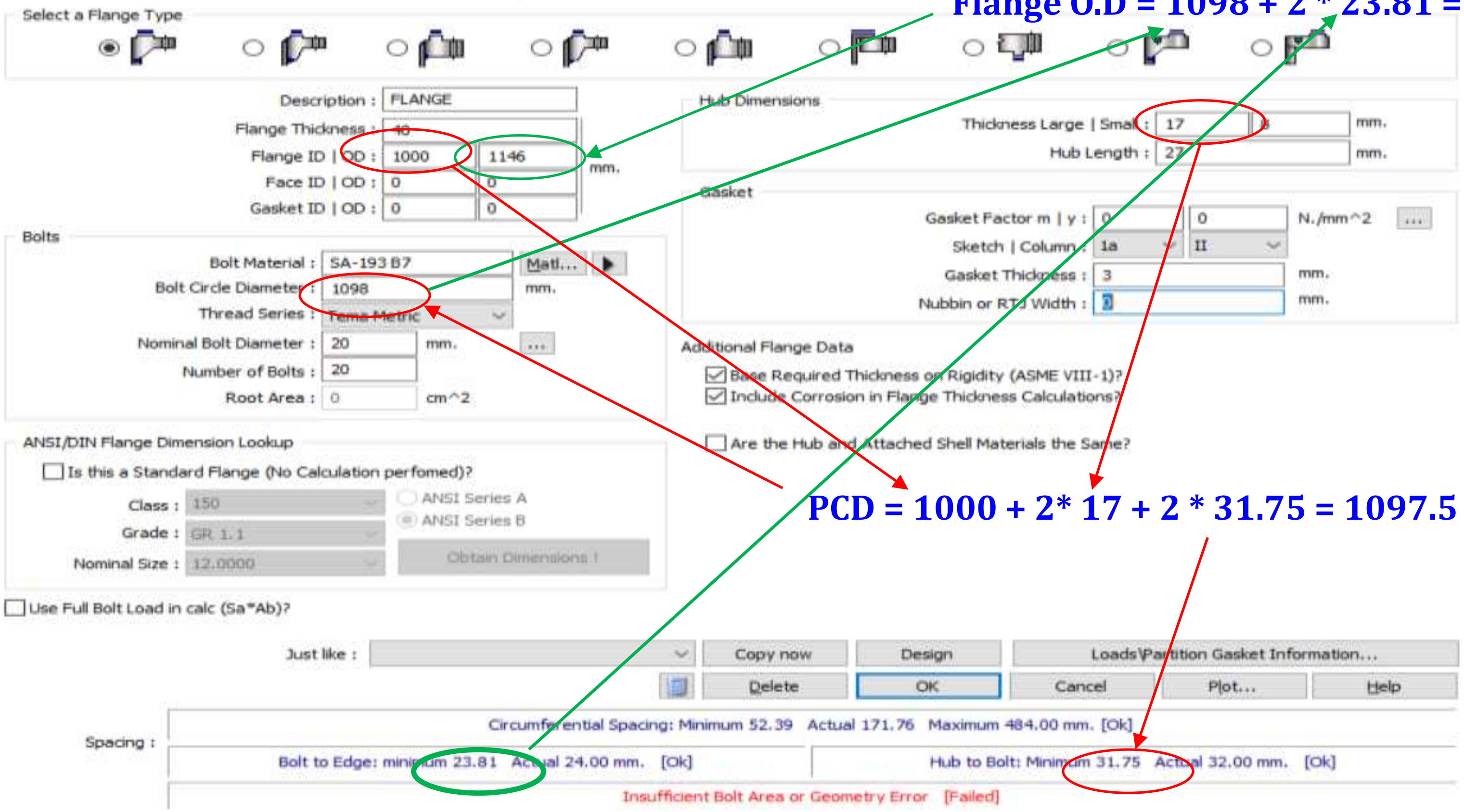
| Bolt Size $d_B$ | Threads | | Nut Dimensions | | Bolt Spacing B | Radial Distance $R_h$ | Radial Distance $R_r$ | Edge Distance E | Bolt Size $d_B$ |
|---|---|---|---|---|---|---|---|---|---|
| | Pitch | Root Area ($mm^2$) | Across Flats | Across Corners | | | | | |
| M12 | 1.75 | 72.398 | 21.00 | 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 | 80.00 | 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 | 139.70 | 84.14 | | 66.68 | M64 |
| M72 | 6.00 | 3221.775 | 110.00 | 127.02 | 155.58 | 88.90 | | 69.85 | M72 |
| M80 | 6.00 | 4076.831 | 120.00 | 138.56 | 166.69 | 93.66 | | 74.61 | M80 |
| 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 |



# Defining Flange Geometry- Integral Flange

## Define Bolt PCD and Flange O.D

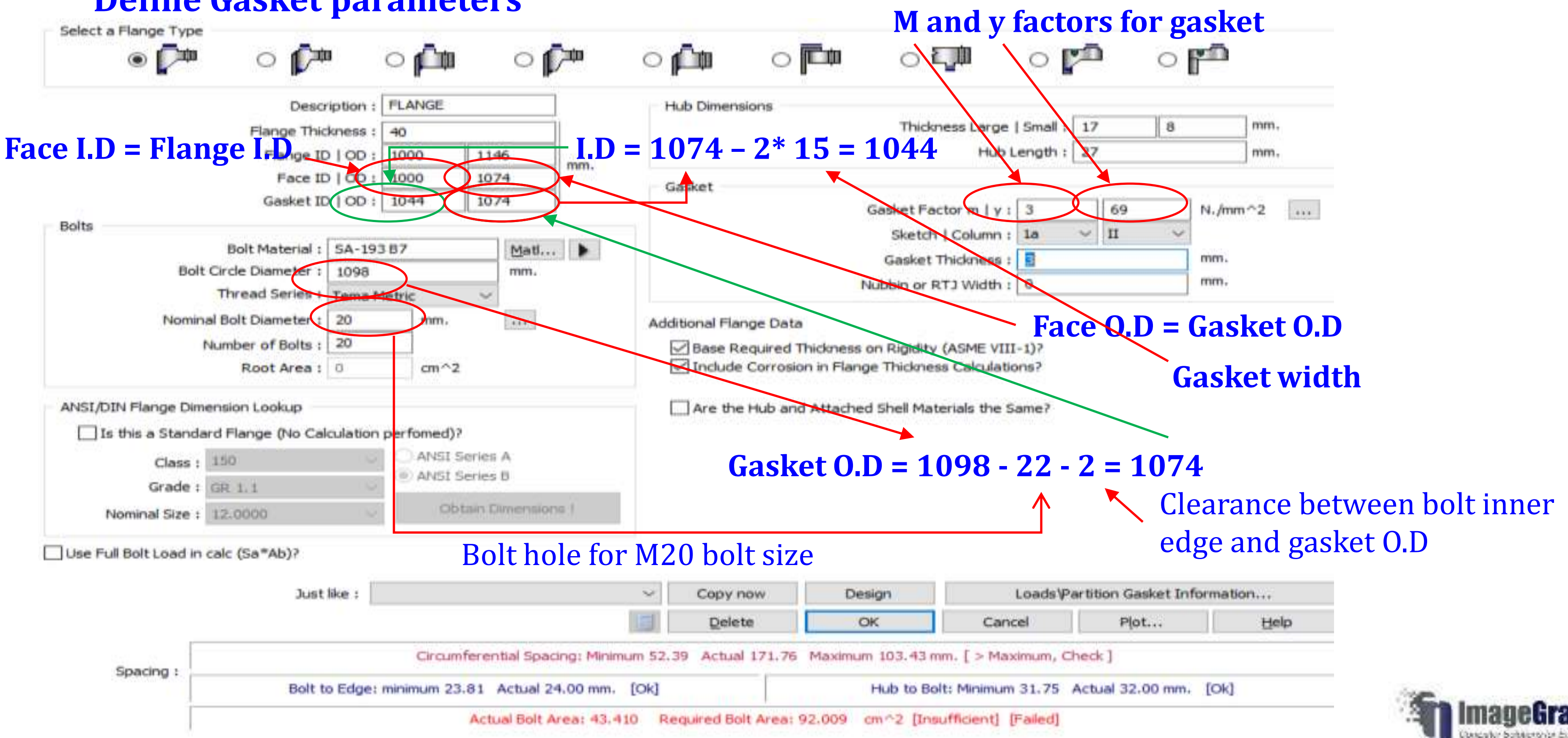
Flange O.D = 1098 + 2 * 23.81 = 1145.62 ~1146




PCD = 1000 + 2* 17 + 2 * 31.75 = 1097.5 ~1098

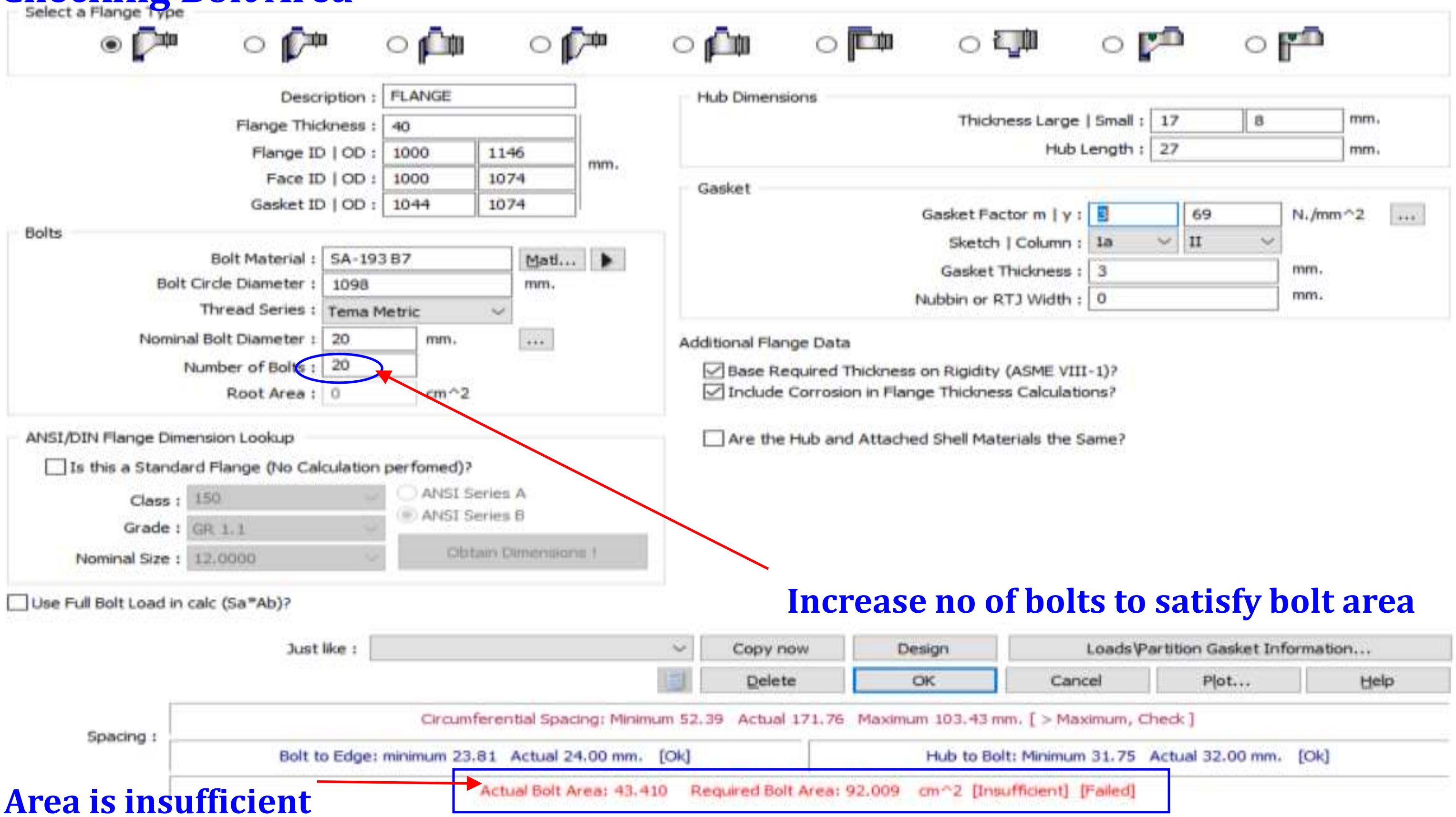
# Defining Flange Geometry- Integral Flange

## Define Gasket parameters



# Defining Flange Geometry- Integral Flange

## Checking Bolt Area

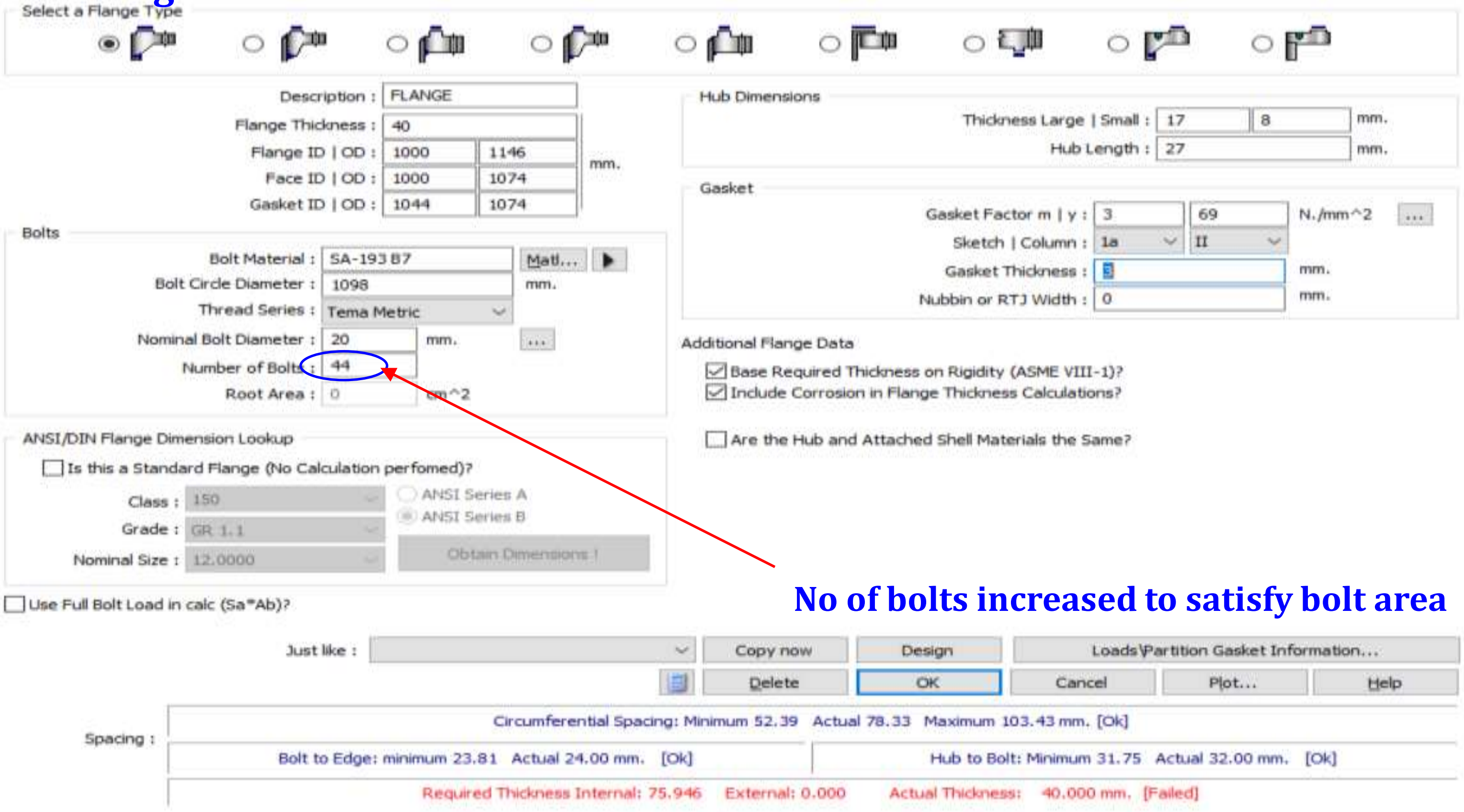



**Increase no of bolts to satisfy bolt area**

**Bolt Area is insufficient**

# Defining Flange Geometry- Integral Flange

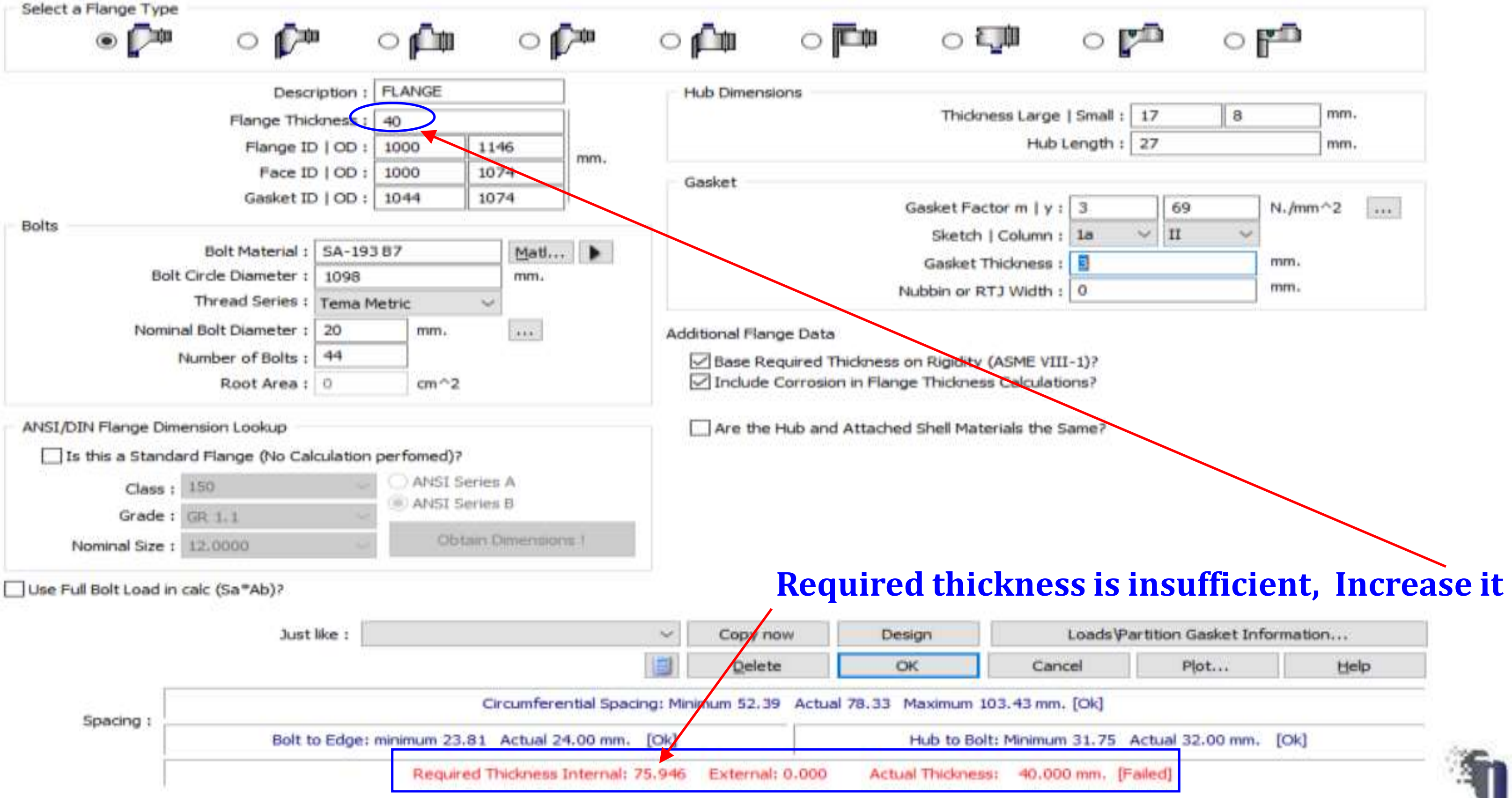
## Checking Bolt Area




**No of bolts increased to satisfy bolt area**

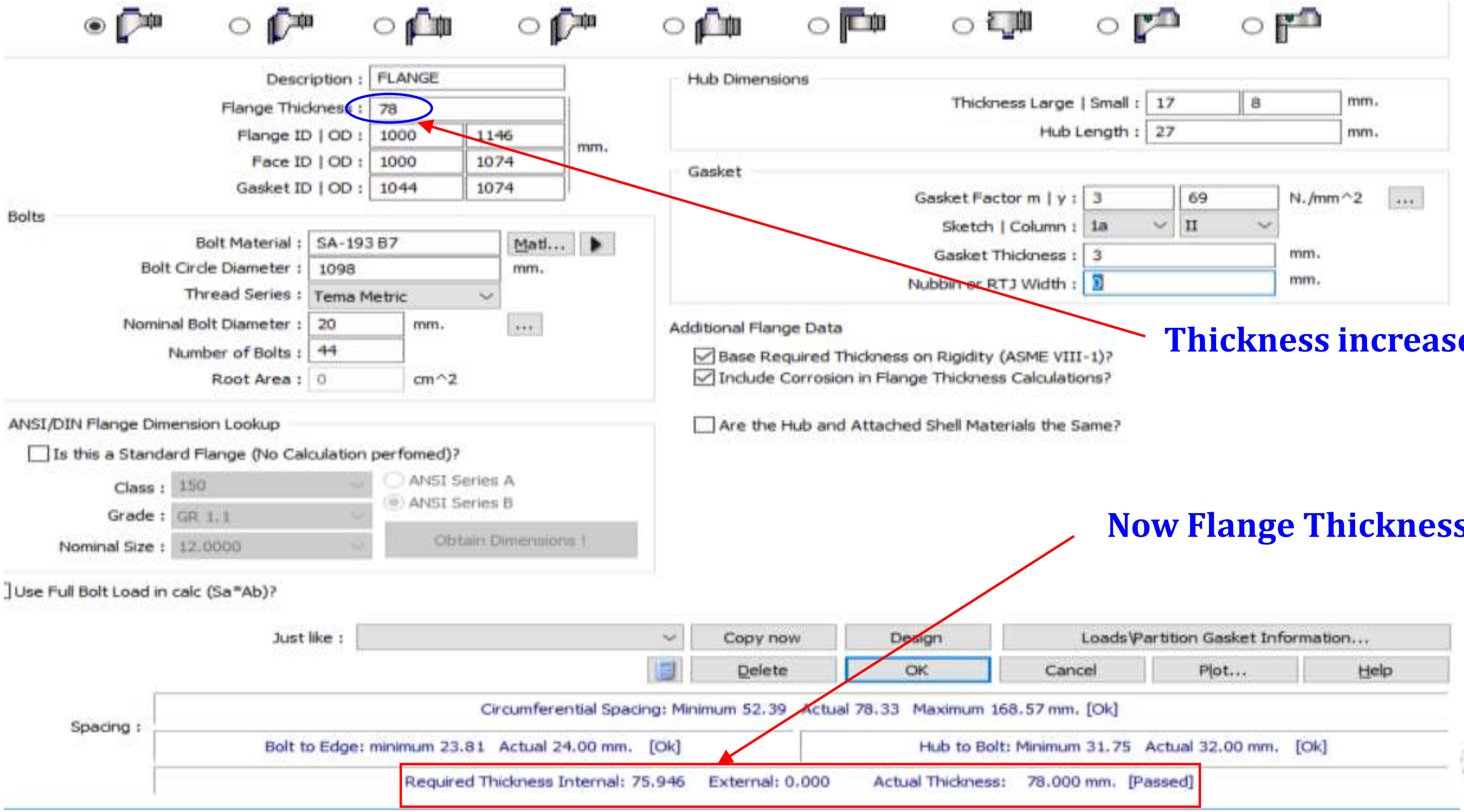
# Defining Flange Geometry- Integral Flange

## Fine tune dimensions



# Defining Flange Geometry- Integral Flange

## Fine tune dimensions

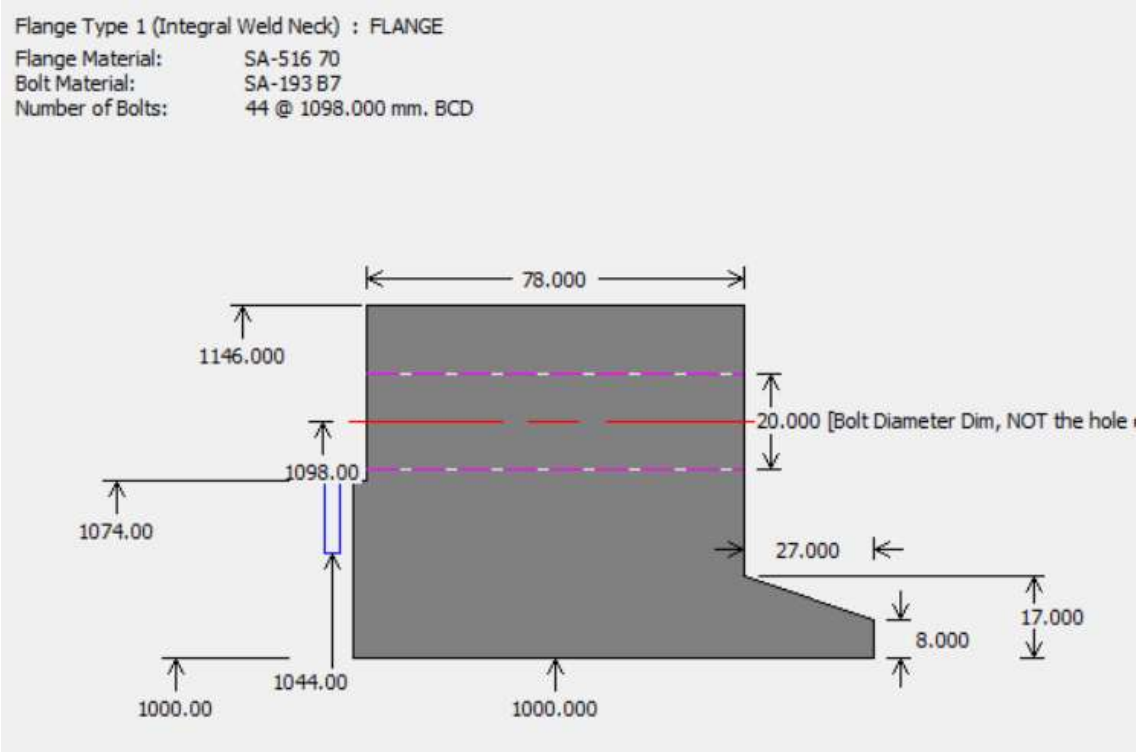



**Thickness increased**

**Now Flange Thickness is passed**

# Defining Flange Geometry- Integral Flange

## Plot of Flange



# Defining Flange Geometry- Integral Flange

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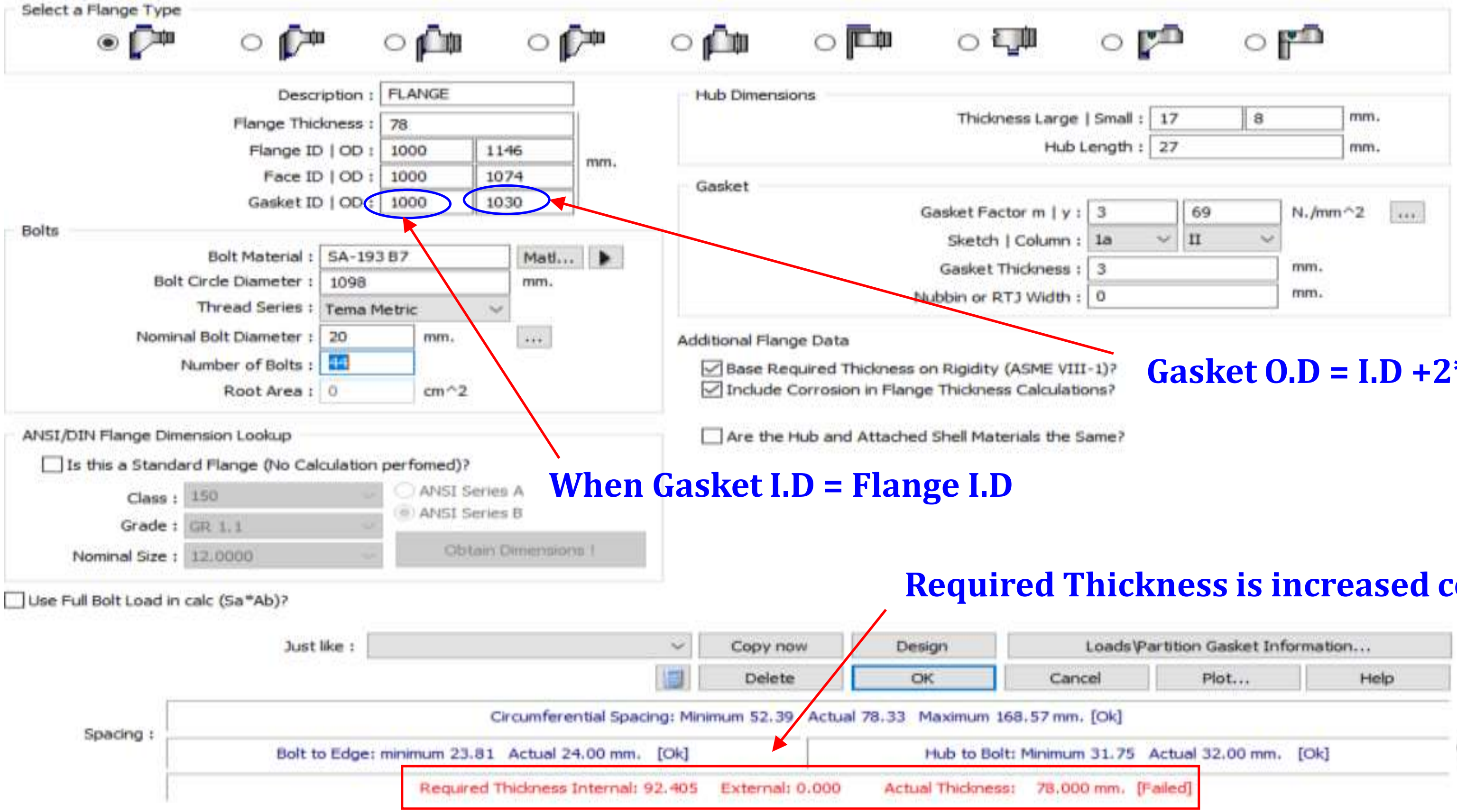
## If gasket is defined from flange I.D




**Gasket O.D = I.D +2*15=1030**

**When Gasket I.D = Flange I.D**

**Required Thickness is increased considerably**

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# Defining Gasket Width

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## 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) | 1¼ in. (32 mm) |
| ID ≥ 60 in. (1500 mm) | 1½ (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

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## As Per ASME Section VIII Div.2

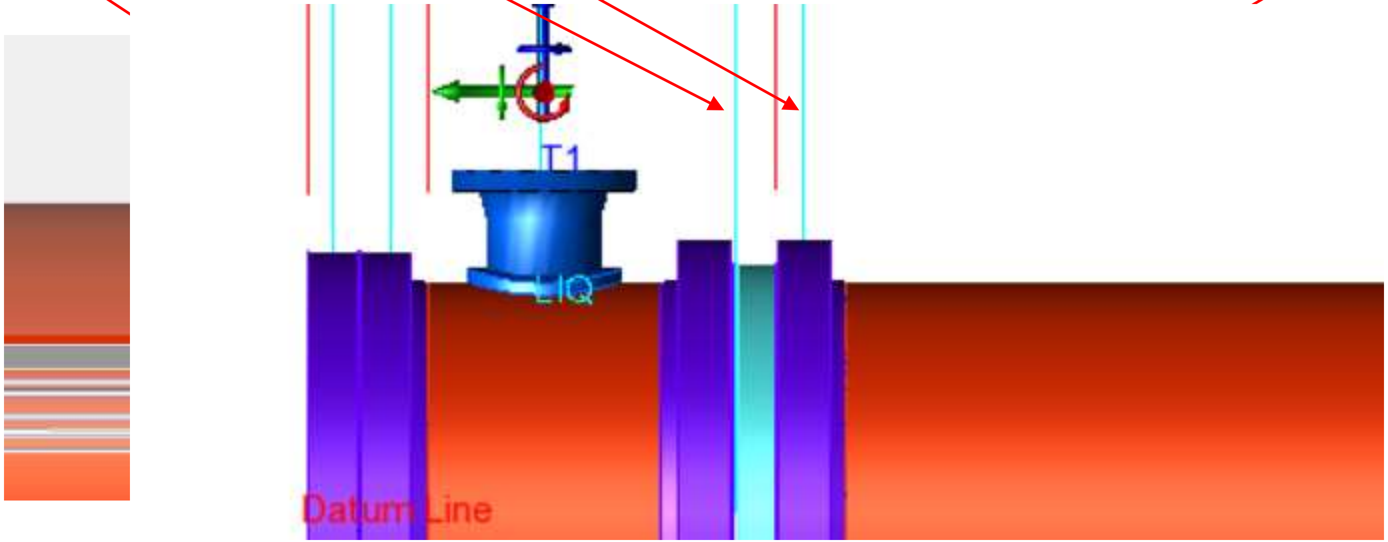
**Table 4.16.2**
**Recommended Minimum Gasket Contact Width**

| Gasket Type | Gasket Contact Width, *N* — Gasket Outside Diameter <150 mm (6 in.) | <300 mm (12 in.) | <600 mm (24 in.) | <900 mm (36 in.) | 900 mm (36 in.) and Over |
|---|---|---|---|---|---|
| Sheet gaskets including laminated sheets gaskets with or without a metal core | 9 mm (0.375 in.) | 12 mm (0.5 in.) | 16 mm (0.625 in.) | 16 mm (0.625 in.) | 19 mm (0.75 in.) |
| Preformed composite gaskets including spiral wound, jacketed, and solid flat metal gaskets | 6 mm (0.25 in.) | 9 mm (0.375 in.) | 12 mm (0.5 in.) | 16 mm (0.625 in.) | 16 mm (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 $P_e$ is simply added to the design pressure **P**
- Where , **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!