



Calculation Example Splined Shaft According to Niemann

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Project Default File	na Eritek Grironik Lesezekhen Egtras Hilfe	Input of supporting length L_tr
Project Default, File: Reference diameter d (mm): [7:5] Supporting length Ltr (mm): 120.0 ■ Handfacturing according tolerance field: Honra: Application factor K_A Nominal operation torque Them [km]: Consider load peaks Maximum load peaks MuLt: No. of load peaks N_L: No. of load Pea	Calculation results Substitute outer diameter hub (0): 240.0 mm Equivalent torque (T_{eq}): 6000.0 km Changes of load direction factor (t_{w}): 1.0 Load distribution factor (t_{whods}): 1.072 Factor for percentage contact area (K_{gBRg}): 1.1 Factor for percentage contact area (K_{gBRg}): 1.0 Material name: 34cm Material name: 34cm Source of data: DIN 743, DIN EN 10084, DINE	Reference diameter d [mn]: 118.5 Profile: Spline shaft-10 x112 H5/IT 4 x125 DiN ISO 14 Selection Supporting length Lif [mn]: 90.0 III H5/IT 4 x125 DiN ISO 14 Selection Application factor K, A 2 1.5 IIII Profile: IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII
K_Jambda is not defined for the existing ratio (_btd). Please check, K_Jambda is not defined for the existing ratio (_btd). Please check, The selected shaft-hub-connection is suitable for the given data.	Stantwissen Namest 2.1, 01 Kind of material: Yield point (R ₂):	The selected shaft-hub-connection is suitable for the given data.
Result: Safety Press	un Support factor (f _s):	Result: Safety Pressure [N/mm*] Safety Pressure [N/mm*]
at operation load: Shaft	Hardiness factor (Hr	at operation load: Shaft: 29.40 20.41 Hub: 44.09 20.41
at max. load:	Permissible pressure (p _{1zul}):	atmax.load: Shaft Hub:
Rosuit: Saely Press at operation load: Shat 20.99 at max load: Shat 20.99	Support lactor (I _g); Hardness factor (I _g); Equivalant pressure (A _{1xq}); Permissible pressure (A _{1xq});	Pesudi: Safaty Pressure (krimn?) Safaty Pressure (krimn?) at optyration load: Shaft 29.40 20.41 Hub: 44.09 20.41 at max (bad: Hub:

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0.1 Calculation Example: Splined Shaft for Lifting Gear

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

0.1.1 Start the Calculation Module

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

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💪 Open 😽 Save 🗖 Lokal 🖩 Calc	ulate 🗠 🗠 🙀	CAD 🛛 Report 🔐 Options 🤞	Help
-	-		
Reference diameter d [mm]: [60.5 Pr	rofile: Spline shaft - 8 x	56 H5/IT4 x 65 DIN ISO 14	Selection
Supporting length I_tr (mm):	120.0		ØD ₂
Manufacturing according tolerance field:	H5/IT4	(TATA)	# gD1
Application factor K_A:	? 1.5		
Nominal operation torque Tnenn [Nm]:	4000.0 🔛	[(A A) M. €	
Consider load peaks			
Maximum load peak torque (T_max) [Nm]:		E Stepped hub	
No. of load peaks N_L: 10^4 Peaks	· · · ·	Outer diameter of hub Ø D2 [mm]:	100.0
Kind of load		Smaller hub diameter Ø D1 [mm]:	100.0
No alternating torque	T	Width c [mm]:	120.0
Load direction changes: 10^4 changes	Y	Axial distance a0 (mm):	60.0
Shaft		Hub	
Material 17CrNiMo6	1.6587 💌	Material 17CrNiMo6	▼ 1.6587 ▼
The selected shaft-hub-connection is suite	hle for the given data		
There are no material data for the reference	diameter of the hub. Pl	ease check!	
			_
Result:	Safety	Pressure (N/mm²) Safe	ety Pressure [N/mm ⁼]
at operation load:	Shaft: 7.57	72.92 Hub:	9.46 72.92
at max. load:	Shaft:	Hub:	

Figure 1: Calculation module'

0.1.2 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:

= 32 mm
= 38 mm
= 8
= 6
= 40 mm
= H7/IT7
= 1
= 2400 Nm
= 2400 Nm with number of load peaks $>10^7$

Outer diameter of hub D_2	= 45 mm
Material shaft	= C45 hardened and tempered
Material hub	= C45 hardened and tempered

0.1.3 The Calculation

Profile Geometry Selection

In order to find the right profile, click the button 'Selection'.



Figure 2: 'Selection' button

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

🕌 Profile geometry selection		×
Kind of profile geometry:	Multiple keyway profile (spline shaft)	
Standard geometry data	Spline shaft profiles DIN ISO 14 medium series	-
	Spline shaft profiles DIN ISO 14 light series	
Profile selection search	Spline shaft profiles DIN ISO 14 medium series	
Frome selection search	Spline shaft profiles DIN 5464 heavy series	
Tip cir	Spline shaft profiles DIN 5471 for machine tools	
Search Tip cir	Spline shaft profiles DIN 5472 for machine tools	

Figure 3: Profile geometry selection

You can narrow your search by entering certain parameters in order 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'.

<ind geometry:<="" of="" profile="" th=""><th>Multiple key</th><th>way profile (spline</th><th>shaft)</th><th>•</th><th></th><th></th></ind>	Multiple key	way profile (spline	shaft)	•		
Standard geometry data	Spline sha	ft profiles DIN ISO 1	4 mediu	ım series		-
Profile selection searc	h		ſ	from	to	-
	Tip circle diameter	rhub d1	-	32.0	32.0	
Search	Number of keys z		•	8.0	8.0	
found: 1	Key width b		-	6.0	6.0	
d1	d2	z		b		
d1 32.0000	d2 38.0000	Z	8	b	6.0000	
d1 32.0000	d2 38.0000	Z	8	b	6.0000	
d1 32,0000 Profile details	d2 38.0000 Tip circle	diameter hub d1 [m	8	b	6.0000	
d1 32,0000 Profile details	d2 38.0000 Tip circle Tip circle	diameter hub d1 [m diameter shaft d2 [r	8 Im] mm]	b	6.0000 32.0 38.0	

Figure 4: Refine the profile geometry selection

After clicking the button 'Search', only one profile remains. Please select the profile and click the button 'OK'.

🕙 eassistant - GWJ-Technology - profil shaft c	alculation acc	ording to Niemann - Mozilla	a Firefox	<u>_0×</u>
🗳 Open 🐟 Save 🗖 Lokal 🖩 Calculat	e n o	CAD Report	🚡 Options 🛛 🛷 Help	
Reference diameter d (mm): 35.0 Profile	Spline sha	- 8 x 32 H5/IT4 x 38 DIN ISI	0.14	Selection
Supporting length tr [mm]:	120.0			
odpporting tengan _a (min).	120.0			

Figure 5: Selected profile

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

Reference diameter d [mm]: 35.0	Profile: Spline chaft - 8 x
Supporting length I_tr [mm]:	40.0
Manufacturing according tolerance field:	Н5ЛТ4
Application factor K_A:	? 1.5

Figure 6: Supporting length

Tolerance Field

Click the listbox in order to choose the tolerance field 'H7/IT7'.



Figure 7: Tolerance selection

The field 'Profile' displays the previously selected tolerance field.

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🍒 Open Save 🗖 Lokal 📓	Calculate 🖌	🗠 🙀 CAI	D Report 🔂 Optio	ns 🤣 Help	
eference diameter d (mm): 35.0	Profile: Spline	shat - 8 x 32 H	7/IT7 x 38 DIN ISO 14		Selection

Figure 8: Tolerance field

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

HOUL	-
1.0	
2400.0	- 9
	1.0 2400.0

Figure 9: Application factor and nominal operation torque

Load Peaks

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

Consider load peaks			
Maximum load peak torq	ue (T_max) [Nm]:	2400.0	
No. of load peaks N_L:	10^4 Peaks	- 10000.0	

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

Select the number of load peaks from the listbox.

Maximum load peak torqi	Je (T_max) [Nm]:	2400.0
No. of load peaks N_L:	10^4 Peaks	10000.0
Kind of load	Eigene Eingabe 10^2 Peaks	
No alternating torque	10^3 Peaks	•
Load direction changes:	10^4 Peaks 10^5 Peaks 10^6 Peaks	
Shaft	10^7 Peaks	

Figure 11: Number of load peaks

Kind of Load

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

No alternating torque		-
, Lood direction changes:	1084 changes	

Figure 12: Kind of load

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



Figure 13: Outer diameter of hub

Material of Shaft and Hub

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



Figure 14: Material for the shaft

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

naterial fiame.	C45 harden	ed and tempere	d 1.0503	3 <u>*</u>
Comment:				
Source:	DIN 743, DIN	VEN 10084, Dat	enbank FORMAT, Datenban	k Stahlwisser
(ind of material	Ducti	ile 🔻	Hardness factor f. H.	1.0
/ield noint Re/F	. <u>15000</u>	130.0	Sunnort factor f	1.2
ford point reals		430.0	odpportractor (_o	1.2

Figure 15: Material details

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

	Hub	
3 -	Material	C45 hardened and tempere 1.0503
1000		

Figure 16: Material for the hub

0.1.4 Calculation Results

All results (safeties at operation load and maximum load, the pressures for shaft and hub) will be calculated during every input and will be displayed in the result panel. A recalculation occurs after every data input. Any changes that are made to the user interface take effect immediately.

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:	3.95	179.78	Hub:	4.24	179.78

Figure 17: Calculation results

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

The selected shaft-hub-connection is suitable for the given data.

Figure 18: Message window

0.1.5 Documentation: Calculation Report

After the completion of your calculation, you can create a calculation report. Click on the 'Report' button. You can navigate through the report via the table of contents that provides links to the input values, results and figures. This calculation report contains all input data, the calculation method as well as all detailed results. The report is available in HTML and PDF format. The calculation report saved in HTML format, can be opened in a web browser or in Word for Windows.

You may also print or save the calculation report:

- To save the report in the HTML format, please select 'File' \rightarrow '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.
- When 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.

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Bearbeiten Ansicht Chronik Lesezeichen Extras		-
Profile description: Spline shaft - 8 x 32 H7/11	7 x 38 DIN ISO 14	
Tip circle diameter hub (d ₁):	32.0 mm	
Tip circle diameter shaft (d ₂):	38.0 mm	
Number of keys (z):	8	
Key width (b):	6.0 mm	
Manufacturing according tolerance field:	H7/IT7	
Application factor (K _A):	1.0	
Nominal torque (T _{nenn}):	2400.0 Nm	
Supporting length (I _{tr}):	40.0 mm	
Maximum load peak torque (T _{max}):	2400.0 Nm	
Number of load peaks (N _L):	10000.0	
Load kind:	No alternating torque	
Bigger outer diameter hub (D ₂):	45.0 mm	
Smaller outer diameter hub (D ₁):	45.0 mm	
Axial distance between load in- and output pos	ition (a _o): 20.0 mm	
Hub width (c):	40.0 mm	
Minimum safety (S _{min}):	1.2	_
Calculation results		
Substitute outer diameter hub (D):	45.0 mm	
Equivalent torque (T _{eg}):	2400.0 Nm	
Changes of load direction factor (f _w):	1.0	
Load distribution factor (K _{lambda}):	1.144	
Factor for percentage contact area (K _{@BEO});	1.3	
Factor for percentage contact area ($K_{\phi\beta Max}$):	1.1	
Shaft		

Figure 19: Calculation report

0.1.6 How to Save the Calculation

When the calculation is finished, you can save it to your computer or to the eAssistant server. Click on the button 'Save'.



Figure 20: 'Save' button

Before you can save the calculation to your computer, you need to activate the checkbox 'Enable save data local' in the project manager and the option 'Local' in the calculation module. A standard Windows dialog for saving files will appear. Now you will be able to save the calculation to your computer.

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Zuletzt besucht									
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N									
Computer									
Netzwerk									
		12				3			
	Dateiname:					•		Speichern	
	Dateityp:	Alle Dateien (*.	")			-		Abbrechen	

Figure 21: Windows dialog for saving the file

In case you do not activate the option in order to save your files locally, then a new window is opened and you can save the calculation to the eAssistant server. 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 'Files'.

ave file		
Projects	Files	
Default		
Project 1 Project 2		
-TOJECI 2		
<i>1</i> 1		
ilename		1
		Cancel
		- 22

Figure 22: Save the calculation

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.