

# ZAR9



## Cross-Axle Helical Gear

for Windows

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ZAR9 cross-helical gear design - niemanne.zr9

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Helical gear 1  
Helical gear 2  
Application example  
Niemann/Winter Maschinenelemente Band III - 1983

Dimensions			material		Worm	Worm wheel
mn	mm	3,000	material		18MnCr5 (1.7)	18MnCr5 (1.7)
a	mm	83,82	E	MPa	210000	210000
alpha	°	20,00	SigHlim	MPa	1470	1470
summa	°	80,00	SigFE	MPa	880	880

Dimensions			Efficiency		
z		1 2	ηz	(tan 4,0°)	0,070
beta	mm	42,000 38,000	ηz z		0,889
beta b	mm	38,980 35,347	ηVz	kW	0,232
d	mm	72,884 85,178	ηV0	kW	0,216
da	mm	78,884 101,178	ηVLP	kW	0,021
df	mm	85,184 87,878	ηVD	kW	0,000
dtb	mm	85,258 88,405	ηV	kW	0,448
b	mm	18,00 18,00	ηza		0,778
k		0,0000 0,0000			
alpha z	mm	28,084 24,791			

power		
PN	kW	2,094 1,825
TN	Nm	10,00 10,78
n	/min	2000 1440,0
FtN	N	275 227

safety	
SV (Sig.HV= 1400)	1,44
SS	1,29
SF	14,08

ZAR9 calculates dimensions and load-bearing capacity of helical gears with crossed axis. Axis angle may be 90 degrees or any other input value. Sum of helical angle of the gear pair is axis angle. For example, it may be a screw gear with 45+45 degrees, or a worm and worm wheel with 80+10 degrees. ZAR9 calculates efficiency, forces and safety against sliding abrasion, tooth root breakage and seizure.

### Pre-Dimensioning

In Pre-dimensioning you enter axis angle, transmission ratio, input or output speed and power or torque. Recommendations are made for center distance, module and teeth numbers. The recommendations can be used or modified in the following geometry and strength calculations.

Rot.speed, Torque, Rated power 1

Gear ratio  $u=n1/n2$   <

application factor KA  < KA ?

gear axis angle summa [deg]  <

worm  worm wheel

n Rot. speed n   1/min

T Rated torque T  Nm

P Rated power P  kW

OK Cancel Help mm <-> inch Calc

ZAR9 cross-helical gear design - 0.zr9

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Worm 1  
Worm Wheel 2  
Deadend Door  
SigmaHV 40 -> 80

Dimensions			material		Worm	Worm wheel
mn	mm	0,838	material		CuZn38Pb3 (2)	Hocsaform C
a	mm	18,00	E	MPa	105000	3100
alpha	°	20,00	SigHlim	MPa	250	40
summa	°	80,00	SigFE	MPa	200	58

Dimensions			Efficiency		
z		2 31	ηz	(tan 1,4°)	0,025
beta	mm	81,818 8,182	ηz z		0,850
beta b	mm	68,455 7,885	ηVz	kW	0,001
d	mm	11,770 28,230	ηV0 (1%)		0,001
da	mm	13,445 27,905	ηVLP	kW	0,000
df	mm	8,878 24,138	ηVD	kW	0,000
dtb	mm	4,288 24,818	ηV	kW	0,903
b	mm	15,00 8,00	ηza		0,728
k		0,0000 0,0000			
alpha z	mm	68,844 20,189			

power		
PN	kW	0,010 0,007
TN	Nm	0,02 0,24
n	/min	4453 287,3
FtN	N	4 18

safety	
SV (Sig.HV= 80)	1,01
SS	3,21
SF	1,15

### Dimensioning

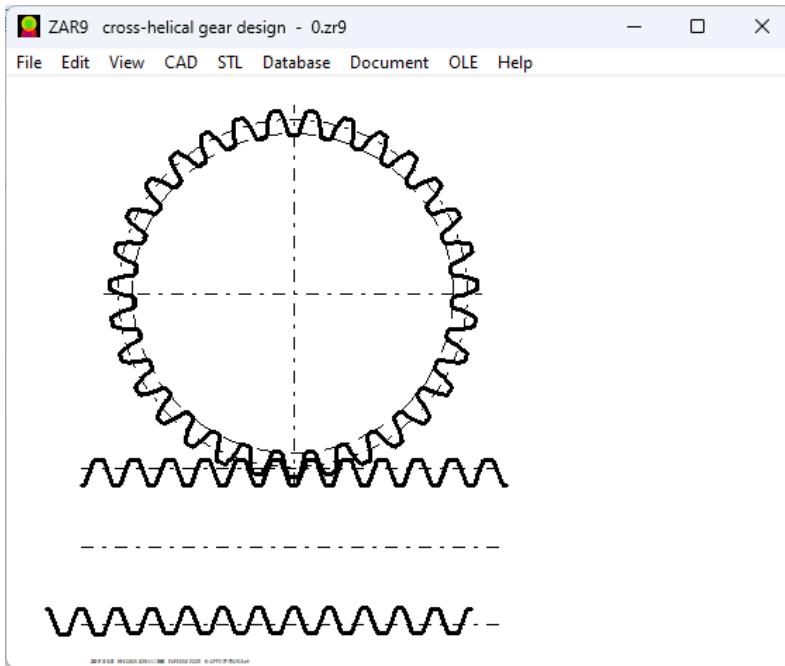
In Dimensioning input, you enter center distance and number of teeth, and ZAR9 calculates normal module and helix angles.

### Recalculation

In Recalculation input you enter number of teeth, module and helix angle, and ZAR9 calculates center distance.

### Load-bearing capacity

ZAR9 calculates safety against sliding abrasion, tooth root breakage and seizure accord. to Niemann.



### Efficiency

ZAR9 calculates efficiency and loss of power by tooth friction, idling, bearing and seals. The program provides a diagram with tooth friction efficiency as function of helix angles.

### Material Data Base

The program includes a data base containing the most important gear materials and their properties. Database can be modified by the user.

### Drawings and Tables

ZAR9 generates drawings and tables of the gear pair, ready to be used with CAD.

### Tooth profile and tooth contact

True-scale tooth profile and tooth contact can be shown in various views on screen.

### Tooth flank tolerance and measurement

ZAR9 calculates tooth thickness and over pin/ball diameters. You can input flank tolerances, or select from DIN 3967 tolerance zone.

### Animation

ZAR9 animates rotation of gear wheels on screen in axial or radial cross section.

### Production Drawing

ZAR9 generates a production drawing of worm and worm wheel with ISO 7200 data field.

### Produce a model gear with your 3D printer

ZAR9 generates STL files for printing the gears together with a carrier or case to build a true-size model gear.

### Data Exchange

Interface to ZAR3+ (worm gear) and ZAR1+ (helical gear) allows import/export of gear dimensions.

### CAD Interface

Drawings and diagrams can be saved as DXF or IGES file to be loaded into CAD.

### Units

ZAR9 can be switched between metric units (mm, N, MPa) and imperial units (inch, lbf, psi).

### System Requirements

ZAR9 is available as 32-bit app or as 64-bit app for Windows 11, Windows 10, Windows 7.

### Scope of Delivery

Software with perpetual license with update rights and user manual (pdf).

### Guarantee

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

