

## Bearing Clearance Calculation Help Guide



### Understanding Bearing Clearance

Bearing internal clearances – or bearing setting – have a direct effect on bearing fatigue life. For radial ball bearings (RBBs), cylindrical roller bearings (CRBs) and spherical roller bearings (SRBs), the bearing internal clearance is measured as a radial internal clearance or RIC. This is the total positive radial gap between the rolling elements and adjacent raceway. For tapered roller bearings (TRBs) and angular contact ball bearings (ACBBs), bearing clearance is an axial measurement due to the separable nature of the inner and outer raceways. These bearing types are set by axially positioning one race relative to the other.

Bearing clearance calculations estimate the change in bearing internal clearance based on the fitting practices (both inner and outer ring) as well as the operating temperatures (specifically the difference in operating temperatures between the inner and outer race or shaft and housing). The final calculation displays the bearing's internal clearance at the final mounted and operating conditions. These calculations can be used to ensure that the proper starting (or bench) setting is selected for any given application.



### How to Use the Bearing Clearance Calculation Tool

Follow these simple steps to get quick and accurate clearance calculations to help you identify the proper starting bearing clearance for your project.

1. Select the **Bearing Type** from the drop-down menu. Select from RBB, SRB, CRB, ACBB and TRB with subsets for single-row and two-row bearings.
2. Select the **Units** format to be used in the calculations and the report.
3. Enter the **Bearing Part Number** as identified or confirmed in the Bearing Search Tool. Note that only a partial part number needs to be entered and a wildcard search will automatically be executed for all part numbers containing the character string entered. Select your specific part number from the search results returned.
4. Select the **Housing Material**. Materials are in alpha-numeric descending order.
5. For single-row TRBs (types TS or TSF), enter the bearing spread. Bearing spread is the axial distance between the bearing effective centers as mounted in the application. See the Timken Engineering Manual for a definition of effective centers and how to determine their location.
6. Enter the starting bearing clearance, which will vary based on bearing type:
  - For multi-row TRBs, enter the Bench Endplay (BEP) or starting bearing clearance as purchased and prior to mounting. If the desired starting BEP is not yet known, start with a value of .102mm (+.004"), then iterate in increments of +.102mm (+.004") as these are the values most commonly available.
  - For all other bearing types, you can select one of the standard ISO clearance designations from the drop-down (e.g. C0, C3, C4, etc.) or you may define your own custom values.
7. For TRBs, you will also be required to enter a spacer width tolerance. Note that standard tolerance is +/- .025mm (+/- 0.001"). This value can be applied for all 2-row TRB assemblies (type TDI, TDO, etc.) supplied with a spacer. This same value can be used as a starting point for single-row TRB mountings as well, even if a spacer is not being used to achieve the setting. For single-row TRBs, the tolerance value should be entered based on what the actual manufacturing tolerances are for the mating components.
8. Specify the **Shaft ID** in the appropriate units. Use shaft ID = 0 for a solid shaft.
9. Enter an estimated steady-state shaft and **Inner Bearing Ring Operating Temperature**. Unless there is an external heat source, the shaft and inner bearing ring temperature will be hotter than the housing and bearing outer-ring temperature in operation. Note that for steady-state operation, the shaft and inner bearing ring are considered to be the same temperature, similar to the housing and bearing outer ring are also considered to be the same temperature. For these calculations, the most critical aspect is the difference in temperature between shaft/inner ring and housing/outer ring as this will affect the bearing clearance. If the inner ring temperature is unknown, start by assuming a temperature that is 10 degrees hotter than the outer ring.
11. Enter the **Housing OD** in the appropriate fields. If it is not uniform because of draft angles or ribs, specify a representative average value for what is directly over the bearing. Approximate values are acceptable.

12. Enter an estimated steady-state **Housing and Outer-Bearing-Ring Temperature**. Note that for steady-state operation the housing and outer bearing ring are considered to be the same temperature.
13. Enter the **Bearing Fits** identified for this application. See the Timken Bearing Fitting Practice Tool if you need help selecting the proper fits for your application. Note that only tight fits affect the Clearance Calculations. Tight or press fit values should be entered as negative numbers and clearance or loose fit values as positive numbers. Note that the tightest fit must be entered first as labeled.

14. Click **Calculate** to generate the output.



## Output and Interpretations

Following are the descriptions of the output information you will gain from this tool.

**Inner and Outer Fit.** This is a summary of the fit data from the Input Section for both the inner and outer fit from tightest to loosest.

**Inner Fit Effect (2 row) Fi.** This describes the Radial Clearance or Lateral Loss for both rows due to the shaft/inner ring tight fits (Fi), tightest to loosest. Note the value will be zero if only loose fits were input.

**Outer Fit Effect (2 row) Fo.** This describes the Radial Clearance or Lateral Loss for both rows due to the housing/outer ring tight fits (Fo), tightest to loosest. Note the value will be zero if only loose fits were input.

**Clearance/ Lateral Loss.** The combined Clearance or Lateral Loss for both the inner ring and the outer ring fits, tightest and loosest.  $F_{total} = F_i + F_o$ .

**Mounted Clearance/ End Play (MEP).** This is the bearing mounted setting after assembly in the equipment. This is also referred to as the cold-mounted setting as it's the setting of the bearings before the machine is turned on and comes to temperature. It combines the initial (bench) setting considering the clearance loss due to any tight (press) fits along with the spacer width tolerance (SWT) where applicable. Bench end play (BEP) or starting clearance should be selected so the resulting assembled MEP or mounted clearance will provide the expected bearing performance in operation.

**Temperature Effect.** The temperature effect is the clearance lost in the bearing due to the transition from cold/ bench temperatures to steady-state operating temperatures. Note that bearing clearance will only be impacted if there is a temperature differential between the inner ring/ shaft and the outer ring/ housing. The temperature differential is defined by the user in the input section and is typically a function of bearing speed and the housing's ability to dissipate heat.

### Mounted Clearance/ Endplay with Temperature Effect.

The final output is the total estimated bearing operating clearance (or MEP for TRBs) after mounting and after reaching the steady-state operating temperature. This is the value used to determine if the correct starting clearance or bench setting was selected. For most applications, a negative MEP (i.e. preload) should be avoided; however, certain applications may require preload, particularly when using TRBs or ACBBs.

### You can take these results and ....

- Enter results into your design software.
- Enter results into Timken's Syber™ Bearing System Designer software.
- Confirm the proper bearing clearance to specify/ purchase.
- Provide to manufacturing/ assembly to ensure proper bearing set-up.
- Combine with bearing life/ system calculations to ensure proper bearing performance.



## Still Need Help?

- Contact your Timken sales office. Locate your local office by visiting [locations.timken.com](https://www.timken.com/locations).
- Email us at [TimkenEngineeringHelp@timken.com](mailto:TimkenEngineeringHelp@timken.com).

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