KISSSOFT
Calculation programs for machine design

Bearing reliability calculation

System level bearing life vs. reliability, KISSsoft release 03-2017

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SHARING KNOWLEDGE

1 Document information

1.1 Document change record

Revision	Date	Author	Comments
0	15.5.15	HD	Original document

1.2 Table of content

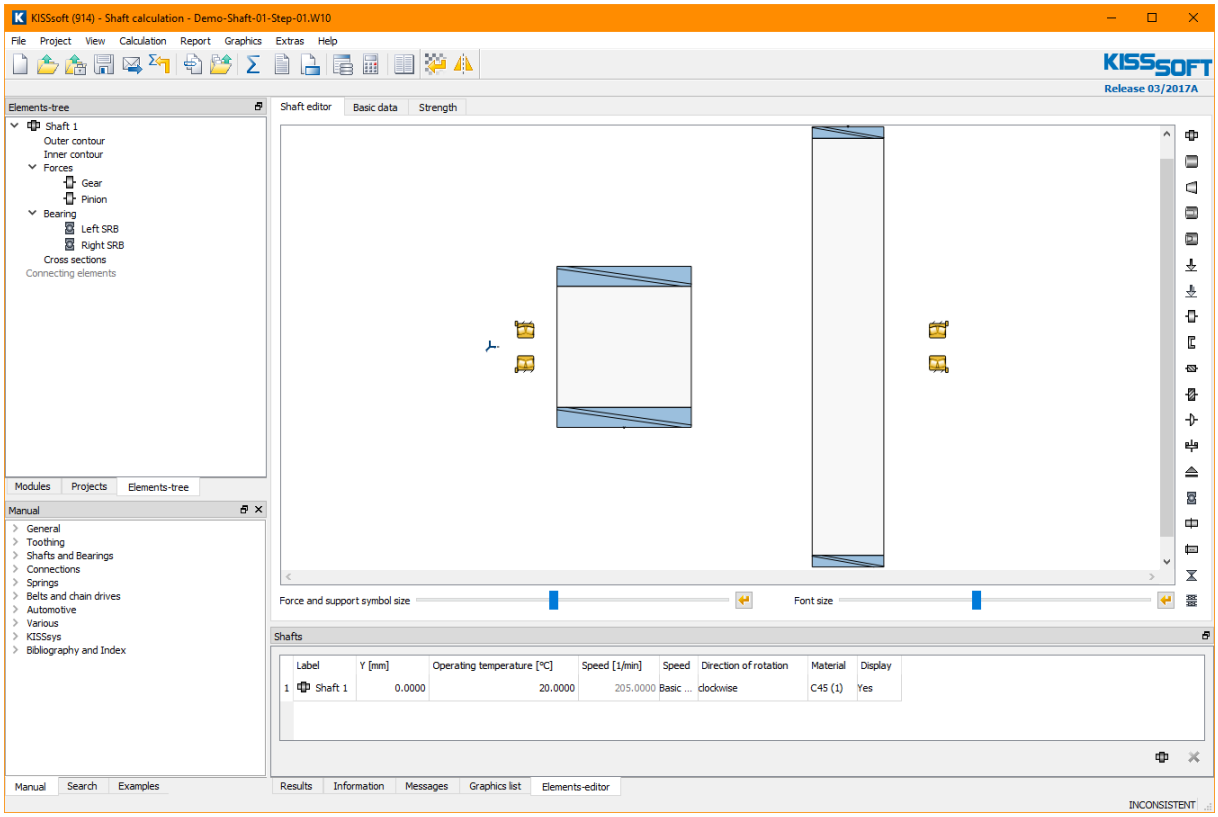
1.3 References

[1] KISSsoft 03-2017A

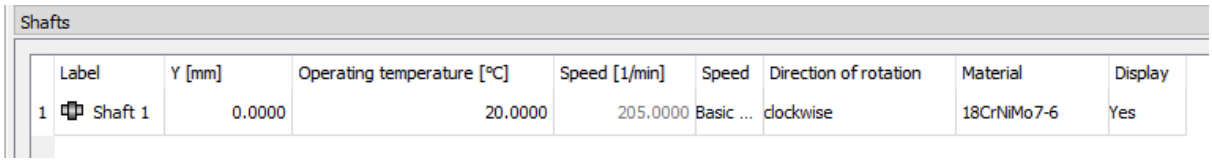
2 Bearing reliability of a industrial gearbox shaft

2.1 Basic model of shaft

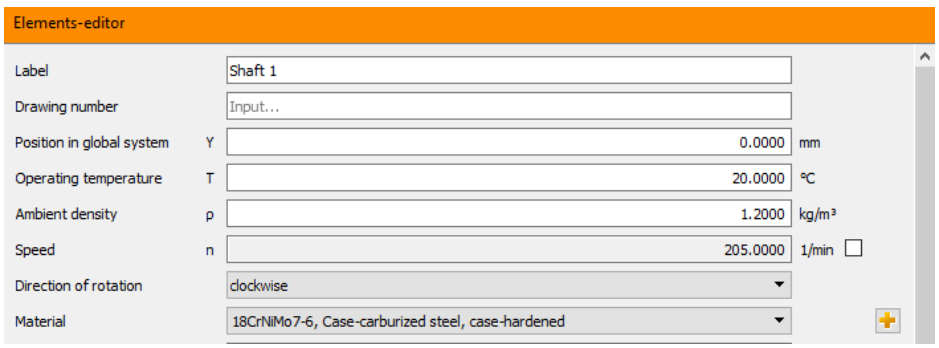
Let us use two SRB, a pinion and a gear on the shaft.
The shaft has a speed of 205RpM and a power of 400kW is transmitted.



Change the shaft material to 18CrNiMo7-6. Either in the table shown below:



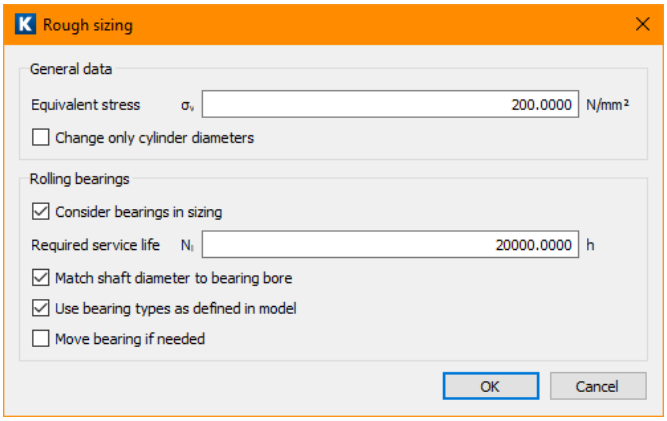
Or in the element editor



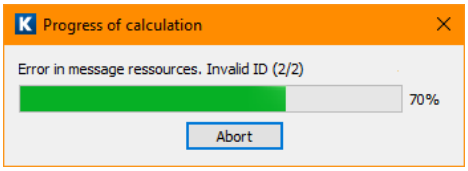
See file “Demo-Shaft-01-Step-01.W10”

2.2 Shaft rough sizing

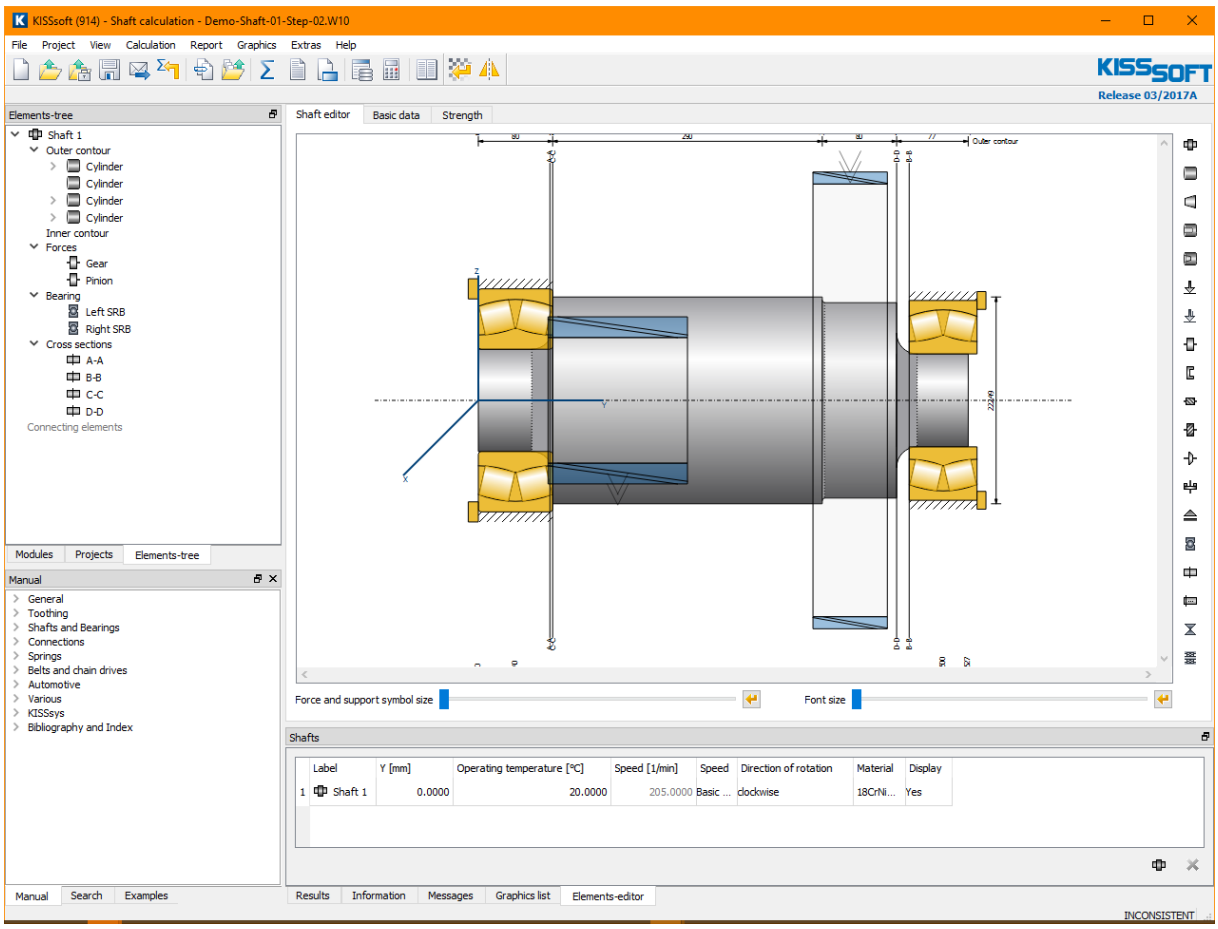
Use the shaft rough sizing function with the below settings:



A message appears



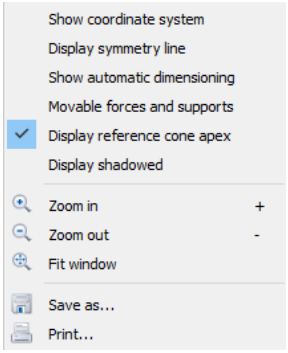
The proposed shaft and bearing geometry is then:



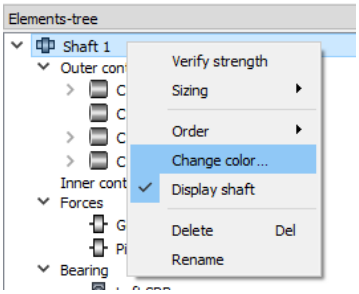
See file “Demo-Shaft-01-Step-02.W10”

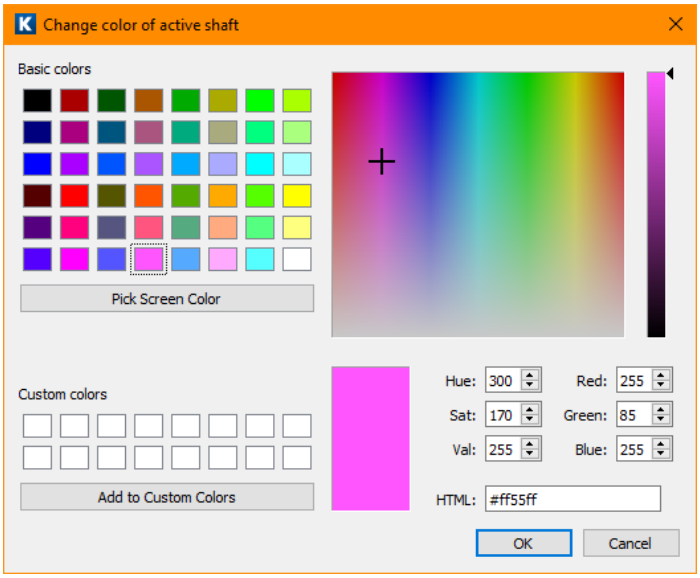
To work faster, change the display by removing

- Symmetry line
- Coordinates system
- Shaded view



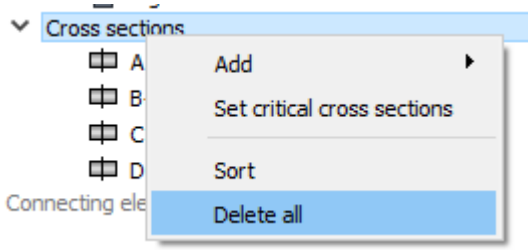
Change the shaft color to something more pleasant:





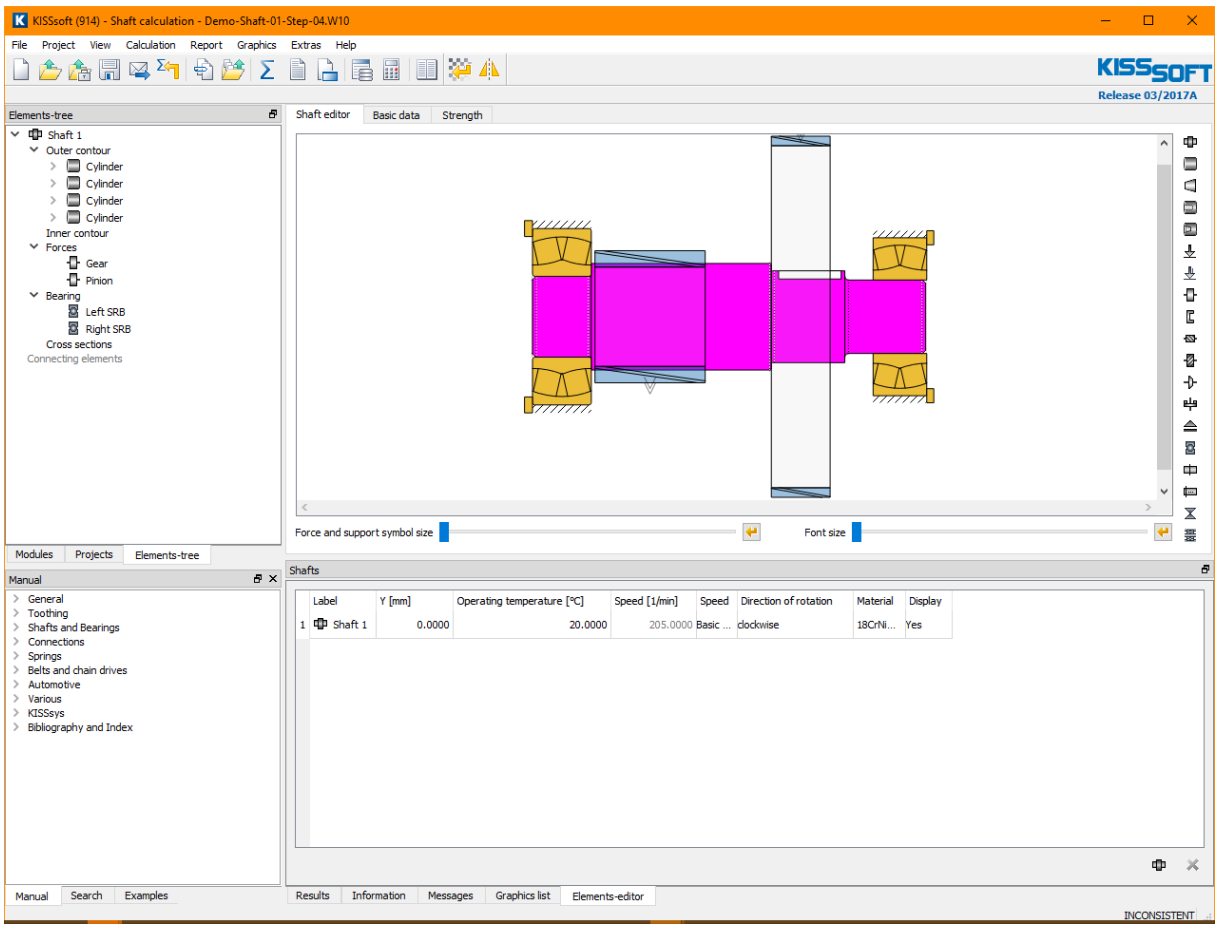
See file “Demo-Shaft-01-Step-03.W10”

Delete the cross sections A-A to D-D as we do not need them right now.



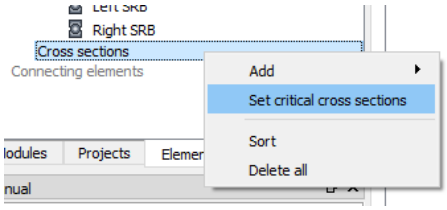
2.3 Finalizing the shaft model

Change the shaft elements diameter and length to get a more reasonable design. Move the gear and the pinon accordingly. Add relief grooves and others.



See file “Demo-Shaft-01-Step-04.W10”

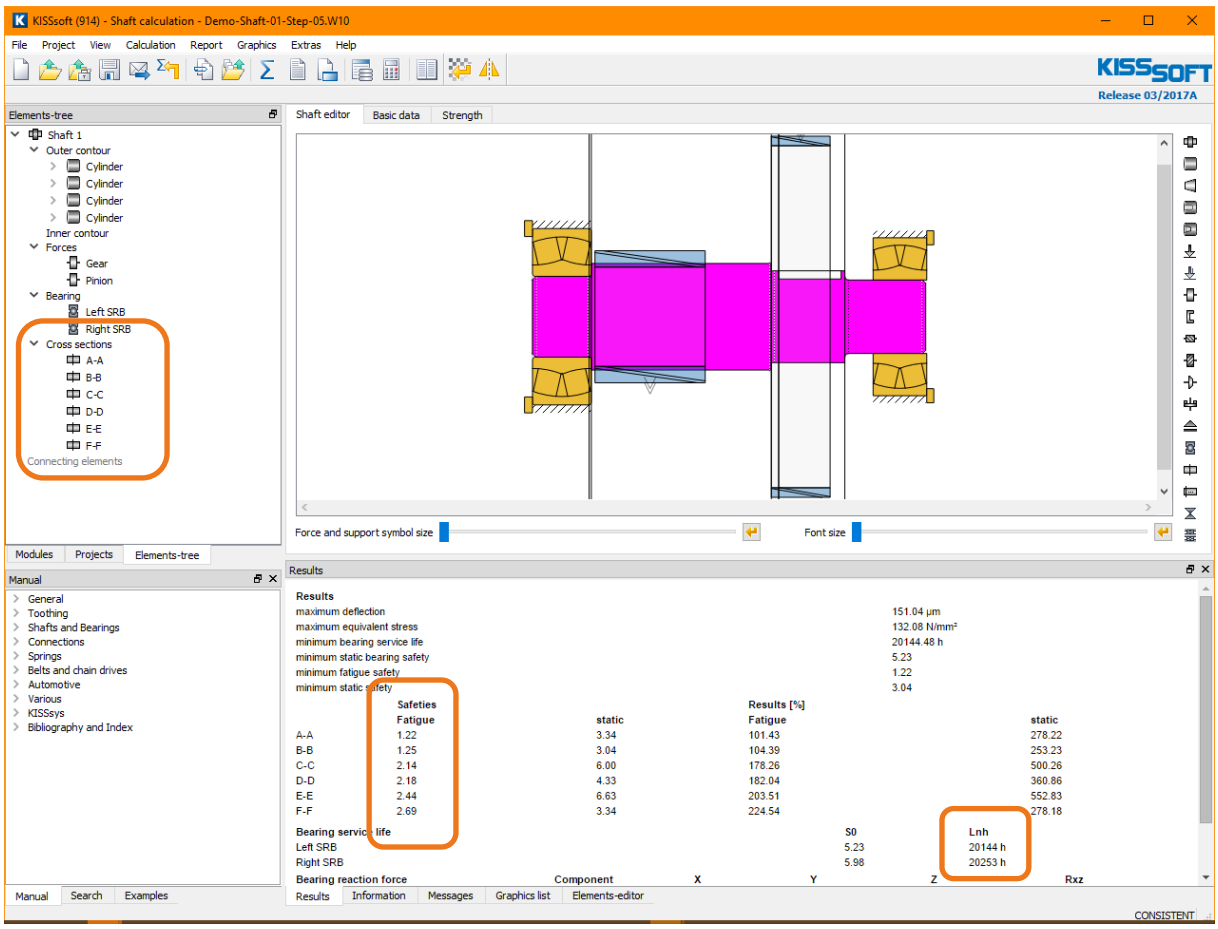
For the strength rating of the shaft with the changed geometry, select:



2.4 Calculation of the shaft

Finally, run the calculation. You will see

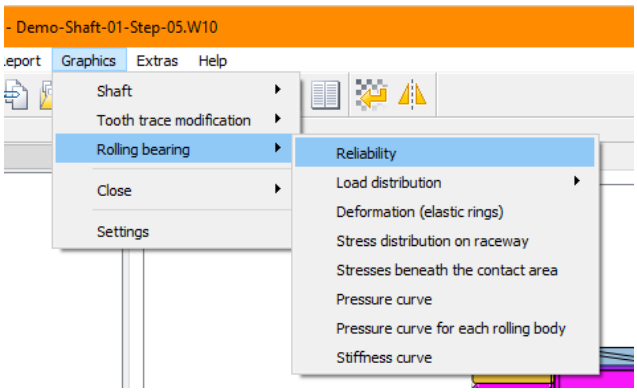
- The critical shaft cross sections A-A to F-F
- The bearing life > 20’000h
- The shaft safety factors > 1.20

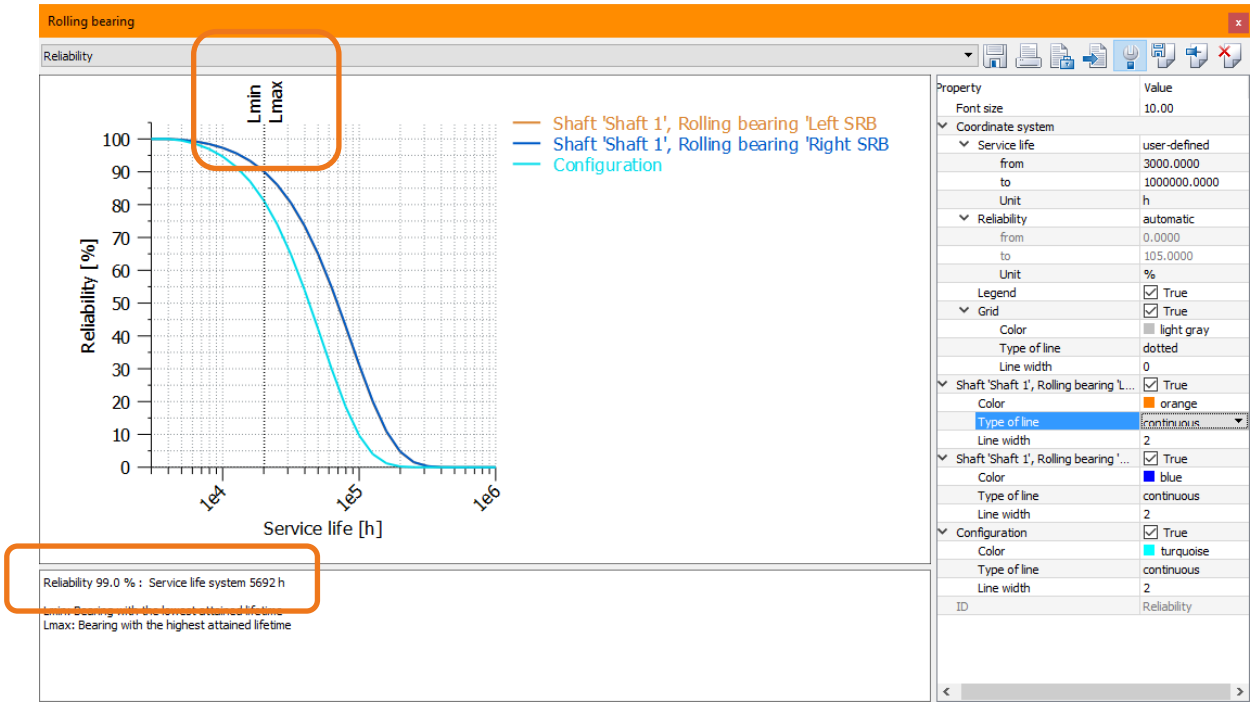


See file “Demo-Shaft-01-Step-05.W10”

2.5 Bearing reliability

Go to the below shown graphic



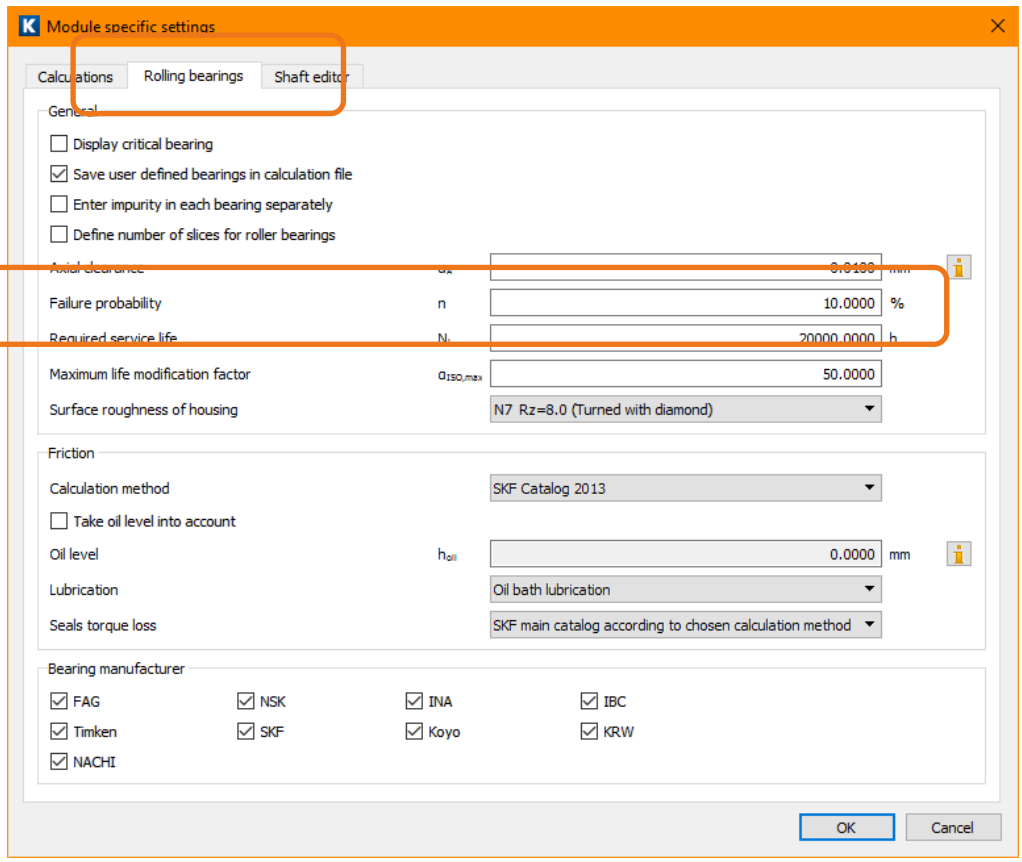


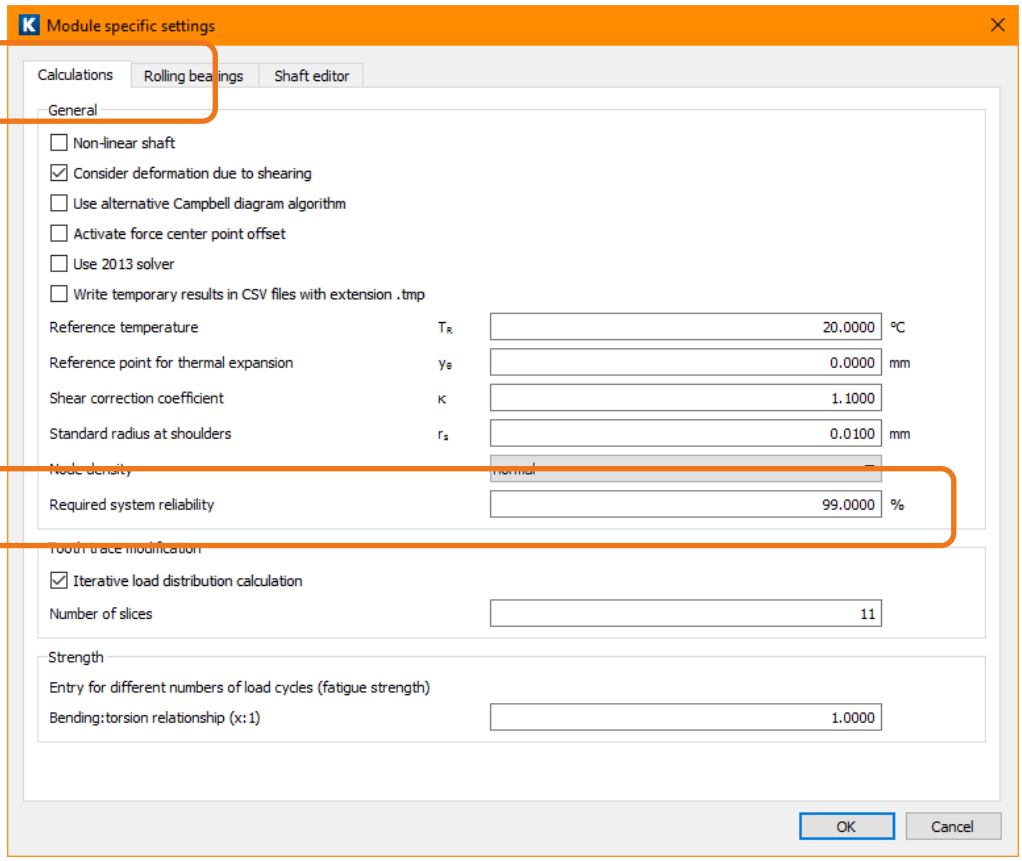
Note

- Set the x axis to 3’000h … 1’000’000h
- Recommended line width is 2
- Activate grid and legend
- The two reliability lines for the two bearings are almost identical because the two bearings have almost identical life.

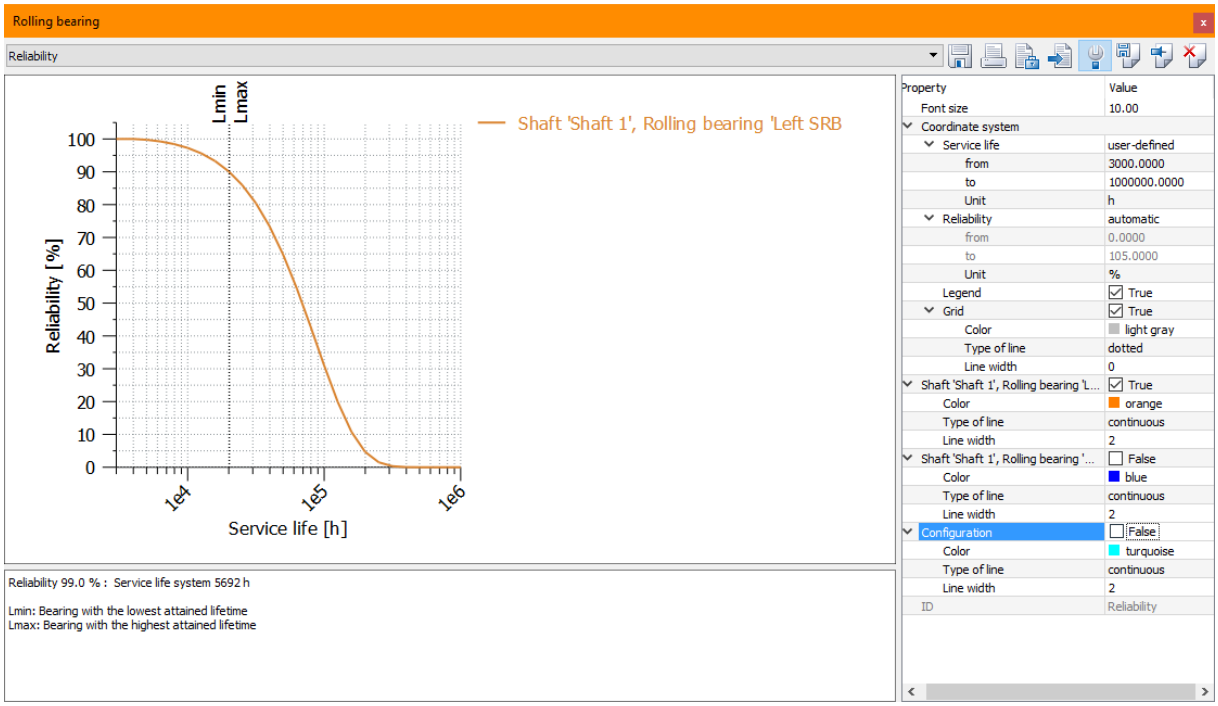
Explanations

- Lmin is the achieved lifetime for the failure probability as defined in the module specific settings (by default, this is 10% or 90% reliability):
- The system reliability is currently 99% and then, a life of 5692h results. The system target reliability can be defined in the module specific settings as shown below

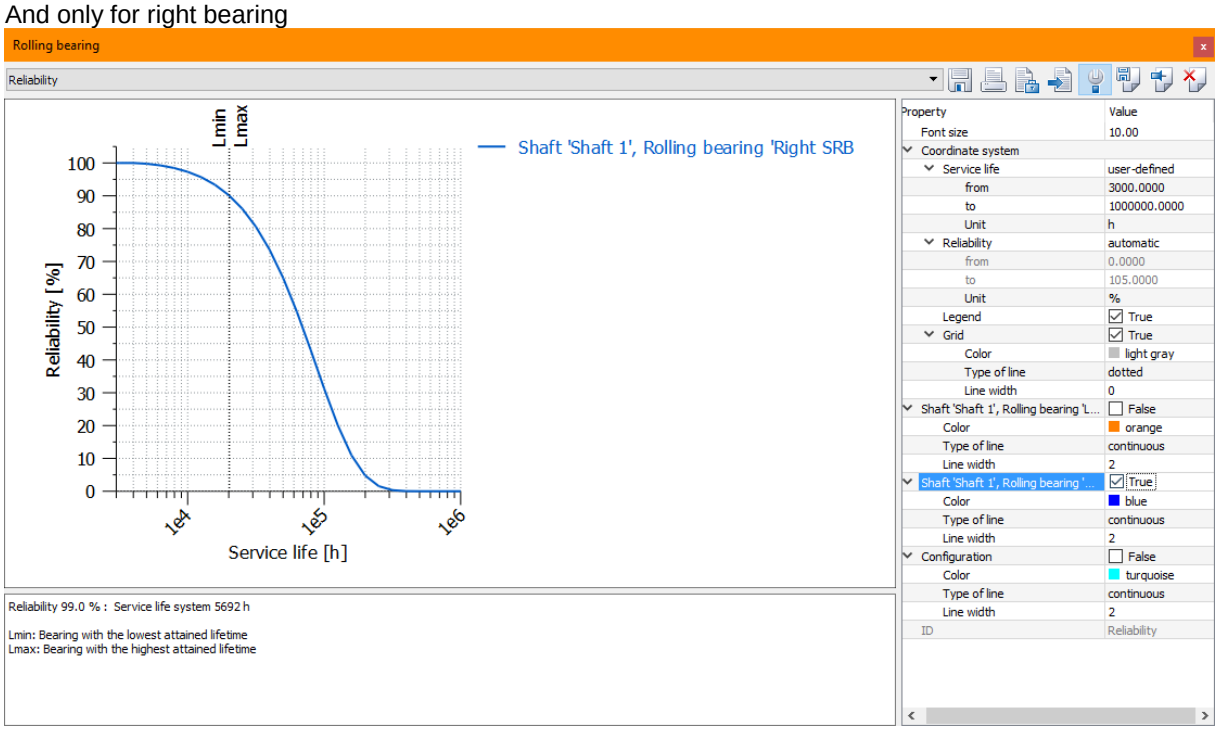




Only reliability curve for left bearing shown

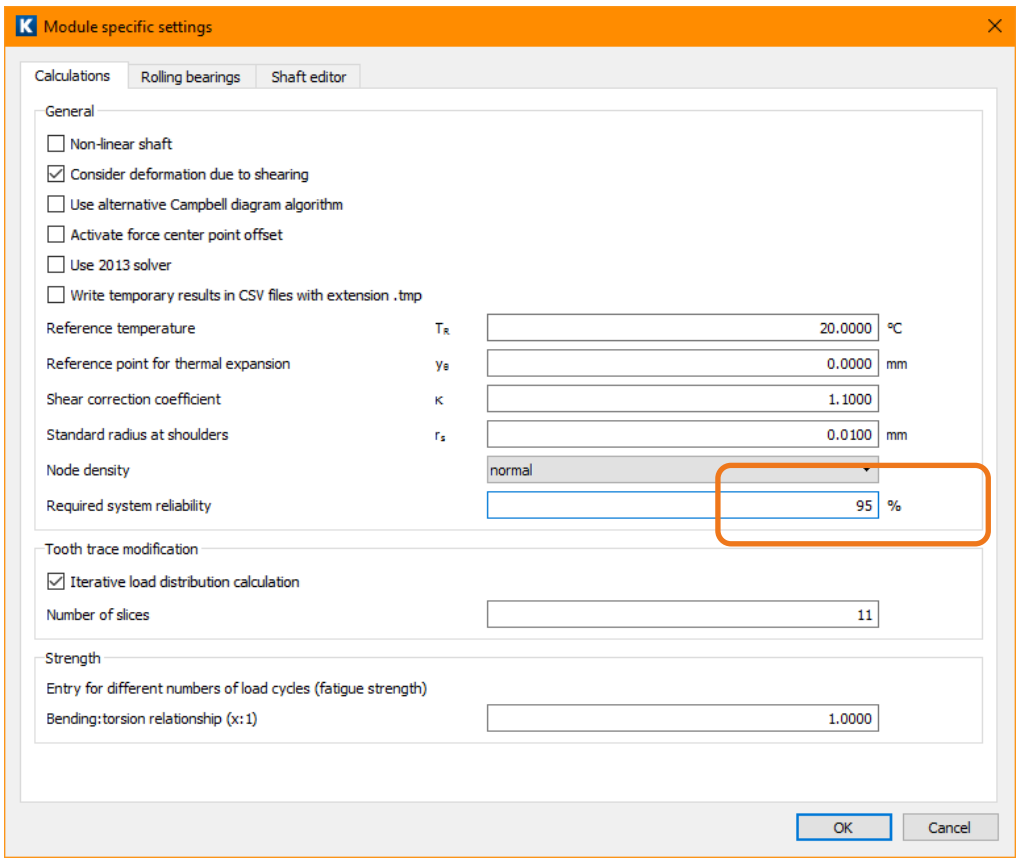


And only for right bearing

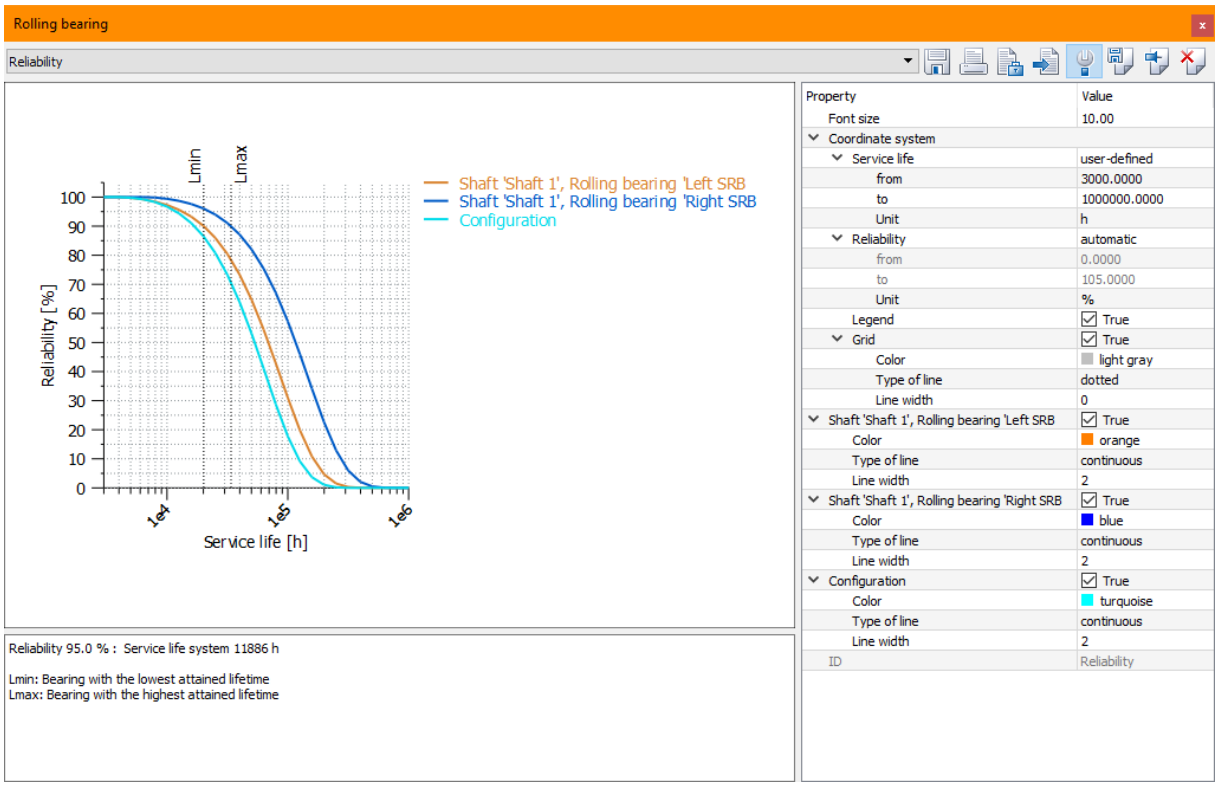


2.6 Variation of bearing reliability

Let us define that we want a system reliability of 95%.
And for some reason, let us use a bearing on the right side with a higher inner diameter



We then find the system life at reliability of 95% at 11’886h and the below reliability curves.

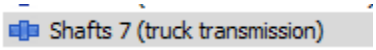


See file “Demo-Shaft-01-Step-06.W10”

3 Bearing reliability of a complex vehicle transmission shaft system

3.1 Files

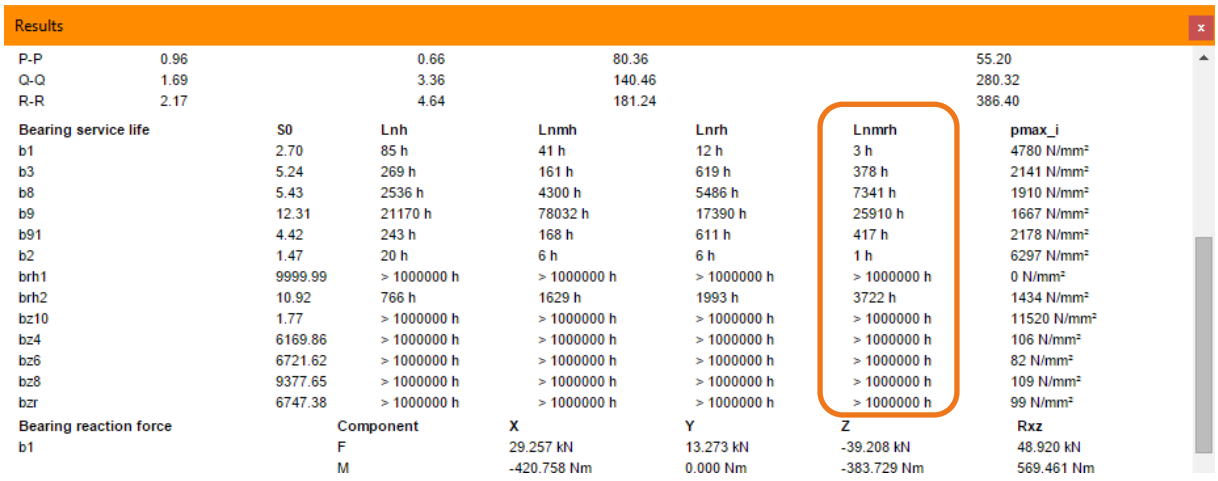
For this demonstration, use the file as shown below which is part of the software installation:

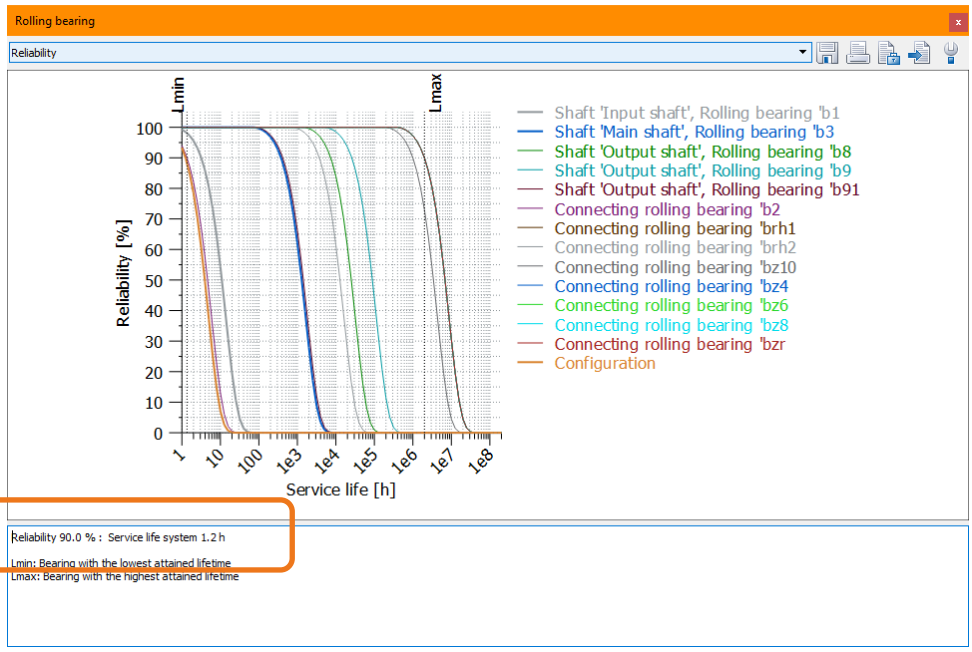


3.2 Reliability curves

Open the file and run the calculation. Open the graphic for bearing reliability. You will get the below shown results and the curves.

Note that the reliability curves are based on the most complex bearing rating method activated. In the below case, all four rating methods (basic rating, modified basic rating, reference rating and modified reference rating are shown, hence, reliability curves are based on modified reference rating).



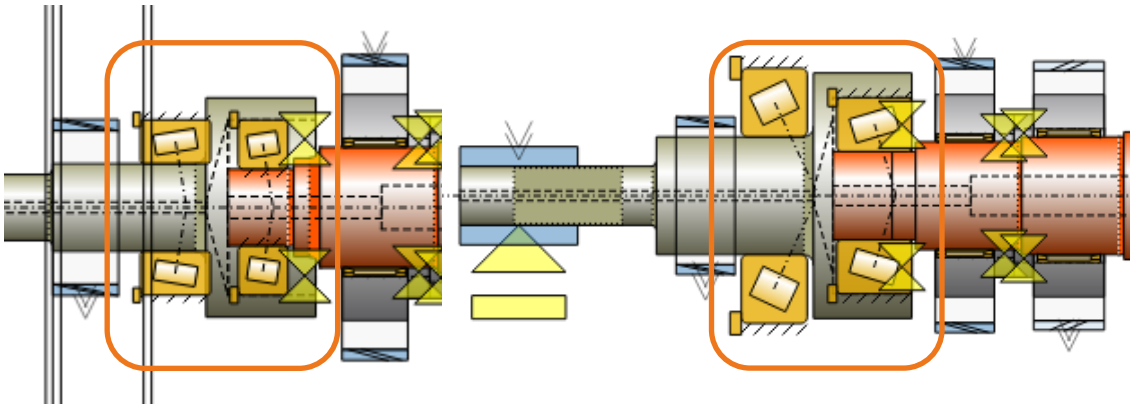


We can see from the results table that bearing b1 has only 3h life and bearing b2 has only 1h life. These two determine the system life.

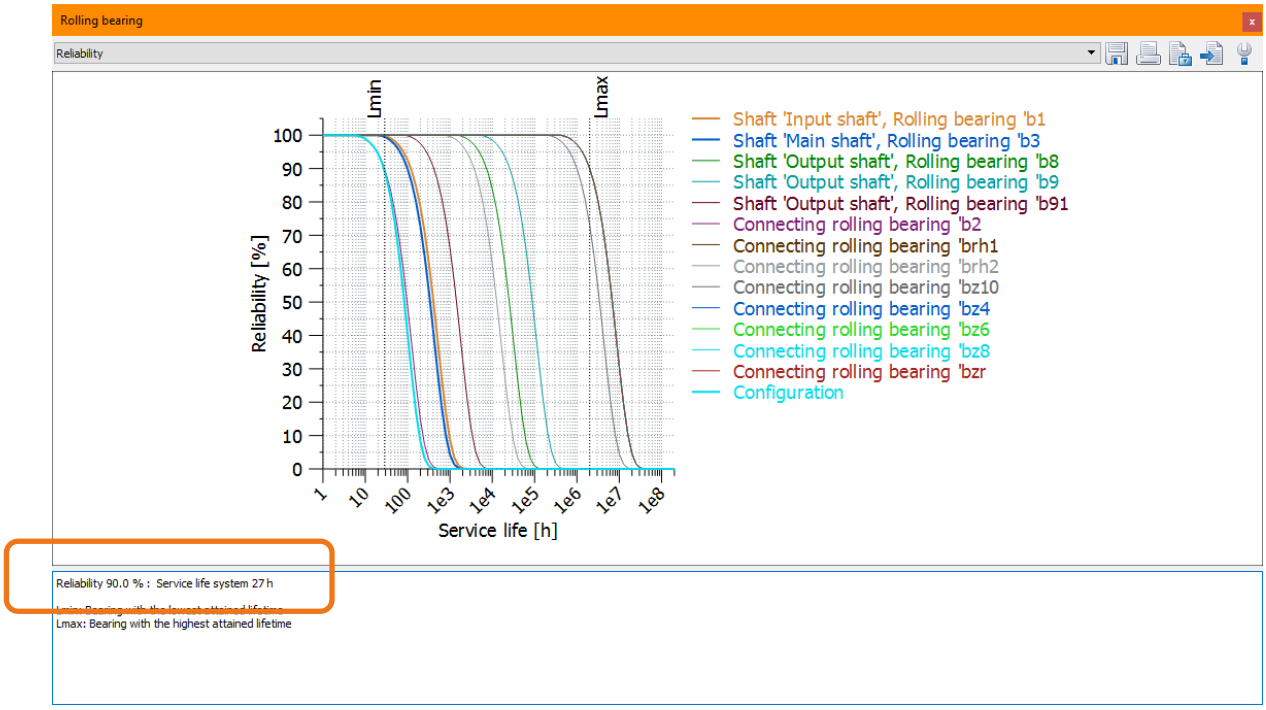
See file Demo-Shaft-02-Step-01.W10

3.3 Design change for higher reliability

Now, we can change the design in the critical area. Left: old design. Right: new design.



When we re-run the calculation with the new design, we now find a change in the reliability curves:



See file Demo-Shaft-02-Step-02.W10