ČESKÉ VYSOKÉ UČENÍ TECHNICKÉ V PRAZE

FAKULTA STROJNÍ

Ústav konstruování a částí strojů

Příloha 3

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File

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Changed by: Adam am: 18.12.2016 um: 23:12:07

Important hint: At least one warning has occurred during the calculation:
1-> The working pressure is smaller than the pressure after mounting (19.5270 N/mm2< 20.0908 N/mm2).
Please check the calculation also with speed zero and ambient temperature.

Cylindrical interference fit [M01a]

Calculation method: According DIN 7190:2001 (elastic range)
with additions (Centrifugal force, Micro sliding, Assembly, etc.)
for shrunken or pressed fits

Diameter shaft (mm)	[DiA]/[DiI]	80.00/ 0.00
Diameter hub (mm)	[DaA]/[DaI]	98.52/ 80.00

Entered outer-diameter of hub and the corresponding lengths in mm:

Part	A:	D =	105.000	l =	17.000
Part	B:	D =	95.000	l =	27.000

Equivalent outer-diameter (mm)	[DaA]	98.52		
Length of Interference fit (mm)	[l]	44.00		
Diameter of joint (mm)	[DF]	80.00		
Tolerance Shaft		s6		
Upper allowance Shaft (µm)	[AoI]	78.0		
Lower allowance Shaft (µm)	[AuI]	59.0		
Tolerance measure Shaft (µm)	[TI]	19.0		
Tolerance hub		H7		
Upper allowance Hub (µm)	[AoA]	30.0		
Lower allowance Hub (µm)	[AuA]	0.0		
Tolerance measure Hub (µm)	[TA]	30.0		
Largest interference (µm)	[Po]	78.0		
Smallest interference (µm)	[Pu]	29.0		
Nominal torque (Nm)	[T]	1.10		
Application factor	[KA]	1.00		
Service torque (Nm)	[Tb]	1.10		
Axial force (N)	[FA]	0.00		
Bending moment (Nm)	[Mb]	0.00		
Radial force (N)	[Fr]	0.00		
Circumferential force (N)	[Fu]	27.50		
Speed (1/min)	[n]	4389.00		
Interference (µm)	[P]	53.5 (	29.0..	78.0)
Embedding (µm)	[s]	7.68		
Effective interference at 20°C(68°F) (µm)	[Pw]	45.82 (	21.3..	70.3)
Effective interference at working temp.. (µm)	[PwTh]	45.82 (	21.3..	70.3)

Service temperature shaft (°C)		[ThB]	20
Service temperature hub (°C)		[ThB]	20
Pressure stress by			
- Interference (after mounting) (N/mm²)		[pM]	20.09 (9.35.. 30.83)
- Interference (working) (N/mm²)		[p]	19.53 (8.78.. 30.27)
- Bending moment (N/mm²)		[pb]	0.00
- Radial force (N/mm²)		[pr]	0.00
Coefficient of friction, axial		[mya]	0.120
Coefficient of friction, circumferential		[myu]	0.100
Safety against sliding		[Sr]	785.23 (353.24.. 1217.21)
Required safety against sliding		[SSr]	1.20

Equivalent stress according to von Mises

Shaft

Material			42 CrMo 4 (1)
Young's modulus (N/mm²)		[El]	206000.00
Poisson's ratio (-)		[nyl]	0.30
Density (kg/m³)		[rho]	7830.00
Coefficient of thermal expansion	(10^-6/K)	[alpha]	11.50
Tensile strength (N/mm²)		[Rm]	900.00 (d= 40- 100mm)
Yield point (N/mm²)		[Rp]	650.00 (d= 40- 100mm)

Surface class of roughness		N6 Rz=4.8 (Grinding)	
Surface roughness (µm)		[Rz]	4.80
External diameter (mm)		[DiA]	80.00
Diameter increase (µm)		[deltaD]	-5.13 (-2.21.. -8.05)
Diameter increase (o/oo)		[deltaD]	-0.06 (-0.03.. -0.10)
Equivalent stress outsideø (N/mm²)		[sigVa]	19.30 (8.56.. 30.04)
- Radial stress (N/mm²)		[sigRa]	-19.53 (-8.78.. -30.27)
- Tangential stress (N/mm²)		[sigTa]	-19.06 (-8.32.. -29.81)
- With outside load (N/mm²)		[sigVaMF]	19.30 (8.56.. 30.04)
Inner diameter (mm)		[Dil]	0.00
Equivalent stress insideø (N/mm²)		[sigVi]	18.44 (7.69.. 29.18)
- Radial stress (N/mm²)		[sigRi]	-18.44 (-7.69.. -29.18)
- Tangential stress (N/mm²)		[sigTi]	-18.44 (-7.69.. -29.18)

Safety against fracture		[SiRm]	46.63 (105.11.. 29.96)
Required safety against fracture		[SSi.Rm]	1.50
Safety against yield point		[Si.Rp]	33.68 (75.91.. 21.64)
Required safety against yield point		[SSi.Rp]	1.00

Hub

Material			42 CrMo 4 (1)
Young's modulus (N/mm²)		[EA]	206000.00

Poisson's ratio (-)		[nyA]	0.30
Density (kg/m³)		[rho]	7830.00
Coefficient of thermal expansion	(10^-6/K)	[alpha]	11.50
Tensile strength (N/mm²)		[Rm]	1100.00 (d= 0- 16mm)
Yield point (N/mm²)		[Rp]	900.00 (d= 0- 16mm)

Surface class of roughness		N6 Rz=4.8 (Grinding)	
Surface roughness (µm)		[Rz]	4.80
Equivalent outer-diameter (mm)		[DaA]	98.52
Diameter increase (µm)		[deltaD]	37.54 (17.65.. 57.44)
Diameter increase (o/oo)		[deltaD]	0.38 (0.18.. 0.58)
Equivalent stress outsideø (N/mm²)		[sigVa]	78.51 (36.90.. 120.11)
- Radial stress (N/mm²)		[sigRa]	-0.00 (-0.00.. -0.00)
- Tangential stress (N/mm²)		[sigTa]	78.51 (36.90.. 120.11)
Inner diameter (mm)		[DaI]	80.00
Diameter increase (µm)		[deltaD]	40.69 (19.11.. 62.27)
Diameter increase (o/oo)		[deltaD]	0.51 (0.24.. 0.78)
Equivalent stress insideø (N/mm²)		[sigVi]	109.99 (51.53.. 168.45)
- Radial stress (N/mm²)		[sigRi]	-19.53 (-8.78.. -30.27)
- Tangential stress (N/mm²)		[sigTi]	98.92 (46.58.. 151.27)
- With outside load (N/mm²)		[sigViMF]	109.99 (51.53.. 168.45)

Safety against fracture		[Si.Rm]	10.00 (21.34.. 6.53)
Required safety against fracture		[SSi.Rm]	1.50

Safety against yield point		[Si.Re]	8.18 (17.46.. 5.34)
Required safety against yield point		[SSi.Re]	1.00

Mere elastic stress, no verification of elastic plastic interference fit according to DIN 7190.

Service / Mounting / Remounting

Transverse-interference-fit:

Mounting clearance (mm)		[PsTh]	0.100

Temperature difference for mounting:

Shaft temperature: (°C)	Hub temperature: [ThA] (°C)
20	213
-150	88

(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]	34.66 (16.13.. 53.19)
Coefficient. of friction (Longitudinal)		[myll=mya*1.6]	0.19
Press out (force) (kN)		[Fpress]	42.66 (19.85.. 65.47)

Coefficient. of friction		[my]	0.19

Max. torque to avoid Micro sliding (Nm) [Tlimit] 311.05 (139.93.. 482.17)

Notice concerning the display: Number-1 (Number-2.. Number-3):
Number-1: Value calculated with the mean allowance
Number-2: Value of the smallest possible allowance
Number-3: Value of the largest possible allowance

Notice: All strains and stresses are calculated for the purely elastic case.

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