F E D 4

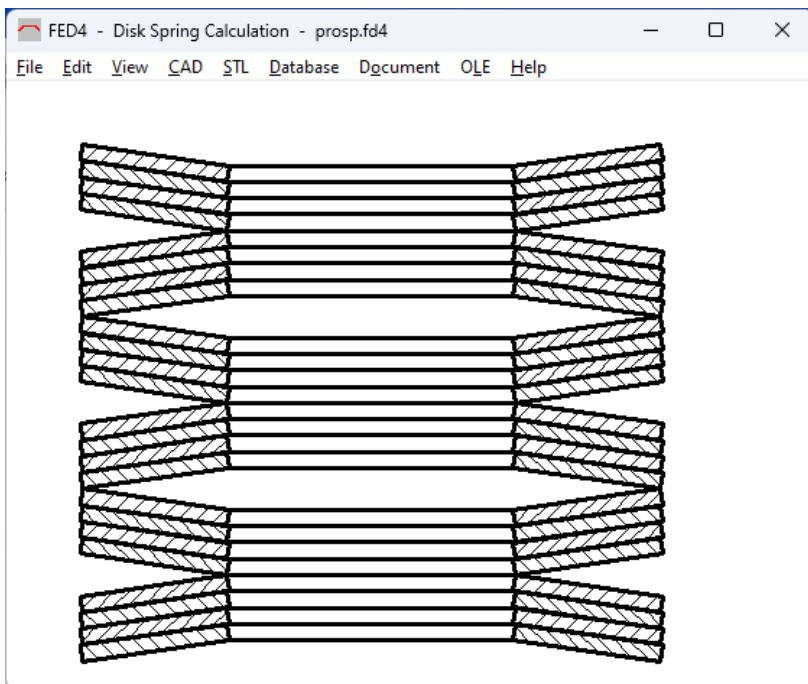## Software for Calculation of Disk Springs

for Windows

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Calculation Basis
The FED4 software calculates cup springs and cup spring packages in accordance with DIN 2092. Two calculation methods are supported:

~ Dimensioning: A disk spring package is calculated after input of load and stroke as close as possible to the required starting data
~ Re-calculation: By entering the dimensions, number of springs per package and number of spring packages the software calculates the loads and stresses for the defined spring heights.

Disk Springs in accordance with DIN 2093
The program provides the dimensions and characteristic values for all disk springs in accordance with DIN 2093.
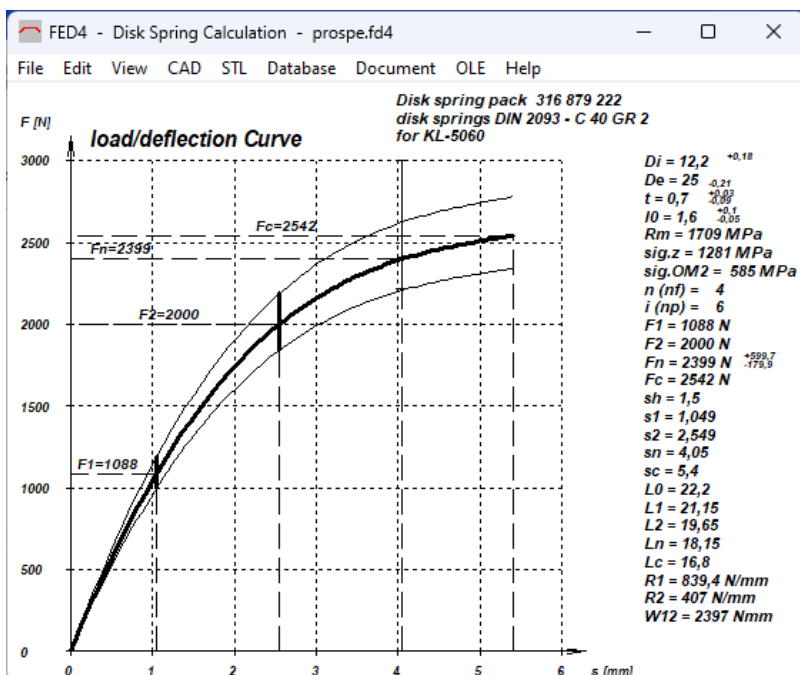
Friction
If you enter friction coefficients, FED4 calculates hysteresis and adds friction limit curve in load-deflection diagram.
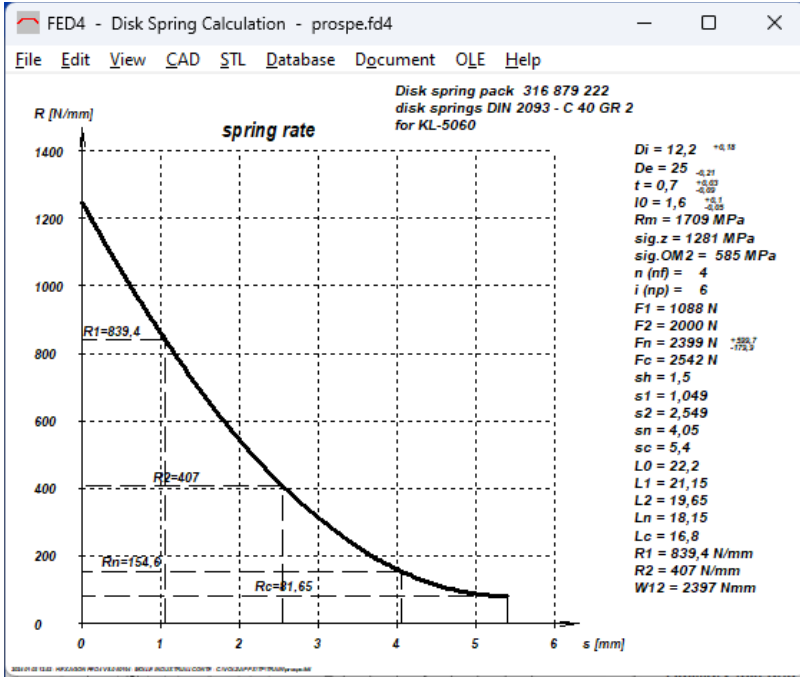
Material Data
The data for all materials in accordance with DIN 2093 are included in the program. In addition, you can define further materials by entering elasticity modulus, Poisson's ratio, density and tensile strength. Or you can use the integrated material database with flat spring steel materials.

Diagrams
The load-deflection diagram can be displayed on screen showing the degressive spring characteristic line of the disk spring. The spring rate diagram shows the decreasing spring rate as function of the deflection. The stress diagram shows the stress curve through the critical points on the disk spring. The Goodman diagram provides important information about tensile strength and life expectancy with dynamic load. All diagrams can be printed out or used in your documentation via DXF files or the clipboard in Windows.

FED4 - Disk Spring Calculation - prospe.fd4

Disk spring pack 316 879 222
disk springs DIN 2093 - C 40 GR 2
for KL-5060

spring rate

R [N/mm]

Di = 12,2 +0,18
De = 25 -0,21
t = 0,7 +0,03/-0,09
l0 = 1,6 +0,1/-0,05
Rm = 1709 MPa
sig.z = 1281 MPa
sig.OM2 = 585 MPa
n (nf) = 4
i (np) = 6
F1 = 1088 N
F2 = 2000 N
Fn = 2399 N
Fc = 2542 N
sh = 1,5
s1 = 1,049
s2 = 2,549
sn = 4,05
sc = 5,4
L0 = 22,2
L1 = 21,15
L2 = 19,65
Ln = 18,15
Lc = 16,8
R1 = 839,4 N/mm
R2 = 407 N/mm
W12 = 2397 Nmm

R1=839,4
R2=407
Rn=154,6
Rc=81,65

FED4 - Disk Spring Calculation - t1.fd4

Tellerfeder 123456789 disk spring

Di = 8,2
De = 16
t = 1
l0 = 1,5
Ft = 1907 N
h0 = 0,5
m = 1,171 g
n (nf) = 2
i (np) = 2
W12 = 437,8 Nmm
WOn = 1511 Nmm
WOc = 2600 Nmm
sh = 0,2 mm

messages
Warning: Sig.OMc > Rm !

L [mm]	F [N]	Sig.II	Sig.III	Sig.OM	s [mm]	R [N/mm]
L0: 5,00						R0: 6118
L1: 4,70	F1 :1687	621	753	701	s1: 0,30	R1: 5182
L2: 4,50	F2 :2677	1108	1207	1169	s2: 0,50	R2: 4742
Ln: 4,25	Fn :3814	1662	1722	1753	sn: 0,75	Rn: 4398
Lc: 4,00	Fc :4895	2216	2178	2337	sc: 1,00	Rc: 4283

l [mm]	Fl [N]	Sig.II	Sig.III	Sig.OM	sl [mm]	Rl [N/mm]
Ll0: 1,50						Rl0: 6118
Ll1: 1,35	Fl1:843,4	621	753	701	sl1: 0,15	Rl1: 5182
Ll2: 1,25	Fl2:1338	1108	1207	1169	sl2: 0,25	Rl2: 4742
Lln: 1,13	Fln:1907	1662	1722	1753	sln: 0,38	Rln: 4398
Llc: 1,00	Flc:2447	2216	2178	2337	slc: 0,50	Rlc: 4283

L0 = 5mm   L2 = 4,5mm

F [N] load/deflection Curve

Goodman chart

sig.OM= 1169 MPa
sig.I= -2217 MPa
sig.II= 1108 MPa
sig.III= 1207 MPa
sig.IV= -497 MPa

E = 195000 MPa
rho = 7,90 kg/dm3
Rm = 2066 MPa
sig.z = 1446 MPa
sig.oz = 1225 MPa

T = 20 °C
E20 = 195000 MPa

t = 1 mm

N = 1,6 mio.cycles
Nt= 455 h (f=1/s)

Fatigue strength chart (Goodman Diagram)
EN 10151-1.4310 +C19 (AISI 301) not shot-blasted

FED4 - Disk Spring Calculation - prospe.fd4

SINGLE DISK SPRING			
Inside diameter	Di	mm	12,2 +0,18
Outside diameter	De	mm	25 -0,21
Thickness	t	mm	0,7 +0,03/-0,09
length	l0	mm	1,6 +0,1/-0,05
weight	m	g	2,055
Usable deflection sn=0.75*h0	sin	mm	0,675
Max. deflection h0=sc	sic	mm	0,9
Spring load at sn=0.75*sc	Fin	N	599,7+150/-45,0
No. of springs per package	n		4
No. of spring packages	i		6

Length mm		deflection mm		Load N		Sigma III MPa	Sigma OM MPa
L0 = 22,20							
L1 = 21,15		s1 = 1,05		F1 = 1087,58		sigma1 = 395	sigma1 = 241
		sh = 1,50		Fh = 912,29		sigmah = 481	sigmah = 344
L2 = 19,65		s2 = 2,55		F2 = 1999,87		sigma2 = 876	sigma2 = 585
Ln = 18,15		sn = 4,05		Fn = 2398,79		sigman = 1259	sigman = 929
Lc = 16,80		sc = 5,40		Fc = 2541,85		sigmac = 1519	sigmac = 1238

Responsible dept.	Technical reference	Created by	Approved by

Document type		Document status	

Title, Supplementary title
Disk spring pack

316 879 222

Rev. | Date of issue | Lang. | Page
2024-01-03 | en

Tolerances
You can either enter tolerances, or let FED4 calculate it according to DIN 2093.

On-Line Input
On-line input provides the advantage of having the most important entries and results together on the screen with possible warnings and error messages. After each entry, a new calculation is carried out in a split second and you can see how changing the input values effects the results.

Goodman Diagram
You can see in the fatigue strength diagram whether or not the permissable varaiation of stress has been adhered to for dynamically stressed springs. The curves for fatigue strength safety (>10 million) as well as for 1 million and 100,000 load cycles are shown.

Spring Energy
Spring energy as function of deflection is drawn as Diagram.
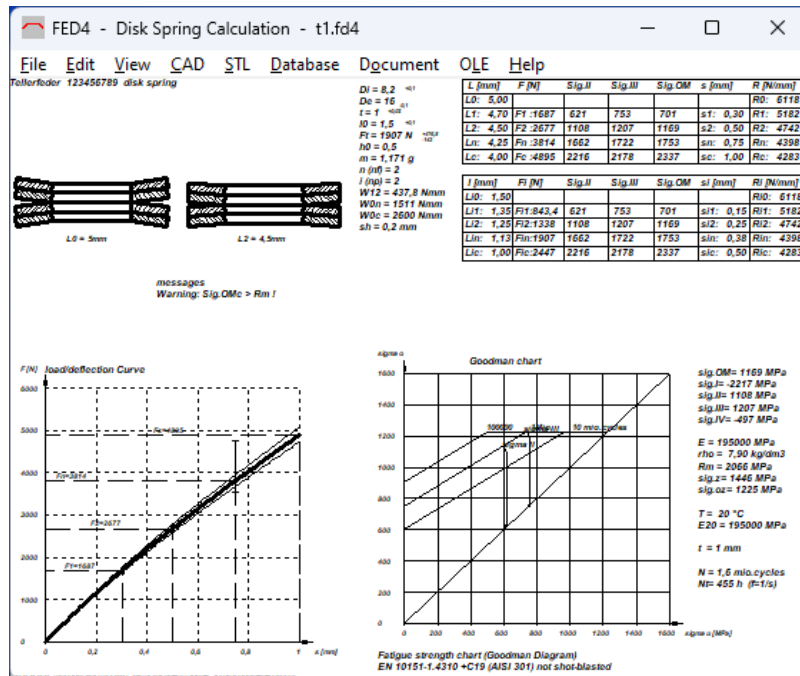
Quick View
In Quick View, drawings, diagrams and tables with the most important spring data are shown or printed on one screen page.

Production Drawing
FED4 generates a production drawing of the disk spring completely with ISO 7200 drawing header.

Printout
Text printout with all input data and results can also be saved as text file, exported to Excel, or saved as HTML file.

HEXAGON Help System
Auxiliary text and images are available for all dialogue windows. If error messages occur, you can get description and remedy suggestion.

Interfaces
All drawings and diagrams can be saved as DXF or IGES file to be loaded with CAD programs. The OLE interface lets you import/export data from/to Excel.

System Requirements
FED4 is available as 32-bit app or as 64-bit app for Windows 11, Windows 10, Windows 7.

Scope of Delivery
FED4 program with database files, example applications and help images, user manual (pdf), perpetual license.

Software Maintenance
HEXAGON Software is continuously improved and updated. Registered users will be informed about news, and can get new versions at a reasonable update price.

Guarantee
HEXAGON gives a 24 month guarantee on full functionality of the software.