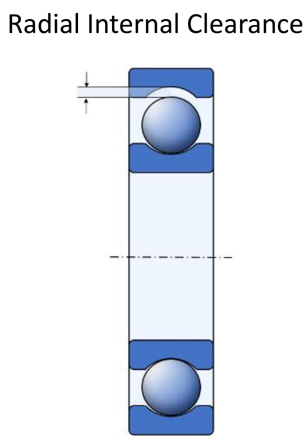
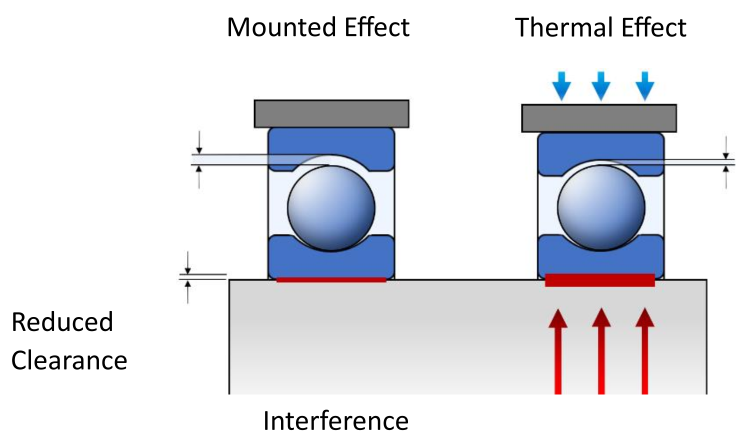
*“Reduction in Radial Clearance Due to Press Fit”*

**Topic: Bearing Selection**

When a designer or application engineer is choosing a bearing, internal radial clearance is one of the most important selections. Radial clearance is defined as the distance one ring can move relative to the other, in the radial direction. For a bearing to operate *optimally* it must have the perfect amount of internal clearance. The internal clearance will control the bearing’s load distribution and thus affect its performance. Calculation of maximum life is based on the assumption that internal load distribution is optimized. For a radial loaded application, optimized internal load distribution occurs when there is exactly zero radial clearance. Obviously, there is not much compliance built into this assumption considering that bearing life goes down and friction goes up precipitously when the bearing becomes radially preloaded. Since bearing radial clearance is impacted by the fitting practice and by thermal conditions within the bearing system. Knowing how bearing clearance changes by these factors is critical.




**Change in RC due to interference fit**

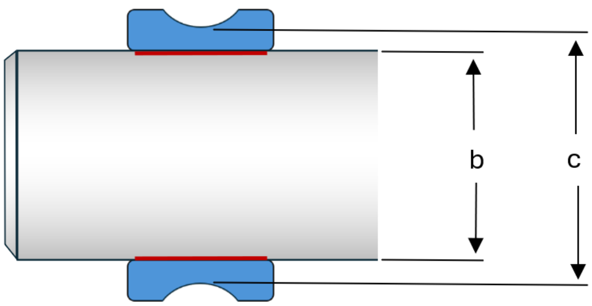
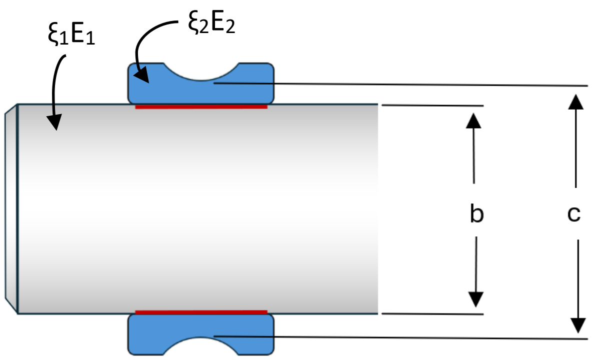
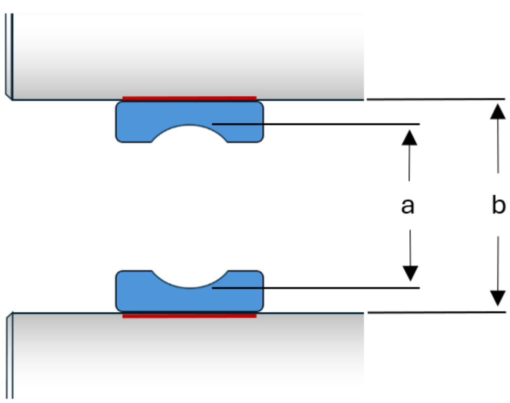
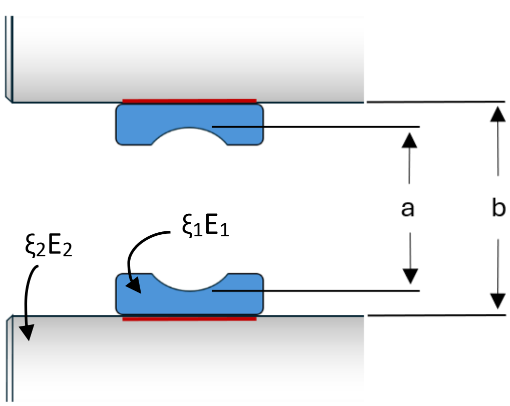
This discussion focuses only on the influence that shaft or housing interference fit has on ring expansion or contraction and provides a simplistic calculation method to determine the risk of having insufficient compliance or margin to offset radial preloading and compromised bearing life as a result. Since the amount of interference fit is a function of load magnitude and speed, one can find out early in the bearing selection and design process what range of radial clearance might be necessary ‘out-of-the-box’. Since bearings with nonstandard radial clearance might have long lead times it’s helpful to know if this might be the case early in the design stage.

**Simple Calculations**

$\Delta$ = Interference amount. Example: Shaft is .0005” larger than bearing bore. Interference amount = .0005”.
E = Modulus of Elasticity. Example: Typical 52100 Bearing Steel = $30.0\text{x}10^6$ psi; 4340 Shaft/Housing = $30.5\text{x}10^6$ psi
$\xi$ = Poisson’s ratio. Example: 52100 Bearing Steel = 0.29, 4340 Shaft/Housing = 0.30
$ɥ_c$ = Amount of radial clearance reduction due to interference fit.
See next page for formulas.

**Contact NES**

It takes a complete understanding of the application that a bearing will operate in for the designer to predict the reduction in clearance from the initial catalog clearance. For a better understanding of change in radial clearance due to interference fit and how it affects bearing life and operation, contact Andrew Hvizdzak (ahvizdzak@nesbearings.com) or Tim Asquith (tasquith@nesbearings.com).

| CONDITION | MATERIAL | CHANGE IN DIAMETER a OR c WITH INTERFERENCE FIT Δ |
|---|---|---|
|  | SAME | $y_c = \Delta\left(\frac{b}{c}\right)$ |
|  | DIFFERENT | $y_c = \frac{2\Delta\left(\frac{c}{b}\right)}{\left[\left(\frac{c}{b}\right)^2 + 1\right] + K_1\left[\left(\frac{c}{b}\right)^2 - 1\right]}$ <br> $K_1 = \frac{E_2}{E_1}(1-\xi_1)+\xi_2$ |
|  | SAME | $y_a = \Delta\left(\frac{a}{b}\right)$ |
|  | DIFFERENT | $y_c = \frac{2\Delta\left(\frac{b}{a}\right)}{\left[\left(\frac{b}{a}\right)^2 + 1\right] + K_2\left[\left(\frac{b}{a}\right)^2 - 1\right]}$ <br> $K_2 = \frac{E_1}{E_2}(1+\xi_2)-\xi_1$ |