HEXAGON Info 160

by Fritz Ruoss

ZAR8 - Software for Ravigneaux Gears

A Ravigneaux gear contains two planetary gear stages: one (minus) planetary gear set and one plus planetary gear set with planet gear pairs instead of planet gears. Carrier as well as ring gear of both planetary gear sets are connected or common. And planet wheel of the minus planetary set is used as outer planet wheel of the plus planetary gear set.



Five gear wheels in two planetary gear sets: Si (small sun wheel), Pi (inner planet wheel), Pe (outer planet wheel), H (hollow wheel), Se (large sun wheel) are calculated by ZAR8 in one pass.

ZAR8 Ravigneaux Gear Software

In pre-dimension, you can enter transmission ratio of first gear and fourth gear. The transmission of the other gears 2, 3 and R are directly calculated and displayed, also the gear step between gear 1,2,3,4. Transmission ratio i0i of plus planetary gear set is transmission ratio of the 1st gear, and transmission ratio of the minus planetary gear set i0e is transmission ratio of the rear gear. Next enter power or input torque and input speed. You can define number of teeth of the ring gear zH, and ZAR8 calculates dimensions of all gear wheels under consideration of assembly conditions for planetary gear sets.

🛞 ZAR8 Pre-Dimensioning	
i	gear step
gear 1 3.077 <	n1 = 325,0
gear 2 1,768	n2 = 565,6
gear 3 1	n3 = 1000
gear 4 0,630 <	1,587 n4 = 1587
gear R -1,703	nR = -587,2
spreading 4,884	
Plus planetary gear set i0i 3,077	Rad
Minus planetary gear set i0e 1,70	3 • T in 1.48 Nm
ring gear no. of teeth zH	< P 0.155 KW
ОК	Cancel <u>H</u> elp Text ?

In the next input window you can modify dimensions such as profile shift coefficients, tooth tip reduction, face width of the gear wheels.

🛞 ZAR8 Dimensions
mm <> inch
Pressure angle alpha 20 * <
Helix angle beta 0 *
Normal module mn 2 mm 12.7 1/in
number planet pairs 3 🛫 <
Si Pi Pe H Se
Number of teeth z 26 文 22 文 17 文 80 文 46 文 < ?
Profile shift coeff. x 0.5 0.5 0.5 0.5 0.5 0.5 0.5
Center distance Se-Pe-H 63,9487 mm 🗖 a const
tip reduction k mn 0 0 0 0 0 mm < ?
Facewidth b 30 30 68 70 30 mm <
b eff
Borehole dB 0 0 0 -183 0 mm <
tooth alignment Si
OK Cancel <u>H</u> elp Text Calc

ZAR8 Ravigneaux Gear Software

Four connector shafts Si, C, H, Se can be defined as driving (in), driven (out), control or idle. By means of the buttons 1,2,3,4,R you can shift the standard gears of the Ravigneaux gear.

🖧 ZAR8 drive				_ _ X
drive C Si sun wheel (+) C C planet carrier C H ring gear Se sun wheel (-)	driven element C Si sun wheel (+) C C planet carrier C H ring gear C Se sun wheel (-)	Control ○ Si sun wheel (+) ○ C planet carrier ○ H ring gear ○ Se sun wheel (-)	idle Si sun wheel (+) C C planet carrier C H ring gear C Se sun wheel (-)	1 2 3 4 8
 n in 1000 /min T in 954,9 Nm P 100 kW 	Calc. n, np OK	✓ locked n ✓ power sharing Input+Cor Cancel Help	ntrol i0i = : i0e = Text	3,077 -1,739 Calc

In an animation you can rotate the gear wheels of the Ravigneaux gear set on the computer screen.

To calculate load bearing capacity for each of the five gear wheels and four tooth contacts (Si-Pi, Pi-Pe, Pe-H, Se-Pe), select gear materials from integrated database and input additional data for strength calculation according to ISO 6336 or DIN 3990.

🛞 ZAR8 Strength		
Calculation method ISO 6336:2006-2008 💌	Si Pi Pe H Se Gear blank inside diameter Di 🔃 26 28 -181 20	mm < ?
Oil viscosity at 50°C 100 mm²/s application factor KAH < ? application factor KAF ? mesh load factor Kgamma 1 <	Tooth contacts per/rotation e 3 2 2 3 3 no. of load reversions/period Np 0 2 2 0 0 Average peak-to-valley height Tooth flank RzZ 5 5 5 5 5 Average peak-to-valley height Tooth root RzY 5 5 5 5 5 C Calculate life expectation ZNT 1 1 1 1	μm μm
Double helical gearing ?	PeH SePe 8.5 1.554 µm	
Contact pattern position Pi Bearing-arrangement pinion shaft Pi Bearing distance I IPi Bedding offset s s Pi Bedding offset s s Pi	Pe: Bearing Pe Pe image a ▼ <	Calc
Shaft-diameter of the pinion dsh Pi 20 mm < dsh F	Pe 12 mm < dsh Pe 12 mm < dsh Pe 12 mm < ?	mm <> inch
Supporting effect Central crowning End relief	 Lapping-in/breaking-in Tooth trace angle correction 	Help Cancel
notch in fillet ?		ОК

ZAR8 is available now for 1950 EUR.

ZAR7 Software for Plus Planetary Gears (double-planet gears)



A Ravigneaux gear is composed of one simple (minus) planetary gear stage and one plus planetary gear set. A minus planetary gear set can be calculated by means of ZAR5. For calculation of a plus planetary gear set, we have made a new software ZAR7. The carrier of a plus planetary gear carries planet gear pairs instead of single planets as in ZAR5. Planet wheel pairs may be on one axis to the center of the sun gear, but usually are offset mounted. This allows larger number of teeth and free definable profile shift coefficients. For number of teeth of ring gear (zH) and sun wheel (zS), assembly condition for plus planetary gears must be considered:

(|zH| - zS) / q = f

"f" must be integer. "q" is the number of planet pairs.

Dimensions and load capacity of the four gear wheels S (sun), Pi (inner planet), Pe (outer planet) and H (hollow gear) calculates ZAR7 in one pass. Additionally, you can select roller bearings for inner planets and outer planets and calculate in ZAR7.

ZAR7 is available now for 1380 EUR.

Planetary Gear Package

Our new planetary gear package contains the programs for design and calculation of planetary gears ZAR5, ZAR7, ZAR8, GR1, and also ZAR1+ for a price of 3600 Euros. If upgrade from ZAR1+ or ZAR5 or spur gear package, old licenses are credited 75%.

GR1 - Gear Construction Kit Software



By means of GR1 you can "build" multistage gears composed of simple gear pairs, planetary gear sets, Ravigneaux gear sets, Simpson gear sets and plus planetary gear sets. For each gear stage element you can define if it is driving (in), driven (out), blocked or idle. For driving elements (i9) you can enter input speed or select a predecessor gear element.

🔢 Gear Stage 3				_ 🗆 ×
Gear Type O Spur/Helical Gear O Planet Gear Ravigneaux O Simpson O Plus Planet Gear	i0e = zH/zSe (i0i = -zH/zSi (- Nam	-) -1,9 < +) 2.11 < re	n in [1	000
	Driven t)y		
Drive 1	ype Gear No.	Element	n [1/min]	CB
Sun Gear Se idle	•			
Planet Carrier C lin	च		100 <	
				0 2
Ring Gear H out	•			C 3
Sun Gear Si in	▼ 1 ▼	H (ring) 💌		C 4
ок	Cancel <u>H</u> elp	Text Aux. Image		

GR1 calculates speed and transmission ratio of all gear elements.

GR1 does not calculate power, torque nor dimensions.

GR1 is available now for 185 Euros.



FED1+,2+,3+,5,6,7,8: Hot-Coiled Springs: 2E6 Load Cycles

Cold-coiled springs are fatigue strength safe if enduring more than ten million load cycles. In the spring calculation software, this was treated equal for hot-coiled springs until now. But Goodman diagrams in EN 13906-1 for hot-coiled springs are drawn for 2E6 load cycles (fatigue strength safe) and for 1E5 load cycles. The EN 13906 Goodman diagram for hot-coiled springs shows curves for bar diameters of d=10mm, 15mm, 25mm, 35mm and 50mm. These diagrams with fatigue strength safety for 2E6 instead of 1E7 load cycles (for hot-coiled springs only) are used now in our software for compression springs, extension springs, torsion springs and torsion bars. However, at "Edit->Calculation Method" you can configure the calculation as used until now with fatigue strength safety at 10 million load cycles for all spring materials.



Goodman diagrams for hot-coiled springs are valid for spring materials to EN10089 with ground or shaved surface. At "Edit->Production" you must set "hot-coiled, steel with reworked surface" and at "Edit->Material->Surface" "ground" or "shaved". For hot-rolled spring steel with drawn or rolled surface is no Goodman diagram available. Instead of 3 curves for 10 million, 1 million and 100,000 load cycles, new Goodman diagram for hot-rolled springs shows only 2 curves: for 2 million cycles and 100,000 cycles.

FED1+, 2+,3+,5, FED6, 7,9: Spring drawings in command line mode

Drawings created in command line mode (i.e. "wfed1 test.fed /CAD1:27") were drawings of the unloaded spring with spring length L0 until now. This has been changed, spring drawings are created in the defined spring length now. This enables you to automate spring drawings as DXF or IGES file in various spring lengths.

FED1+: Quick Input Window: Assembly length L for spring drawings

If you selected spring drawings (front view, section drawing, 3D), you can input assembly length L next to "Display" field now.

FED1+	Compression Spring Software to I	EN 13906-1	- Quick Input	
Display	Drawing 3D	•	L 400	Drawing name Sch
Aux. <u>I</u> mage	CAD-1 : CAD Drawing		•	Drawing name 2
Error :	Warning: L2 <ln !="" (s="0,46)</td"><td></td><td>•</td><td>Line 1 war</td></ln>		•	Line 1 war
	·			Line 2

In FED1+, indices for drawings and diagrams used in command line mode are now equal with indices in Quick Input window, this begins with index 1 = "Quick 1" until Index 35 "stress Rm-d Quick". Index 25, 26, 27 for spring drawings (view, section, 3D centerline). Example command line: "wfed1 actual.fed /cad1:25"

FED4: SigmaOM

Bending stress SigmaOM of the disk spring is mainly used to calculate static stressed disk springs. SigmaOM has been added to stress diagrams and printout.



FED4: Load cycles for disk spring materials according to DIN 2093

In FED4 you can decide to use material according to DIN 2093 or from material database. Calculation of load cycles has been added to disk springs with material data to DIN 2093.

GEO4, ZAR4: New Input Windows Sinus-Linear, Polygon, Eccentric

New input windows were created for cam geometry in GEO4 and for pitch curve of nonlinear gear in ZAR4 for sine-linear, polygon and eccentric element geometry.



ZAR1+, ZAR5: New Dialogue Window for Strength Calculation Data

Input data for strength calculation to ISO 6336 and DIN 3990 have been integrated into one common dialogue window.

🐼 ZAR5 Strength	
Calculation method ISO 6336:2006-2008 Oil viscosity at 50°C 120.8 mm²/s application factor KAH 0.835 application factor KAF 0.78 mesh load factor Kgamma	S P H Gear blank inside diameter Di 0 100 435 mm < ? Tooth contacts per/rotation e 3 2 3 < ? no. of load reversions/period Np 0 1 0 (2 2 3 (2 2 2 3 (2 2 2 2 2 2 2 2 2 2 2
Double helical gearing	C Input limited-life factors
S · P: Bearing S Contact pattern position ring-arrangement pinion shaft Bearing distance Bearing offset S · D Bearing offset S · D Bearing distance Bearing offset S · D Bearing S S · D S · D	▼ < ? ▼ < ? mm < ?
Shaft-diameter of the pinion dsh S 53 mm < dsh P 45	
Supporting effect Central crowning Central crowning Contrace angle Central relief notch in fillet ? ?	sing in e correction

ZAR1+, ZARXP, ZAR1W, ZAR5: Drawing Options and Ring Gear with Bore Holes

Same as known from WN2, at "CAD->Gear Wheel" and "STL->Gear Wheel" you first get a dialogue window with settings. New for ring gears is the possibility to define a pitch circle with bore holes. This is useful if you produce ring gears directly with 3D printer.

ZAR1+ Spur and Helical Gears 📃 🗖 🗙	ZAR1+ Spur and Helical Gears - hohl.zar
	<u>File E</u> dit <u>V</u> iew <u>C</u> AD STL <u>D</u> atabase D <u>o</u> cument <u>D</u> LE <u>H</u> elp
involute curve as Polyline ?	
🔲 draw diameters ?	$\left(\left(\left$
Tooth Root Trochoide	
✓ draw bore ?	$\langle \mathcal{A} \rangle$
number of points for involute polycurve	\circ
gen.addend.modif.coef.xe -0.527475 <	\mathcal{S}
☑ ring gear pitch circle ?	
pitch circle diameter 90 mm < borehole diameter 5,5 mm <	04 20/
no. bore 16 🚖 <	
OK Cancel <u>H</u> elp	V~V~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

SR1/SR1+ : Tightening Torque

SR1+ tightening procedure	;		
Calculation base FM, MA VDI 2230 - 1986 VDI 2230-1:2015	tightening procedure		
C Bolt driven	reduction coefficient k tau	0,5 <	
MA max O v Fie O MA,max O FM,max assemble	yield point factor for tightening tightening torque MA,max (76,16=max.) y prestress. force FM,max (46124=max.)	0,888061 < 72 Nm 43602,64 N	$\label{eq:main_state} \begin{split} \mu G &= 0.1 \pm 0\% \\ \mu K &= 0.1 \pm 0\% \\ MA &= 60 \ \text{Nm} \pm 20.0 \ \% \\ FM &= 36336 \pm 20 \ \% \\ alpha &= 52.12 \pm 20 \ \% \end{split}$
MA min C alpha A C Tol MA % O MA,min C FM,min	Tightening Factor alpha A tolerance torque MAtol/MA,nom min. tightening torque MA,min min. assembly prestress. force FM,min	1.5 20 % 48 Nm 29068,43 N	? Calc N <> lbf <u>H</u> elp Text Cancel
₩A = 60 Nm ±	20 %	Sigma 3	К ОК

Instead of min/max tightening torque MA,max and MA,min, or nueRp and alphaA, you have a new alternative to input average tightening torque with tolerance in % instead.

Modify Dialogue Window Size and Dialogue Element Size (Text Size)

FED1+ Configuration
Directories Graphics CAD Colour Printer Printout Settings external Drawing
Color graphics dialog window size • color 150 • % • monochrom background colour Window Size 150 • % × 1672 < <
Text 2 Font Arial Textwidth/height 0.8 Text height factor 1
OK Cancel <u>S</u> ave Export Import

If text and input fields are too small (i.e. notebook with high graphic resolution but small display) you can modify dialogue window size and dialogue element size at "File->Settings->Graphics". Also in Control Panel of Windows you can modify size of text and dialogue elements. These Windows settings differ in Windows 10, Windows 8, Windows 7.

Control Panel	 Appearance and Personalization Display 		Search Control Panel	_
Control Panel Home	Make it easier to read what's or	your screen		
Adjust resolution Calibrate color	You can change the size of text and other temporarily enlarge just part of the screer	items on your screen by on the second s	choosing one of these options. To	
Change display settings Adjust ClearType text) <u>S</u> maller - 100% (default)	Preview		
Set custom text size (DPI)	Medium - 125%			
	© <u>L</u> arger - 150%			
See also			87 E	
Personalization				
Devices and Printers			App	ly

If you make changes in the Windows settings, you maybe next have to adapt the new settings in the HEXAGON programs. Or set "Auto" instead of "Input" to adapt Windows settings automatically. We improved handling with enlarged dialogue windows, input tables were not enlarged in previous versions. Also we fixed a bug at enlarging database windows. If you configure dialogue element size, save new configuration, then close and restart program to set new text size also for database windows. Anyway, if you plan to use HEXAGON software with enlarged dialogue elements and dialogue windows, we recommend first to update your programs to the latest version.

FED17 - New Software for Magazine Springs

Especially for compression springs with rectangular, oval or elliptic coil shape we can provide a new software in short.

HEXAGON PRICELIST 2017-01-01

PRODUCT	EUR
DI1 Version 1.2 O-Ring Seal Software	190,-
DXF-Manager Version 9.0	383,-
DXFPLOT V 3.2	123
FED1+ V29.3 Helical Compression Springs incl. spring database, animation, relax., 3D	695
FED2+ V20.1 Helical Extension Springs incl. spring database, animation, relaxation,	675
FED3+ V18.8 Helical Torsion Springs incl. prod.drawing, animation, 3D, rectang wire,	480
FED4 Version 7.3 Disk Springs	430 -
FED5 Version 15.3 Conical Compression Springs	741 -
FED6 Version 16.0 Nonlinear Cylindrical Compression Springs	634 -
FED7 Version 12.8 Nonlinear Compression Springs	660 -
EED8 Version 6.0 Tersion Bar	217
FEDO Version 6.0 Spiral Spring	204
FED9 Version 0.0 Spiral Spring	594,-
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FED11 Version 3.3 Spring Lock and Bushing	210,-
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FED13 Version 3.9 Wave Spring Washers	185,-
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FED15 Version 1.3 Leaf Spring (simple)	180,-
FED16 Version 1.0 Constant Force Spring	225,-
GEO1+ V6.1 Cross Section Calculation incl. profile database	294
GEO2 V2.6 Rotation Bodies	194,-
GEO3 V3.3 Hertzian Pressure	205,-
GEO4 V4.1 Cam Software	265,-
GR1 V1.0 Gear construction kit software	185,-
HPGL-Manager Version 9.0	383,-
LG1 V6.4 Roll-Contact Bearings	296,-
LG2 V2.2 Hydrodynamic Plain Journal Bearings	460,-
SR1 V22.2 Bolted Joint Design	640,-
SR1+ V22.2 Bolted Joint Design incl. Flange calculation	750,-
TOL1 V11.8 Tolerance Analysis	506,-
TOL1CON V1.5 Conversion Program for TOL1	281,-
TOL2 Version 3.3 Tolerance Analysis	495,-
TOLPASS V4.1 Library for ISO tolerances	107,-
TR1 V4.0 Girder Calculation	757
WL1+ V19.8 Shaft Calculation incl. Roll-contact Bearings	945
WN1 Version 11.6 Cylindrical and Conical Press Fits	485
WN2 V 9.6 Involute Splines to DIN 5480	250 -
WN2+ V 9.6 Involute Splines to DIN 5480 and non-standard involute splines	380 -
WN3 V 5 4 Parallel Key Joints to DIN 6885, ANSI B17 1, DIN 6892	245 -
WN4 V 4.5 Involute Splines to ANSLB 92.1	276 -
WN5 V 4.5 Involute Splines to ISO 4156 and ANSI B 92.2 M	255 -
WN6 V 3.0 Polygon Profiles P3G to DIN 32711	180 -
WN0 V 3.0 Polygon Profiles P4C to DIN 32712	175 -
$\frac{1}{12}$	175,-
WN0 V 2.2 Selfation to DIN 3401	195,-
WN9 V 2.2 Spline Shars to DIN ISO 14	170,-
WNTU V 4.0 Involute Splines to DIN 5482	260,-
WN11 V 1.3 Woodruff Key Joints	240,-
WINKE V 2.0 Involute Splines - dimensions, graphic, measure	375,-
WNXK V 2.0 Serration Splines - dimensions, graphic, measure	230,-
WST1 V 10.0 Material Database	235,-
ZAR1+ V 25.4 Spur and Helical Gears	1115,-
ZAR2 V7.7 Spiral Bevel Gears to Klingelnberg	792,-
ZAR3 V8.9 Worm Gears	404,-
ZAR4 V5.1 Non-circular Spur Gears	1610,-
ZAR5 V11.1 Planetary Gearings	1355,-
ZAR6 V3.7 Straight/Helical/Spiral Bevel Gears	585,-
ZAR7 V1.0 Plus Planetary Gears	1380,-
ZAR8 V1.0 Ravigneaux Planetary Gears	1950,-
ZARXP V2.1 Involute Profiles - dimensions, graphic, measure	275,-

ZAR1W V1.7 Gear Wheel Dimensions, tolerances, measure	450,-
ZM1.V2.4 Chain Gear Design	326,-

PACKAGES	EUR
HEXAGON Mechanical Engineering Package (TOL1, ZAR1+, ZAR2, ZAR3+, ZAR5, ZAR6, WL1+, WN1, WN2+, WN3, WST1, SR1+, FED1+, FED2+, FED3+, FED4, ZARXP, TOLPASS, LG1, DXFPLOT, GEO1+, TOL2, GEO2, GEO3, ZM1, WN6, WN7, LG2, FED12, FED13, WN8, WN9, WN11, DI1, FED15, WNXE, GR1)	8,500
HEXAGON Mechanical Engineering Base Package (ZAR1+, ZAR3+, ZAR5, ZAR6, WL1+, WN1, WST1, SR1+, FED1,+, FED2+, FED3+)	4.900,-
HEXAGON Spur Gear Package (ZAR1+ and ZAR5)	1,585
HEXAGON Planetary Gear Package (ZAR1+, ZAR5, ZAR7, ZAR8, GR1)	3,600
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HEXAGON Complete Package (All Programs of Engineering Package, Graphics Package, Tolerance Package, Helical Spring Package, Planetary Gear Package, TR1, FED8, FED9, FED10, ZAR4, GEO4, WN4, WN5, FED11,WN10, ZAR1W, FED14, WNXK, FED16)	12,900

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(Negotive Discount means additional cost)									

(Negative Discount means additional cost)

Language Version:

- German and English : all Programs

- French: FED1+, FED2+, FED3+, FED4, FED5, FED6, FED7, FED9, FED10, FED13, FED14, FED15, TOL1, TOL2.

- Italiano: FED1+, FED2+, FED3+, FED4, FED5, FED6, FED7, FED9, FED14.

- Swedish: FED1+, FED2+, FED3+, FED5, FED6, FED7.

- Portugues: FED1+

- Spanish: FED1+, FED2+, FED3+

Updates:

Update prices	EUR
Software Update (software + pdf manual)	40,-
Software Update (software 64-bit Win + pdf manual)	50 -

Software Update (software 64-bit win + pdf manual) 50,-

Update Mechanical Engineering Package: 800 EUR, Update Complete Package: 1000 EUR

Maintenance contract for free updates: annual fee: 150 EUR + 40 EUR per program

Upgrades

For upgrades to network licenses or plus versions or software bundles, upgraded licenses are credited 75%.

Hexagon Software Network Licenses

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Conditions for delivery and payment

General packaging and postage costs are EUR 60, (EUR 25 inside Europe) Delivery by Email (zip file, manual as pdf files): EUR 0. Conditions of payment: bank transfer in advance with 2% discount, or by credit card (Master, Visa) net.

Key Code

After installation, software has to be released by key code. Key codes will be sent after receipt of payment.

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