

eAssistant

the engineering assistant

A calculation example Splined shaft connection according to Niemann

Release January 2009

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1 The calculation example: Splined shaft connection for a lifting gear drive

We have prepared the following example to guide you through the calculation module. This calculation module refers to: G. Niemann, H. Winter, B.-R. Höhn: Maschinenelemente Band I: Konstruktion von Verbindungen, Lagern, Wellen. Springer Verlag, 3. edition, 2001: p.857 Example 4: Splined shaft for a lifting gear drive.

1.1 Start the calculation module

Please login with your user name and your password. Select the module through the tree structure of the Project Manager by double-clicking on the module or clicking on the button 'New calculation'.

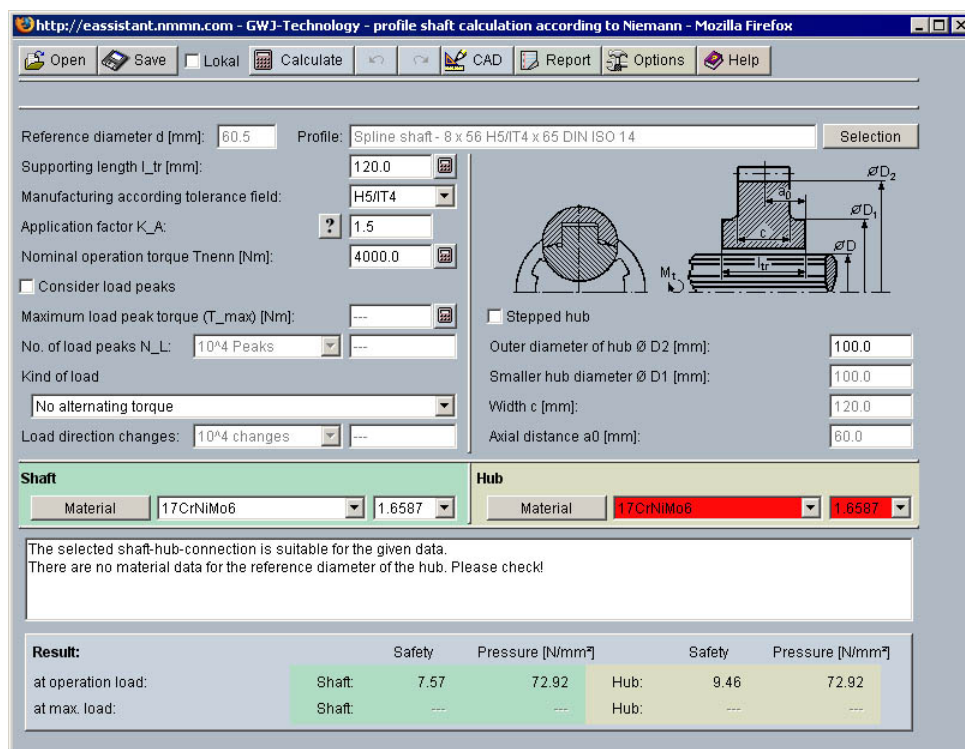


Figure 1: The calculation module 'Splined shaft'

1.2 The input values

A splined shaft connection with a splined shaft according to DIN ISO 14 is given. The safety against pressure is required. For our calculation example the following input values are given:

- Diameter d_1 = 32 mm
- Diameter d_2 = 38 mm
- Number of keys = 8
- Key width = 6
- Supporting length l_{tr} = 40 mm
- Manufacturing according to tolerance field = H7/IT7
- Application factor = 1
- Nominal operation torque T_{nenn} = 2400 Nm
- Maximum load peak torque T_{max} = 2400 Nm with number of load peaks $> 10^7$, no alternating torque
- Outer diameter of hub D_2 = 45 mm
- Material shaft = C45 hardened and tempered
- Material hub = C45 hardened and tempered

1.3 The calculation

The profile geometry selection

To find the right profile, click on the button 'Selection'.



Figure 2: The button 'Selection'

The profile geometry selection is opened.

Select from the listbox 'Standard geometry data' the splined shaft profile according to DIN ISO 14 medium series.

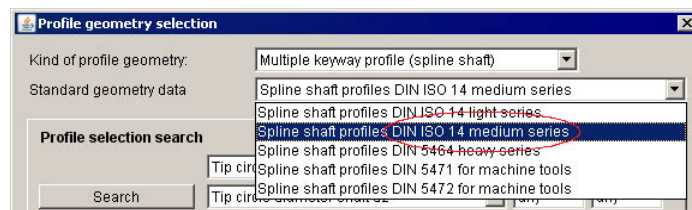


Figure 3: The profile geometry selection

You can refine the profile geometry selection by including specific parameters to find the right profile quicker. Just add the diameter d_1 , the number of keys as well the key width. Click on the button 'Search'.

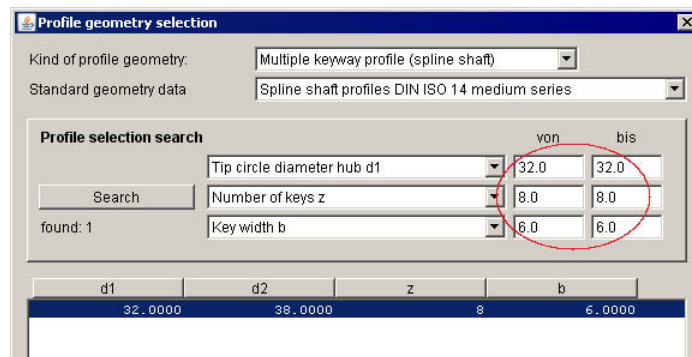


Figure 4: Refine the profile geometry selection

After clicking the button 'Search', only one profile remains. Please take over this profile to the main mask with the button 'OK'.



Figure 5: Profile

Enter '40 mm' for the supporting length l_{tr} .



Figure 6: The supporting length

The tolerance field

Use the listbox to select the tolerance field 'H7/IT7'.

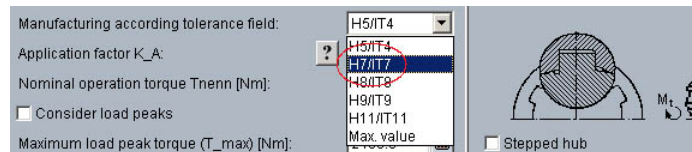


Figure 7: The tolerance selection

The field 'Profile' displays the corresponding tolerance.



Figure 8: Tolerance

Please add now the application factor as well as the nominal operation factor T_{nenn} .

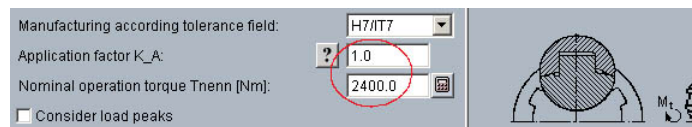


Figure 9: Application factor and nominal operation torque

The load peaks

Activate the load peaks and enter '2400' for the maximum load peak torque T_{max} .



Figure 10: The load peaks and load peak torque T_{max}

Select the number of load peaks from the listbox.

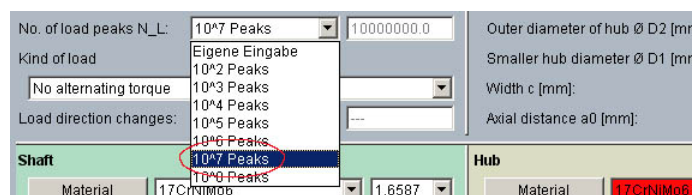


Figure 11: The number of load peaks

The kind of load

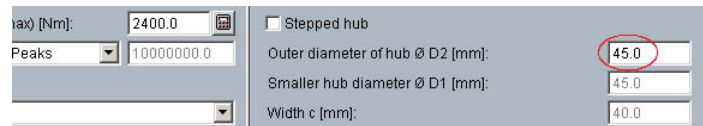
There is no change in load direction, so enter the default setting 'No alternating torque' for the 'kind of load'.



Kind of load	Smaller hub diameter Ø D1 [mm]
No alternating torque	
Load direction changes: 10 ⁴ changes	Width c [mm]:
	Axial distance a0 [mm]:

Figure 12: The kind of load

Enter the value '45 mm' for the outer diameter of the hub.

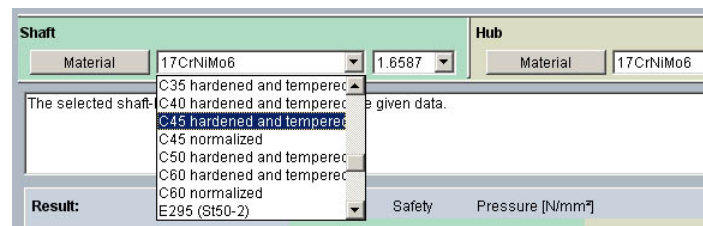


max [Nm]: 2400.0	<input type="checkbox"/> Stipped hub
Peaks: 10000000.0	Outer diameter of hub Ø D2 [mm]: 45.0
	Smaller hub diameter Ø D1 [mm]: 45.0
	Width c [mm]: 40.0

Figure 13: Outer diameter of hub

The material of shaft and hub

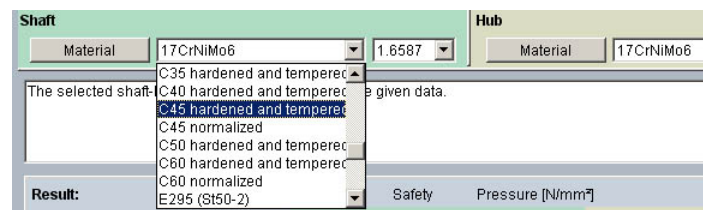
Select the material 'C45 hardened and tempered' for the shaft.



Shaft	Hub
Material: 17CrNiMo6	Material: 17CrNiMo6
The selected shaft: C45 hardened and tempered	
Result: E295 (St50-2)	Safety: Pressure [N/mm ²]

Figure 14: The material for the shaft

Note: In case you need further information on the material, click on the button 'Material'.



Shaft	Hub
Material: 17CrNiMo6	Material: 17CrNiMo6
The selected shaft: C45 hardened and tempered	
Result: E295 (St50-2)	Safety: Pressure [N/mm ²]

Figure 15: The button 'Material'

A new window is opened.



Material name: C45 hardened and tempered	1.0503
Comment: ---	
Source: DIN 743, DIN EN 10084, Datenbank FORMAT, Datenbank Stahlwisser	
Kind of material: Ductile	Hardness factor f_H: 1.0
Yield point Re/Rp0.2: 430.0	Support factor f_S: 1.2
max. Ø material data [mm]: 100.0	Ø current [mm]: 35.0

Figure 16: The material details

Select the hub material 'C45 hardened and tempered' from the listbox.

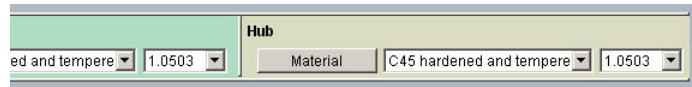


Figure 17: The material for the hub

1.4 The results

The safeties at operation load and maximum load, the pressures for shaft and hub are determined and displayed immediately in the result panel. In general, the results will be calculated and displayed during every input.

Result:		Safety	Pressure [N/mm ²]	Safety	Pressure [N/mm ²]	
at operation load:	Shaft:	2.43	212.47	Hub:	2.61	212.47
at max. load:	Shaft:	2.87	179.78	Hub:	3.09	179.78

Figure 18: The results

For our calculation example the splined shaft is sufficiently dimensioned. In addition, the message window contains the hint that this shaft-hub-connection can be used.

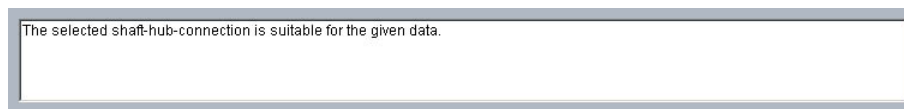


Figure 19: The message window

The documentation: The calculation report

Click on the button 'Report' to create a calculation report. The report contains all detailed results and input values. Using the table of contents, all results can be called up very quickly. The report is available in HTML and PDF format. Save the report in HTML format to open the file later in the web browser or in Word for Windows.

- To save the report in the HTML format, please select 'File' → 'Save as' from your browser menu bar. Select the file type 'Webpage complete', then just click on the button 'Save'.
- If you click on the symbol 'Print', then you can print the report very easily.
- If you click on the symbol 'PDF', then the report appears in the PDF format. If you right-click on the PDF symbol, you should see the 'Save Target As' option. Click on that option and you will see the dialog box for saving the report.

How to save the calculation

Finally, selecting the button 'Save' allows you to save the calculation either on the eAssistant server or on your own workstation.



Figure 20: The button 'Save'

A standard Windows dialog for saving the file on your workstation appears, providing that the options 'Enable file save local' in the Project Manager and 'Local' in the calculation module are activated.

Note: You must not forget that the calculation module has to be closed to activate the option 'Enable file save local.'

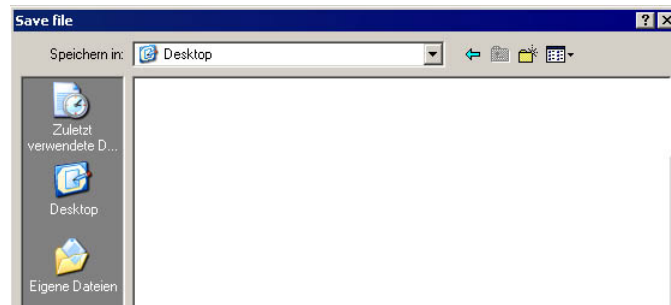


Figure 21: Windows dialog for saving the file

In case you have not activated this option, a new window is opened and you can save the calculation on the eAssistant server.

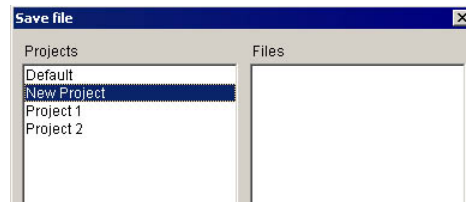


Figure 22: Save the calculation

Please enter a name into the input field 'Filename' and click on the button 'Save'. Then click on the button 'Refresh' in the Project Manager. Your saved calculation file is displayed in the window 'File'.

Our manual is improved continually. Of course we are always interested in your opinion, so we would like to know what you think. We appreciate your feedback and we are looking for ideas, suggestions or criticism. If you have anything to say or if you have any questions, please let us know via phone +49 (0) 531 129 399-0 or email eAssistant@gwj.de.