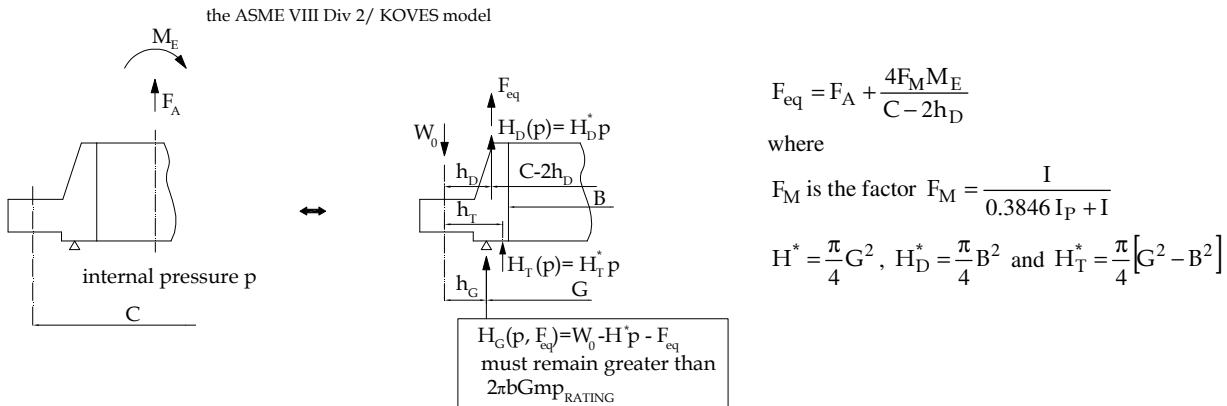
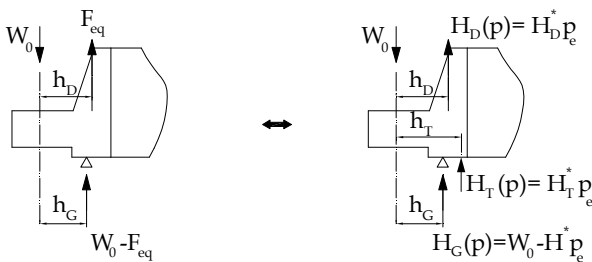


Two ways to calculate the equivalent pressure for piping flanges, based on the 2007 ASME VIII Div2 relations

The 2007 ASME VIII Div 2 design flange model is based on the conservative assumption that the pressure and the external loads are changing the gasket load while the bolts load remains at constant value W_0 . Maintaining the same conservative assumption, this model can be adapted for the piping flange checking case.



Based on this model, the external loads alone, F_A and M_E , can be converted into equivalent pressure. The equivalence may be made in two ways and gives complementary results.



The first pressure equivalence may be considered in terms of pressure that gives the same gasket load as that one given by the external loads. This is the gasket load equivalence.

That means:

$$W_0 - H^* p_e = W_0 - F_{eq}$$

$$p_e = \frac{F_{eq}}{H^*} = \frac{1}{H^*} \left(F_A + \frac{4F_M M_E}{C - 2h_D} \right) = \frac{4F_A}{\pi G^2} + \frac{16F_M M_E}{\pi G^2 (C - 2h_D)} = \frac{4F_A}{\pi G^2} + \frac{16M_E}{\pi G^3} \frac{I}{0.3846 I_P + I} \frac{G}{C - 2h_D}$$

It is worth to note the similitude with the Kellogg/ASME III Code formulas.

Under the operational conditions (i.e. p , F_A and M_E as flange's loads), the gasket load must remain greater than the gasket load at the rating pressure, as a gasket tightness reserve. This condition is covered by imposing the limit $p + p_e < p_{RATING}$.

The second pressure equivalence may be considered in terms of pressure that gives the same bending moment as that one given by the external loads. This is bending moment/ flange stress/ J index equivalence.

The equivalence condition is:

$$(W_0 - F_{eq})h_G + F_{eq}h_D = (W_0 - H^* p_e)h_G + H_D^* p_e h_D + H_T^* p_e h_T$$

$$p_e = \frac{F_{eq}(h_D - h_G)}{H_D^* h_D + H_T^* h_T - H^* h_G} = \frac{\left(F_A + \frac{4M_E F_M}{C - 2h_D} \right) (h_D - h_G)}{\frac{\pi}{4} B^2 h_D + \frac{\pi}{4} [G^2 - B^2] h_T - \frac{\pi}{4} G^2 h_G} = \frac{4}{\pi} \frac{\left(F_A + \frac{4M_E}{C - 2h_D} \frac{I}{0.3846 I_P + I} \right) (h_D - h_G)}{B^2 h_D + (G^2 - B^2) h_T - G^2 h_G}$$

This is the bending moment equivalence and the total pressure $p + p_e$ can be introduced as pressure for the calculation of the ASME VIII flange stress and ASME VIII J index. The total pressure calculated in this way shouldn't be limited to the p_{RATING} , unless there is the real intention to limit the flange stress and the J index to the values corresponding to the pressure rating. Instead, the ASME VIII Div2 limits must be considered for the flange stress and J index.

Note: the meaning of the symbols are described in 2007 ASME VIII Div2