KISSsoft evaluation

File

Name : shaft2_coax
Changed by: jirri on: 29.07.2019 at: 01:29:40

Important hint: At least one warning has occurred during the calculation:

1-> For shaft with internal diameter the notch factors are not available.
None of the known calculation methods produces reliable data. It is proposed to use the data for the full shaft and to judge the results conservatively.

Analysis of shafts, axle and beams

Input data

Coordinate system shaft: see picture W-002

Label		Shaft1
Drawing		
Initial position (mm)		0.000
Length (mm)		180.000
Speed (1/min)		0.00
Sense of rotation: clockwise		
Material		16 MnCr 5 (1)
Young's modulus (N/mm²)		206000.000
Poisson's ratio nu		0.300
Density (kg/m³)		7830.000
Coefficient of thermal expansion	(10^-6/K)	11.500
Temperature (°C)		20.000
Weight of shaft (kg)		0.996
Weight of shaft, including additional masses (kg)		0.996
Mass moment of inertia (kg*mm²)		112.078
Momentum of mass GD2 (Nm²)		0.004
Label		Shaft2
Drawing		
Initial position (mm)		25.000
Length (mm)		118.000
Speed (1/min)		11818.29
Sense of rotation: counter clockwise		
Material		34 CrAlNi 7-10
Young's modulus (N/mm²)		206000.000
Poisson's ratio nu		0.300
Density (kg/m³)		7830.000
Coefficient of thermal expansion	(10^-6/K)	11.500
Temperature (°C)		20.000
Weight of shaft (kg)		2.380
Weight of shaft, including additional masses (kg)		2.380
Mass moment of inertia (kg*mm²)		4060.566

Momentum of mass GD2 (Nm²)	0.159
The direction of the weight is not considered	
Consider deformations due to shearing	
Shear correction coefficient	1.100
Contact angle of rolling bearings is considered	
Tolerance field: Mean value	
Reference temperature (°C)	20.000

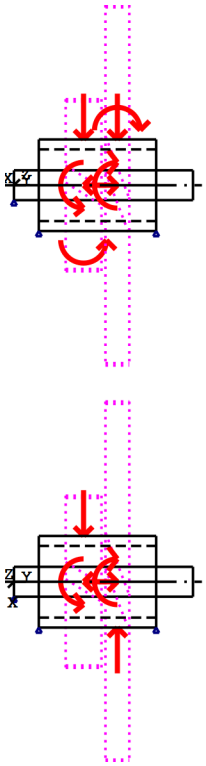


Figure: Load applications

Shaft definition (Shaft1)

Outer contour

Cylinder (Cylinder)			0.000mm ... 180.000mm
Diameter (mm)	[d]	30.0000	
Length (mm)	[l]	180.0000	
Surface roughness (µm)	[Rz]	8.0000	

Forces

Type of force element		**Coupling**
Label in the model		Coupling1(Fix)
Position on shaft (mm)	[y_{local}]	180.0000
Position in global system (mm)	[y_{global}]	180.0000
Effective diameter (mm)		50.0000
Radial force factor (-)		0.0000

Direction of the radial force (°)	0.0000
Axial force factor (-)	0.0000
Length of load application (mm)	10.0000
Power (kW)	0.0000
Torque (Nm)	-0.0000
Axial force (N)	0.0000
Shearing force X (N)	0.0000
Shearing force Z (N)	0.0000
Bending moment X (Nm)	0.0000
Bending moment Z (Nm)	0.0000
Mass (kg)	0.0000
Mass moment of inertia Jp (kg*m²)	0.0000
Mass moment of inertia Jxx (kg*m²)	0.0000
Mass moment of inertia Jzz (kg*m²)	0.0000
Eccentricity (mm)	0.0000

Bearing

Label in the model		Support1
Bearing type		Own Input
Bearing position (mm)	[y_{lokal}]	0.000
Bearing position (mm)	[y_{global}]	0.000

Degrees of freedom
X: fixedY: fixedZ: fixed
Rx: freeRy: freeRz: free

Shaft definition (Shaft2)

Outer contour

Cylinder (Cylinder)			0.000mm ... 118.000mm
Diameter (mm)	[d]	92.0000	
Length (mm)	[l]	118.0000	
Surface roughness (µm)	[Rz]	8.0000	

Inner contour

Cylinder inside (Cylindrical bore)			0.000mm ... 118.000mm
Diameter (mm)	[d]	72.0000	
Length (mm)	[l]	118.0000	
Surface roughness (µm)	[Rz]	8.0000	

Forces

Type of force element		**Cylindrical gear**
Label in the model		z1
Position on shaft (mm)	[y_{local}]	45.0000
Position in global system (mm)	[y_{global}]	70.0000
Operating pitch diameter (mm)		172.8972
Helix angle (°)		15.0435 right
Working pressure angle at normal section (°)		20.4402
Position of contact (°)		0.0000
Length of load application (mm)		36.0000
Power (kW)		756.2500 driving (output)
Torque (Nm)		611.0578

Axial force (N)	-1899.7405
Shearing force X (N)	-2727.8676
Shearing force Z (N)	-7068.4521
Bending moment X (Nm)	0.0000
Bending moment Z (Nm)	-164.2299

Type of force element		**Cylindrical gear**
Label in the model		z2
Position on shaft (mm)	[y_{local}]	79.0000
Position in global system (mm)	[y_{global}]	104.0000
Operating pitch diameter (mm)		362.0690
Helix angle (°)		20.2317 right
Working pressure angle at normal section (°)		21.6623
Position of contact (°)		0.0000
Length of load application (mm)		24.0000
Power (kW)		756.2500 driven (input)
Torque (Nm)		-611.0578
Axial force (N)		1244.0123
Shearing force X (N)		-1428.8073
Shearing force Z (N)		3375.3668
Bending moment X (Nm)		-0.0000
Bending moment Z (Nm)		225.2091

Bearing

Label in the model		Support2
Bearing type		Own Input
Bearing position (mm)	[y_{lokal}]	0.000
Bearing position (mm)	[y_{global}]	25.000

Degrees of freedom
X: fixedY: fixedZ: fixed
Rx: freeRy: freeRz: free

Label in the model		Support3
Bearing type		Own Input
Bearing position (mm)	[y_{lokal}]	118.000
Bearing position (mm)	[y_{global}]	143.000

Degrees of freedom
X: fixedY: freeZ: fixed
Rx: freeRy: freeRz: free

CONNECTIONS

SKF NU 2306 ECML (ConnectionRollerBearing1) 38.500mm
Shaft 'Shaft1' <-> Shaft 'Shaft2'
Set fixed bearing right
d = 30.000 (mm), D = 72.000 (mm), b = 27.000 (mm), r = 1.100 (mm)
C = 83.000 (kN), C0 = 75.000 (kN), Cu = 9.700 (kN)

SKF NU 2306 ECML (ConnectionRollerBearing2) 129.500mm
Shaft 'Shaft1' <-> Shaft 'Shaft2'
Set fixed bearing left
d = 30.000 (mm), D = 72.000 (mm), b = 27.000 (mm), r = 1.100 (mm)

C = 83.000 (kN), C0 = 75.000 (kN), Cu = 9.700 (kN)

SKF BSA 206 C (ConnectionRollerBearing3) 80.000mm
Shaft 'Shaft1' <-> Shaft 'Shaft2'
Set axial bearing left
d = 30.000 (mm), D = 62.000 (mm), b = 16.000 (mm), r = 1.000 (mm)
C = 28.500 (kN), C0 = 71.000 (kN), Cu = 2.700 (kN)

Results

Shaft

Maximum deflection	0.967 (µm) (Shaft2 pos = 70.000 mm)

Mass center of gravity

Shaft1 (mm)	90.000
Shaft2 (mm)	59.000

Total axial load

Shaft1 (N)	0.000
Shaft2 (N)	-655.728

Torsion under torque

Shaft1 (°)	-0.000
Shaft2 (°)	-0.003

Bearing

Probability of failure	[n]	1.00	%
Axial clearance	[u_A]	10.00	µm
Lubricant	Oil: ISO-VG 220		
Lubricant - service temperature	[T_B]	70.00	°C

Rolling bearings, classical calculation (contact angle considered)

Shaft 'Shaft1' Bearing 'Support1'

Position (Y-coordinate)	[y]	0.00	mm	
Bearing reaction force	[Fx]	0.000	kN	
Bearing reaction force	[Fy]	0.000	kN	
Bearing reaction force	[Fz]	0.000	kN	
Bearing reaction force	[Fr]	0.000	kN	
Displacement of bearing	[u_x]	0.000	µm	
Displacement of bearing	[u_y]	0.000	µm	
Displacement of bearing	[u_z]	0.000	µm	
Displacement of bearing	[u_r]	0.000	µm	
Misalignment of bearing	[r_x]	0.000	mrad	(0')
Misalignment of bearing	[r_y]	0.000	mrad	(0')
Misalignment of bearing	[r_z]	0.000	mrad	(0')
Misalignment of bearing	[r_r]	0.000	mrad	(0')

Shaft 'Shaft2' Bearing 'Support2'

Position (Y-coordinate)	[y]	0.00	mm
Bearing reaction force	[Fx]	1.643	kN
Bearing reaction force	[Fy]	0.656	kN
Bearing reaction force	[Fz]	3.257	kN
Bearing reaction force	[Fr]	3.648	kN (63.23°)
Displacement of bearing	[u_x]	0.000	µm
Displacement of bearing	[u_y]	0.000	µm
Displacement of bearing	[u_z]	0.000	µm
Displacement of bearing	[u_r]	0.000	µm
Misalignment of bearing	[r_x]	-0.008	mrad (-0.03')
Misalignment of bearing	[r_y]	0.000	mrad (0')
Misalignment of bearing	[r_z]	0.002	mrad (0.01')
Misalignment of bearing	[r_r]	0.009	mrad (0.03')

Shaft 'Shaft2' Bearing 'Support3'

Position (Y-coordinate)	[y]	118.00	mm
Bearing reaction force	[Fx]	2.513	kN
Bearing reaction force	[Fy]	0.000	kN
Bearing reaction force	[Fz]	0.435	kN
Bearing reaction force	[Fr]	2.551	kN (9.83°)
Displacement of bearing	[u_x]	0.000	µm
Displacement of bearing	[u_y]	0.024	µm
Displacement of bearing	[u_z]	0.000	µm
Displacement of bearing	[u_r]	0.000	µm
Misalignment of bearing	[r_x]	0.005	mrad (0.02')
Misalignment of bearing	[r_y]	-0.060	mrad (-0.21')
Misalignment of bearing	[r_z]	0.003	mrad (0.01')
Misalignment of bearing	[r_r]	0.006	mrad (0.02')

Rolling bearing 'ConnectionRollerBearing1'

Position (Y-coordinate)	[y]	38.50	mm
Dynamic equivalent load	[P]	0.00	kN
Equivalent load	[P_0]	0.00	kN
Life modification factor for reliability	[a_1]	0.248	
Nominal bearing service life	[L_{nh}]	248331.67	h
Operating viscosity	[v]	0.00	mm²/s
Static safety factor	[S_0]	9999.99	
Bearing reaction force	[Fx]	0.000	kN
Bearing reaction force	[Fy]	0.000	kN
Bearing reaction force	[Fz]	0.000	kN
Bearing reaction force	[Fr]	0.000	kN
Oil level	[H]	0.000	mm
Rolling moment of friction	[M_{rr}]	0.000	Nm
Sliding moment of friction	[M_{sl}]	0.019	Nm
Moment of friction, seals	[M_{seal}]	0.000	Nm
Moment of friction for seals determined according to SKF main catalog 10000/1 EN:2013			
Moment of friction flow losses	[M_{drag}]	0.000	Nm
Torque of friction	[M_{loss}]	0.019	Nm
Power loss	[P_{loss}]	23.575	W
The moment of friction is calculated according to the details in SKF Catalog 2013.			
The calculation is always performed with a coefficient for additives in the lubricant µbl=0.15.			
Displacement of bearing	[u_x]	0.150	µm
Displacement of bearing	[u_y]	0.017	µm
Displacement of bearing	[u_z]	0.346	µm
Displacement of bearing	[u_r]	0.377	µm (66.57°)

Misalignment of bearing	[r_x]	0.008	mrad (0.03')
Misalignment of bearing	[r_y]	-0.000	mrad (0')
Misalignment of bearing	[r_z]	-0.002	mrad (-0.01')
Misalignment of bearing	[r_r]	0.008	mrad (0.03')

Rolling bearing 'ConnectionRollerBearing2'

Position (Y-coordinate)	[y]	129.50	mm
Dynamic equivalent load	[P]	0.00	kN
Equivalent load	[P_0]	0.00	kN
Life modification factor for reliability[a_1]		0.248	
Nominal bearing service life	[L_{nh}]	248331.67	h
Operating viscosity	[v]	0.00	mm²/s
Static safety factor	[S_0]	9999.99	
Bearing reaction force	[Fx]	0.000	kN
Bearing reaction force	[Fy]	0.000	kN
Bearing reaction force	[Fz]	0.000	kN
Bearing reaction force	[Fr]	0.000	kN
Oil level	[H]	0.000	mm
Rolling moment of friction	[M_{rr}]	0.000	Nm
Sliding moment of friction	[M_{sl}]	0.019	Nm
Moment of friction, seals	[M_{seal}]	0.000	Nm
Moment of friction for seals determined according to SKF main catalog 10000/1 EN:2013			
Moment of friction flow losses	[M_{drag}]	0.000	Nm
Torque of friction	[M_{loss}]	0.019	Nm
Power loss	[P_{loss}]	23.575	W
The moment of friction is calculated according to the details in SKF Catalog 2013.			
The calculation is always performed with a coefficient for additives in the lubricant µbl=0.15.			
Displacement of bearing	[u_x]	0.140	µm
Displacement of bearing	[u_y]	-0.024	µm
Displacement of bearing	[u_z]	0.102	µm
Displacement of bearing	[u_r]	0.173	µm (36.04°)
Misalignment of bearing	[r_x]	-0.005	mrad (-0.02')
Misalignment of bearing	[r_y]	0.060	mrad (0.21')
Misalignment of bearing	[r_z]	-0.004	mrad (-0.01')
Misalignment of bearing	[r_r]	0.006	mrad (0.02')

Rolling bearing 'ConnectionRollerBearing3'

Position (Y-coordinate)	[y]	80.00	mm
Dynamic equivalent load	[P]	0.00	kN
Equivalent load	[P_0]	0.00	kN
Life modification factor for reliability[a_1]		0.248	
Nominal bearing service life	[L_{nh}]	248331.67	h
Operating viscosity	[v]	0.00	mm²/s
Static safety factor	[S_0]	9999.99	
Bearing reaction force	[Fx]	0.000	kN
Bearing reaction force	[Fy]	0.000	kN
Bearing reaction force	[Fz]	0.000	kN
Bearing reaction force	[Fr]	0.000	kN
Displacement of bearing	[u_x]	0.397	µm
Displacement of bearing	[u_y]	0.029	µm
Displacement of bearing	[u_z]	0.818	µm
Displacement of bearing	[u_r]	0.909	µm (64.1°)
Misalignment of bearing	[r_x]	-0.001	mrad (0')
Misalignment of bearing	[r_y]	0.019	mrad (0.07')
Misalignment of bearing	[r_z]	-0.001	mrad (0')

Misalignment of bearing [r_r] 0.002 mrad (0.01')

Damage (%) [Lreq] (7200.000)

Bin no	B1	B2	B3
1	0.72	0.72	0.72
Σ	0.72	0.72	0.72

Utilization (%) [Lreq] (7200.000)

B1	B2	B3
34.57	34.57	30.72

Note: Utilization = (Lreq/Lh)^(1/k)
Ball bearing: k = 3, roller bearing: k = 10/3

B1: ConnectionRollerBearing1 (Connecting rolling bearing)
B2: ConnectionRollerBearing2 (Connecting rolling bearing)
B3: ConnectionRollerBearing3 (Connecting rolling bearing)

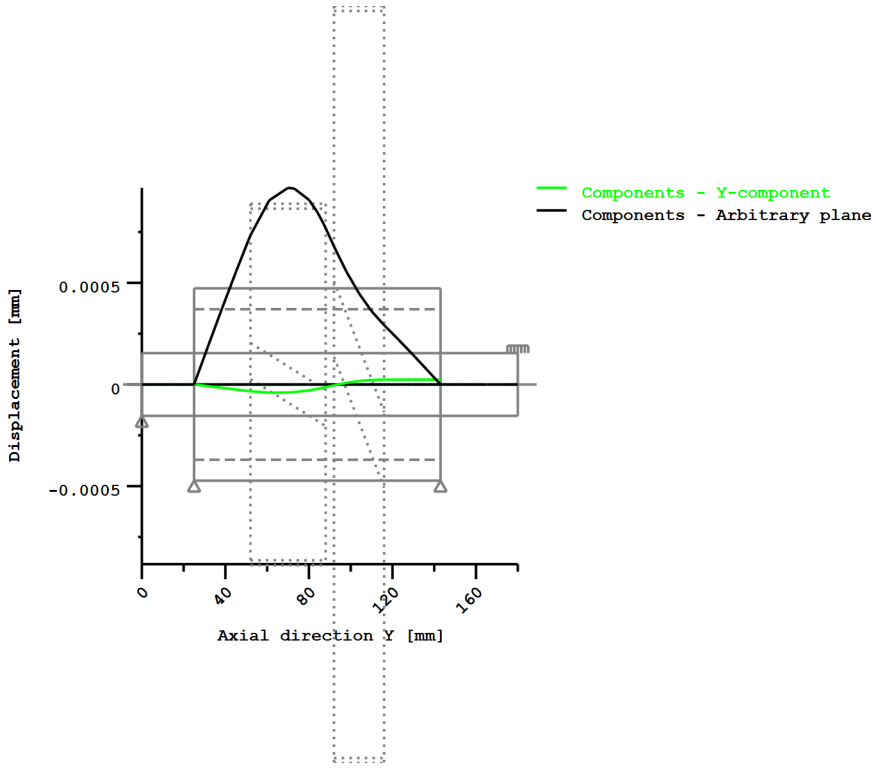
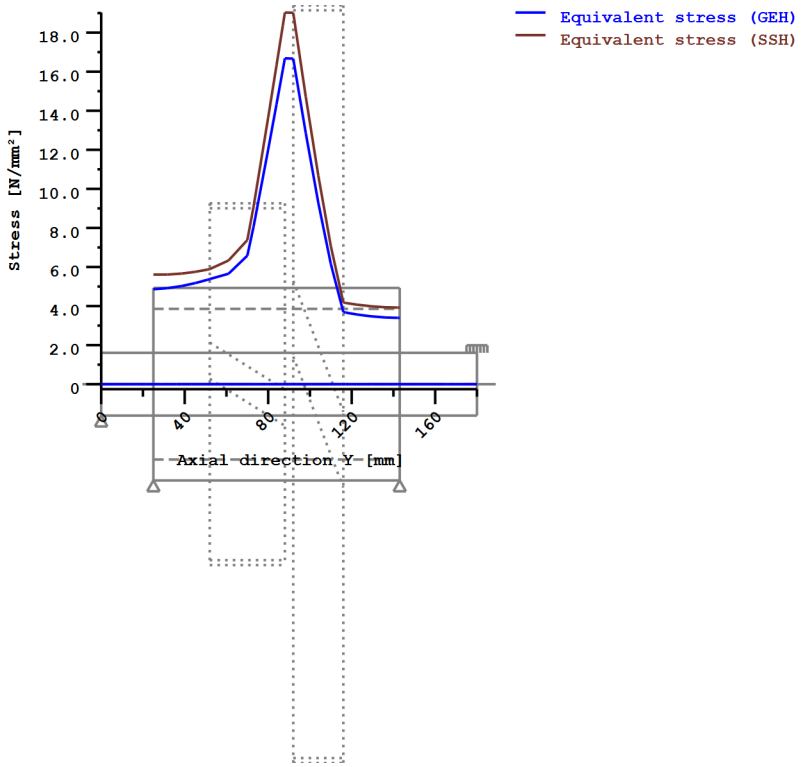


Figure: Deformation (bending etc.) (Arbitrary plane 245.9879804 121)



Nominal stresses, without taking into account stress concentrations
GEH(von Mises): sigV = ((sigB+sigZ,D)^2 + 3*(tauT+tauS)^2)^1/2
SSH(Tresca): sigV = ((sigB-sigZ,D)^2 + 4*(tauT+tauS)^2)^1/2

Figure: Equivalent stress

Eigenfrequencies/Critical speeds

1. Eigenfrequency:	0.00 Hz,	Critical speed:	0.00 1/min	Rigid body rotation Y 'Shaft1'
2. Eigenfrequency:	2774.65 Hz,	Critical speed:	166479.11 1/min	Bending YZ 'Shaft1', Bending XY 'Shaft1'
3. Eigenfrequency:	7123.94 Hz,	Critical speed:	427436.38 1/min	Axial 'Shaft1'
4. Eigenfrequency:	8216.39 Hz,	Critical speed:	492983.45 1/min	Bending XY 'Shaft1', Bending YZ 'Shaft1'
5. Eigenfrequency:	8836.16 Hz,	Critical speed:	530169.58 1/min	Torsion 'Shaft1'

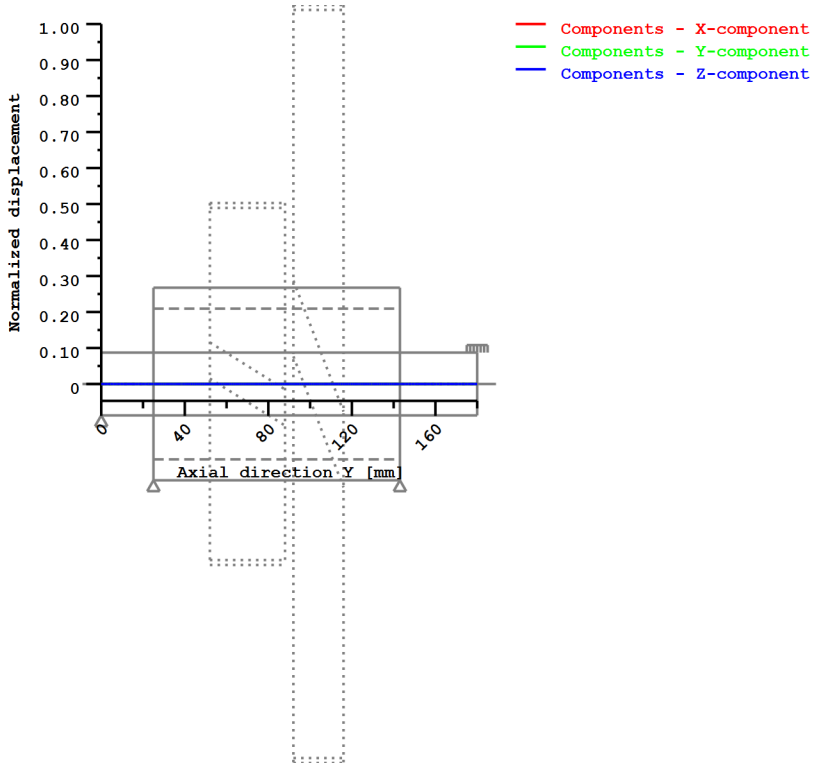


Figure: Eigenfrequencies (Normalized rotation) (Eigenfrequency: 1. (0 Hz))

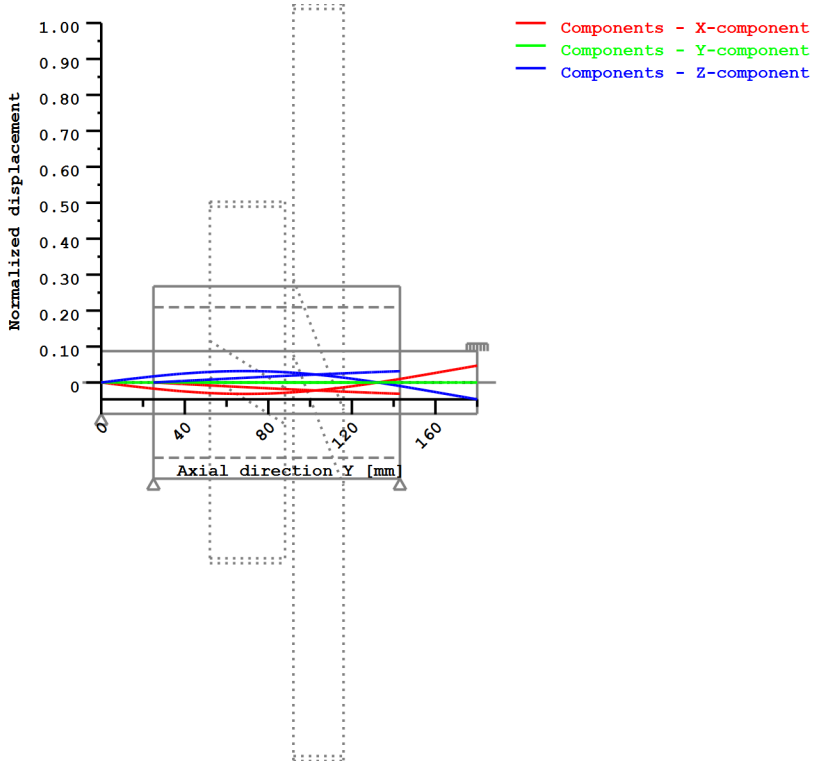


Figure: Eigenfrequencies (Normalized rotation) (Eigenfrequency: 2. (2774.65 Hz))

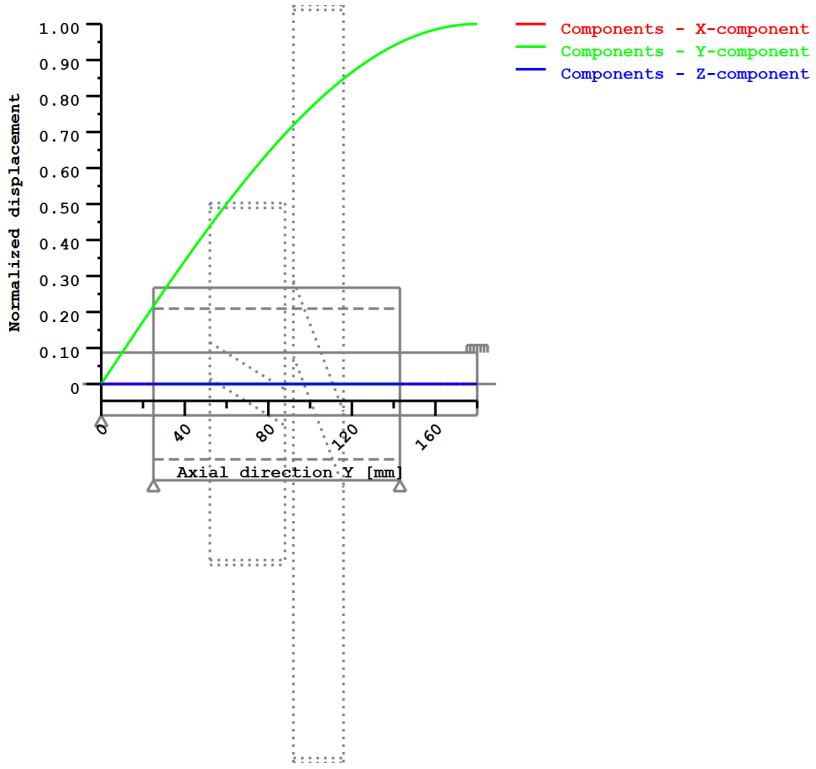


Figure: Eigenfrequencies (Normalized rotation) (Eigenfrequency: 3. (7123.94 Hz))

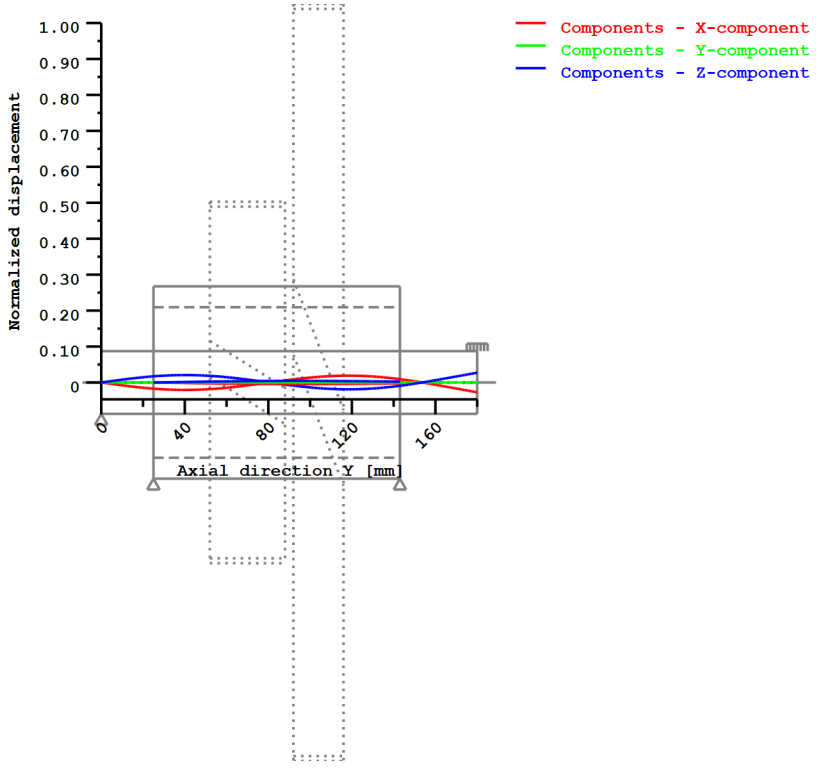


Figure: Eigenfrequencies (Normalized rotation) (Eigenfrequency: 4. (8216.39 Hz))

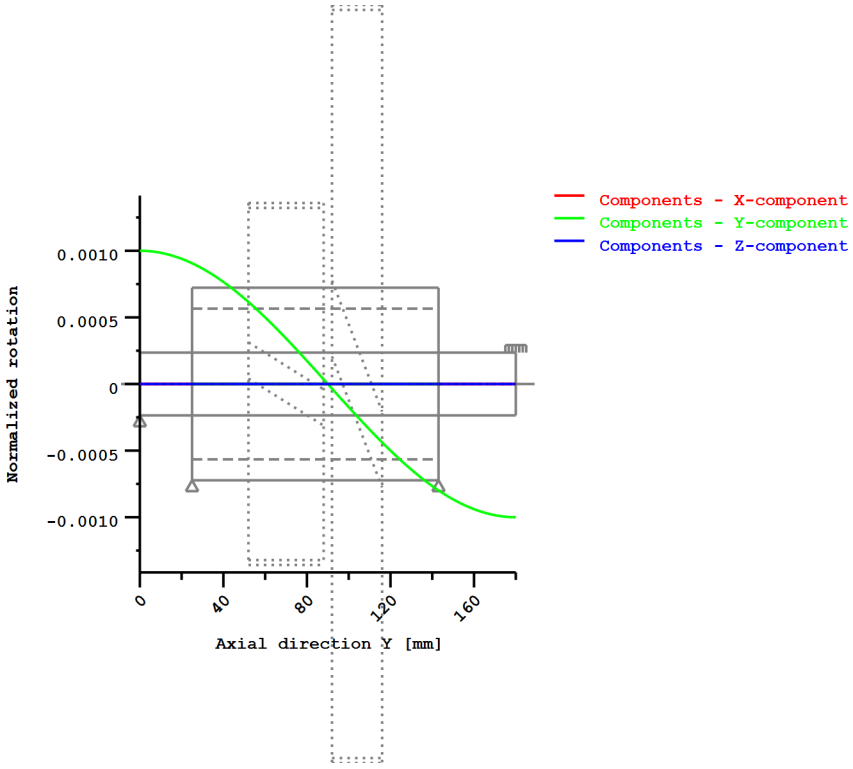


Figure: Eigenfrequencies (Normalized displacement) (Eigenfrequency: 5. (8836.16 Hz))

Buckling cases

1. Buckling case: S1=2495036.33

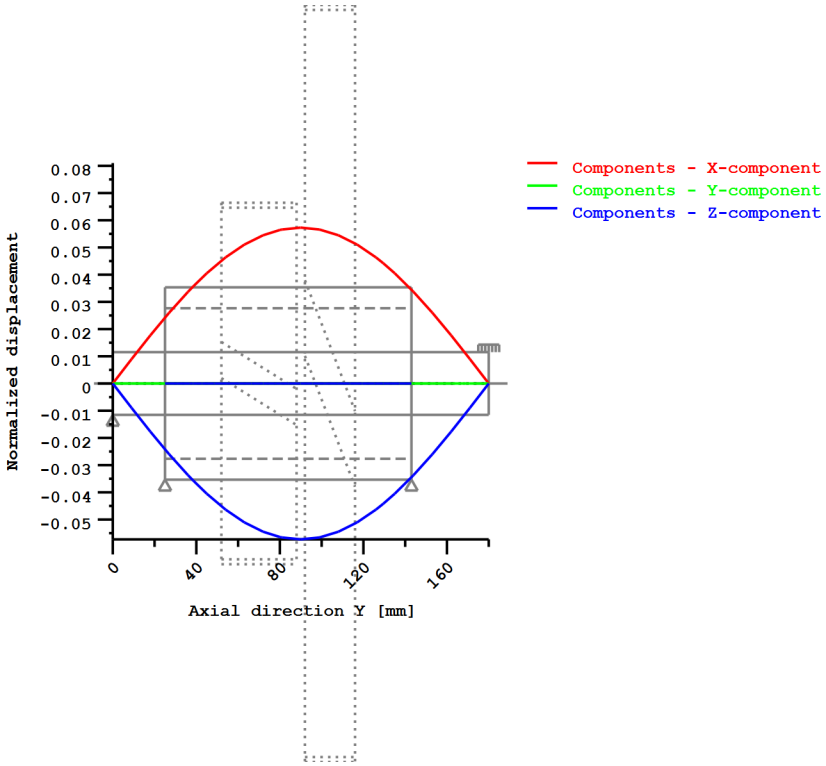


Figure: Buckling cases (Normalized rotation) (Buckling case: 1. (2495036.327))

Strength calculation according to DIN 743:2012

Summary

Shaft2

Material	34 CrAlNi 7-10
Material type	Nitriding steel
Material treatment	gas-nitrided
Surface treatment	No

Calculation of endurance limit and the static strength

Calculation for load case 2 (σav/σmv = const)

Cross section	Position (Y-Coord) (mm)	
A-A	13.50	Own Input
B-B	45.00	Own Input
C-C	55.00	Own Input
D-D	79.00	Own Input
E-E	104.50	Own Input

Results:

Cross section	Kfb	Kfσ	K2d	SD	SS
A-A	1.00	0.88	0.83	281.00	492.53
B-B	1.00	0.88	0.83	59.73	62.69
C-C	1.00	0.88	0.83	43.58	42.09
D-D	1.00	0.88	0.83	74.93	68.07
E-E	1.00	0.88	0.83	438.79	530.42
Required safeties:				1.40	1.40

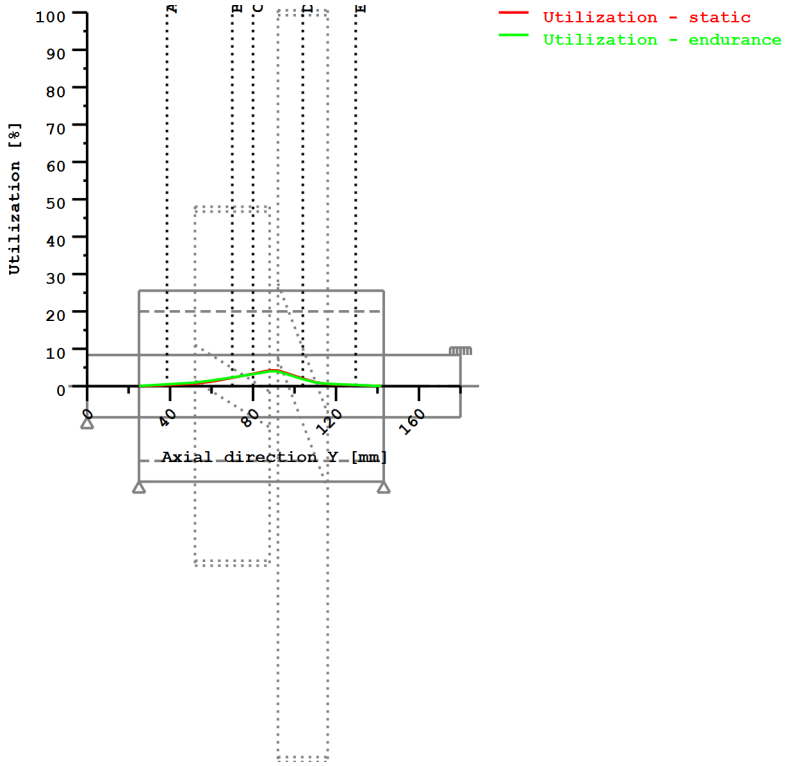
Abbreviations:
Kfb: Notch factor bending
Kfσ: Surface factor
K2d: size factor bending
SD: Safety endurance limit
SS: Safety against yield point

Utilization (%) [Smin/S]

Cross section	Static	Endurance
A-A	0.284	0.498
B-B	2.233	2.344
C-C	3.326	3.212
D-D	2.057	1.868
E-E	0.264	0.319

Maximum utilization of shafts (%)

	[A]
Shaft2:	3.326



Utilization = Smin/S (%)

Figure: Strength

Calculation details

General statements

Label	Shaft2		
Drawing			
Length (mm)		[l]	118.00
Speed (1/min)		[n]	11818.29
Material	34 CrAlNi 7-10		
Material type	Nitriding steel		
Material treatment	gas-nitrided		
Surface treatment	No		

	Tension/Compression	Bending	Torsion	Shearing
Load factor static calculation	1.700	1.700	1.700	1.700
Load factor endurance limit	1.000	1.000	1.000	1.000

Reference diameter material (mm)	[dB]	100.00
σB according to DIN 743 (at dB) (N/mm²)	[σB]	850.00
σS according to DIN 743 (at dB) (N/mm²)	[σS]	650.00
[σzdW] (bei dB) (N/mm²)		340.00
[σbW] (bei dB) (N/mm²)		425.00
[τtW] (bei dB) (N/mm²)		255.00
Thickness of raw material (mm)	[dWerkst]	95.00

Material data calculated according DIN743/3 with K1(d)
Material strength calculated from size of raw material
Geometric size factor K1d calculated from raw material diameter

[σBeff] (N/mm²)	850.00
[σSeff] (N/mm²)	650.00
[σbF] (N/mm²)	650.00
[τtF] (N/mm²)	375.28
[σBRand] (N/mm²)	0.00
[σzdW] (N/mm²)	340.00
[σbW] (N/mm²)	425.00
[τtW] (N/mm²)	255.00

Endurance limit for single stage use

Calculation for load case 2 (σ.av/σ.mv = const)

Cross section 'A-A' Own Input

Comment		
Position (Y-Coordinate) (mm)	[y]	13.500
External diameter (mm)	[da]	92.000
Inner diameter (mm)	[di]	72.000
Notch effect		Own Input
Mean roughness (µm)	[Rz]	8.000

Load: (N) (Nm)		Tension/Compression	Bending	Torsion	Shearing	
Mean value	[Fzdm, Mbm, Tm, Fqm]	-327.9	0.0	0.0	0.0	
Amplitude	[Fzda, Mba, Ta, Fqa]	327.9	49.2	0.0	3647.6	
Maximum value	[Fzdmax, Mbmax, Tmax, Fqmax]	-1114.7	83.7	0.0		6201.0
Cross section, moment of resistance: (mm²)						
[A, Wb, Wt, A]		2576.1	47770.0	95539.9	2576.1	

Stresses: (N/mm²)					
[σzdm, σbm, τm, τqm] (N/mm²)		-0.127	0.000	0.000	0.000
[σzda, σba, τa, τqa] (N/mm²)		0.127	1.031	0.000	2.804
[σzdmax,σbmax,τmax,τqmax] (N/mm²)		-0.433	1.752	0.000	4.767
Technological size influence	[K1(σB)]	1.000			
	[K1(σS)]	1.000			

		Tension/Compression	Bending	Torsion
Notch effect coefficient	[ß(dB)]	0.000	0.000	0.000
[dB] (mm) = 0.0				
Geometrical size influence	[K3(d)]	0.000	0.000	0.000
Geometrical size influence	[K3(dB)]	0.000	0.000	0.000
Notch effect coefficient	[ß]	1.000	1.000	1.000
Geometrical size influence	[K2(d)]	1.000	0.833	0.833
Influence coefficient surface roughness	[KF]	0.875	0.875	0.928
Surface stabilization factor	[KV]	1.000	1.000	1.000
Total influence coefficient	[K]	1.143	1.344	1.278

Present safety for endurance limit:

Equivalent mean stress (N/mm²)	[σmV]		-0.127	
Equivalent mean stress (N/mm²)	[τmV]		0.000	
Fatigue limit of part (N/mm²)	[σWK]	297.552	316.299	199.477
Influence coefficient of mean stress sensitivity.				
	[ψσK]	0.212	0.229	0.133
Permissible amplitude (N/mm²)	[σADK]	325.000	325.485	199.477
Safety against fatigue	[S]		281.003	
Required safety against fatigue	[Smin]		1.400	
Result (%)	[S/Smin]		20071.7	
Present safety				
for proof against exceed of yield point:				
Static notch sensitivity factor	[K2F]	1.000	1.000	1.000
Increase coefficient	[γF]	1.000	1.000	1.000
Yield stress of part (N/mm²)	[σFK]	650.000	650.000	375.278
Safety yield stress	[S]		492.528	
Required safety	[Smin]		1.400	
Result (%)	[S/Smin]		35180.5	

Cross section 'B-B' Own Input

Comment		
Position (Y-Coordinate) (mm)	[y]	45.000
External diameter (mm)	[da]	92.000
Inner diameter (mm)	[di]	72.000
Notch effect		Own Input
Mean roughness (µm)	[Rz]	8.000

		Tension/Compression	Bending	Torsion	Shearing	
Load: (N) (Nm)						
Mean value	[Fzdm, Mbm, Tm, Fqm]	147.1	0.0	152.8	0.0	
Amplitude	[Fzda, Mba, Ta, Fqa]	147.1	116.6	152.8	393.5	
Maximum value	[Fzdmax, Mbmax, Tmax, Fqmax]	500.1	198.1	519.4		669.0
Cross section, moment of resistance: (mm²)						
[A, Wb, Wt, A]		2576.1	47770.0	95539.9	2576.1	

Stresses: (N/mm²)					
[σzdm, σbm, τm, τqm] (N/mm²)		0.057	0.000	1.599	0.000
[σzda, σba, τa, τqa] (N/mm²)		0.057	2.440	1.599	0.303
[σzdmax,σbmax,τmax,τqmax] (N/mm²)		0.194	4.148	5.436	0.514
Technological size influence	[K1(σB)]	1.000			
	[K1(σS)]	1.000			

		Tension/Compression	Bending	Torsion
Notch effect coefficient	[ß(dB)]	0.000	0.000	0.000
[dB] (mm) = 0.0				
Geometrical size influence	[K3(d)]	0.000	0.000	0.000
Geometrical size influence	[K3(dB)]	0.000	0.000	0.000
Notch effect coefficient	[ß]	1.000	1.000	1.000

Geometrical size influence	[K2(d)]	1.000	0.833	0.833
Influence coefficient surface roughness	[KF]	0.875	0.875	0.928
Surface stabilization factor	[KV]	1.000	1.000	1.000
Total influence coefficient	[K]	1.143	1.344	1.278
Present safety for endurance limit:				
Equivalent mean stress (N/mm²)	[σmV]		2.770	
Equivalent mean stress (N/mm²)	[τmV]		1.599	
Fatigue limit of part (N/mm²)	[σWK]	297.552	316.299	199.477
Influence coefficient of mean stress sensitivity.				
	[ψσK]	0.212	0.229	0.133
Permissible amplitude (N/mm²)	[σADK]	13.127	251.126	176.066
Safety against fatigue	[S]		59.729	
Required safety against fatigue	[Smin]		1.400	
Result (%)	[S/Smin]		4266.3	
Present safety				
for proof against exceed of yield point:				
Static notch sensitivity factor	[K2F]	1.000	1.000	1.000
Increase coefficient	[γF]	1.000	1.000	1.000
Yield stress of part (N/mm²)	[σFK]	650.000	650.000	375.278
Safety yield stress	[S]		62.686	
Required safety	[Smin]		1.400	
Result (%)	[S/Smin]		4477.6	

Cross section 'C-C' Own Input

Comment		
Position (Y-Coordinate) (mm)	[y]	55.000
External diameter (mm)	[da]	92.000
Inner diameter (mm)	[di]	72.000
Notch effect		Own Input
Mean roughness (µm)	[Rz]	8.000

		Tension/Compression	Bending	Torsion	Shearing	
Load: (N) (Nm)						
Mean value	[Fzdm, Mbm, Tm, Fqm]	410.9	0.0	237.6	0.0	
Amplitude	[Fzda, Mba, Ta, Fqa]	410.9	122.2	237.6	2291.5	
Maximum value	[Fzdmax, Mbmax, Tmax, Fqmax]	1397.2	207.8	808.0		3895.6
Cross section, moment of resistance: (mm²)						
[A, Wb, Wt, A]		2576.1	47770.0	95539.9	2576.1	

Stresses: (N/mm²)					
[σzdm, σbm, τm, τqm] (N/mm²)	0.160	0.000	2.487	0.000	
[σzda, σba, τa, τqa] (N/mm²)	0.160	2.558	2.487	1.762	
[σzdmax,σbmax,τmax,τqmax] (N/mm²)	0.542	4.349	8.457	2.995	

Technological size influence	[K1(σB)]	1.000	
	[K1(σS)]	1.000	

	Tension/Compression	Bending	Torsion

Notch effect coefficient	[ß(dB)]	0.000	0.000	0.000
[dB] (mm) = 0.0				
Geometrical size influence	[K3(d)]	0.000	0.000	0.000
Geometrical size influence	[K3(dB)]	0.000	0.000	0.000
Notch effect coefficient	[ß]	1.000	1.000	1.000
Geometrical size influence	[K2(d)]	1.000	0.833	0.833
Influence coefficient surface roughness	[KF]	0.875	0.875	0.928
Surface stabilization factor	[KV]	1.000	1.000	1.000
Total influence coefficient	[K]	1.143	1.344	1.278

Present safety for endurance limit:				
Equivalent mean stress (N/mm²)	[σmV]		4.311	
Equivalent mean stress (N/mm²)	[τmV]		2.489	
Fatigue limit of part (N/mm²)	[σWK]	297.552	316.299	199.477
Influence coefficient of mean stress sensitivity.				
	[ψσK]	0.212	0.229	0.133
Permissible amplitude (N/mm²)	[σADK]	23.193	228.340	176.056
Safety against fatigue	[S]		43.580	
Required safety against fatigue	[Smin]		1.400	
Result (%)	[S/Smin]		3112.9	

Present safety				
for proof against exceed of yield point:				
Static notch sensitivity factor	[K2F]	1.000	1.000	1.000
Increase coefficient	[γF]	1.000	1.000	1.000
Yield stress of part (N/mm²)	[σFK]	650.000	650.000	375.278
Safety yield stress	[S]		42.091	
Required safety	[Smin]		1.400	
Result (%)	[S/Smin]		3006.5	

Cross section 'D-D' Own Input

Comment		
Position (Y-Coordinate) (mm)	[y]	79.000
External diameter (mm)	[da]	92.000
Inner diameter (mm)	[di]	72.000
Notch effect		Own Input
Mean roughness (µm)	[Rz]	8.000

		Tension/Compression	Bending	Torsion	Shearing	
Load: (N) (Nm)						
Mean value	[Fzdm, Mbm, Tm, Fqm]	311.0	0.0	152.8	0.0	
Amplitude	[Fzda, Mba, Ta, Fqa]	311.0	33.0	152.8	2782.7	
Maximum value	[Fzdmax, Mbmax, Tmax, Fqmax]	1057.4	56.2	519.4		4730.7
Cross section, moment of resistance: (mm²)						
[A, Wb, Wt, A]		2576.1	47770.0	95539.9	2576.1	

Stresses: (N/mm²)				
[σzdm, σbm, τm, τqm] (N/mm²)	0.121	0.000	1.599	0.000
[σzda, σba, τa, τqa] (N/mm²)	0.121	0.691	1.599	2.139
[σzdmax,σbmax,τmax,τqmax] (N/mm²)	0.410	1.175	5.436	3.637

Technological size influence	[K1(σB)]	1.000	
	[K1(σS)]	1.000	

		Tension/Compression	Bending	Torsion
Notch effect coefficient	[ß(dB)]	0.000	0.000	0.000
[dB] (mm) = 0.0				
Geometrical size influence	[K3(d)]	0.000	0.000	0.000
Geometrical size influence	[K3(dB)]	0.000	0.000	0.000
Notch effect coefficient	[ß]	1.000	1.000	1.000
Geometrical size influence	[K2(d)]	1.000	0.833	0.833
Influence coefficient surface roughness	[KF]	0.875	0.875	0.928
Surface stabilization factor	[KV]	1.000	1.000	1.000
Total influence coefficient	[K]	1.143	1.344	1.278
Present safety for endurance limit:				
Equivalent mean stress (N/mm²)	[σmV]		2.772	
Equivalent mean stress (N/mm²)	[τmV]		1.600	
Fatigue limit of part (N/mm²)	[σWK]	297.552	316.299	199.477
Influence coefficient of mean stress sensitivity.				
	[ψσK]	0.212	0.229	0.133
Permissible amplitude (N/mm²)	[σADK]	27.126	129.765	176.051
Safety against fatigue	[S]		74.928	
Required safety against fatigue	[Smin]		1.400	
Result (%)	[S/Smin]		5352.0	
Present safety				
for proof against exceed of yield point:				
Static notch sensitivity factor	[K2F]	1.000	1.000	1.000
Increase coefficient	[γF]	1.000	1.000	1.000
Yield stress of part (N/mm²)	[σFK]	650.000	650.000	375.278
Safety yield stress	[S]		68.071	
Required safety	[Smin]		1.400	
Result (%)	[S/Smin]		4862.2	

Cross section 'E-E' Own Input

Comment		
Position (Y-Coordinate) (mm)	[y]	104.500
External diameter (mm)	[da]	92.000
Inner diameter (mm)	[di]	72.000
Notch effect		Own Input
Mean roughness (µm)	[Rz]	8.000

		Tension/Compression	Bending	Torsion	Shearing
Load: (N) (Nm)					
Mean value	[Fzdm, Mbm, Tm, Fqm]	0.0	0.0	0.0	0.0
Amplitude	[Fzda, Mba, Ta, Fqa]	0.0	34.4	0.0	2550.7
Maximum value	[Fzdmax, Mbmax, Tmax, Fqmax]	0.0	58.5	0.0	4336.2
Cross section, moment of resistance: (mm²)					
[A, Wb, Wt, A]		2576.1	47770.0	95539.9	2576.1

Stresses: (N/mm²)					
[σzdm, σbm, τm, τqm] (N/mm²)		0.000	0.000	0.000	0.000
[σzda, σba, τa, τqa] (N/mm²)		0.000	0.721	0.000	1.961
[σzdmax,σbmax,τmax,τqmax] (N/mm²)		0.000	1.225	0.000	3.334
Technological size influence	[K1(σB)]	1.000			
	[K1(σS)]	1.000			

		Tension/Compression	Bending	Torsion
Notch effect coefficient	[ß(dB)]	0.000	0.000	0.000
[dB] (mm) = 0.0				
Geometrical size influence	[K3(d)]	0.000	0.000	0.000
Geometrical size influence	[K3(dB)]	0.000	0.000	0.000
Notch effect coefficient	[ß]	1.000	1.000	1.000
Geometrical size influence	[K2(d)]	1.000	0.833	0.833
Influence coefficient surface roughness	[KF]	0.875	0.875	0.928
Surface stabilization factor	[KV]	1.000	1.000	1.000
Total influence coefficient	[K]	1.143	1.344	1.278
Present safety for endurance limit:				
Equivalent mean stress (N/mm²)	[σmV]		0.000	
Equivalent mean stress (N/mm²)	[τmV]		0.000	
Fatigue limit of part (N/mm²)	[σWK]	297.552	316.299	199.477
Influence coefficient of mean stress sensitivity.				
	[ψσK]	0.212	0.229	0.133
Permissible amplitude (N/mm²)	[σADK]	297.552	316.299	199.477
Safety against fatigue	[S]		438.788	
Required safety against fatigue	[Smin]		1.400	
Result (%)	[S/Smin]		31342.0	
Present safety for proof against exceed of yield point:				
Static notch sensitivity factor	[K2F]	1.000	1.000	1.000
Increase coefficient	[γF]	1.000	1.000	1.000
Yield stress of part (N/mm²)	[σFK]	650.000	650.000	375.278
Safety yield stress	[S]		530.421	
Required safety	[Smin]		1.400	
Result (%)	[S/Smin]		37887.2	

Remarks:
- The shearing force is not considered in the analysis specified in DIN 743.
- Cross section with interference fit:
  The notching factor for the light fit case is no longer defined in DIN 743.
  The values are imported from the FKM-Guideline..

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