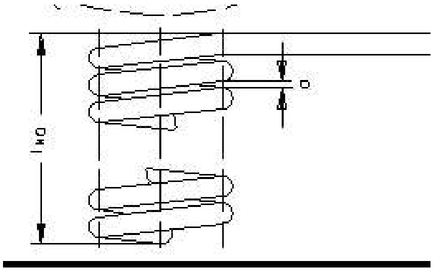
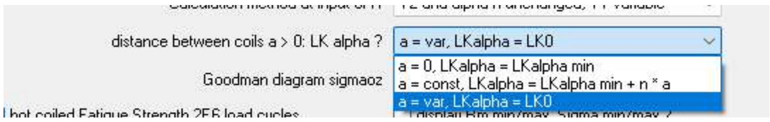
by Fritz Ruoss

FED3+: Distance between coils a for constant torsion spring width





If you enter a coil spacing a, this can either be constant and the spring width LKalpha changes when the spring is compressed. Or the coil spacing “a” decreases if torsion in coil direction. It is important to ensure that the distance between coils is large enough to accommodate the widening of the spring under load. In this setting "a=var, Lkalpha = LK0", the coil spacing a1, a2, an for spring positions 1, 2 and usable spring angle “n” are calculated and listed in the printout. If a<0 would result, a=0 is now set and the spring width LKalpha is calculated for a=0. This had not previously been checked in this setting by FED3+; the user had to ensure that the extension of the spring body when the spring is compressed in the coil direction was accommodated by the coil spacing “a”. To do this, you can first have FED3+ calculate the spring body length at alpha0 and at alphan (or alpha2 or as applied). Then input a > (Lkalpan or LKaplha2 – LKalpha0) / number of coils “n”. If you recalculate LKalpha for a=0, you may get a smaller value than the program. This is because the spring width without the coil spacing is calculated with the number of turns * (wire diameter + wire tolerance). If the coil spacing a > wire tolerance, the wire tolerance is not taken into account.

Nos. of active coils	n		8,75
Distance between coils	a0	mm	0,12
Distance between coils	a1	mm	0,11
Distance between coils	a2	mm	0,02
Distance between coils	an	mm	0,00
Spring package length(incl. a)	Lk0	mm	25,45 ± 6,60
Calculation LK alpha:			LKalpha=LK0
Max.spring pack.length at alpha1	Lk al.1	mm	25,45
Max.spring pack.length at alpha2	Lk al.2	mm	25,46
Max.spring pack.length at alphan	Lk al.n	mm	26,17
Total rot.angle at T1 al.1+be.1	al.s1	°	10,00
Total rot.angle at T2 al.2+be.2	al.s2	°	120,00
Max.rot.angle (q=1)	alfa n	°	221,07

ZAR5 Torsional backlash

The backlash of planetary gears between the input shaft and output shaft in angular degrees can be found in the expression (dimensions S-P-H). The backlash with a blocked output shaft is greater by the gear ratio than with a blocked input shaft.

TOLERANCES, BACKLASH

Tolerance zone DIN 3967			e 25	e 25	e 25
Upper tooth thickn.allow.	Asne	mm	-0,030	-0,030	-0,040
Lower tooth thickn.allow.	Asni	mm	-0,060	-0,060	-0,080
Tooth thickn.tolerance	Tsn	µm	30	30	40
Torsional backlash min.	jtmin	mm	0,052	0,061	
Torsional backlash max.	jtmax	mm	0,128	0,149	
Torsional backlash I/O (S-C)	jtmin	°	0,541	0,108	
Torsional backlash I/O (S-C)	jtmax	°	1,321	0,264	
Torsional backlash In (S)	jt in	°	0,541	1,321	
Torsional backlash Out (C)	jt out	°	0,108	0,264	

Because there were misunderstandings with the previous representation of jtmin I/O and jtmax I/O, the smallest and largest flank clearance on the input shaft "jt in" min/max and on the output shaft "jt out" min/max are now given in 2 additional lines. These are the same numbers, just in a different order.

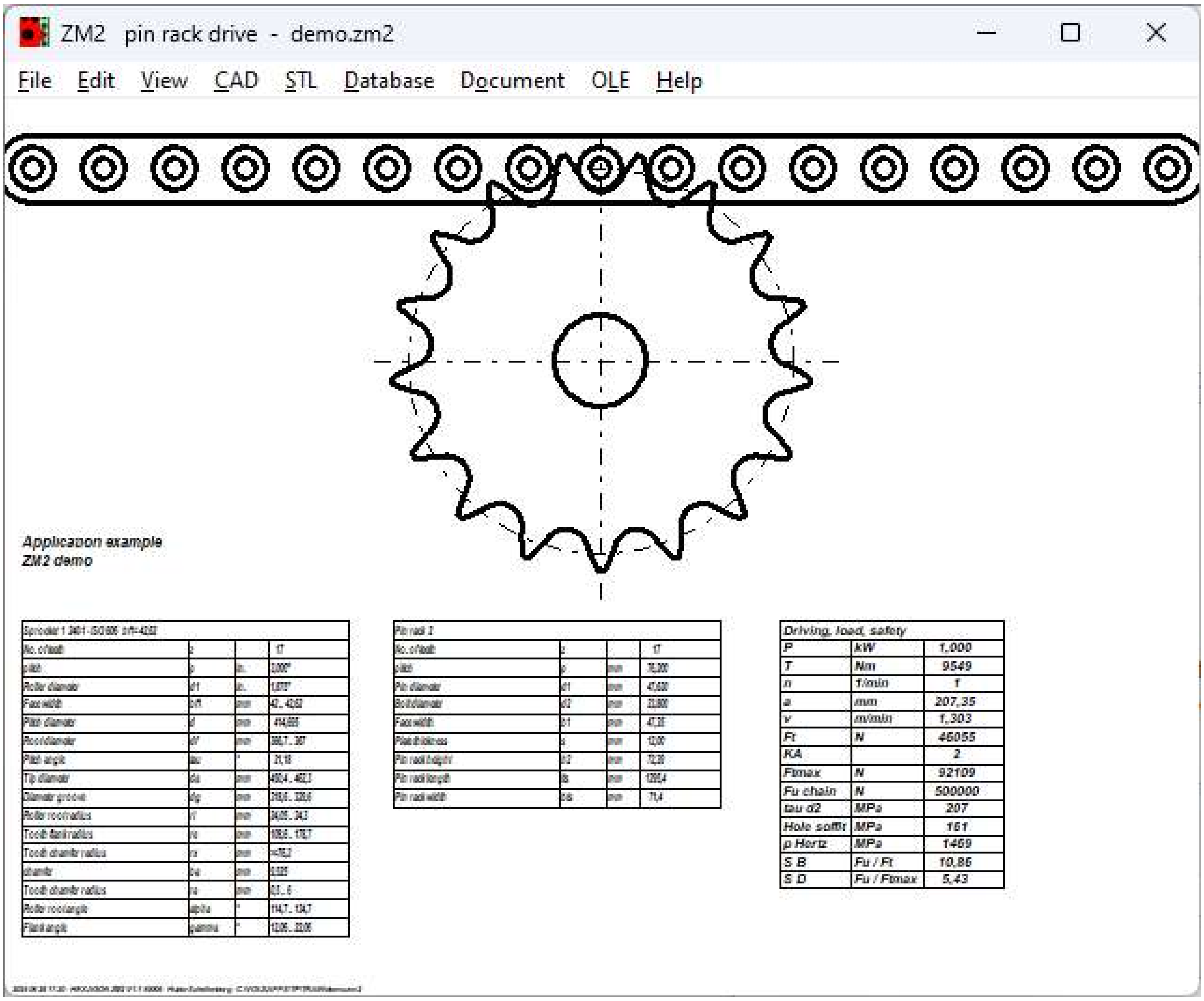
ZAR5 rotational flank clearance for multi-stage planetary gears

The rotational flank clearance can be extremely large for multi-stage planetary gears (see multi-stage expression)

Tolerance zone DIN 3967			S-P-H		e 25	e 25	e 25
torsional backlash I/O (Input S, Output C)				jtmin/jtmax°			
i	n1 /min	mn	u	jImin	jImax	jOmin	jOmax
1	1450,0	2,50	5,625	0,408	0,984	0,073	0,175
2	257,8	5,00	5,625	0,285	0,640	0,051	0,114
3	45,8	8,00	5,625	0,207	0,470	0,037	0,084
4	8,1	16,00	5,625	0,132	0,289	0,024	0,051
Torsional backlash I/O min	jtmin	°				32,14	0,03
Torsional backlash I/O max	jtmax	°				70,80	0,07
Torsional backlash In	jt in	°				32,14	70,80
Torsional backlash Out	jt out	°				0,03	0,07

In a 4-stage planetary gear with a transmission ratio i=1000, the backlash of the output shaft is 0.03 to 0.07°, but in the input shaft it is between 32° and 70°. Multi-stage planetary gears are therefore not suitable for reversible drives. In the example, it takes almost a fifth of a revolution of the input shaft until the reversal of rotation reaches the output shaft.

ZM2: Edit Dimensions

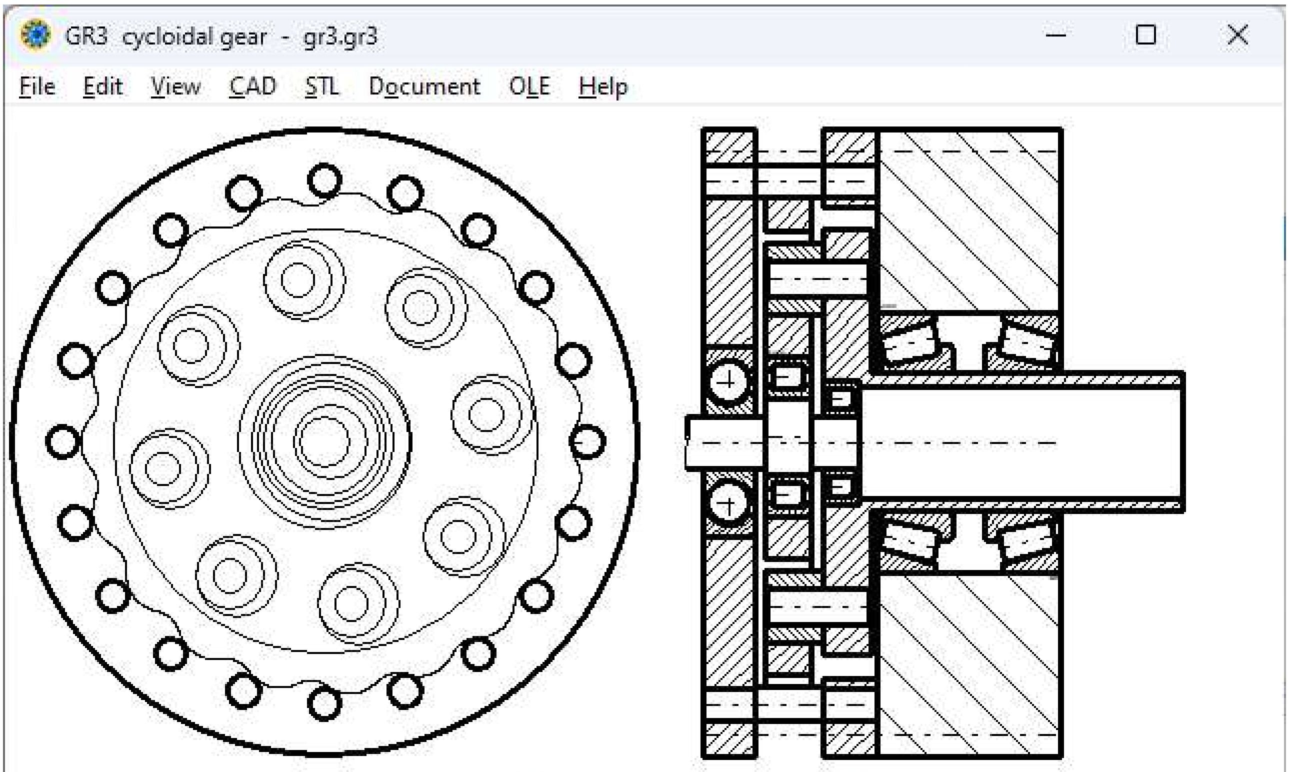


If the standard database dimensions for the rack and pinion gearing are to be changed, "Edit" must first be checked now. If "Edit" is checked, the profile designation according to DIN/ISO is no longer displayed in the title line of the table.

Sprocket 1			
No. of teeth	z		17
pitch	p	in.	3,000"

GR3 – New Software for Cycloid gears

GR3 is a new calculation program for cycloid gears. Cycloid gears are eccentric gears, similar to the calculation with our GR2 software, except that in GR3 the involute gearing is replaced by cycloid gearing. The ring gear is made of cylindrical bolts on a bolt circle, the planet gear is a cam disk (cycloid disk). The number of teeth on the ring gear (number of bolts) is 1 greater than the number of teeth on the cycloid disk. The cycloid disk runs on the eccentric drive shaft, and for the output the torque is transmitted to the output shaft via holes in the cycloid disk using rollers and bolts.



Load		1	2
P	kW	7,5	6,75
T	Nm	47,75	816,5
n	1/min	1500	78,95
tau	MPa	49	77
Sig.b	MPa	70	122
Sig.v	MPa	111	181

Dimens.		1	2
dshaft	mm	17	45
Lshaft	mm	25	40
Fr shaft	N	0	0
dgear	mm	162,5	171

Dimens. Main		
ISC		-19
ISH		20
exz	mm	2,138
dcase	mm	205
bcase	mm	116,7
L tot	mm	181,7

Load capacity		
Ft gear	N	10487
Fr gear	N	33167
Fn gear	N	34785
pHz Gear	MPa	1760
Ft bolt	N	7631
p max z	MPa	44
Sig.b.z	MPa	383
p Hertz	MPa	1293

Bearings		1	2	3	4	5
Name		6403	NUP	NU	32209	32209
Loc.		in/case	ecc./gear	in/out	out/case	out/case
Fr	N	15607	33509	17902	72734	36224
C	N	22900	28600	17200	80900	80900
C0	N	10800	27000	14300	98000	98000
Cu	N	455	3350	1730	11000	11000
S0		0,692	0,806	0,799	1,347	2,705
S		1,467	0,854	0,96	1,112	2,233
L10	1E6	3,159	0,590	0,875	1,426	14,56

GR3 calculates the stresses and Hertzian pressure in the cycloidal gear; an export function allows the drive shaft, output shaft and bolt with dimensions and load to be transferred to our shaft calculation program WL1+.

GR3 generates the profile of the cycloidal disk as a DXF or IGES file; resolution and flank clearance can be configured.

GR3 generates STL files for creating the individual parts on a 3D printer to build a functional model of the cycloidal gear.

GR3 will be available from July 15, 2024 at a price of 600 euros.

HEXAGON PRICE LIST 2024-07-01

Base price for single licences (perpetual)	EUR
DI1 Version 2.2 O-Ring Seal Software	190.-
DXF-Manager Version 9.1	383.-
DXFPLOT V 3.2	123.-
FED1+ V32.1 Helical Compression Springs incl. spring database, animation, relax., 3D,..	695.-
FED2+ V22.6 Helical Extension Springs incl. Spring database, animation, relaxation, ...	675.-
FED3+ V22.1 Helical Torsion Springs incl. prod.drawing, animation, 3D, rectang.wire, ...	600.-
FED4 Version 8.0 Disk Springs	430.-
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FED6 Version 18.6 Nonlinear Cylindrical Compression Springs	634.-
FED7 Version 15.6 Nonlinear Compression Springs	660.-
FED8 Version 7.6 Torsion Bar	317.-
FED9+ Version 7.0 Spiral Spring incl. production drawing, animation, Quick input	490.-
FED10 Version 4.5 Leaf Spring	500.-
FED11 Version 3.6 Spring Lock and Bushing	210.-
FED12 Version 2.7 Elastomer Compression Spring	220.-
FED13 Version 4.3 Wave Spring Washers	228.-
FED14 Version 2.8 Helical Wave Spring	395.-
FED15 Version 1.7 Leaf Spring (simple)	180.-
FED16 Version 1.4 Constant Force Spring	225.-
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FED19 Version 1.0 Buffer Spring	620.-
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GEO3 V4.0 Hertzian Pressure	205.-
GEO4 V5.3 Cam Software	265.-
GEO5 V1.0 Geneva Drive Mechanism Software	218.-
GEO6 V1.0 Pinch Roll Overrunning Clutch Software	232.-
GEO7 V1.0 Internal Geneva Drive Mechanism Software	219.-
GR1 V2.2 Gear Construction Kit Software	185.-
GR2 V1.3 Eccentric Gear Software	550,-
GR3 V1.0 Cycloidal Gear Software	600,-
HPGL Manager Version 9.1	383.-
LG1 V7.0 Roll-Contact Bearings	296.-
LG2 V3.1 Hydrodynamic Plain Journal Bearings	460.-
SR1 V25.2 Bolted Joint Design	640.-
SR1+ V25.2 Bolted Joint Design incl. Flange calculation	750.-
TOL1 V12.0 Tolerance Analysis	506.-
TOL2 Version 4.1 Tolerance Analysis	495.-
TOLPASS V4.1 Library for ISO tolerances	107.-
TR1 V6.5 Girder Calculation	757.-
WL1+ V21.9 Shaft Calculation incl. Roll-contact Bearings	945.-
WN1 V12.4 Cylindrical and Conical Press Fits	485.-
WN2 V11.5 Involute Splines to DIN 5480	250.-
WN2+ V11.5 Involute Splines to DIN 5480 and non-standard involute splines	380.-
WN3 V 6.0 Parallel Key Joints to DIN 6885, ANSI B17.1, DIN 6892	245.-
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WN7 V 4.1 Polygon Profiles P4C to DIN 32712	175.-
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WN11 V 2.0 Woodruff Key Joints	240.-
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WN13 V 1.0 Polygon Profiles PnG	238.-
WN14 V 1.0 Polygon Profiles PnC	236.-
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WNXK V 2.2 Serration Splines – dimensions, graphic, measure	230.-
WST1 V 10.2 Material Database	235.-

ZAR1+ V 27.0 Spur and Helical Gears	1115.-
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ZAR3+ V10.6 Cylindrical Worm Gears	620.-
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ZAR1W V2.7 Gear Wheel Dimensions, tolerances, measure	450.-
ZM1.V3.0 Chain Gear Design	326.-
ZM2.V1.1 Pin Rack Drive Design	320.-
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