

# **Tutorial Series**

# **Rolling Bearing Calculation - Starter Essential Operation – Settings – Results**

### Content

This tutorial provides a practical introduction to the key functions of the MESYS Rolling Bearing Calculation software. The goal is to help new users quickly become familiar with the core features and typical workflows. The version used in this guide is MESYS 12-2024.



#### General

Please refer to the corresponding section of the online manual for detailed information on the settings under the "General" tab.

For the purposes of this tutorial, keep the default settings after launching the rolling bearing calculation module.



Conclusion, Key Takeaway Call to Actions

| General Bearing geometry Bearing configuration | Material and Lubrication | on Loa | ding T | rack roller                                    |          |  |  |  |  |
|--|--------------------------|--------|--------|--|----------|--|--|--|--|
| Rolling Bearing Calculation                    |                          |        |        |  |          |  |  |  |  |
| Project name                                   |                          |        |        |  |          |  |  |  |  |
| Calculation description                        |                          |        |        |  |          |  |  |  |  |
| Settings                                       |                          |        |        |  |          |  |  |  |  |
| Reliability                                    | S                        | 90     | %      | Calculation for medium clearance               | ~ (J)    |  |  |  |  |
| Limit for alSO                                 | alSOMax                  | 50     |        | Rolling element has maximum temperature        | ~        |  |  |  |  |
| Friction coefficient                           | ц                        | 0.1    |        | First rolling element on y-axis                | ✓ 4.5    |  |  |  |  |
| Calculate lubricant film thickness             |                          |        |        | Gyroscopic moment is not considered            | ~        |  |  |  |  |
| Consider centrifugal force                     |                          |        |        | Rolling element set life is not calculated     | ~        |  |  |  |  |
| Consider temperature gradient in fits          |                          |        |        | Elastic ring expansion is not considered       | ~        |  |  |  |  |
| Oscillating bearing                            |                          |        |        | Use load spectrum                              |          |  |  |  |  |
| Calculate required hardness depth              |                          |        |        | Calculate modified life                        |          |  |  |  |  |
| Use fatigue strength for hardness depth        |                          |        |        | Use extended method for pressure distribution  |          |  |  |  |  |
| Required subsurface safety                     | Ssmin                    | 1      |        | Calculate static safety factor based on stress | Figure 1 |  |  |  |  |

## **Bearing geometry**

Here you have the option to select a rolling bearing directly from the software's internal database, using filters for bearing type and diameter.



| Engineering Consulting Software                        | AG<br>MESYS AG<br>Technoparkstrasse 1<br>CH–8005 Zürich<br>info@mesys.ch<br>T: +41 44 455 68 00 |  | Options for selected bearing type  Bearing has filling slot             |
|--|---|--|---|
| General Bearing geometry Bearing configuration Materia | and Lubrication Loading Track-roller  |  | Bearing inner ring is shaft   |
| Angular contact ball bearing                           |   | ~  | Bearing outer ring is housing   |
| Inner diameter   | d 40 mm N Dynamic load rating   | Cr 15.8297 kN                            | Use ring diameter for equivalent cross section for calculation of fits  |
| Outer diameter   | D 68 mm G Static load rating  | C0r 10.5592 kN                           | ☑ Calculate load capacity for hybrid bearings automatically             |
| Width  | B 15 mm Fatigue load limit  | Cur 0.55028 kN                           | Calculate load capacity for hybrid bearings                             |
| Number of rolling elements                             | Z 11 Bearing clearance  | User input as operating clearance $\vee$ | Calculate X/Y-factors based on free contact angle                       |
| Diameter of rolling elements Internal Ge-              | Dw 7.9375 mm Axial clearance  | Pa 0 µn                                  | Direction of contact angle left ~                                       |
| Pitch diameter Omotry Pa-                              | Daw 54 mm   |  | Permissible ellipse length ratio 100 %                                  |
| Contact apple  | ~ 0 · 6   | Calculation of Axial clearance Pa X      | Lower stress limit for truncation pmin(eLR) 1 MPa                       |
| Conformity inner ring                                  | fi 0.52   | Mounted axial clearance Pam 0 mm O       | Stress concentration factor for truncation cTr 1.8                      |
| Conformity outer ring                                  | fe 0.52   | Effective axial clearance Paeff 0 mm O   | Use ISO conformity in case of small conformity                          |
| Shoulder diameter inner ring                           | dsi 0 Avial Clearance   | Pretension force Fp 1000 N               | Limit for conformity for dynamic load rating f_limCr 0.515              |
| Shoulder diameter outer ring                           |   | Unmounted pretension force Fpu 0 N O     | Limit for conformity for static load rating f_limC0r 0.515              |
|  | (Pa) Depending  | Mounted pretension force Fpm 0 N O       | Friction coefficient for fitting µfit 0.1                               |
|  | on Preload (Fp)   | Effective pretension force FpEff 0 N O   | Reduction of load rating because of hardness according to Harris $\sim$ |
|  |   | OK Cancel                                | OK Cancel   |

Figure 3

## **Bearing configuration**

A generic angular contact ball bearing 7308B is to be paired or considered as a double-row bearing of the same type:



Select the generic 7308B and activate 'Consider bearing set'. Define the Positions and orientations of contact cone Centers by adding rows using the button 🛟 , as shown in Figure 4.

# **Material and Lubrication**





#### Loading

📥 For each coordinate direction, either a force or a displacement (ux) can be specified as needed (see Figure 6). If the ring used to apply preload on our angular contact bearing is assumed to be fixed, the axial displacement (ux) can be set to zero, and the resulting reaction force in the axial direction (Fx) will be calculated.

A moment load or a tilt can only be defined in two directions, since rotation around the bearing axis (X) cannot be constrained.

| Gener | al     | Bearing geometry | Bearing configuration | Material and L | ubrication | Load | ing | Track roller           |            |            |    |           | Figure 7 |
|-------|--------|------------------|-----------------------|----------------|------------|------|-----|------------------------|------------|------------|----|-----------|----------|
| Axia  | l load | i                |                       | Fx             | 100        | N    | ۲   | Displacement           |            |            | ux | 0.262831  | ] µm ()  |
| Radi  | al loa | d                |                       | Fy             | 0          | Ν    | ۲   | Displacement           |            | Ý          | uy | 0         | mm O     |
| Radi  | al loa | d                |                       | Fz             | 5000       | Ν    | ۲   | Displacement           | Load or di | splacement | uz | 0.0192696 | mm O     |
| Mor   | nent   |                  |                       | My             | 2.83925    | Nm   | 0   | Rotation angle         |            | placement  | ry | 0         | mrad 🖲   |
| Mor   | nent   |                  |                       | Mz             | 0          | Nm   | 0   | Rotation angle         |            |            | rz | 0         | mrad 🖲   |
| Spee  | ed inr | ner ring         |                       | ni             | 550        | rpm  | I   | Inner ring rotates to  | load       |            |    |           |          |
| Spee  | ed ou  | ter ring         |                       | ne             | 0          | rpm  |     | Outer ring rotates to  | o load     |            |    |           |          |
| Tem   | perat  | ure inner ring   |                       | Ti             | 20         | °C   |     | Temperature outer ring | 1          |            | Te | 20        | ] °C     |

## Calculation

Calculation Report Graphics Extras The calculation can be started using the 🚯 button, the F5 key, or the correspon-G Calculate ding menu item.

Please always check the icon in the bottom right corner, which confirms that the calculation has been executed and is up to date.

Apply the loads as shown in Figure 6 and start the calculation with an axial clearance Pa = 0 mm.

| Axial clearance | Pa | 0 | μm |
|-----------------|----|---|----|
|-----------------|----|---|----|

#### **Results**

**Result overview** 

This overview provides various details about the bearing condition at the bottom of the user interface.



distribution 3D, Contact Stress, Subsurface stress, and Reliability as shown in Figure 9.

| Circumferential ball advance                   | Load rating diagram |
|--|---------------------|
| Gyroscopic slip coefficient                    | Deformation of ring |
| Wear Parameter QV                              | Radial expansion of |
| Wear Parameter PVmax                           |                     |
| Wear Parameter PV on major axis                |                     |
| Contact stress and sliding speed on major axis | maxSni              |

eformation of rings

Radial expansion of races

15VS 100022.0

mm Ef

N

Pdeff 0.26203

maxSpinToRoll 0.216789

Circumferential ball advance

c safety factor (ISO 17956)

Deformation of rings 2D

Deformation of rings 3D

Deformation of rings

Gap width for rings

Deformation of rings 3D (animated)

Н

F5







Deactivate the checkbox for 'Consider bearing set' (see Figure 4).

| General Bearing geometry | Bearing configuration Ma | aterial and Lubrication | Loading Track roller             |                | Bild 14            |
|--------------------------|--------------------------|-------------------------|----------------------------------|----------------|--------------------|
| Avial land               |                          | F 5000                  |                                  |                | 10 1171            |
| Axiai load               |                          | FX 5000                 |                                  |                | ux 10.1171 μm Ο    |
| Radial load              | Assign the val-          | Fy 0                    | N ( Displacement                 | Run the calcu- | uy 0.0265106 mm () |
| Radial load              | ues under                | Fz 4500                 | N                                | lation: 73     | uz 0.029306 mm 🔾   |
| Moment                   | 'Loading' ac-            | My 119.302              | Nm O Rotation angle              |                | ry 0 mrad 🖲        |
| Moment                   | cording to Fig-          | Mz 9.06963              | Nm O Rotation angle              |                | rz 1 mrad 🖲        |
| Speed inner ring         | ure 14.                  | ni 1500                 | rpm 🗹 Inner ring rotates to load |                |                    |
| Speed outer ring         |                          | ne 0                    | rpm 🔲 Outer ring rotates to load |                |                    |
| Temperature inner ring   |                          | Ti 20                   | °C Temperature outer ring        |                | Te 20 °C           |

Drag the graphics to the lower area next to the results overview, as shown in Figure 15.



| Result overview  | 5 Sp | in to roll ratio 🛛 🗗 🗙      | Life over load 🗗 🛪  | Load Distribution 🗗 🗙                                | Contact angle 🗗 🗙   |  |  |  |  |
|--|------|-----------------------------|---|--|---|--|--|--|--|
| Modified reference rating life         Lnmrh         90067.3         h           Maximal pressure         pmax         2146.22         MPa           Static safety factor         SF         7.49423 | ^    | Spin to roll ratio          | Life over load<br>100% Fx = 5kN Fy = 0kN Fz = 4<br>L10rh<br>1e+07<br>1e+06<br>1e+06 | SULUMPa<br>2000MPa<br>3000M0<br>3000M0<br>-inner_res | Contact angle<br>outer race<br>outer race<br>outer race<br>time to be<br>unit (inner<br>to be<br>to be |  |  |  |  |
| Static safety factor (ISO 17956) S0eff 7.52085   |      | 00x52222222222222           | 10000   | -outer pe  | to 15   |  |  |  |  |
| Reference load Pref 4319.36 N  |      | Position of ball [*]        | 20<br>60-<br>120-<br>120-<br>140-   |  | 32555555555555555555555555555555555555  |  |  |  |  |
| Viscosity ratio K 3.59395  | ~ 5  | Spin to roll ratio Messages | Loading [%]   |  | Position of ball [*]  |  |  |  |  |
| Figure 15 M 🜌  |      |                             |   |  |   |  |  |  |  |

Modify the inputs under 'Loads' and observe the changes in the graphics.

Activate the load spectrum and check the corresponding box under the 'General' tab 🛛 🔽 Use load spectrum (see Figure 1).

Enter a load spectrum as shown in Figure 16 by adding entries using the 🖶 button.



|   |    |           |          |        |        |             |           |             |             |         | F        | igure 16   |
|---|----|-----------|----------|--------|--------|-------------|-----------|-------------|-------------|---------|----------|------------|
| G | en | eral Bear | ing geor | metry  | Bearin | ng configur | ation N   | laterial an | d Lubricati | on L    | oading   | Track roll |
|   |    | Frequency | Fx [N]   | Fy [N] | Fz [N] | ry [mrad]   | rz [mrad] | ni [rpm]    | ne [rpm]    | Tj [°C] | T_e [°C] | TOil [°C]  |
|   | 1  | 0.333333  | 5000     | 0      | 4500   | 0           | 1         | 1500        | 0           | 20      | 20       | 70         |
|   | 2  | 0.333333  | 5500     | 0      | 5000   | 0           | 1         | 1600        | 0           | 22      | 20       | 70         |
|   | 3  | 0.333333  | 6000     | 0      | 5500   | 0           | 1         | 1700        | 0           | 24      | 20       | 70         |

Compare the results in the results overview and in the graphics for the three load spectrum elements.

MESYS wishes you an instructive and profitable experience with our tutorials. If you have any queries, suggestions or questions, please do not hesitate to contact info@mesys.ch .