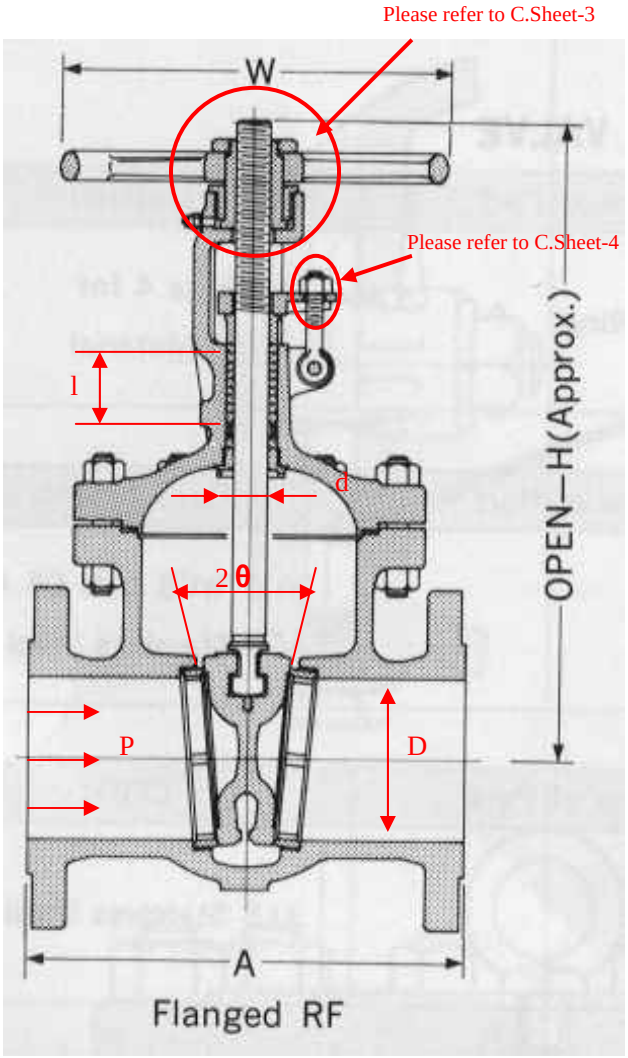
Wings Corporation

Engineering Data
Calculation Sheet-1 Rev.2

Basic Calculation of Thrust Force and Torque for Gate Valve



1. Seating and Un-seating Force without Double-block & Bleed Valve.

(1) For Disc Area:

$$F_1 = f \cdot \tan(\lambda + \theta)$$

$$f = P \times \frac{\pi D^2}{4}$$

f: Axial force to disc area against flow direction under the pressure.

P: Pressure

D: Inside diameter of the valve bore.

λ:Friction angle.

$=\tan^{-1}$ **μ**

μ:Coefficient of friction,

when seating ;

Active coefficient **μ**$_A$,

when un-seating; ;

Static coefficient **μ**$_S$.

μ$_A$**<μ**$_S$

(2) For Stem Area:

$$F_2 = P \times \frac{\pi d^2}{4}$$

d: Diameter of Stem

(3) For Gland Packing Area:

$$F_3 = \left[(\pi \times d \times l) \times P_g\right] \times \mu_0$$

l: Total length of Gland Packing

P_g: Tightening Stress of Gland Packing

μ$_0$: Coefficient of tighten friction factor for Gland Packing

Toatal Seating Force : $\mathbf{F_S = F_1 + F_2 + F_3 - W_T}$

Toatal Un-seating Force: $\mathbf{F_{US} = F_1 - F_2 + F_3 + W_T}$

For intermadiate: Seating=$F_2+F_3-W_T$, Un-seating= $F_3-F_2+W_T$

W_T: Total weight of Stem & Disc. (If, **F_S**or **F_{US}**$\gg$ **W_T**, W_T may neglect)

2. Seating and Un-seating Torque without *Yoke Sleeve Friction*[*-1]

(1) For Seating Torque:

$$T_S = F_S \cdot \left(\frac{d}{2}\right) \cdot \tan(\rho + \beta)$$

(2) For Un-seating Torque:

$$T_{US} = F_{US} \cdot \left(\frac{d}{2}\right) \cdot \tan(\rho + \beta)$$ Rev.1

Note) If $F_3 < F_2$, the un-seating and intermediate opening torque shall be "($\rho - \beta$)".

where,

β : Lead angle of the stem thread,

$$= \tan^{-1}\left(\frac{L}{2r \cdot \pi}\right)$$

L=n×PT

L:Lead, 2r:Pitch diameter, n:Multi start thread no., PT:Pitch of the stem thread,

ρ :Friction angle of the stem thread, Rev.2

$$= \tan^{-1}\left[\frac{\cos\left(\frac{\theta'}{2}\right)}{\tan^{-1}\mu_t}\right]$$

μ_t:Coefficient of the stem thread,

θ ':Angle of the stem thread.

Remarks)

*-1: Please refer to Calculation Sheet-3.

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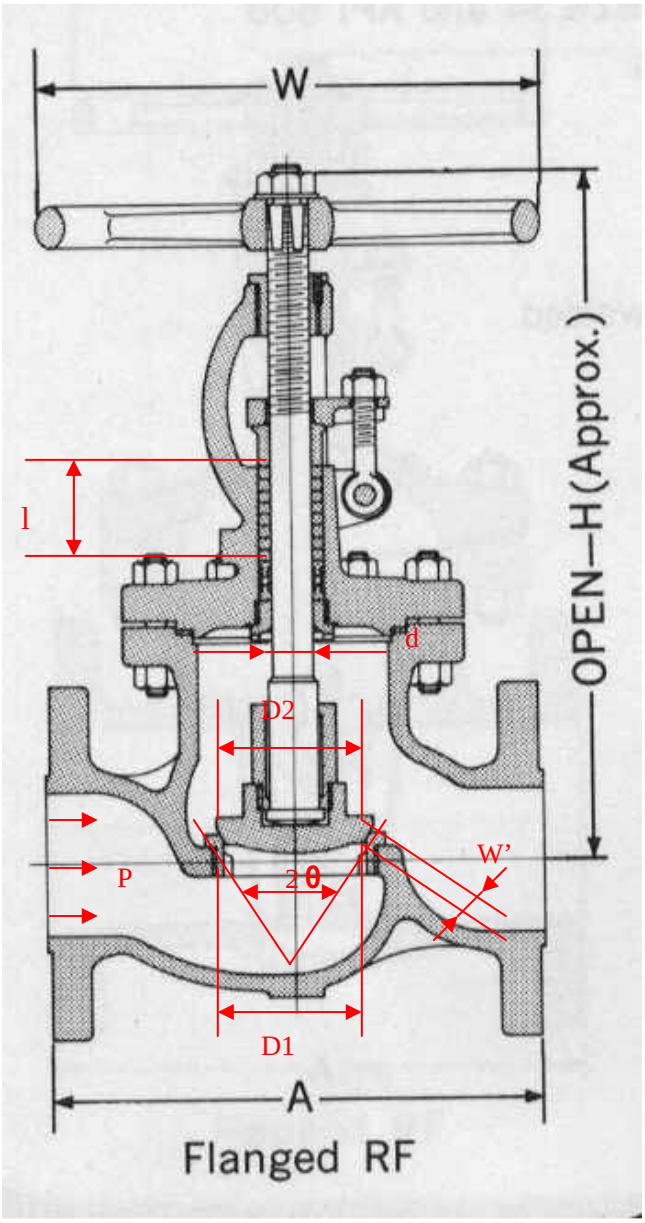
Calculation Sheet-2 Rev.2

Basic Calculation of Thrust Force and Torque for Globe Valve

(Turned Stem Type)



1. Seating Force

(1)For Disc Area Rev.1

$$F_1 = [\pi \times D_2 \times W' \times P \times \sin(\theta + \lambda) \times C] + \left(P \times \frac{\pi \times D_2^{\ 2}}{4} \right)$$

where;

W': Wide of seating surface

$$= \frac{(D_2 - D_1)/2}{\sin\theta}$$

P: Fluid Pressure

2θ: Angle of Disc

λ: Friction Angle

$=\tan^{-1}\mu$

μ: Coefficient of Friction

C: Seating Factor=3 (JPI Recommend)

For intermediate,

$$F' = P \times \frac{\pi d}{4}$$

d: Stem Diameter

If necessary,

F_1+F'

2. Seating Torque

(1) For Gland Packing Area

$$T_G = (\pi \times d \times l \times P_g \times \mu_0) \times \frac{d}{2}$$

where;

P_g: Tightning Stress of Gland Packing (specified by the packing maker)

μ_0: Coefficient of Tightining Friction Factor for Gland Packing (specified by packing maker)

(2) Stem Thread Rev.1

$$T_S = (F_1 + F') \times \frac{d}{2} \times \tan(\rho \pm \beta)$$

where;

+: Seating

-: Un-seating

β : Lead Angle of Stem Thread,

$$= \tan^{-1}\left(\frac{L}{2\pi r}\right)$$

L: Lead

2r: Pitch Diameter

ρ : Friction Angle of Stem Thread, Rev.2.

$$= \tan^{-1}\left[\frac{\cos\left(\frac{\theta'}{2}\right)}{\tan^{-1}\mu_t}\right]$$

μ_t: Coefficient of Stem Thread

θ ': Angle of Stem Thread

If intermediate, F' instead of F_1.

(3) Total Seating Torque (or Un-seating Torque)

$T=T_G+T_S$

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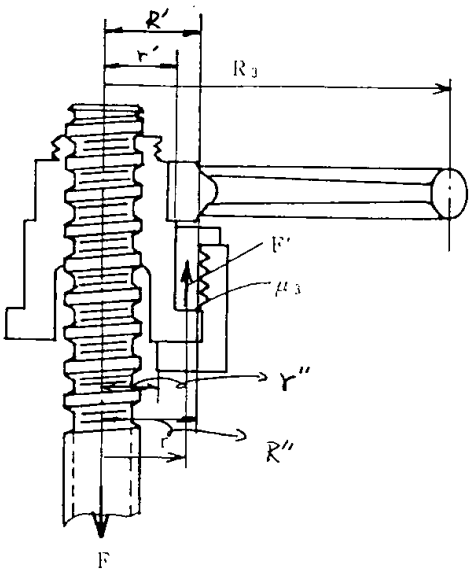
Engineering Data
Calculation Sheet-3 Rev.2

Basic Calculation of Thrust-Torque for Yoke Sleeve



1. Seating Torque

$$T_{YS} = \frac{2}{3} \times \mu_3 \times F \times \left(\frac{R'^3 - r'^3}{R'^2 - r'^2} \right)$$

μ_3 : Coefficient of friction
(Yoke-to-Sleeve)

F : Seating Force

2. Un-seating Torque

$$T_{YUS} = \frac{2}{3} \times \mu_3 \times F' \times \left(\frac{R''^3 - r''^3}{R''^2 - r''^2} \right)$$

F': Un-seating Force

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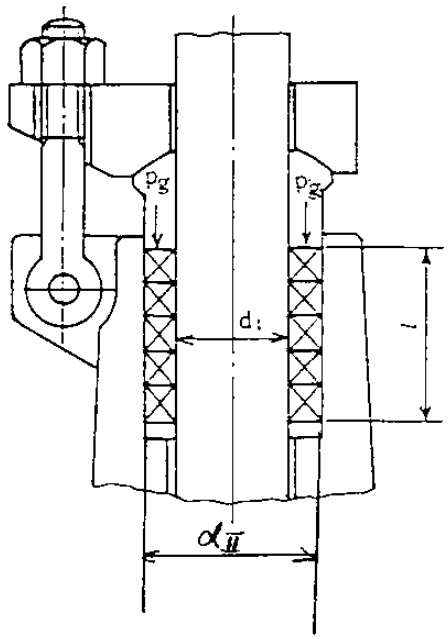
Engineering Data
Calculation Sheet-4

Basic Calculation of Tightening-Torque for Gland Bolting



$$M_Q \cong 0.2 \times Q \times (d' \times 1.1)$$

where,

M_Q: Tightening-Torque of Gland Bolt Nut.
(In case of 30 deg. Metric-Coarse Screw Threads, and μ=0.15)

d': Pitch Diameter of Gland Bolt.

Q: Tightening Force

$$Q = \left(\frac{\pi \left(d_{II}^2 - d_I^2 \right)}{8} \right) \times P_g$$

d_I: Stem Diameter

d_{II}: Out Side Diameter of Stuffing Box

P_g: Specified Tightening Packing Stress