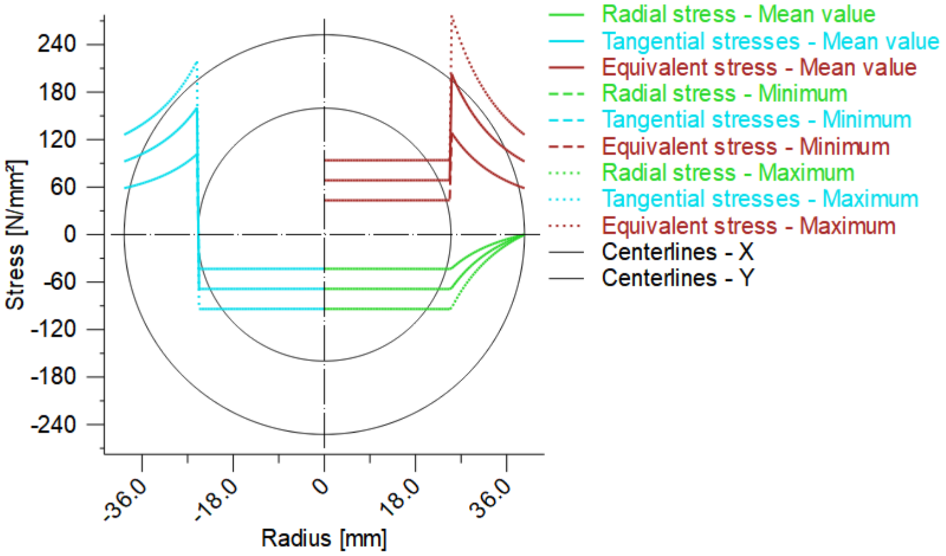
KISSsoft Exercise Shaft-Hub Connections 00

Cylindrical interference fit



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Sharing Knowledge

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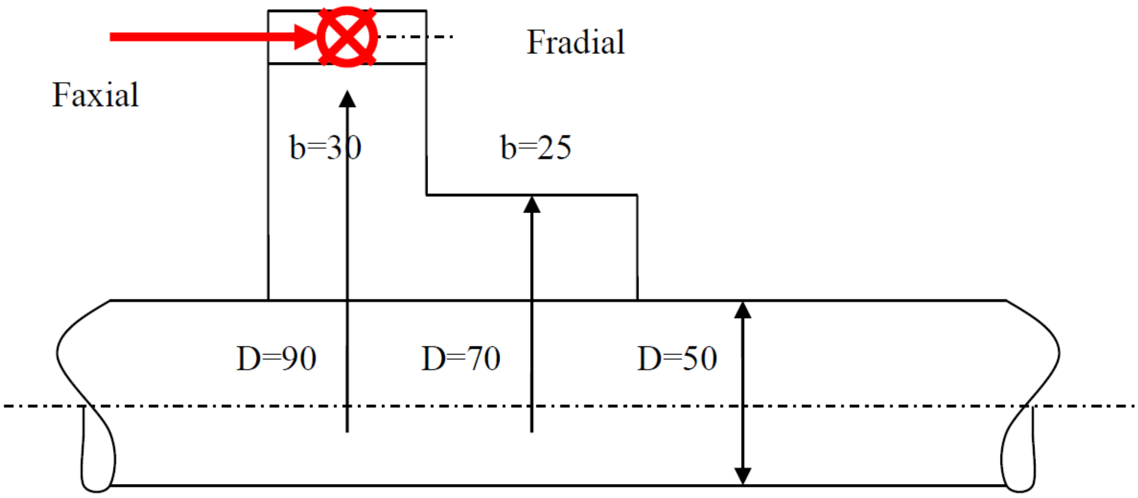
1.2 Document change record

Revision	Author	Date	Remarks
0	HD	2008	Original document
1	HD	2017	Updated screenshots
2	RP	2022-06-15	Updated to new template

2 Exercise Shaft-hub connections 00: Cylindrical interference fit

2.1 Summary

In an automotive transmission, a helical gear is connected to the shaft by means of an interference fit. The torque transmitted results in an axial and radial force (due to the pressure and helix angle).



2.2 Tasks

1. Enter the data given. How can you find out the value to be given for “bending moment”?
2. Decide on the tolerances to be used such that the torque can be transmitted safely. How can you find out suitable tolerances?
3. Check whether the safety factors are ok. Why are there three safety factors?
4. Find out what would be the maximum torque that could be transmitted by the connection (if axial and radial force remained the same).
5. Find out what the maximum torque would be if you need to achieve a minimal safety factor against sliding of 1.40 exactly.
6. Find out how the shaft must be cooled / the gear to be heated to assemble the gear on the shaft

3 Given data

Nominal torque:	300 Nm
Axial force:	2000 N
Radial force:	300 N
Bending moment:	?
Speed:	3000 rpm
Application factor:	1.25

Surfaces:	N6
Coeff. of friction:	0.12

Nominal diameter:	50mm
Shaft bore:	solid shaft
Hub:	The gear consists of two parts. The part for the tooting has a width of 30mm and a pitch diameter of 90mm. The part for the synchronizer has a width of 25mm and an outer diameter of 70mm

Materials:

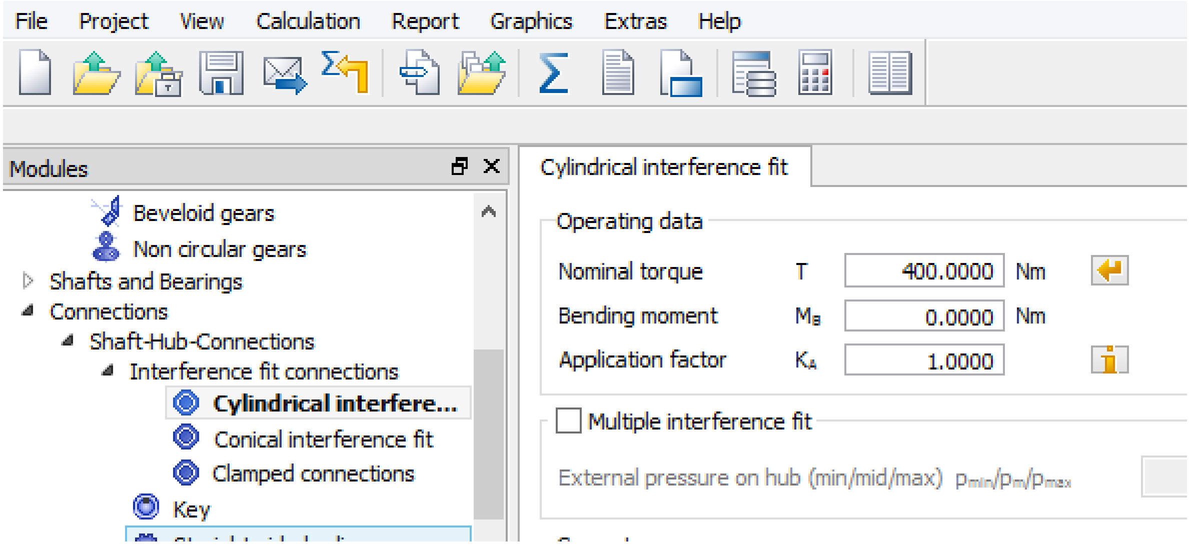
Hub/Gear:	18CrNiMo7
Shaft:	34CrNiMo6

Temperatures:

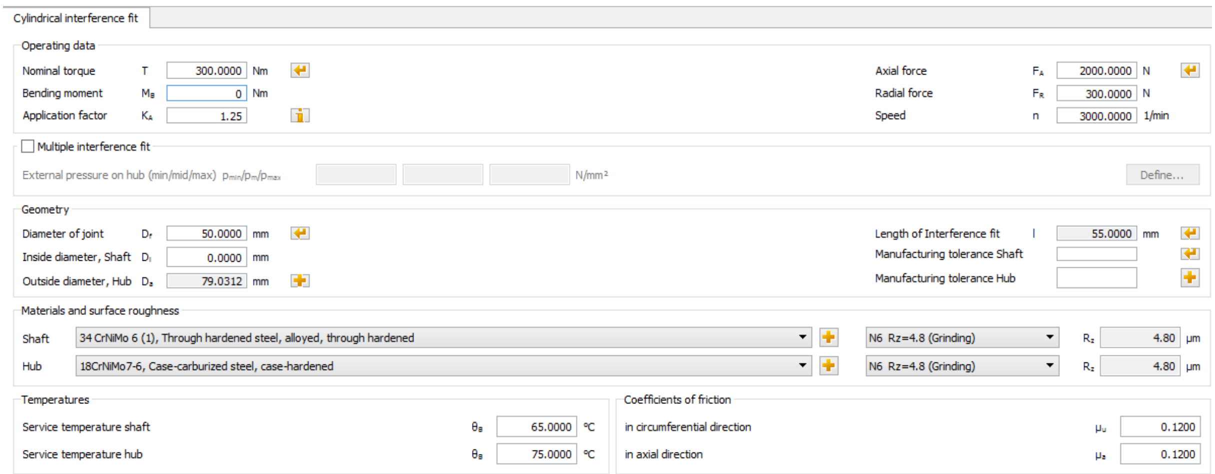
At assembly:	30°C
At operation:	65°C for shaft, 75°C for hub

4 Solution

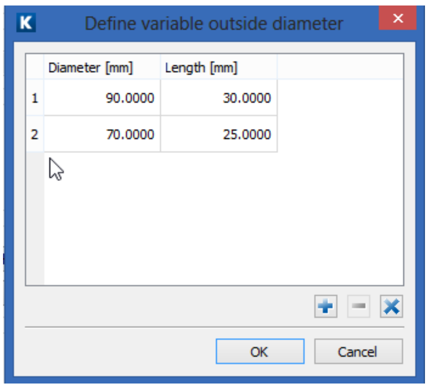
Start cylindrical interference fit module:



Enter all data given:



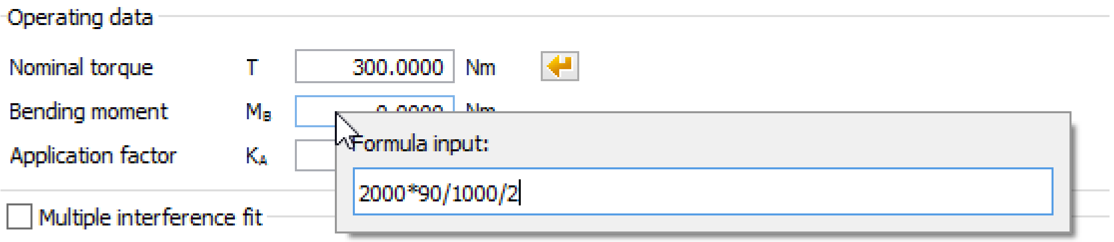
To enter several hub diameters / hub widths, press  next to Outside diameter, Hub D_a 0.0000 mm
There you can enter different diameters / widths. Once you press “OK”, an equivalent diameter / hub combination will be calculated.



5 Questions

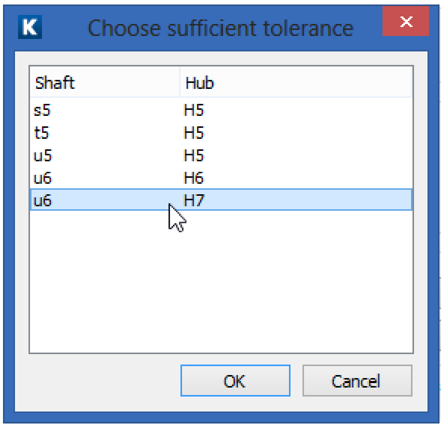
5.1 Question 1

To enter the bending moment, calculate it from axial force and half the pitch diameter. To do this, you can use the formula editor. Press right mouse click into the field for “Bending Moment” and calculate it (be careful to consider dimensions correctly):



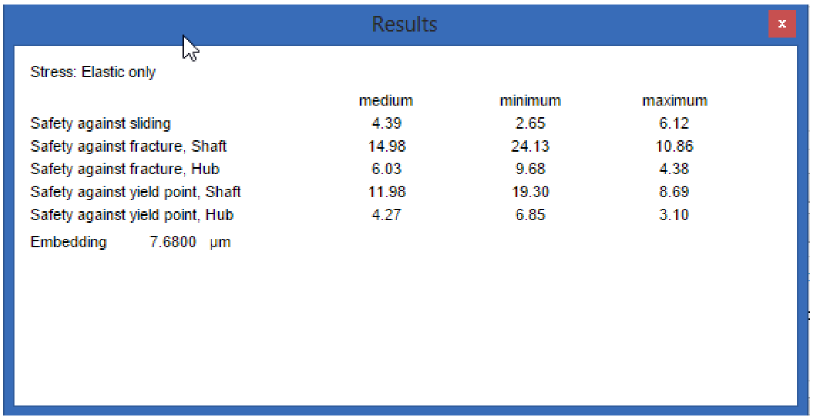
5.2 Question 2

To have the software propose you suitable tolerances, press sizing button next to tolerance input. A list with possible combination appears, choose suitable combination:



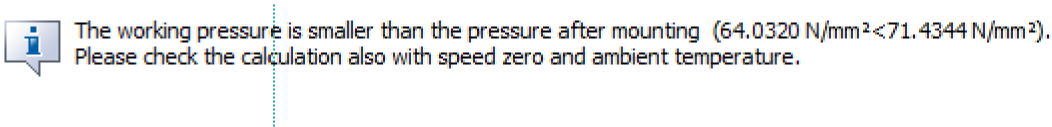
5.3 Question 3

Now that all data is given, press  or F5 to get the results. Three sets of results are shown, for nominal dimensions, for highest shaft diameter/smallest hub inner diameter, for highest hub inner diameter/smallest shaft diameter. Note that the flag “Results are consistent” is now active.



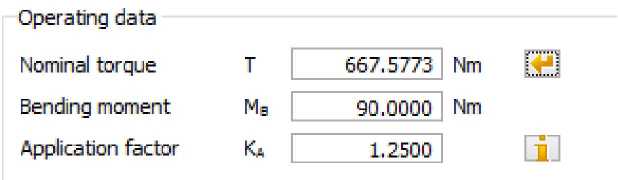
	medium	minimum	maximum
Safety against sliding	4.39	2.65	6.12
Safety against fracture, Shaft	14.98	24.13	10.86
Safety against fracture, Hub	6.03	9.68	4.38
Safety against yield point, Shaft	11.98	19.30	8.69
Safety against yield point, Hub	4.27	6.85	3.10

Note that you will get the below message, which tells you that the contact stress between hub and shaft is actually higher during assembly of connection compared to operation (as in operation, hub will heat up more and expand and it will also expand due to centrifugal forces from rotation)

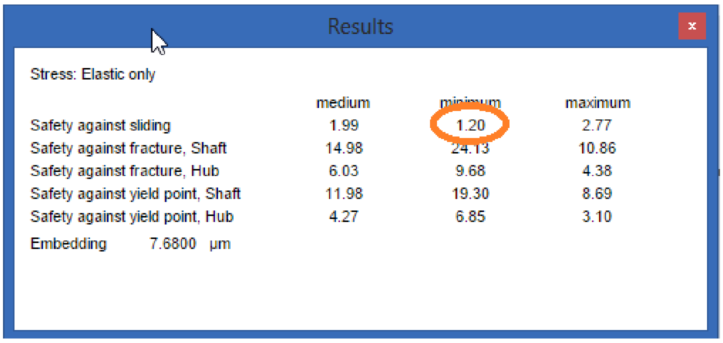


5.4 Question 4

Use the sizing button next to torque input to reverse calculate a maximum possible torque:



If the interference fit is now calculated again, you will find the below safety factors:

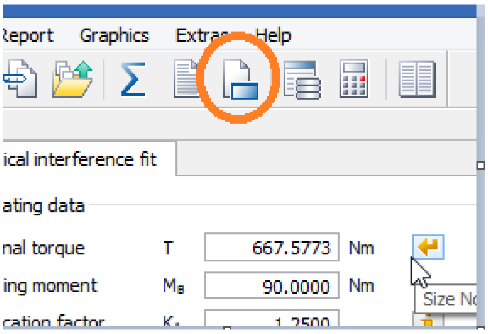


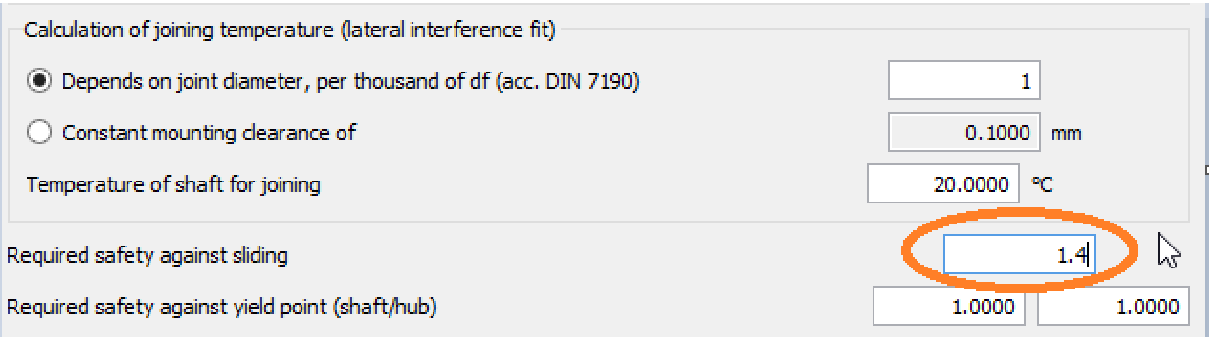
	medium	minimum	maximum
Safety against sliding	1.99	1.20	2.77
Safety against fracture, Shaft	14.98	24.13	10.86
Safety against fracture, Hub	6.03	9.68	4.38
Safety against yield point, Shaft	11.98	19.30	8.69
Safety against yield point, Hub	4.27	6.85	3.10

Note the smallest safety factor of 1.20!

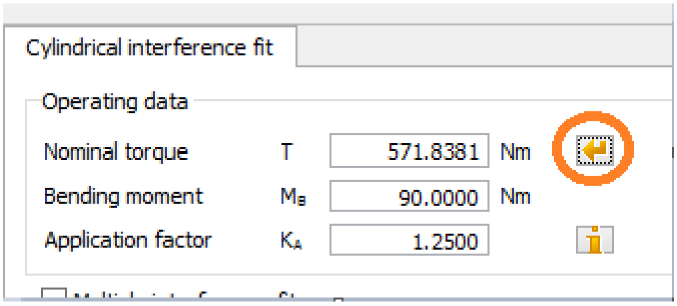
5.5 Question 5

Above, we have a resulting safety factor of 1.20. Obviously, this safety factor was used to reverse calculate the maximum torque transmittable. So, this value was used as a target value. To change the target value, go to the module specific settings and change it there:

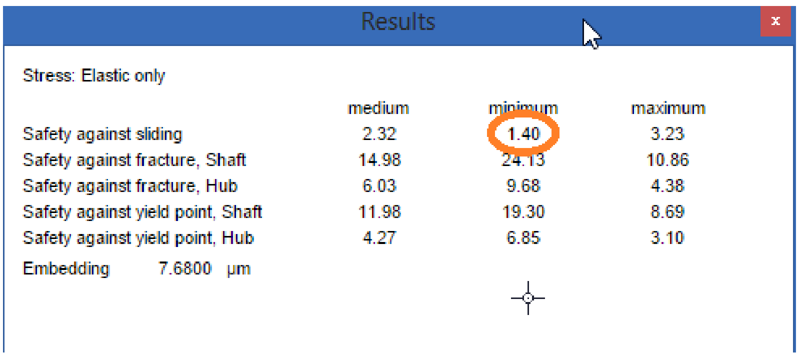




Then, in a second step, recalculate the maximal torque transmittable again by pressing the sizing button next to the input field for nominal torque. You will then get a lower value as the required safety factor is higher:



Now, re-run the calculation and you will find the safety factor of 1.40 in the results



5.6 Question 6

Additional results, like temperatures for assembly (cooling of shaft or heating up of hub) are shown in the report. Get the report using the report symbol or press F6