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KISSsoft Tutorial: Cylindrical Interference Fit

1 Starting KISSsoft

Once you have installed and activated KISSsoft either as a test or licensed version, follow these steps to call the KISSsoft system. Usually you start the program by clicking "Start→Program Files→KISSsoft 03-2011→KISSsoft". This opens the following KISSsoft user interface:

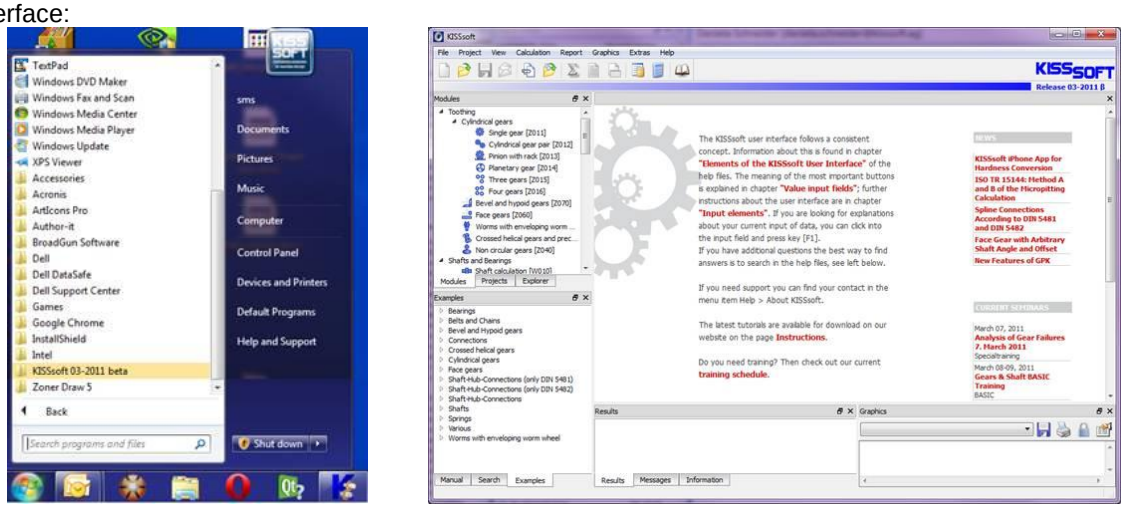


Figure 1.1 Starting KISSsoft, initial window

1.1 Selecting a calculation

In the Modules tree window, select the **"Modules"** tab to call the calculation for cylindrical interference fit:

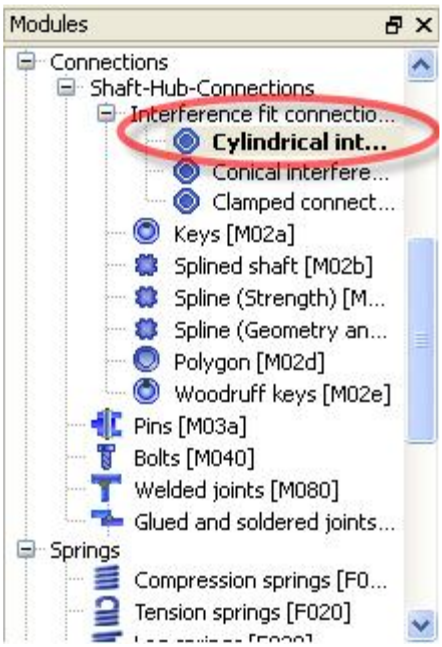


Figure 1.2 Selecting the "Cylindrical interference fit" calculation module under Shaft-Hub-Connections

2 Calculating a cylindrical interference fit

2.1 Task

To size a cylindrical interference fit using the following data to ensure no slippage occurs.

Diameter of joint	60 mm	Coefficient of friction	0.12
Length of interference fit	50 mm	Operating temperature	20 °C
External diameter, hub	90 mm	Application factor	1.25
Shaft bore	10 mm	Shaft material	34CrNiMo6
Nominal torque	400 Nm	Hub material hub	C60
Axial force	200 N	Shaft surface quality	N6
Number of rotations	10000 rpm	Hub surface quality	N6

Enter this data as follows:

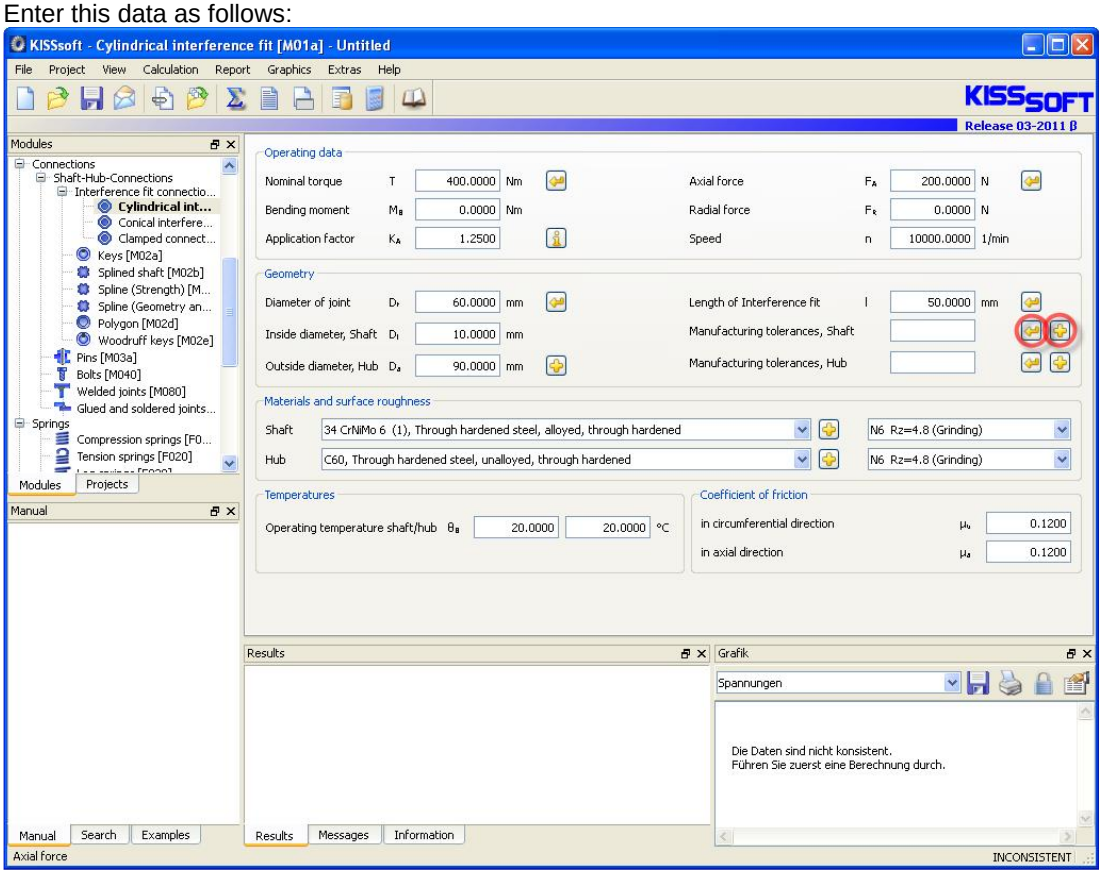


Figure 2.1 Input window - inputting the known data

The first step is to define a suitable tolerance pair.

2.2 Sizing a tolerance pair

Click  to the right of the entries for manufacturing tolerances, see the marking in **Figure 2.1** to open a list with possible tolerance pairs. You can select any of these tolerance pairs, for example, the one that is most cost-effective to manufacture. Then click **"OK"** to transfer your selection to the main screen.

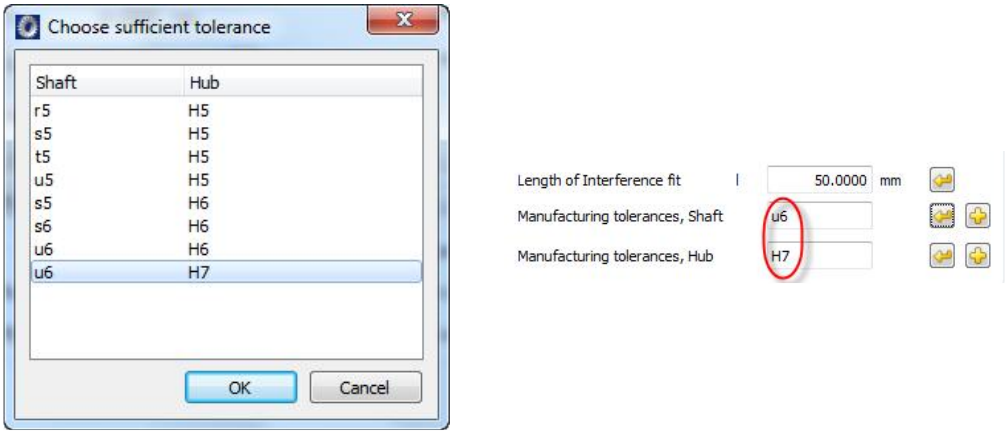


Figure 2.2 Selecting and transferring a tolerance pair

Alternatively, if you already know the tolerances of the shaft and hub, you can also input these values directly. This is described in section 2.4.4 "Defining your own tolerances". You now have all the data required to verify an interference fit.

2.3 Running the analysis and report

Click the  icon in the tool bar (see upper marking in **Figure 2.4** or press "F5" to run the calculation. Some of the selected results then appear in the lower part of the main window (here, for example, safety against sliding). KISSsoft issues a message in the example shown here:

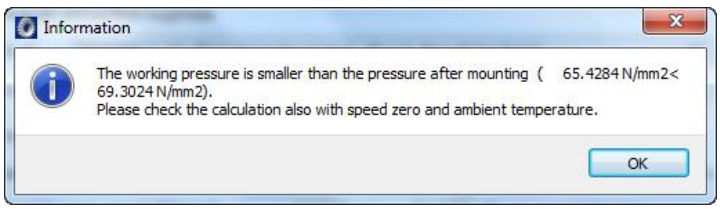


Figure 2.3 KISSsoft message

The forces created by operating speed mean that the pressure in the connection is higher during assembly than during operation. For this reason, you should run another calculation with speed set to zero to check the yield point during assembly. Click **"OK"** to close the message.

Note that the status bar shows "Results are consistent" (see marking on the lower-right hand side in **Figure 2.8** Sizing to maximum nominal torque). This shows that the data you input matches the displayed results (for example, if you now change the nominal torque, the status "INCONSISTENT" is displayed until you click  again to rerun the calculation).
The method used to calculate a cylindrical interference fit is applied as specified by DIN 7190, valid for the elastic range.

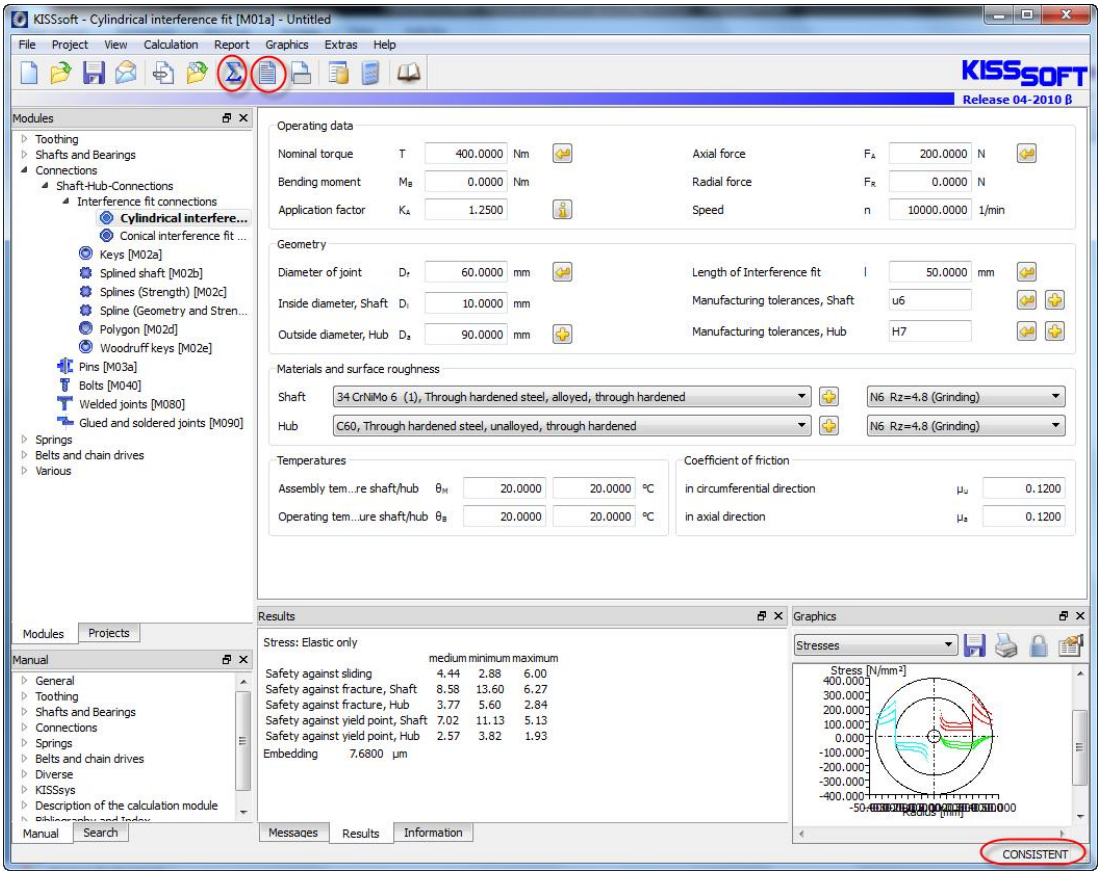


Figure 2.4 Performing the analysis - calling the report

Either click **"Generate report"**, (see the marking to the right of  in **Figure 2.8**) or press "F6" to create the analysis report which lists all the parameters used in the calculation. You can now, for example, include this report in a proof report.

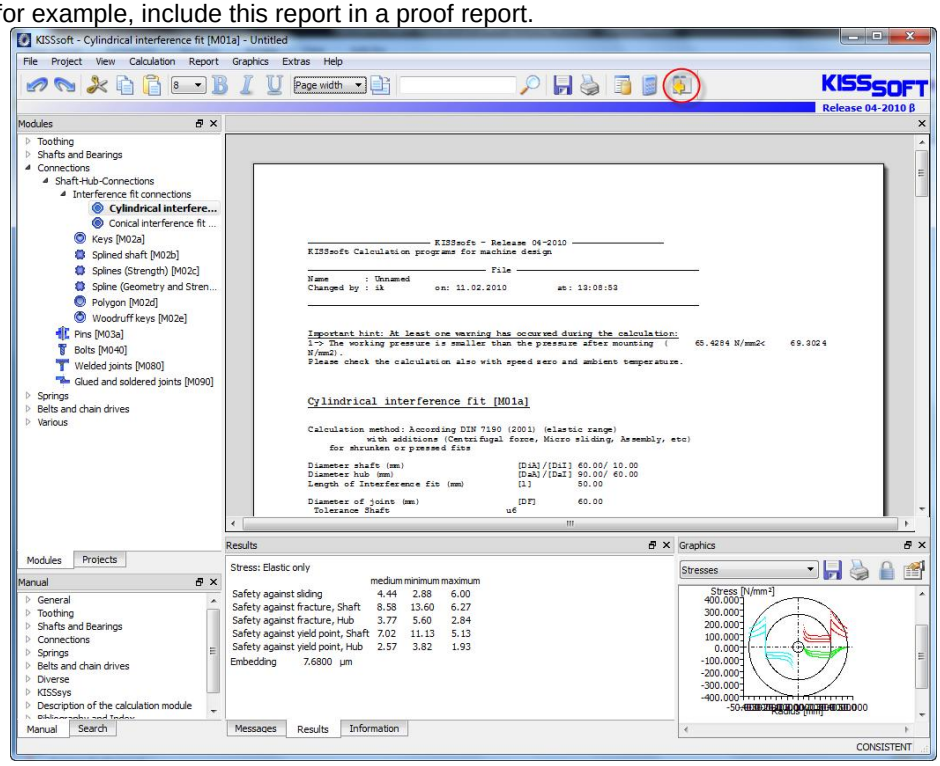


Figure 2.5 Report viewer

The report also contains other results, for example **"Details about hub and shaft temperature during assembly"** or **"Limiting torque"** to avoid micro-sliding.

```
Service/Mounting/Remounting

Transverse interference fit:
Mounting clearance (mm) [PsTh] 0.060
Temperature difference for mounting:
Shaft temperature: (°C) Hub temperature: [ThA] (°C)
      20 261
     -150 135
(calculated using coefficient of thermal expansion)
 shaft according to DIN 7190 (10^-6/K) [alpha] 8.50

Longitudinal pressure fit:
Assembly temperature shaft (°C) [ThM] 20.00
Assembly temperature hub (°C) [ThM] 20.00
Coefficient. of friction (longitudinal)
                        [mye=mya*1.3] 0.16
Press on (force) (kN) [Fpress] 101.89 (68.08. .135.71)
Coefficient. of friction (longitudinal)
                       [myll=mya*1.6] 0.19
Press out (force) (kN) [Fpress] 125.41 (83.79. .167.03)

Note:
 Micro sliding can occur in Interference fit!
 => Risk of contact corrosion.
Coefficient. of friction [my] 0.19
Max. torque to avoid micro-sliding (Nm) [Tlimit] 561.60 (364.18. .759.02)
```

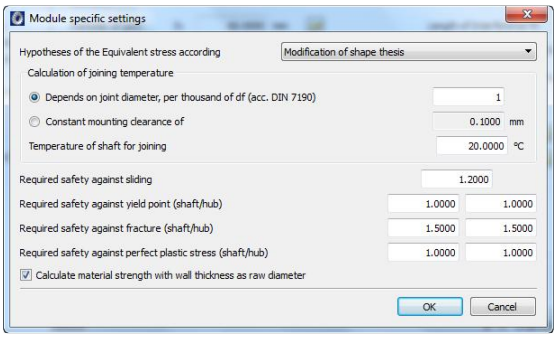
Figure 2.6 Section of the report showing details about assembly and the limiting torque to prevent micro-sliding

Click the  icon, ringed in red in **Figure 2.5**, to return to the input window.

2.4 Further analysis options and settings

2.4.1 Settings

Select the **"Calculation"→"Settings"** menu option, or use the tool bar and click the appropriate button to open this menu. The values shown here influence the calculation and must therefore be checked carefully.



Select the hypothesis for stress invariant

Required safety factors, especially against sliding. These values are not included in the calculation run. However, the system issues a warning if these values are not reached during the analysis process.

Shows how the part strength is determined from test strength analysis (size influence)

Figure 2.7 Module-specific settings

2.4.2 Calculating the maximum permissible nominal torque

Now calculate the maximum permissible torque such that the minimum safety against sliding is 1.20. All other parameters remain as defined above.

To do this, click the "Sizing" button  to the right of the input field for nominal torque (see ringed icon 1 in **Figure 2.8**). The software then determines the maximum nominal torque, which in this case is 959.68 Nm.

If you then recalculate the shaft hub connection with this load (or press F5), the minimum Safety against sliding will be equal to the required minimum safety of 1.2 (see ringed value 3 below in Figure 2.8):

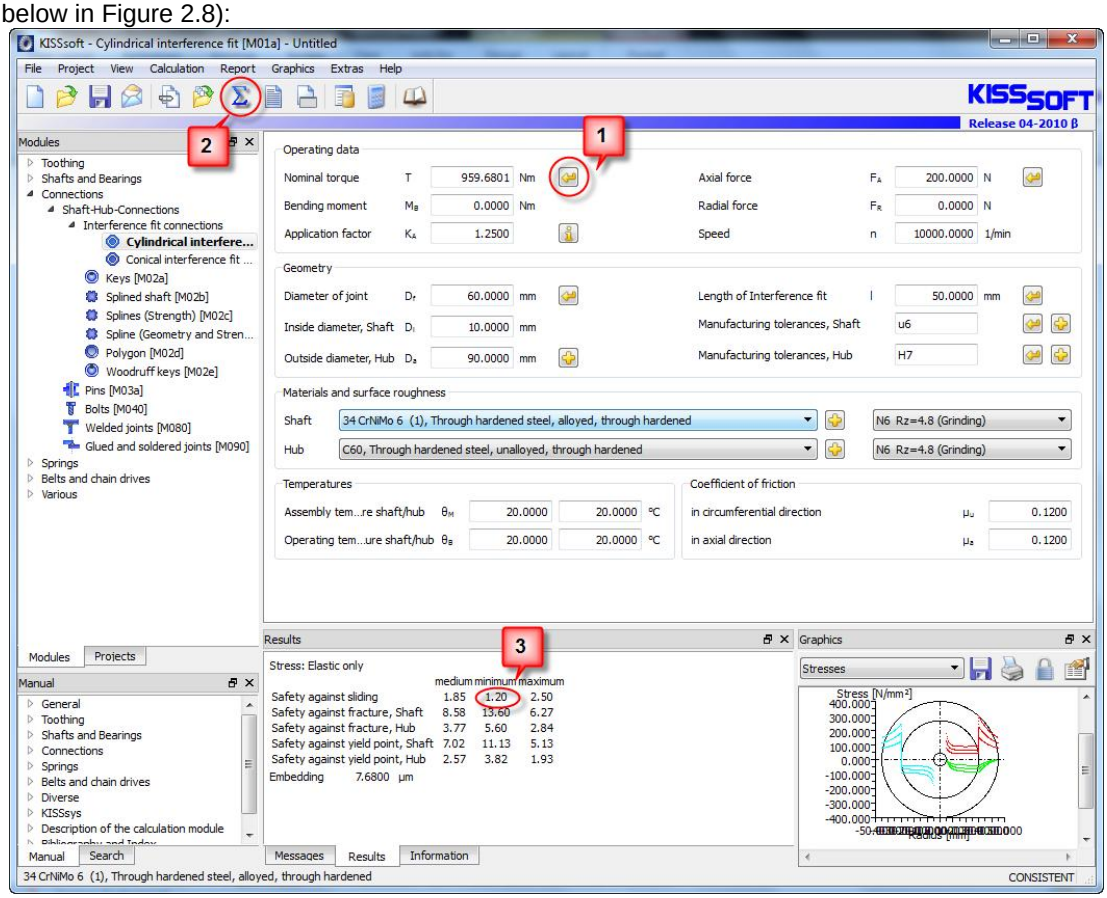


Figure 2.8 Sizing to maximum nominal torque

2.4.3 Hub with varying outer diameters

Click the "Plus button" to the right of the input for the hub outer diameter to allow extended input for hub geometry. Click this "Plus button" to define a hub with a variable external diameter. The hub in this example has a range with 90 mm external diameter over 25 mm length and 100 mm external diameter over 25 mm length:

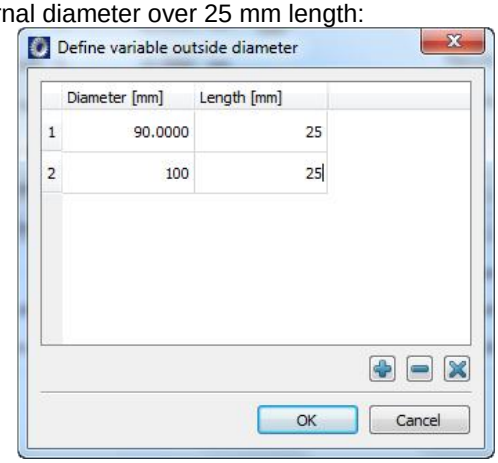


Figure 2.9 Defining a hub with variable external diameter

However, you can only input this data if the shaft does not have a hole. Otherwise the following error message appears:

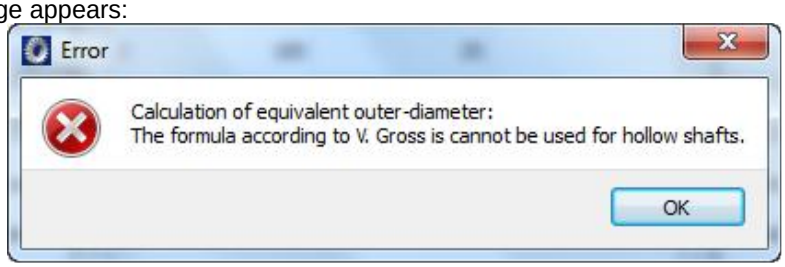


Figure 2.10 Error message

2.4.4 Defining your own tolerances

Click the "Plus button"  to the right of the input field for tolerances to input your own tolerance values. To do this, set the flag in the **"Checkbox"** for **"Own tolerances"** and input the value you require:

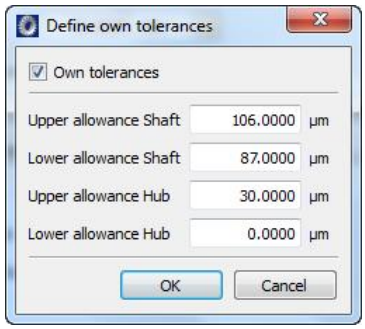


Figure2.11 Defining your own tolerances

2.4.5 Influence of temperature

The reference temperature used is 20°C.

Note: the maximum operating temperature is 700°C.

However, if you input a different operating temperature in the main screen, the interference pressure changes as a function of the difference in the coefficient of thermal expansion of the shaft/hub material. You can modify this by setting the material to **"Own Input"** in the material properties screen.

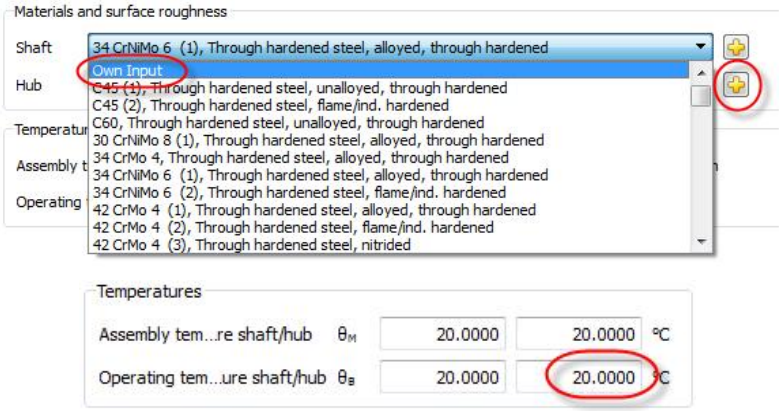


Figure 2.12 Inputting your own material (in particular coefficient of thermal expansion) and operating temperature

Click  (upper right-hand marking in Figure 2.12) to the right of the material selection list to modify the material properties:

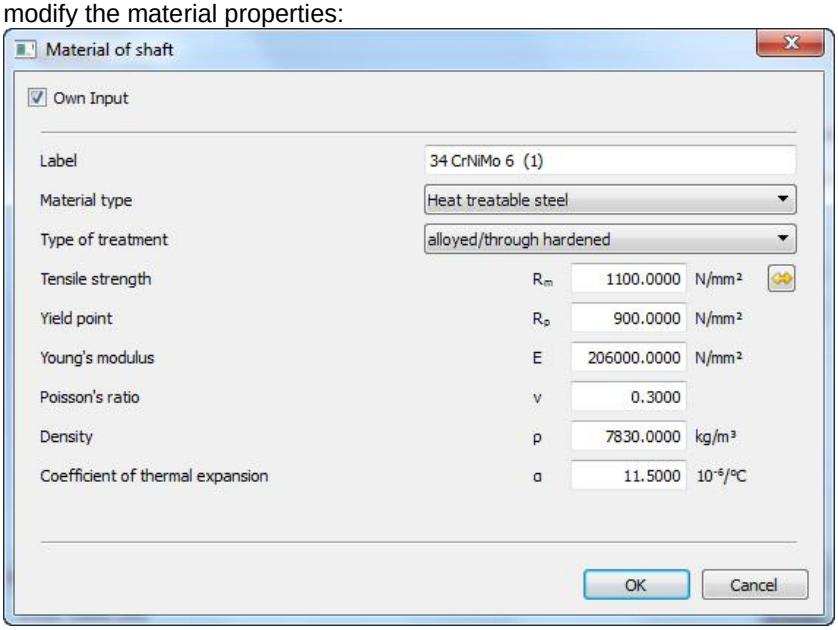


Figure 2.13 Defining a specific material

The data you input for this new material only applies to this calculation. After you save this file, this data is no longer available to any other calculation. However, if you want other calculations to be able to use the data for this new material, you must store this information in the material database.

2.4.6 Additional loads

In the **"Radial force"** and **"Bending moment"** input fields you can also input additional radial forces and bending moments (for example, those that result from the tooth forces in a gear). The software then also calculates additional stress. To ensure no gaps occur between the hub and the shaft, the additional pressure must be less than the minimum interference pressure. If not, an error message appears and the calculation is not performed.