Surface Stress in Gear Teeth

The pitting resistance formula is given by:

$$s_c = C_p \sqrt{\frac{W_t}{FId} \frac{C_a C_m}{C_v} C_s C_f}$$

d is the pitch diameter of the smaller of two engaging gears
I is a surface geometry factor for pitting resistance
F is face width
Ca, Cm, Cv, and **Cs** are the same as the bending stress formulas (application factor, load distribution factor, dynamic factor and sizing factor).

Cp is the **elastic coefficient** and is given by

$$C_p = \left(\sqrt{\frac{1}{p\left[\left(\frac{1-n_p{}^2}{E_p}\right)+\left(\frac{1-n_g{}^2}{E_g}\right)\right]}} \right)$$

The elastic coefficient accounts for differences in tooth materials. Ep is the modulus of elasticity for the pinion and Eg is the modulus of elasticity of the gear. νg and νp are Poisson's ratios for the gear and pinion respectively.

The **surface geometry factor**, I, is given by

$$I = \frac{\cos(f)}{\left(\frac{1}{r_p} \pm \frac{1}{r_g}\right) d_p}$$

ρp and ρg are the radii of curvature for the pinion and gear respectively. ϕ is the pressure angle and dp is the pitch diameter of the pinion. The +/- sign is used based on whether the gears are externally meshing (+) or (-) for internally meshing. The radius of curvature for the pinion and gear are given below:

$$r_p = \sqrt{\left(r_p + \frac{1+x_p}{P_d}\right)^2 - \left(r_p \cos(f)\right)^2} - \frac{p}{P_d}\cos(f)$$

$$r_g = (r_p + r_g)\sin(f) \mp r_p$$

for full-depth teeth, xp =0 . Use the (-) sign for external, the (+) for internal

C_f is the **surface finish factor**. Use 1, unless surface finish is unusually rough, then use something > 1.0