

## Framo® - Worm gear sets

Progressive manufacturing methods and long-standing experience in manufacturing and consulting made Framo worm gear sets become a synonyme for quality. Since the 1950's Framo has sold more than 20 million worm gear sets worldwide and became one of the world's biggest manufacturer of industrial high quality worm gears.

More than 50 years of manufacturing and engineering experience in the field of worm gearing lead to the industry's widest range of worm gear sets. Catalog worm gear sets in center distances between 17mm and 80mm can be ordered from stock. Custom worm gear sets are available on request.

Quality has always been an important sales criteria for our customers. Framo's quality management system and measuring procedures is ISO 9001 : 2000 certified.

## Metric conversion table

MORAT standard catalog worm gears are metric worm gears. The catalog data can be converted into 'English measures' by using the following conversion table:

Metric units	Factor	English units
Torque (Nm)	x 8.85	in.lb.
Distance (mm)	x 0.03937	in.

## ISO-tolerances

The worm gear drawings show ISO-tolerances like  $\varnothing 32^{H7}$ . If you are not familiar with ISO-tolerances please call MORAT or the local distributor to get the precise dimensions.

## Materials

The worms are made of case hardened steel. The bore and the worm profile are ground. The worm gears are made of a special alloy (copper-zinc alloy with additives of aluminum, silicon and manganese). Chemically this alloy belongs to the material group of CuZn40Al2 (DIN 17660) but is treated for better sliding characteristics. The chemical resistance is very high due to aluminum additives.

Mechanical characteristics:

- High corrosion resistance
- High mechanical strength:
  - Tensile strength  $R_m$ : 560 N/mm<sup>2</sup>
  - Strain limit  $R_{p0.2}$ : 290 N/mm<sup>2</sup>
  - Strain at failure  $A_5$ : 15%
  - Hardness HB2,5/62,5: 140-170
  - Shearing strength: 470 N/mm<sup>2</sup>
  - Alternating stress: 170 N/mm<sup>2</sup> (20x10<sup>6</sup> cycles)
- Good gliding characteristics
- High wear resistance

## Plastic worm gears

Plastic worm gears are suitable for low sliding speeds (< 1.5 m/s) and medium tooth pressure due to their bad thermal conductivity. Worms have to be hardened and ground.

Plastic worm gears are suitable for 50% torque of bronze worm gears.

Mechanical characteristics:	POM	PA 66
Tensile strength $R_m$ with 23°C:	70 N/mm <sup>2</sup>	50 N/mm <sup>2</sup>
Tensile strength $R_m$ with 70°C:	48 N/mm <sup>2</sup>	35 N/mm <sup>2</sup>
Temperature range:	-50 .... +100°C	-40 .... +100°C

The thermal expansion coefficient is appr. 4 times higher than with bronze. Therefore the backlash shouldn't be too small. At the limit temperature of 100°C the mechanical values drop to 40% of the nominal values. The case temperature shouldn't exceed 50°C, which means the temperature of the gears must not exceed 70°C.

## 2 Framo - Worm gear sets (Framo-Norm)

### Phenolic worm gears

Phenolic (Hgw 2083) is a laminated material of phenolic resin and cotton fabric. Phenolic worm gears are an economical alternative and are even quieter than bronze gears.

Mechanical characteristics of Phenolic (Hgw 2083 DIN 7735)

Tensile strenght:	100 N/mm <sup>2</sup>
Compression strenght:	170 N/mm <sup>2</sup>
Bending strenght:	150 N/mm <sup>2</sup>
Max. temperature:	+110°C

Phenolic worm wheels can transmit 40% of the torque of comparable bronze worm wheels.

Market offers a variety of different bronze for worm gears. Some of them are described here. "Soft" bronze is good for higher speed, "hard" bronze' is good for lower speed. "Soft" bronze worm gears can be paired with unhardened steel worms but that means reductions in torque and life time. "Hard" bronze worm gears can only be paired with hardened steel worms.

### Cu Sn 12 DIN 1705

Comparatively soft material with good wear resistance, suitable for high sliding speeds.

	<i>G-CuSn12</i>	<i>GZ-CuSn12</i>	<i>GC-CuSn12</i>
Tensile strength $R_m$ :	260 N/mm <sup>2</sup>	280 N/mm <sup>2</sup>	280 N/mm <sup>2</sup>
Strain limit $R_{p0,2}$ :	140 N/mm <sup>2</sup>	150 N/mm <sup>2</sup>	140 N/mm <sup>2</sup>
Strain at failure $A_5$ :	12 %	5 %	8 %
Hardness HB10:	80	95	90

### Cu Sn 12 Ni DIN 1705

Comparatively soft material with very good wear resistance, suitable for very high sliding speeds.

	<i>G-CuSn12Ni</i>	<i>GZ-CuSn12Ni</i>	<i>GC-CuSn12Ni</i>
Tensile strength $R_m$ :	280 N/mm <sup>2</sup>	300 N/mm <sup>2</sup>	300 N/mm <sup>2</sup>
Strain limit $R_{p0,2}$ :	160 N/mm <sup>2</sup>	180 N/mm <sup>2</sup>	170 N/mm <sup>2</sup>
Strain at failure $A_5$ :	14 %	8 %	10 %
Hardness HB10:	90	100	90

G = dead mold casting  
GZ = centrifugal casting  
GC = continuous casting

### CuAl10Fe3 Mn2 DIN 17665 / 17672

Comparatively hard material for high torque and low speed.

	<i>CuAl10Fe3 Mn2</i>	<i>CuAl10Ni5F4</i>
Tensile strength $R_m$ :	590 N/mm <sup>2</sup>	700 N/mm <sup>2</sup>
Strain limit $R_{p0,2}$ :	250 N/mm <sup>2</sup>	300 N/mm <sup>2</sup>
Strain at failure $A_5$ :	12 %	13 %
Hardness HB 2,5 / 62,5:	150	160

### Torque factor

The catalog torque ratings are based on 2,800 rpm worm speed. The following table shows the torque factors for different worm speeds:

$n_1$	2800 rpm	1400 rpm	950 rpm	700 rpm	500 rpm	250 rpm	125 rpm
Factor $n_1$	1	1,12	1,2	1,26	1,33	1,49	1,67

## Lifetime factor

The catalog torque ratings are based on 3000 hours expected lifetime. The following table shows the torque ratings for different lifetimes:

life time	appr. 3000 h	appr. 1500 h	appr. 6000 h
factor $L_n$	1	1,4	0,71

### 1. Calculation example (*without* consideration of the operating conditions)

worm gear set A40 U35, lubrication with mineral oil,  
worm speed  $700 \text{ min}^{-1}$ , life time 1500 h

Question: What's the expected maximum torque?

$$\begin{aligned} \text{Output torque:} &= T_2 \text{ (Mineral oil)} \times n_1 \text{ (Factor)} \times L_n \text{ (Factor)} \\ &= 37,2 \text{ Nm} \times 1,26 \times 1,4 && T_2 \text{ see table on page 14} \\ &= 65,6 \text{ Nm} \end{aligned}$$

**Attention!** The torque is limited by the tooth strength of the gear. The tooth strength is reached at approx. 300% of the catalog specification for synthetic oil ( $T_2$  SO).

EXAMPLE: Breaking point for A40 U35 =  $46,5 \text{ Nm} \times 3 = 139,5 \text{ Nm}$ .

## Application factors

Due to the wide range of applications the following factors are recommendations which enable the customer to choose the correct configuration. The case temperature shouldn't exceed  $80^\circ\text{C}$ .

Shocks	none	moderate	heavy
shock factor $f_1$	1	1,2	1,5
No. of starts	10/h	60/h	360/h
start factor $f_2$	1	1,1	1,2
duty cycle	<40 %	<70 %	<100 %
duty cycle factor $f_3$	1	1,15	1,3

### 2. Calculation example (*with* consideration of the operating conditions)

worm gear set A40 Ü35;  $T_2 = 65,6 \text{ Nm}$  (see above), but with the following operating conditions:

- heavy shocks
- 360 starts / h
- 100 % duty cycle 1,5

$$\begin{aligned} \text{Output torque} &= \frac{T_2}{f_1 \times f_2 \times f_3} \\ &= \frac{65,6 \text{ Nm}}{1,5 \times 1,2 \times 1,3} \\ &= 28 \text{ Nm} \end{aligned}$$

## 4 Framo - Worm gear sets (Framo-Norm)

The relationship between life time, speed and torque can be calculated by these simplified formulas

Calculation of the life time ( $L_{h\text{ neu}}$ ) with given torque ( $T_{2\text{ neu}}$ )

$$L_{h\text{ neu}} = \left( \frac{T_{2\text{ Nenn.}} \times \text{Factor } n_1}{T_{2\text{ neu}}} \right)^2 \cdot L_{h\text{ Nenn}}$$

$T_{2\text{ Nenn.}}$  = Output torque (catalog specification)

$L_{h\text{ Nenn}}$  = Life time (catalog specification ca. 3000 h)

Calculation of the torque ( $T_{2\text{ neu}}$ ) with given life time ( $L_{h\text{ neu}}$ )

$$T_{2\text{ neu}} = \frac{T_{2\text{ Nenn.}} \times \text{Factor } n_1}{\sqrt{\frac{L_{h\text{ neu}}}{L_{h\text{ Nenn}}}}}$$

### Self locking

Self-locking is affected by lead angle, surface quality, running speed, lubrication and temperature. A distinction must be made between dynamic (from motion) and static (standstill) self-locking.

**Dynamic self locking:** lead angle up to  $3^\circ$  with grease lubrication; lead angle up to  $2,5^\circ$  with synthetic oil lubrication.

**Static self locking:** lead angle from  $3^\circ$  up to  $5^\circ$  with grease lubrication; lead angle from  $2,5^\circ$  up to  $4,5^\circ$  with synthetic oil lubrication.

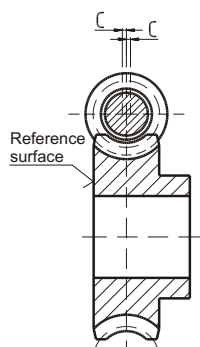
Lead angles above  $4,5^\circ$  or  $5^\circ$  are not self locking.

Shocks or vibrations can neutralize self-locking.

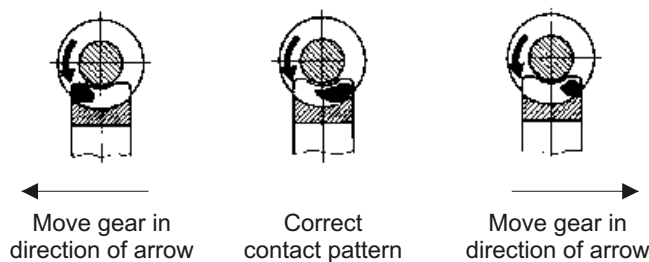
A number of factors associated with lubrication, running speed and loading can favour slip characteristics to such an extent that self-locking is counteracted.

Therefore it is impossible for us to accept warranty obligations in respect to self-locking.

### Mounting of the worm gear



Use the reference surface for lateral adjustment. The lateral tolerance "c" must not exceed 0,15 mm regardless of the center distance.



The contact pattern shows installation errors. The contact pattern should tend to the outgoing side. In case of reversing operation the contact pattern should tend to the center of the worm gear.

### Efficiency

Generally efficiency depends on the following conditions:

- lead angle of the worm,
- running speed,
- lubrication,
- surface quality,
- mounting conditions.

The efficiency increases with growing center distance. The use of plain bearings with high coefficients of friction may affect the overall efficiency. The stated efficiency values apply for optimum mounting conditions.

## Starting efficiency

The lubricating film between the flanks is not formed until the gear is running. That is the reason for a lower starting efficiency (approx. 30% below running efficiency).

## Efficiency with driving worm gear

The efficiency with driving worm gear is smaller than with driving worm. The following formula can be used:

$$\eta' = 2 - \frac{1}{\eta}$$

with:  $\eta'$  => efficiency with driving worm gear  
 $\eta$  => efficiency with driving worm (specified in catalog)

if  $\eta'$  is negative, self locking is likely.

## Custom worm gear sets

Custom worm gear sets are produced in different versions and materials according to cutomers specification. Framo offers custom worm gear sets in the range of 17 mm - 125 mm center distance with a max. worm gear diameter of approx. 200 mm. Framo sizes worm gear sets and specifies materials and lubrications on demand.

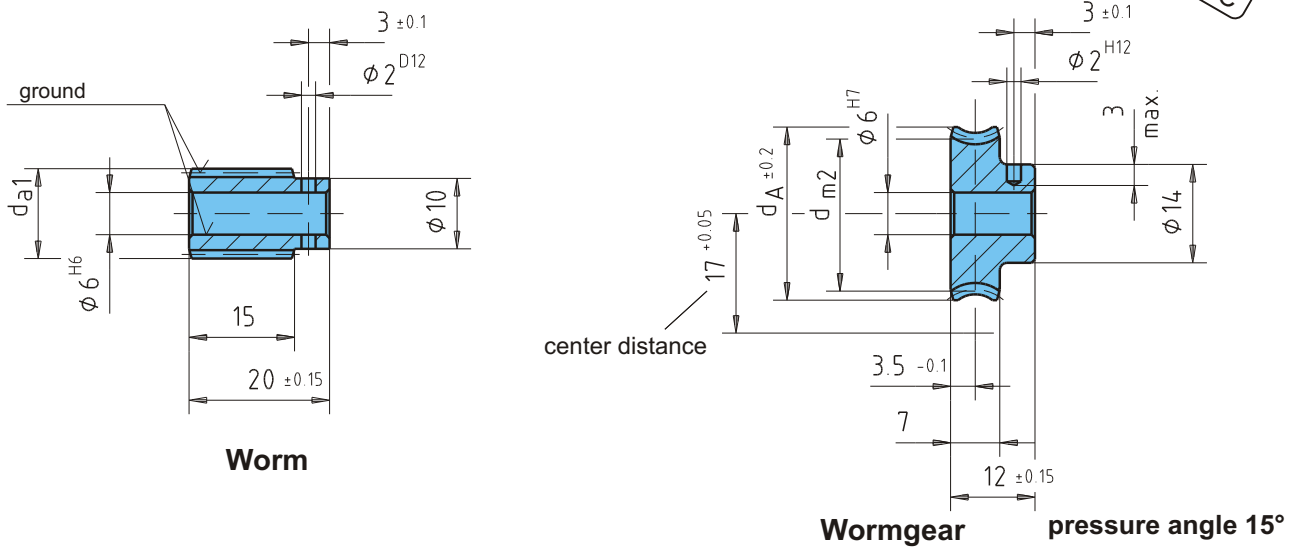
## Crossed helical gears

Crossed helical gears are nothing but a spur gear with helix angle meets the lead angle of the worm. The gliding surface is only a line. The result is reduced torque or reduced life time compared with conventional worm gear sets.



# A17 (17 mm center distance)

METRIC



$i$  = gear ratio  
 $m$  = lead angle  
 $m$  = module  
 $z_1$  = number of threads  
 $d_{m1}$  = pitch diameter (worm)

$d_{a1}$  = tip diameter (worm)  
 $z_2$  = No. of teeth  
 $d_{m2}$  = pitch diameter (worm gear)  
 $d_A$  = max. diameter (worm gear)  
 $T_2$  = output torque

MG = mineral grease  
 MO = mineral oil / synthetic grease  
 SO = synthetic oil

Catalog No.				worm			wormgear			$T_2$ [Nm]			
	$i$	$m$	$m$	$z_1$	$d_{m1}$	$d_{a1}$	$z_2$	$d_{m2}$	$d_A$	Bronze			Phenolic
										MG	MO	SO	
A17U2*	2.25	48°15'	0.9	8	10.15	11.95	18	23.85	25.63	1.1	1.3	1.6	0.4
A17U4	4.5	21°50'	0.75	6	12.1	13.6	27	21.9	24.6	1.7	2.0	2.6	0.7
A17U5	5	21°37'	0.7	6	11.4	12.8	30	22.6	24.6	1.8	2.2	2.7	0.7
A17U7	7	14°4'	1	3	12.34	14.34	21	21.66	24.6	1.6	1.9	2.4	0.6
A17U9	9	9°40'	0.75	3	13.4	14.9	27	20.6	22.7	1.5	1.8	2.2	0.6
A17U10	10	11°48'	0.75	3	11.0	12.5	30	23.0	24.6	1.9	2.3	2.8	0.8
A17U15	15	7°38'	0.75	2	11.3	12.8	30	22.7	24.6	1.9	2.3	2.8	0.8
A17U25	25	4°32'	0.9	1	11.4	13.2	25	22.6	24.6	1.8	2.2	2.7	0.7
A17U30	30	3°45'	0.75	1	11.45	12.95	30	22.55	24.6	1.9	2.3	2.8	0.8
A17U40	40	2°3'	0.5	1	13.98	14.98	40	20.02	21.6	1.4	1.7	2.1	0.6
A17U50**	50	3°12'	0.5	1	8.95	9.95	50	25.05	27.2	1.0	1.2	1.5	0.4
A17U60	60	2°18'	0.4	1	9.95	10.75	60	24.05	26.0	1.6	1.9	2.4	0.6
A17U75	75	1°28'	0.3	1	11.74	12.34	75	22.26	24.0	-	-	-	-
A17U80	80	1°43'	0.3	1	10.0	10.6	80	24.0	26.0	-	-	-	-

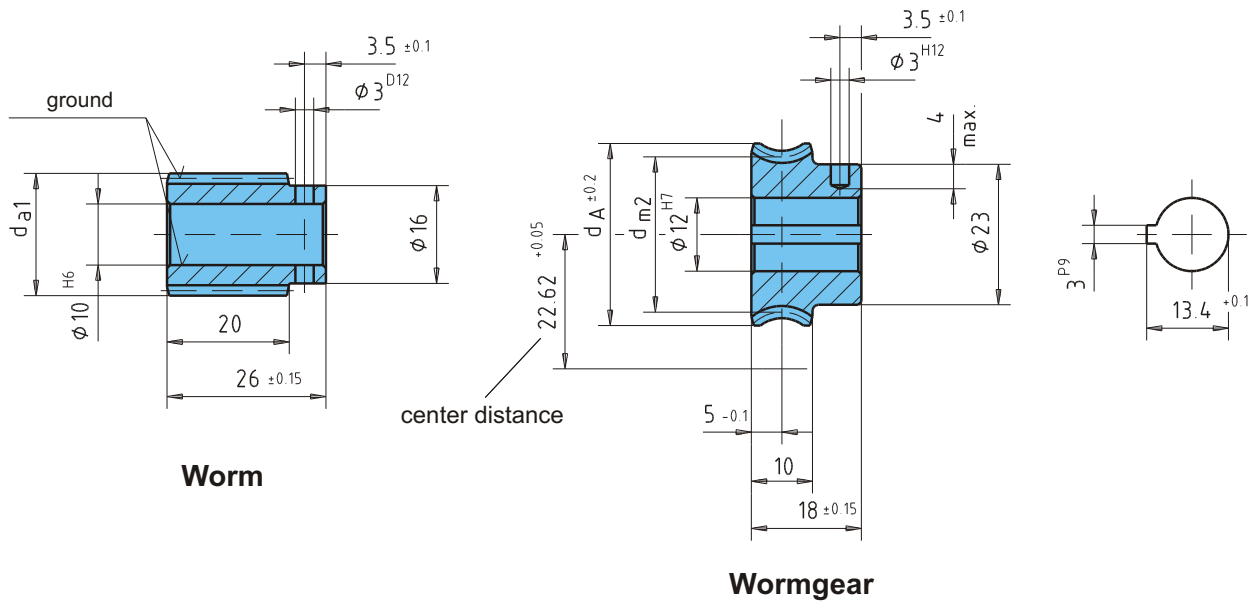
\* Worm gear set A17U2 only available with polished worm profile and crossed helical gear.

\*\* The hub diameter of the A17U50 worm is 9 mm. The worm gear of the A17U50 gear set can also be delivered as a crossed helical gear ( $d_A = 25.73\text{mm}$ )

All worms and worm gears stocked right hand only.  
 Worm made of case hardened and ground steel (HV 620 - 700).  
 Worm gear made of CuZn40Al2/So or phenolic (Hgw 2083). Phenolic worm gears do not have the pre-drilled start for a pin. The outside diameter of the phenolic gear hub is 18 mm.

METRIC

**A22 (22.62 mm center distance)**



pressure angle 15°

$i$  = gear ratio  
 $\alpha_m$  = lead angle  
 $m$  = module  
 $z_1$  = number of threads  
 $d_{m1}$  = pitch diameter (worm)

$d_{a1}$  = tip diameter (worm)  
 $z_2$  = No. of teeth  
 $d_{m2}$  = pitch diameter (worm gear)  
 $d_A$  = max. diameter (worm gear)  
 $T_2$  = output torque

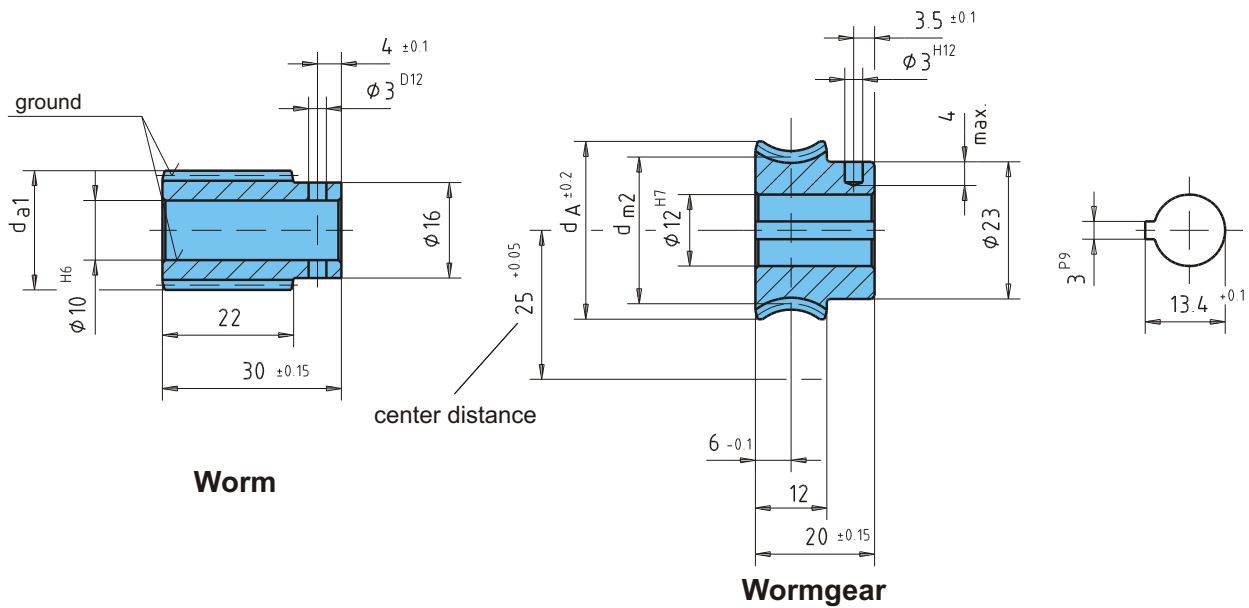
MG = mineral grease  
 MO = mineral oil / synthetic grease  
 SO = synthetic oil

Catalog No.	worm			wormgear			$T_2$ [Nm]						
	$i$	$\alpha_m$	$m$	$z_1$	$d_{m1}$	$d_{a1}$	$z_2$	$d_{m2}$	$d_A$	Bronze			Phe-nolic
										MG	MO	SO	
<b>A22U3</b>	3:1	17°36'	1.0	7	23.15	25.15	21	22.09	24.8	2.2	2.6	3.3	0.9
<b>A22U4</b>	4:1	19°32'	1.25	5	18.7	21.2	20	26.54	29.8	3.6	4.3	5.4	1.4
<b>A22U7</b>	7:1	11°46'	1.25	3	18.4	20.9	21	26.84	29.8	3.6	4.3	5.4	1.4
<b>A22U11</b>	10.5:1	7°41'	1.25	2	18.7	21.2	21	26.54	29.8	3.4	4.1	5.1	1.4
<b>A22U21</b>	21:1	3°48'	1.25	1	18.9	21.4	21	26.34	29.8	3.4	4.1	5.1	1.4
<b>A22U30</b>	30:1	2°50'	0.9	1	18.2	20	30	27.04	29.8	3.6	4.3	5.4	1.4
<b>A22U40</b>	40:1	2°20'	0.7	1	17.2	18.6	40	28.04	29.8	3.9	4.7	5.8	1.6

All worms and worm gears stocked right hand only.  
 Worm made of case hardened and ground steel (HV 620 - 700).  
 Worm gear made of CuZn40Al2/So or phenolic (Hgw 2083).

METRIC

# A25 (25 mm center distance)



pressure angle 15°

i = gear ratio  
 $\alpha_m$  = lead angle  
 m = module  
 $z_1$  = number of threads  
 $d_{m1}$  = pitch diameter (worm)

$d_{a1}$  = tip diameter (worm)  
 $z_2$  = No. of teeth  
 $d_{m2}$  = pitch diameter (worm gear)  
 $d_A$  = max. diameter (worm gear)  
 $T_2$  = output torque

MG = mineral grease  
 MO = mineral oil / synthetic grease  
 SO = synthetic oil

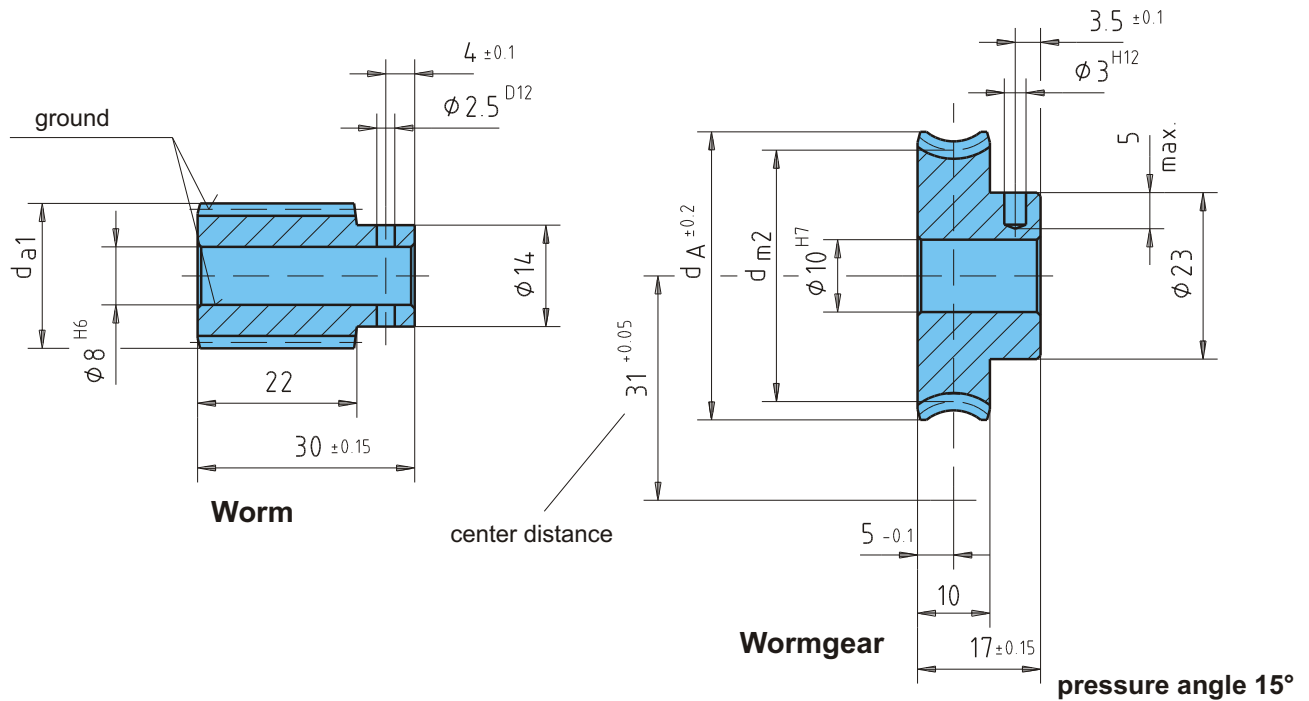
Catalog No.				worm			wormgear			$T_2$ [Nm]			
	i	$\alpha_m$	m	$z_1$	$d_{m1}$	$d_{a1}$	$z_2$	$d_{m2}$	$d_A$	Bronze			Phenolic
										MG	MO	SO	
A25U4	4:1	20°29'	1.4	5	20	22.8	20	30.0	33.5	5.1	6.1	7.6	2.0
A25U5	5:1	19°15'	1.5	4	18.2	21.2	20	31.8	34.8	6.5	7.8	9.7	2.6
A25U6	6.5:1	13°52'	1.15	4	19.2	21.5	26	30.8	34.4	6	7.2	9	2.4
A25U10	10:1	8°48'	1.5	2	19.6	22.6	20	30.4	34.4	5.9	7.1	8.8	2.4
A25U15	15:1	6°29'	1.0	2	17.7	19.7	30	32.3	34.8	5.7	6.8	8.5	2.3
A25U20	20:1	4°19'	1.5	1	19.9	22.9	20	30.1	34.4	5.8	7.0	8.7	2.3
A25U25	25:1	2°18'	1.0	1	24.96	26.96	25	25.04	27.8	4.1	4.9	6.1	1.6
A25U30	30:1	2°53'	1.0	1	19.9	21.9	30	30.1	33.5	5.9	7.1	8.8	2.4
A25U40	40:1	2°33'	0.8	1	17.96	19.56	40	32.04	34.4	6.2	7.4	9.3	2.5
A25U50	50:1	1°43'	0.6	1	19.96	21.16	50	30.04	33.5	5.1	6.1	7.6	2.0

All worms and worm gears stocked right hand only.  
 Worm made of case hardened and ground steel (HV 620 - 700).  
 Worm gear made of CuZn40Al2/So or phenolic (Hgw 2083).



METRIC

# A31 (31 mm center distance)



i = gear ratio  
 $\alpha_m$  = lead angle  
 m = module  
 $z_1$  = number of threads  
 $d_{m1}$  = pitch diameter (worm)

$d_{a1}$  = tip diameter (worm)  
 $z_2$  = No. of teeth  
 $d_{m2}$  = pitch diameter (worm gear)  
 $d_A$  = max. diameter (worm gear)  
 $T_2$  = output torque

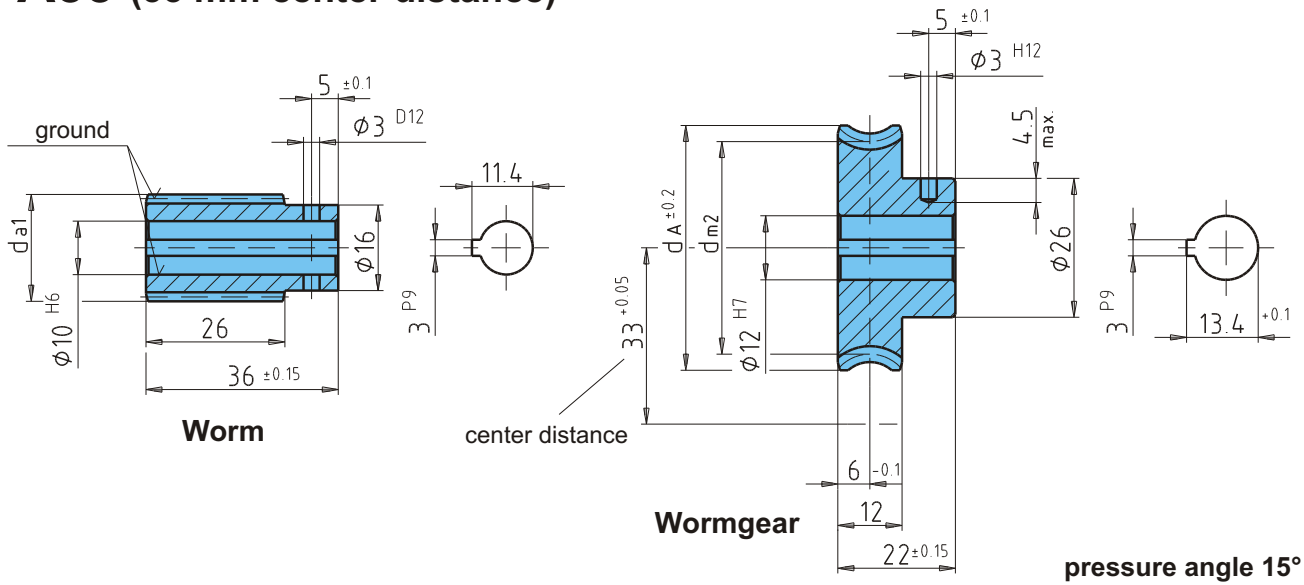
MG = mineral grease  
 MO = mineral oil / synthetic grease  
 SO = synthetic oil

Catalog No.	i	$\alpha_m$	m	worm			wormgear			$T_2$ [Nm]			
				$z_1$	$d_{m1}$	$d_{a1}$	$z_2$	$d_{m2}$	$d_A$	Bronze MG	Bronze MO	Bronze SO	Phenolic
A31U25	25:1	5°35'	1.75	1	18	21.5	25	44	48.5	9.6	11.5	14.4	3.8
A31U28	28:1	4°20'	1.5	1	19.85	22.85	28	42.15	46.5	9.1	10.9	13.6	3.6
A31U30	30:1	5°7'	1.5	1	16.8	19.8	30	45.2	48.8	10.3	12.4	15.4	4.1
A31U32	32:1	4°45'	1.4	1	16.9	19.7	32	45.1	48.8	10.2	12.2	15.3	4.1
A31U38	38:1	5°1'	1.25	1	14.3	16.8	38	47.7	51.2	11.4	13.7	17.1	4.6
A31U45	45:1	3°23'	1	1	16.93	18.93	45	45.07	48	9.5	11.4	14.2	3.8
A31U50	50:1	3°3'	0.9	1	16.9	18.7	50	45.1	48	9	10.8	13.5	3.6
A31U55	55:1	4°12'	0.9	1	12.3	14.1	55	49.7	52	10.4	12.5	15.6	4.2
A31U60	60:1	2°33'	0.75	1	16.9	18.4	60	45.1	48	8.2	9.8	12.3	3.3
A31U70	70:1	3°7'	0.7	1	12.9	14.3	70	49.1	52	9	10.8	13.5	3.6
A31U75	75:1	2°2'	0.6	1	16.9	18.1	75	45.1	47	7.3	8.8	10.9	2.9
A31U90	90:1	1°41'	0.5	1	17	18	90	45	48	6.4	7.7	9.6	2.6
A31U100	100:1	2°24'	0.5	1	11.96	12.96	100	50.04	52.7	7.4	8.9	11.1	3.0

All worms and worm gears stocked right hand only, worm made of case hardened and ground steel (HV 620 - 700). Worm gear made of CuZn40Al2/So or phenolic (Hgw 2083). Also available with keyway 3P9.

METRIC

**A33 (33 mm center distance)**



- i = gear ratio
- $\alpha_m$  = lead angle
- m = module
- $z_1$  = number of threads
- $d_{m1}$  = pitch diameter (worm)
- $d_{a1}$  = tip diameter (worm)
- $z_2$  = No. of teeth
- $d_{m2}$  = pitch diameter (worm gear)
- $d_A$  = max. diameter (worm gear)
- $T_2$  = output torque
- MG = mineral grease
- MO = mineral oil / synthetic grease
- SO = synthetic oil

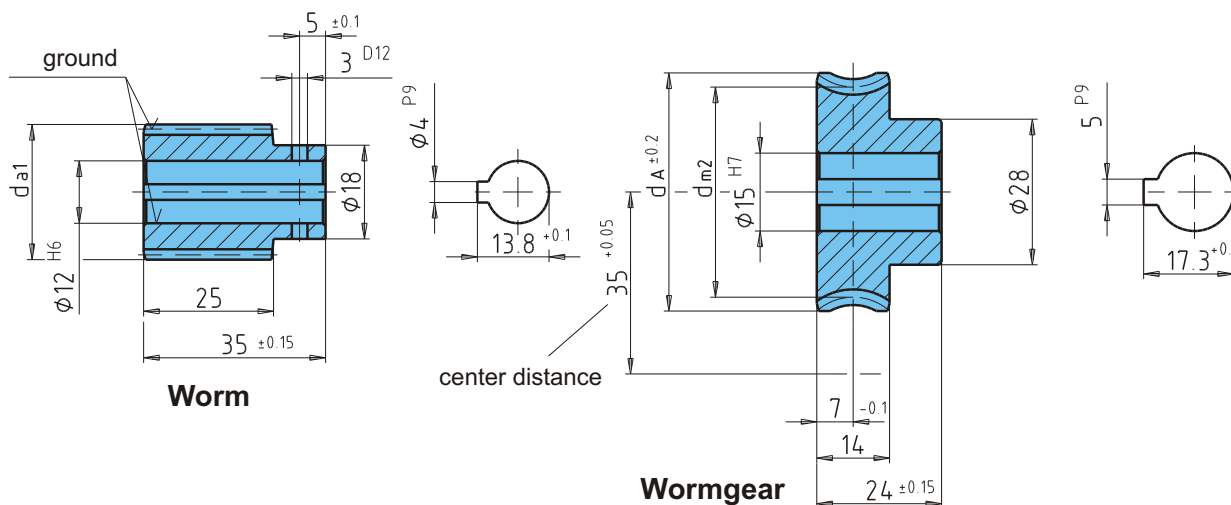
Catalog No.	worm						wormgear			$T_2$ [Nm]			
	i	$\alpha_m$	m	$z_1$	$d_{m1}$	$d_{a1}$	$z_2$	$d_{m2}$	$d_A$	Bronze MG	MO	SO	Phenolic
A33U3	3.5:1	25°57'	1.75	6	24	27.5	21	42	47	10.1	12.1	15.1	4.0
A33U5	5:1	20°50'	2	4	22.5	26.5	20	43.5	49	10.6	12.7	15.9	4.2
A33U7	7:1	15°32'	1.5	4	22.4	25.4	28	43.6	48	12.2	14.6	18.3	4.9
A33U10	10:1	13°10'	1.5	3	19.75	22.75	30	46.25	51	13.3	16	19.9	5.3
A33U11	11.33:1	10°42'	1.3	3	21	23.6	34	45	49.2	13.3	16	19.9	5.3
A33U12	12:1	11°14'	1.9	2	19.5	23.3	24	46.5	52	13.5	16.2	20.2	5.4
A33U14	14:1	7°20'	1.5	2	23.5	26.5	28	42.5	47	11.4	13.7	17.1	4.6
A33U15	15:1	8°25'	1.5	2	20.5	23.5	30	45.5	50	13	15.6	19.5	5.2
A33U16	16:1	10°1'	1.5	2	17.24	20.24	32	48.76	53	14	16.8	21	5.6
A33U17	17:1	9°3'	1.4	2	17.8	20.6	34	48.2	52.5	14.2	17	21.3	5.7
A33U18	18:1	6°57'	1.25	2	20.65	23.15	36	45.35	49.2	12.6	15.1	18.9	5.0
A33U20	20:1	6°43'	1.15	2	19.66	21.96	40	46.34	50.5	12.7	15.2	19	5.1
A33U24	24:1	5°27'	1.9	1	20	23.8	24	46	51	13.2	15.8	19.8	5.3
A33U28	28:1	3°36'	1.5	1	23.9	26.9	28	42.1	46.6	11.2	13.4	16.8	4.5
A33U30	30:1	4°8'	1.5	1	20.85	23.85	30	45.15	50	12.7	15.2	19	5.1
A33U32	32:1	4°50'	1.5	1	17.8	20.8	32	48.2	52.5	13.5	16.2	20.2	5.4
A33U38	38:1	3°55'	1.25	1	18.26	20.76	38	47.74	51.6	13.9	16.7	20.8	5.6
A33U50	50:1	2°27'	0.9	1	21	22.8	50	45	48	10	12	15	4.0
A33U56	56:1	2°10'	0.8	1	21.15	22.75	56	44.85	48	10.1	12.1	15.1	4.0
A33U60	60:1	2°33'	0.8	1	17.96	19.56	60	48.04	51.5	11.4	13.7	17.1	4.6
A33U72	72:1	1°30'	0.6	1	22.8	24	72	43.2	46	8.4	10.1	12.6	3.4
A33U75	75:1	1°41'	0.6	1	20.5	21.7	75	45.5	48	9	10.8	13.5	3.6

All worms and worm gears stocked right hand only, worm made of case hardened and ground steel (HV 620 - 700). Worm gear made of CuZn40Al2/So or phenolic (Hgw 2083).

DS-012e1/07.05

METRIC

# A35 (35 mm center distance)



pressure angle 15°

i = gear ratio  
 $\alpha_m$  = lead angle  
 m = module  
 $z_1$  = number of threads  
 $d_{m1}$  = pitch diameter (worm)

$d_{a1}$  = tip diameter (worm)  
 $z_2$  = No. of teeth  
 $d_{m2}$  = pitch diameter (worm gear)  
 $d_A$  = max. diameter (worm gear)  
 $T_2$  = output torque

MG = mineral grease  
 MO = mineral oil / synthetic grease  
 SO = synthetic oil

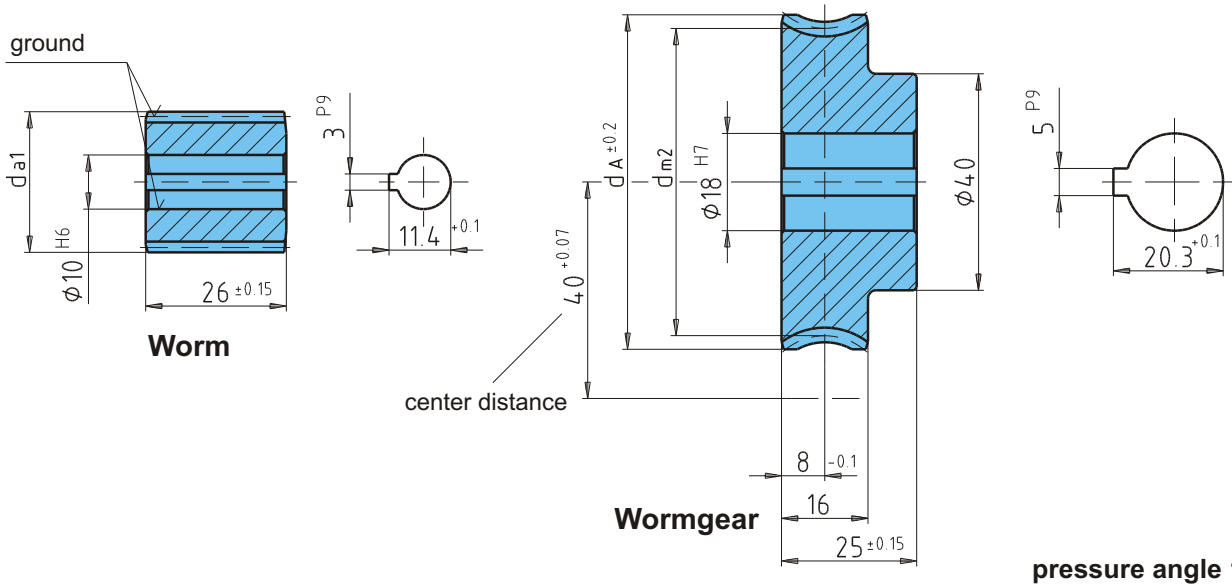
Catalog No.				worm			wormgear			T <sub>2</sub> [Nm]		
	i	$\alpha_m$	m	$z_1$	$d_{m1}$	$d_{a1}$	$z_2$	$d_{m2}$	$d_A$	Bronze		
										MG	MO	SO
A35U3*	2.78:1	31°55'	1.5	9	26.2	29.2	25	43.8	46.76	6.6	8.2	10.2
A35U5	5:1	22°52'	1.75	5	22.52	26.02	25	47.48	53	15.3	18.4	22.9
A35U7	7.25:1	13°47'	1.5	4	25.18	28.18	29	44.82	50	14.7	17.6	22
A35U8	8:1	14°25'	1.9	3	22.89	26.69	24	47.11	53	16.7	20	25
A35U10	10:1	10°43'	1.5	3	24.2	27.2	30	45.8	51	16	19.2	24
A35U11	11:1	10°32'	1.4	3	22.98	25.78	33	47.02	52	16.7	20	25
A35U12	12:1	9°11'	1.9	2	23.8	27.6	24	46.2	52	16.1	19.3	24
A35U15	15:1	7°	1.5	2	24.62	27.62	30	45.38	50	15.3	18.4	22.9
A35U20	20:1	5°33'	1.15	2	23.78	26.08	40	46.22	50.5	14.8	17.8	22.2
A35U25	25:1	4°9'	0.9	2	24.87	26.67	50	45.13	49	12.9	15.5	19.3
A35U30	30:1	3°27'	1.5	1	24.92	27.92	30	45.08	50	15	18	22.5
A35U35	35:1	3°51'	1.4	1	20.85	23.65	35	49.15	53	17.1	20.5	25.6
A35U40	40:1	2°45'	1.15	1	23.91	26.21	40	46.09	50.5	14.7	17.6	22
A35U50	50:1	2°4'	0.9	1	24.93	26.73	50	45.07	49	12.9	15.5	19.3
A35U58	58:1	2°21'	0.85	1	20.65	22.35	58	49.35	53	14.5	17.4	21.7
A35U90	90:1	1°9'	0.5	1	25	26	90	45	49	9.1	10.9	13.6

\* The worm gear of the A35U3 gear set can also be delivered as a crossed helical gear, pressure angle 20°.

All worms and worm gears stocked right hand only, worm made of case hardened and ground steel (HV 620 - 700). Worm gear made of CuZn40Al2/So.

METRIC

**A40 (40 mm center distance)**



$i$  = gear ratio  
 $\alpha_m$  = lead angle  
 $m$  = module  
 $z_1$  = number of threads  
 $d_{m1}$  = pitch diameter (worm)

$d_{a1}$  = tip diameter (worm)  
 $z_2$  = No. of teeth  
 $d_{m2}$  = pitch diameter (worm gear)  
 $d_A$  = max. diameter (worm gear)  
 $T_2$  = output torque

MG = mineral grease  
 MO = mineral oil / synthetic grease  
 SO = synthetic oil

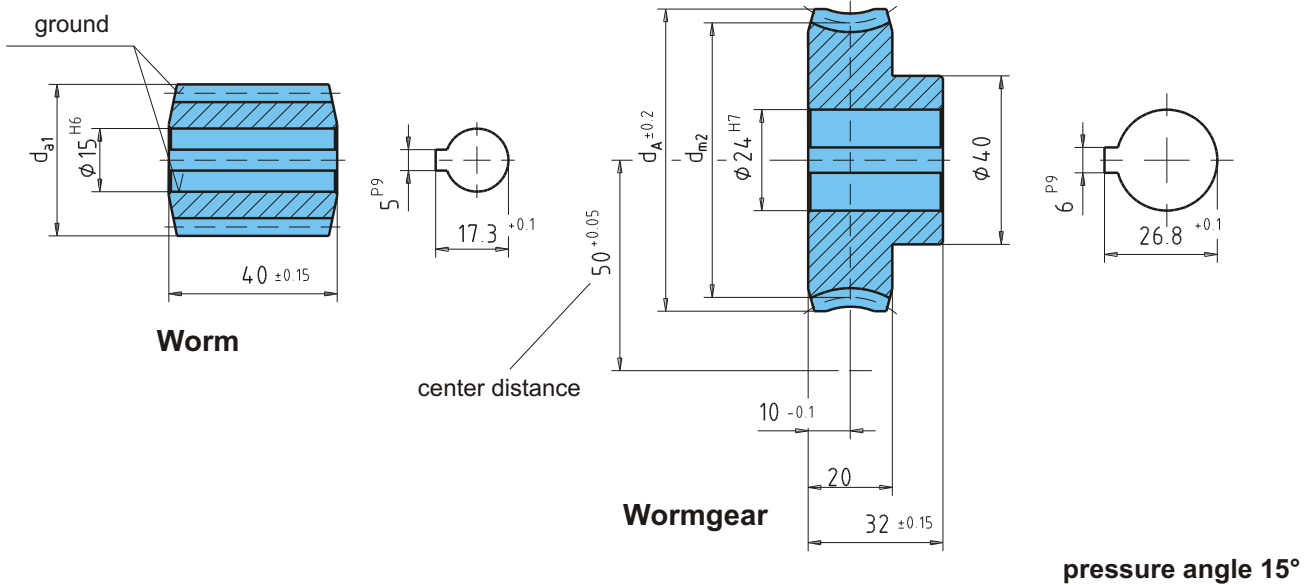
Catalog No.	i		m	worm			worm gear			T <sub>2</sub> [Nm]		
	i	$\alpha_m$		$z_1$	$d_{m1}$	$d_{a1}$	$z_2$	$d_{m2}$	$d_A$	MG	MO	SO
A40U7	6.75:1	21°19'	2	4	22	26	27	58	64	29.5	35.4	44.2
A40U8	8:1	16°35'	2.25	3	23.64	28.14	24	56.36	62.5	27.5	33	41.2
A40U10	10:1	16°1'	1.9	3	20.66	24.46	30	59.34	65	29.5	35.4	44.2
A40U12	12:1	10°21'	1.5	3	25.05	28.05	36	54.95	60	25.2	30.2	37.8
A40U15	15:1	9°53'	1.9	2	22.14	25.94	30	57.86	64	28	33.6	42
A40U20	20:1	8°59'	1.5	2	19.2	22.2	40	60.8	66	28.9	34.6	43.3
A40U25	25:1	5°58'	1.15	2	22.15	24.45	50	57.85	62	24.4	29.2	36.6
A40U28	28:1	4°47'	2	1	24	28	28	56	61.5	28.4	34	42.6
A40U30	30:1	5°50'	2	1	19.68	23.68	30	60.32	66	30.1	36.1	45.1
A40U35	35:1	5°26'	1.75	1	18.48	21.98	35	61.52	67	31	37.2	46.5
A40U36	36:1	3°19'	1.5	1	25.91	28.91	36	54.09	59	23.9	28.6	35.8
A40U38	38:1	3°46'	1.5	1	22.85	25.85	38	57.17	61.5	27	32.4	40.5
A40U40	40:1	4°20'	1.5	1	19.83	22.83	40	60.17	65	28.3	33.9	42.4
A40U50	50:1	4°8'	1.25	1	17.3	19.8	50	62.7	68	27	32.4	40.5
A40U56	56:1	2°23'	1	1	24	26	56	56	59	21.9	26.2	32.8
A40U60	60:1	1°59'	0.9	1	25.92	27.72	60	54.08	57.5	19.3	23.1	28.9
A40U70	70:1	3°3'	0.9	1	16.91	18.71	70	63.09	67	24.1	28.9	36.1
A40U75	75:1	1°48'	0.75	1	23.75	25.25	75	56.26	60	18.8	22.5	28.2
A40U80	80:1	2°10'	0.75	1	19.9	21.4	80	60.1	64	20.1	24.1	30.1
A40U90	90:1	2°22'	0.7	1	16.95	18.35	90	63.05	67	19.1	22.9	28.6

All worms and worm gears stocked right hand only, worm made of case hardened and ground steel (HV 620 - 700). Worm gear made of CuZn40Al2/So.

DS-014e1/07.05

METRIC

**A50 (50 mm center distance)**



$i$  = gear ratio  
 $\alpha_m$  = lead angle  
 $m$  = module  
 $z_1$  = number of threads  
 $d_{m1}$  = pitch diameter (worm)

$d_{a1}$  = tip diameter (worm)  
 $z_2$  = No. of teeth  
 $d_{m2}$  = pitch diameter (worm gear)  
 $d_A$  = max. diameter (worm gear)  
 $T_2$  = output torque

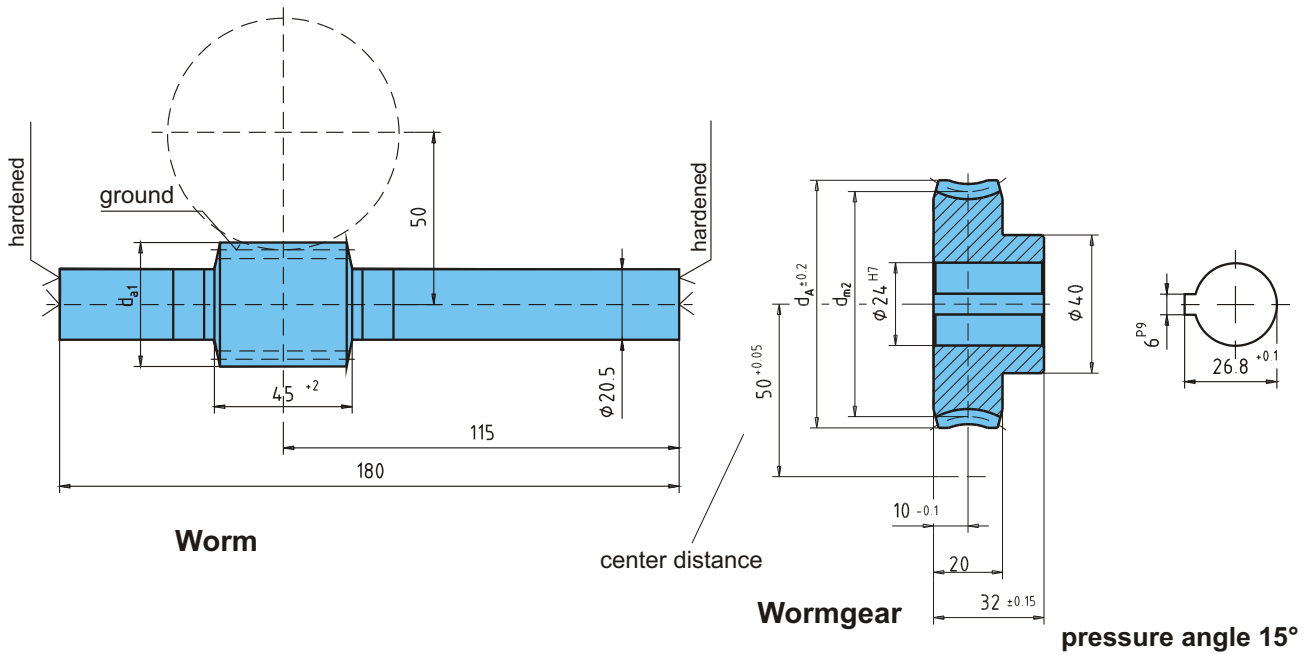
MG = mineral grease  
 MO = mineral oil / synthetic grease  
 SO = synthetic oil

Catalog No.				worm		wormgear			T <sub>2</sub> [Nm]			
	i	$\alpha_m$	m	z <sub>1</sub>	d <sub>m1</sub>	d <sub>a1</sub>	z <sub>2</sub>	d <sub>m2</sub>	d <sub>A</sub>	MG	MO	SO
<b>A50U4</b>	4.25:1	25°51'	3.5	4	32.1	39.1	17	67.9	77	34	40.8	51
<b>A50U6</b>	6:1	19°17'	3.5	3	31.8	38.8	18	68.2	77	52	62.4	78
<b>A50U9</b>	8.66:1	13°52'	2.5	3	31.29	36.29	26	68.71	77	64.3	77.1	96.4
<b>A50U12</b>	12:1	10°23'	2.75	2	30.5	36	24	69.5	77	66.4	79.6	99.6
<b>A50U14</b>	13.5:1	9°38'	2.5	2	29.9	34.9	27	70.1	77	62.8	75.4	94.2
<b>A50U19</b>	19:1	6°17'	3.5	1	32	39	19	68	77	78.2	93.8	117.3
<b>A50U23</b>	23:1	5°38'	3	1	30.58	36.58	23	69.42	77	71.1	85.3	106.6
<b>A50U27</b>	27:1	4°40'	2.5	1	30.73	35.73	27	69.27	77	64.5	77.4	96.7
<b>A50U35</b>	35:1	3°51'	2	1	29.78	33.78	35	70.22	77	56.7	68	85
<b>A50U46</b>	46:1	2°47'	1.5	1	30.85	33.85	46	69.15	74	50.6	60.7	75.9
<b>A50U55</b>	55:1	2°19'	1.25	1	30.9	33.4	55	69.1	74	46.2	55.4	69.3
<b>A50U69</b>	69:1	1°51'	1	1	30.9	32.9	69	69.1	74	41.4	49.6	62.8

All worms and worm gears stocked right hand only, worm made of case hardened and ground steel (HV 620 - 700). Worm gear made of CuZn40Al2/So.

METRIC

**A50 (50 mm center distance)**



$i$  = gear ratio  
 $\alpha_m$  = lead angle  
 $m$  = module  
 $z_1$  = number of threads  
 $d_{m1}$  = pitch diameter (worm)

$d_{a1}$  = tip diameter (worm)  
 $z_2$  = No. of teeth  
 $d_{m2}$  = pitch diameter (worm gear)  
 $d_A$  = max. diameter (worm gear)  
 $T_2$  = output torque

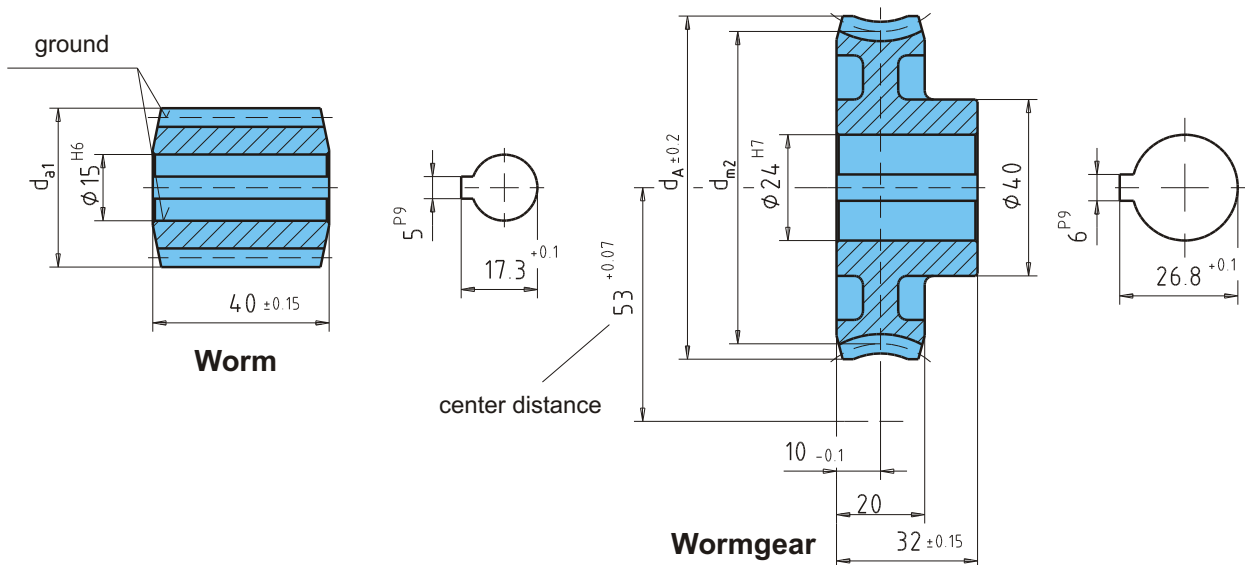
MG = mineral grease  
 MO = mineral oil / synthetic grease  
 SO = synthetic oil

Catalog No.				worm			wormgear			$T_2$ [Nm]		
	$i$	$\alpha_m$	$m$	$z_1$	$d_{m1}$	$d_{a1}$	$z_2$	$d_{m2}$	$d_A$	Bronze		
										MG	MO	SO
A50U4	4.25:1	25°51'	3.5	4	32.1	39.1	17	67.9	77	34	40.8	51
A50U6	6:1	19°17'	3.5	3	31.8	38.8	18	68.2	77	52	62.4	78
A50U9	8.66:1	13°52'	2.5	3	31.29	36.29	26	68.71	77	64.3	77.1	96.4
A50U12	12:1	10°23'	2.75	2	30.5	36	24	69.5	77	66.4	79.6	99.6
A50U14	13.5:1	9°38'	2.5	2	29.9	34.9	27	70.1	77	62.8	75.4	94.2
A50U19	19:1	6°17'	3.5	1	32	39	19	68	77	78.2	93.8	117.3
A50U23	23:1	5°38'	3	1	30.58	36.58	23	69.42	77	71.1	85.3	106.6
A50U27	27:1	4°40'	2.5	1	30.73	35.73	27	69.27	77	64.5	77.4	96.7
A50U35	35:1	3°51'	2	1	29.78	33.78	35	70.22	77	56.7	68	85
A50U46	46:1	2°47'	1.5	1	30.85	33.85	46	69.15	74	50.6	60.7	75.9
A50U55	55:1	2°19'	1.25	1	30.9	33.4	55	69.1	74	46.2	55.4	69.3
A50U69	69:1	1°51'	1	1	30.9	32.9	69	69.1	74	41.4	49.6	62.8

All worms and worm gears stocked right hand only, worm made of case hardened and ground steel (HV 620 - 700), shafts not hardened. Worm gear made of CuZn40Al2/So.

METRIC

# A53 (53 mm center distance)



pressure angle 15°

i = gear ratio  
 $\alpha_m$  = lead angle  
 m = module  
 $z_1$  = number of threads  
 $d_{m1}$  = pitch diameter (worm)

$d_{a1}$  = tip diameter (worm)  
 $z_2$  = No. of teeth  
 $d_{m2}$  = pitch diameter (worm gear)  
 $d_A$  = max. diameter (worm gear)  
 $T_2$  = output torque

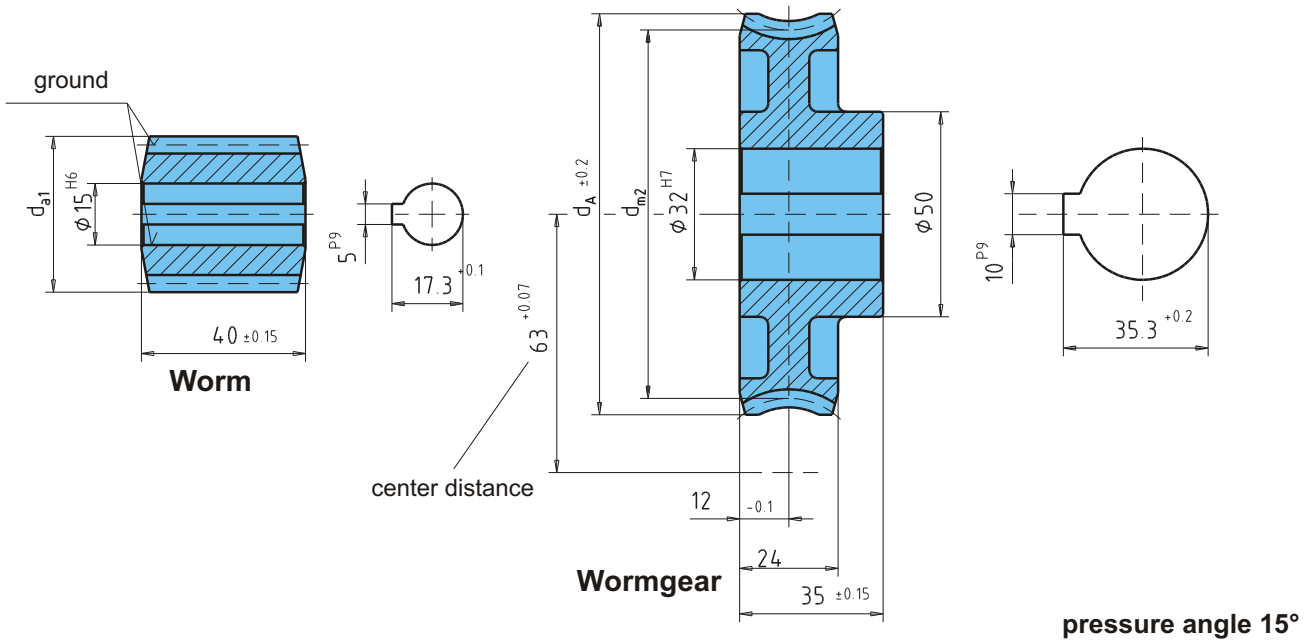
MG = mineral grease  
 MO = mineral oil / synthetic grease  
 SO = synthetic oil

Catalog No.				worm			wormgear			T <sub>2</sub> [Nm]		
	i	$\alpha_m$	m	$z_1$	$d_{m1}$	$d_{a1}$	$z_2$	$d_{m2}$	$d_A$	MG	MO	SO
A53U5	4.75:1	25°51'	3.5	4	32.1	39.1	19	73.9	83	45	54	67.5
A53U7	6.67:1	19°17'	3.5	3	31.8	38.8	20	74.2	84	67	81	101
A53U10	9.67:1	13°52'	2.5	3	31.29	36.29	29	74.71	82	77	93	116
A53U14	13.5:1	10°23'	2.75	2	30.5	36	27	75.5	84	80	96	120
A53U15	15:1	9°38'	2.5	2	29.9	34.9	30	76.1	83	75	90	113
A53U21	21:1	6°17'	3.5	1	32	39	21	74	83	94	113	141
A53U25	25:1	5°38'	3	1	30.58	36.58	25	75.42	84	84	101	127
A53U28	28:1	3°59'	2.5	1	36	41	28	70	77.5	87	104	130
A53U30	30:1	4°40'	2.5	1	30.73	35.73	30	75.27	83	77	93	116
A53U38	38:1	3°51'	2	1	29.78	33.78	38	76.21	83	68	81	102
A53U50	50:1	2°47'	1.5	1	30.85	33.85	50	75.15	81	60	72	90
A53U60	60:1	2°19'	1.25	1	30.9	33.4	60	75.1	80	55	66	82
A53U75	75:1	1°51'	1	1	30.9	32.9	75	75.1	78	49	59	74

All worms and worm gears stocked right hand only, worm made of case hardened and ground steel (HV 620 - 700). Worm gear made of CuZn40Al2/So.

METRIC

**A63 (63 mm center distance)**



$i$  = gear ratio  
 $\alpha_m$  = lead angle  
 $m$  = module  
 $z_1$  = number of threads  
 $d_{m1}$  = pitch diameter (worm)

$d_{a1}$  = tip diameter (worm)  
 $z_2$  = No. of teeth  
 $d_{m2}$  = pitch diameter (worm gear)  
 $d_A$  = max. diameter (worm gear)  
 $T_2$  = output torque

MG = mineral grease  
 MO = mineral oil / synthetic grease  
 SO = synthetic oil

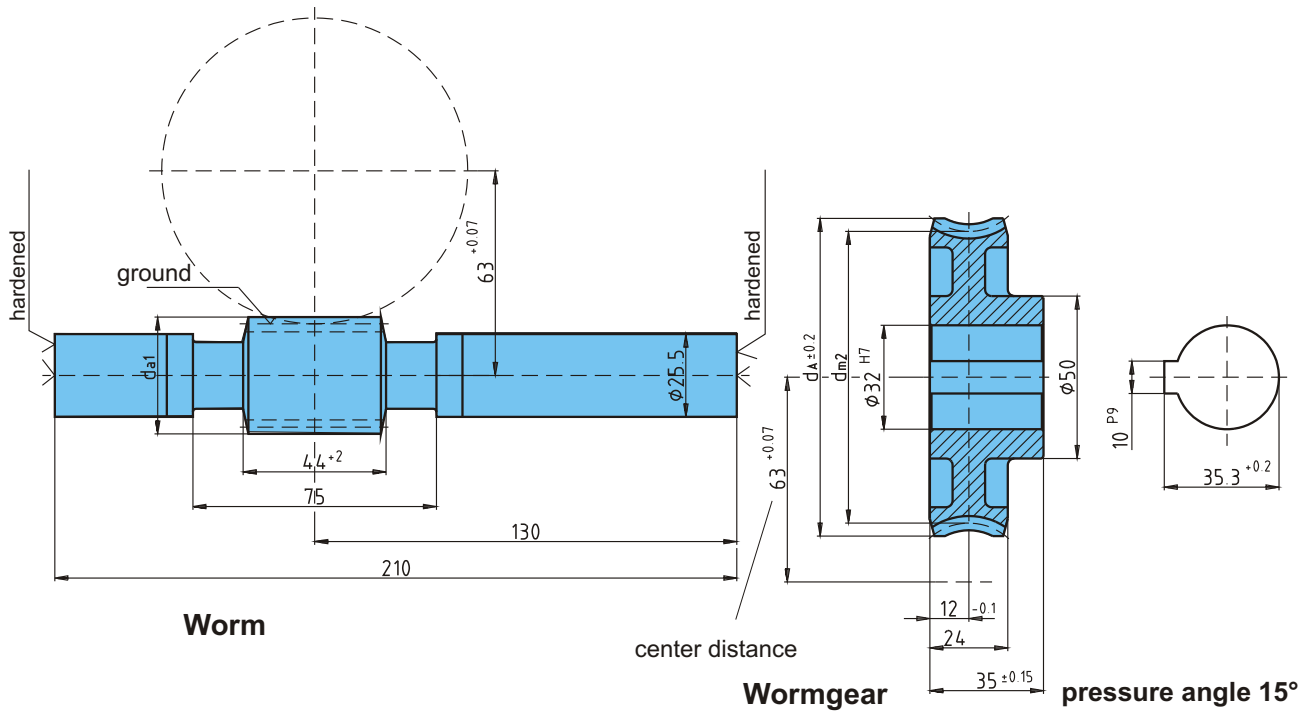
Catalog No.				worm			wormgear			$T_2$ [Nm]		
	$i$	$\alpha_m$	$m$	$z_1$	$d_{m1}$	$d_{a1}$	$z_2$	$d_{m2}$	$d_A$	Bronze		
										MG	MO	SO
<b>A63U6</b>	6:1	25°51'	3.5	4	32.1	39.1	24	93.9	104	89	107	134
<b>A63U12</b>	12:1	13°52'	2.5	3	31.29	36.29	36	94.71	104	141	170	212
<b>A63U19</b>	19:1	10°8'	2.5	2	28.4	33.4	38	97.6	104	133	159	199
<b>A63U26</b>	26:1	6°17'	3.5	1	32	39	26	94	104	172	206	258
<b>A63U34</b>	34:1	5°9'	2.75	1	30.6	36.1	34	95.4	104	148	178	222
<b>A63U48</b>	48:1	3°51'	2	1	29.78	33.78	48	96.22	104	125	150	187
<b>A63U63</b>	63:1	2°47'	1.5	1	30.85	33.85	63	95.15	101	111	133	166
<b>A63U70</b>	70:1	1°59'	1.25	1	36.1	38.6	70	89.9	97	112	135	169

All worms and worm gears stocked right hand only, worm made of case hardened and ground steel (HV 620 - 700). Worm gear made of CuZn40Al2/So.

DS-018e2/07.05

METRIC

**A63 (60 mm center distance)**



$i$  = gear ratio  
 $\alpha_m$  = lead angle  
 $m$  = module  
 $z_1$  = number of threads  
 $d_{m1}$  = pitch diameter (worm)

$d_{a1}$  = tip diameter (worm)  
 $z_2$  = No. of teeth  
 $d_{m2}$  = pitch diameter (worm gear)  
 $d_A$  = max. diameter (worm gear)  
 $T_2$  = output torque

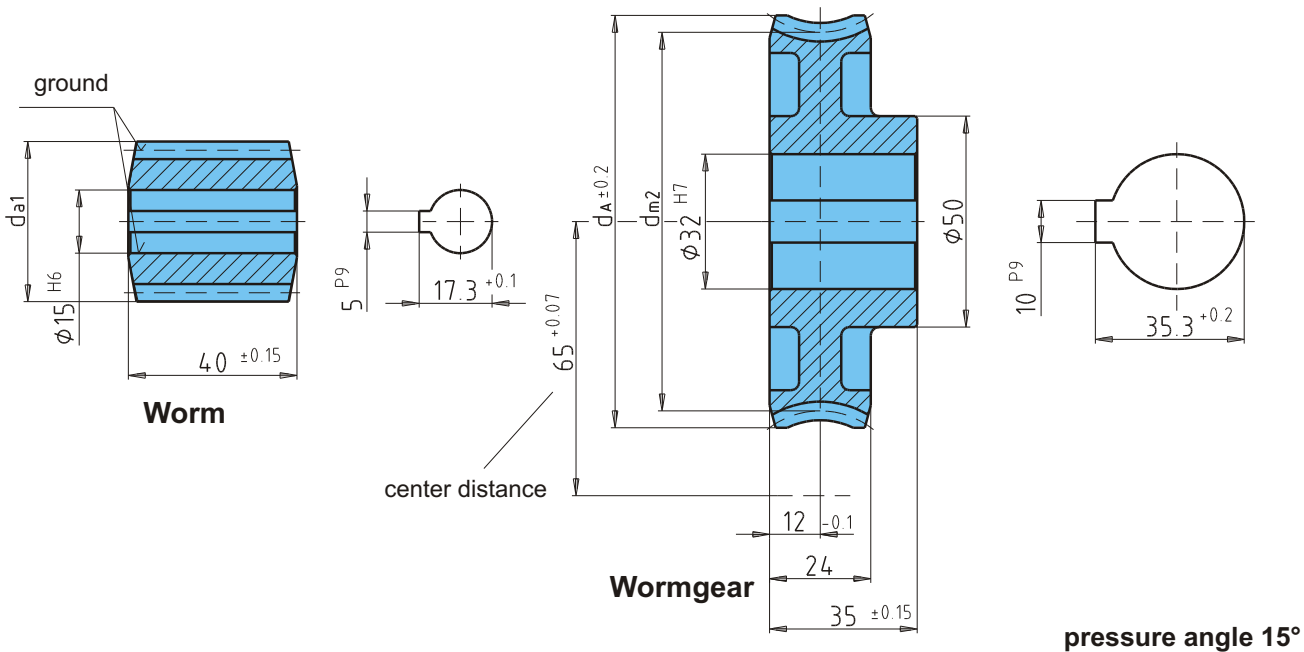
MG = mineral grease  
 MO = mineral oil / synthetic grease  
 SO = synthetic oil

Catalog No.	worm						wormgear			$T_2$ [Nm]		
	$i$	$\alpha_m$	$m$	$z_1$	$d_{m1}$	$d_{a1}$	$z_2$	$d_{m2}$	$d_A$	MG	MO	SO
A63U6	6:1	25°51'	3.5	4	32.1	39.1	24	93.9	104	89	107	134
A63U12	12:1	13°52'	2.5	3	31.29	36.29	36	94.71	104	141	170	212
A63U19	19:1	10°8'	2.5	2	28.4	33.4	38	97.6	104	133	159	199
A63U26	26:1	6°17'	3.5	1	32	39	26	94	104	172	206	258
A63U34	34:1	5°9'	2.75	1	30.6	36.1	34	95.4	104	148	178	222
A63U48	48:1	3°51'	2	1	29.78	33.78	48	96.22	104	125	150	187
A63U63	63:1	2°47'	1.5	1	30.85	33.85	63	95.15	101	111	133	166
A63U70	70:1	1°59'	1.25	1	36.1	38.6	70	89.9	97	112	135	169

All worms and worm gears stocked right hand only, worm made of case hardened and ground steel (HV 620 - 700), shafts not hardened. Worm gear made of CuZn40Al2/So.

METRIC

**A65 (65 mm center distance)**



$i$  = gear ratio  
 $m$  = lead angle  
 $m$  = module  
 $z_1$  = number of threads  
 $d_{m1}$  = pitch diameter (worm)

$d_{a1}$  = tip diameter (worm)  
 $z_2$  = No. of teeth  
 $d_{m2}$  = pitch diameter (worm gear)  
 $d_A$  = max. diameter (worm gear)  
 $T_2$  = output torque

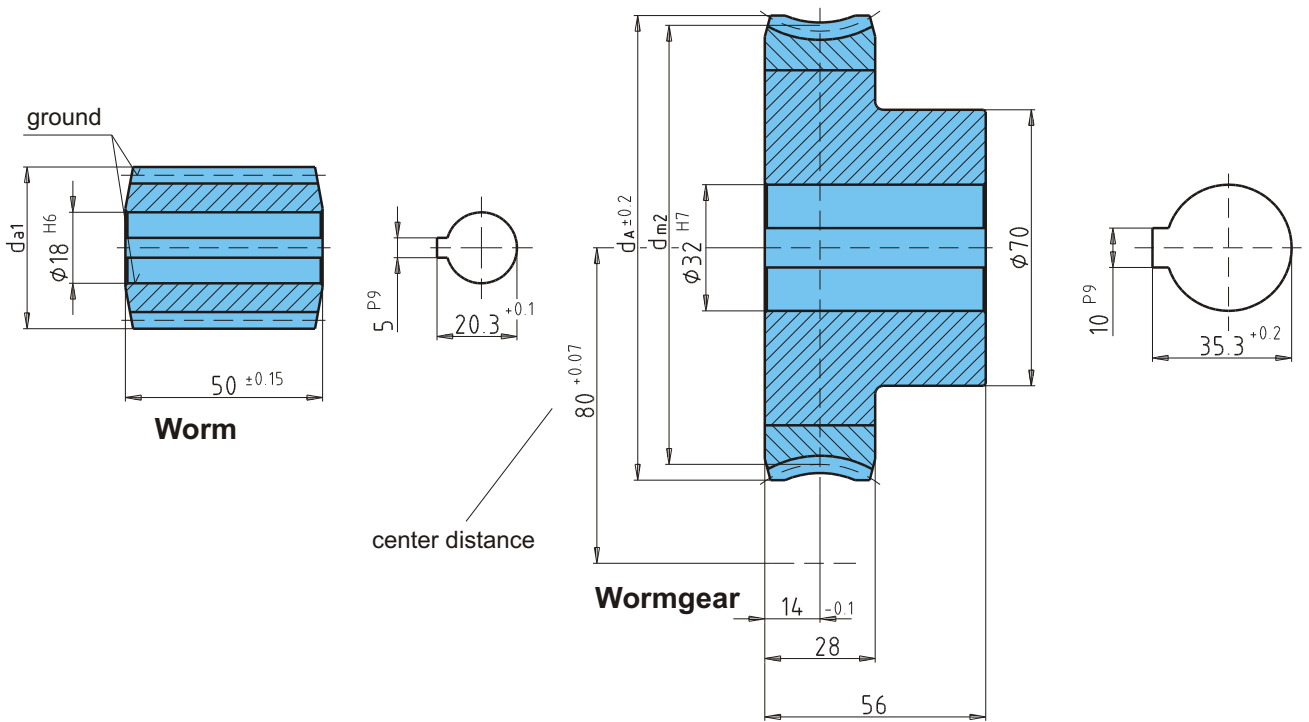
MG = mineral grease  
 MO = mineral oil / synthetic grease  
 SO = synthetic oil

Catalog No.			worm				wormgear			$T_2$ [Nm]		
	i	m	m	$z_1$	$d_{m1}$	$d_{a1}$	$z_2$	$d_{m2}$	$d_A$	Bronze		
										MG	MO	SO
<b>A65U6</b>	6.25:1	25°51'	3.5	4	32.1	39.1	25	97.9	108	101	121	151
<b>A65U13</b>	12.66:1	13°52'	2.5	3	31.29	36.29	38	98.71	108	156	187	234
<b>A65U20</b>	20:1	10°8'	2.5	2	28.4	33.4	40	101.6	108	146	176	220
<b>A65U28</b>	28:1	6°17'	3.5	1	32	39	28	98	108	192	230	288
<b>A65U36</b>	36:1	5°9'	2.75	1	30.6	36.1	36	99.4	108	164	197	246
<b>A65U50</b>	50:1	3°51'	2	1	29.78	33.78	50	100.22	108	137	164	205
<b>A65U66</b>	66:1	2°47'	1.5	1	30.85	33.85	66	99.15	107	122	146	183
<b>A65U75</b>	75:1	1°59'	1.25	1	36.1	38.6	75	93.9	100	125	150	188

All worms and worm gears stocked right hand only, worm made of case hardened and ground steel (HV 620 - 700). Worm gear made of CuZn40Al2/So.

METRIC

**A80 (80 mm center distance)**



pressure angle 15°

$i$  = gear ratio  
 $\alpha_m$  = lead angle  
 $m$  = module  
 $z_1$  = number of threads  
 $d_{m1}$  = pitch diameter (worm)

$d_{a1}$  = tip diameter (worm)  
 $z_2$  = No. of teeth  
 $d_{m2}$  = pitch diameter (worm gear)  
 $d_A$  = max. diameter (worm gear)  
 $T_2$  = output torque

MG = mineral grease  
 MO = mineral oil / synthetic grease  
 SO = synthetic oil

Catalog No.	$i$	$\alpha_m$	$m$	worm			wormgear			$T_2$ [Nm]		
				$z_1$	$d_{m1}$	$d_{a1}$	$z_2$	$d_{m2}$	$d_A$	MG	MO	SO
A80U7	6.75:1	23°35'	4	4	40	48	27	120	132	150	180	225
A80U12	12:1	16°36'	2.5	4	35	40	48	125	135	243	290	365
A80U20	20:1	8°58'	3	2	38.5	44.5	40	121.5	132	290	348	435
A80U30	30:1	5°44'	4	1	40	48	30	120	132	348	417	522
A80U50	50:1	4°6'	2.5	1	35	40	50	125	135	248	297	372
A80U80	80:1	2°9'	1.5	1	40	43	80	120	129	213	255	320

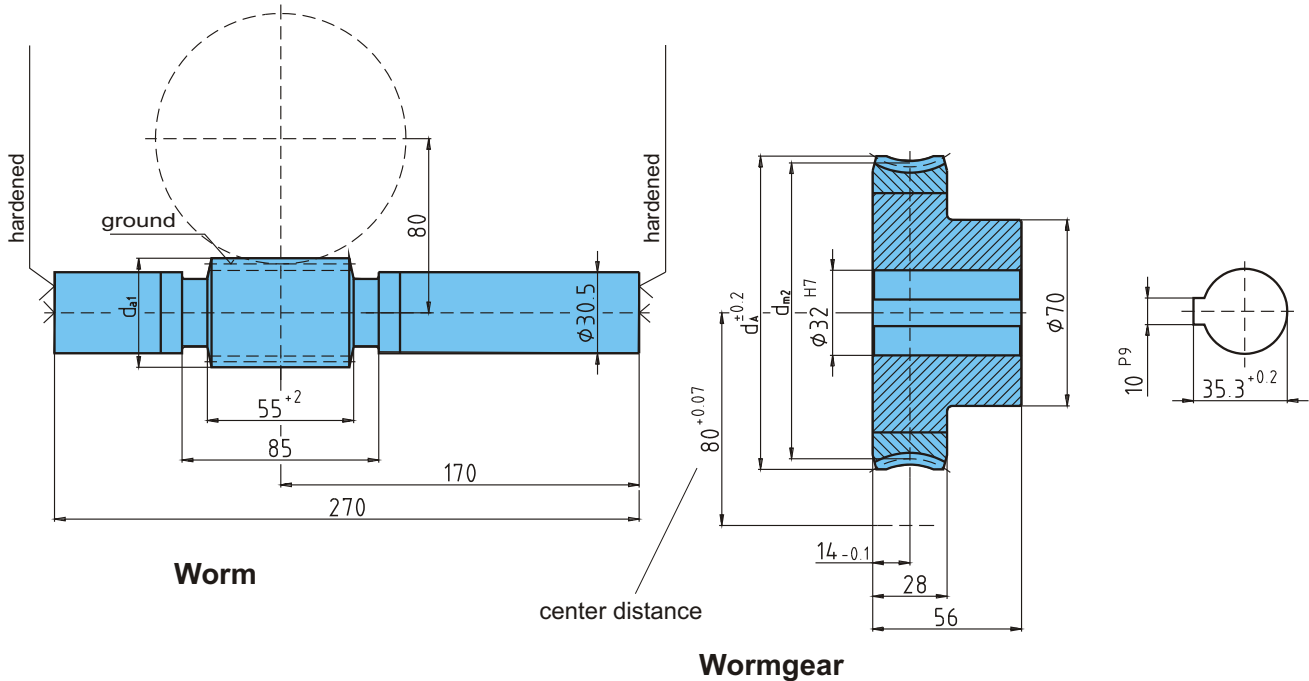
All worms and worm gears stocked right hand only, worm made of case hardened and ground steel (HV 620 - 700).

Worm gear made of bronze G-CuSn12Ni.

Hub made of cast iron GG-20.

METRIC

# A80 (80 mm center distance)



pressure angle 15°

$i$  = gear ratio  
 $\alpha_m$  = lead angle  
 $m$  = module  
 $z_1$  = number of threads  
 $d_{m1}$  = pitch diameter (worm)

$d_{a1}$  = tip diameter (worm)  
 $z_2$  = No. of teeth  
 $d_{m2}$  = pitch diameter (worm gear)  
 $d_A$  = max. diameter (worm gear)  
 $T_2$  = output torque

MG = mineral grease  
 MO = mineral oil / synthetic grease  
 SO = synthetic oil

Catalog No.	worm						wormgear			T <sub>2</sub> [Nm]		
	i	α <sub>m</sub>	m	z <sub>1</sub>	d <sub>m1</sub>	d <sub>a1</sub>	z <sub>2</sub>	d <sub>m2</sub>	d <sub>A</sub>	Bronze		
										MG	MO	SO
<b>A80U7</b>	6.75:1	23°35'	4	4	40	48	27	120	132	150	180	225
<b>A80U12</b>	12:1	16°36'	2.5	4	35	40	48	125	135	243	290	365
<b>A80U20</b>	20:1	8°58'	3	2	38.5	44.5	40	121.5	132	290	348	435
<b>A80U30</b>	30:1	5°44'	4	1	40	48	30	120	132	348	417	522
<b>A80U50</b>	50:1	4°6'	2.5	1	35	40	50	125	135	248	297	372
<b>A80U80</b>	80:1	2°9'	1.5	1	40	43	80	120	129	213	255	320

All worms and worm gears stocked right hand only, worm made of case hardened and ground steel (HV 620 - 700), shafts not hardened.  
 Worm gear made of bronze G-CuSn12Ni.  
 Hub made of cast iron GG-20.

DS-022e1/07.05

## Efficiency factors

Efficiency factors depending on input (worm) speed and lubrication (mineral grease 'MG', mineral oil 'MO' or synthetic grease, synthetic oil 'SO')

### A17

	n <sub>1</sub> = 2800 rpm			n <sub>1</sub> = 1400 rpm			n <sub>1</sub> = 950 rpm			n <sub>1</sub> = 700 rpm			n <sub>1</sub> = 500 rpm		
	MG	MO	SO	MG	MO	SO	MG	MO	SO	MG	MO	SO	MG	MO	SO
Ü2	0,8	0,84	0,87	0,77	0,81	0,85	0,76	0,8	0,84	0,76	0,8	0,84	0,76	0,8	0,84
Ü4	0,75	0,79	0,83	0,72	0,76	0,8	0,7	0,75	0,79	0,7	0,74	0,79	0,7	0,74	0,79
Ü5	0,74	0,79	0,82	0,71	0,76	0,8	0,7	0,75	0,79	0,69	0,74	0,79	0,69	0,74	0,79
Ü7	0,68	0,73	0,77	0,64	0,7	0,75	0,63	0,68	0,73	0,62	0,68	0,73	0,62	0,68	0,73
Ü9	0,61	0,66	0,71	0,57	0,63	0,68	0,55	0,61	0,66	0,54	0,6	0,66	0,54	0,6	0,66
Ü10	0,64	0,69	0,74	0,6	0,66	0,71	0,59	0,65	0,7	0,59	0,64	0,7	0,59	0,64	0,7
Ü15	0,54	0,6	0,65	0,51	0,57	0,62	0,49	0,55	0,61	0,49	0,55	0,61	0,49	0,55	0,61
Ü25	0,42	0,48	0,53	0,38	0,44	0,5	0,37	0,43	0,48	0,37	0,42	0,48	0,37	0,42	0,48
Ü30	0,37	0,43	0,49	0,34	0,4	0,45	0,33	0,38	0,44	0,33	0,38	0,44	0,33	0,38	0,44
Ü40	0,26	0,3	0,36	0,23	0,27	0,32	0,22	0,26	0,31	0,21	0,25	0,3	0,21	0,25	0,3
Ü50	0,33	0,38	0,44	0,3	0,35	0,41	0,29	0,34	0,4	0,29	0,34	0,4	0,29	0,34	0,4
Ü60	0,26	0,31	0,36	0,24	0,28	0,33	0,23	0,27	0,32	0,23	0,27	0,32	0,23	0,27	0,32
Ü75	0,19	0,23	0,27	0,17	0,21	0,25	0,16	0,2	0,24	0,16	0,19	0,23	0,16	0,19	0,23
Ü80	0,21	0,25	0,3	0,19	0,23	0,27	0,18	0,22	0,26	0,18	0,22	0,26	0,18	0,22	0,26

### A22

	n <sub>1</sub> = 2800 rpm			n <sub>1</sub> = 1400 rpm			n <sub>1</sub> = 950 rpm			n <sub>1</sub> = 700 rpm			n <sub>1</sub> = 500 rpm		
	MG	MO	SO	MG	MO	SO	MG	MO	SO	MG	MO	SO	MG	MO	SO
Ü3	0,74	0,79	0,82	0,71	0,76	0,8	0,69	0,74	0,79	0,68	0,73	0,78	0,67	0,72	0,77
Ü4	0,75	0,79	0,83	0,72	0,76	0,8	0,7	0,75	0,79	0,69	0,74	0,78	0,68	0,73	0,77
Ü7	0,66	0,71	0,76	0,63	0,68	0,73	0,61	0,66	0,71	0,6	0,65	0,7	0,59	0,64	0,69
Ü10,5	0,57	0,63	0,68	0,53	0,59	0,65	0,51	0,57	0,63	0,5	0,56	0,62	0,49	0,55	0,61
Ü21	0,4	0,46	0,52	0,37	0,42	0,48	0,35	0,4	0,46	0,34	0,39	0,45	0,33	0,38	0,44
Ü30	0,34	0,39	0,45	0,3	0,35	0,41	0,29	0,34	0,39	0,27	0,32	0,38	0,27	0,32	0,37
Ü40	0,29	0,34	0,4	0,26	0,31	0,36	0,25	0,29	0,34	0,24	0,28	0,33	0,23	0,28	0,33

### A25

	n <sub>1</sub> = 2800 rpm			n <sub>1</sub> = 1400 rpm			n <sub>1</sub> = 950 rpm			n <sub>1</sub> = 700 rpm			n <sub>1</sub> = 500 rpm		
	MG	MO	SO	MG	MO	SO	MG	MO	SO	MG	MO	SO	MG	MO	SO
Ü4	0,76	0,8	0,84	0,73	0,77	0,81	0,71	0,76	0,8	0,7	0,75	0,79	0,69	0,74	0,78
Ü5	0,75	0,79	0,83	0,71	0,76	0,8	0,7	0,75	0,79	0,69	0,74	0,78	0,68	0,73	0,77
Ü6,5	0,7	0,74	0,79	0,66	0,71	0,76	0,64	0,7	0,75	0,63	0,68	0,73	0,62	0,67	0,72
Ü10	0,61	0,66	0,71	0,57	0,62	0,68	0,55	0,61	0,66	0,53	0,59	0,65	0,52	0,58	0,64
Ü15	0,53	0,59	0,64	0,49	0,55	0,61	0,47	0,53	0,59	0,46	0,52	0,58	0,45	0,51	0,57
Ü20	0,44	0,5	0,55	0,4	0,46	0,51	0,38	0,44	0,5	0,37	0,42	0,48	0,36	0,41	0,47
Ü25	0,3	0,36	0,41	0,27	0,32	0,38	0,26	0,3	0,35	0,25	0,29	0,34	0,23	0,28	0,33
Ü30	0,34	0,4	0,46	0,31	0,36	0,42	0,29	0,34	0,4	0,28	0,33	0,38	0,27	0,32	0,37
Ü40	0,31	0,36	0,42	0,28	0,33	0,38	0,26	0,31	0,37	0,25	0,3	0,35	0,25	0,29	0,35
Ü50	0,24	0,28	0,33	0,21	0,25	0,3	0,2	0,24	0,28	0,19	0,23	0,27	0,18	0,22	0,26

The stated values are approximate values

**Operative efficiency**

Efficiency factors depending on input (worm) speed and lubrication (mineral grease 'MG', mineral oil 'MO' or synthetic grease, synthetic oil 'SO')

**A31**

	n <sub>1</sub> = 2800 rpm			n <sub>1</sub> = 1400 rpm			n <sub>1</sub> = 950 rpm			n <sub>1</sub> = 700 rpm			n <sub>1</sub> = 500 rpm		
	MG	MO	SO	MG	MO	SO	MG	MO	SO	MG	MO	SO	MG	MO	SO
Ü2,5	0,82	0,85	0,88	0,79	0,83	0,86	0,78	0,82	0,85	0,77	0,81	0,85	0,76	0,8	0,84
Ü3	0,81	0,85	0,87	0,78	0,82	0,86	0,77	0,81	0,85	0,76	0,8	0,84	0,75	0,79	0,83
Ü4,28	0,79	0,82	0,86	0,76	0,8	0,83	0,74	0,78	0,82	0,73	0,77	0,81	0,72	0,76	0,81
Ü5	0,78	0,82	0,85	0,75	0,79	0,83	0,73	0,78	0,82	0,72	0,77	0,81	0,71	0,76	0,8
Ü6	0,74	0,79	0,82	0,71	0,76	0,8	0,7	0,74	0,79	0,68	0,73	0,78	0,67	0,72	0,77
Ü7	0,75	0,79	0,83	0,72	0,77	0,81	0,71	0,75	0,8	0,69	0,74	0,79	0,69	0,74	0,78
Ü8,33	0,74	0,79	0,82	0,71	0,76	0,8	0,7	0,75	0,79	0,69	0,74	0,78	0,68	0,73	0,78
Ü10	0,68	0,73	0,77	0,64	0,7	0,75	0,63	0,68	0,73	0,61	0,67	0,72	0,6	0,66	0,71
Ü12	0,69	0,74	0,78	0,65	0,7	0,75	0,64	0,69	0,74	0,62	0,68	0,73	0,62	0,67	0,72
Ü15	0,64	0,69	0,74	0,6	0,66	0,71	0,58	0,64	0,69	0,57	0,63	0,68	0,56	0,62	0,68
Ü18	0,59	0,65	0,7	0,56	0,61	0,67	0,54	0,6	0,65	0,53	0,58	0,64	0,52	0,58	0,63
Ü20 *	0,57	0,63	0,68	0,53	0,59	0,64	0,51	0,57	0,63	0,5	0,56	0,62	0,49	0,55	0,61
Ü20 **	0,59	0,64	0,69	0,55	0,61	0,66	0,53	0,59	0,64	0,52	0,58	0,63	0,51	0,57	0,63
Ü22	0,53	0,59	0,64	0,49	0,55	0,61	0,47	0,53	0,59	0,46	0,52	0,58	0,45	0,51	0,57
Ü23	0,56	0,61	0,67	0,52	0,58	0,63	0,5	0,56	0,61	0,49	0,55	0,6	0,48	0,54	0,6
Ü24	0,48	0,54	0,59	0,44	0,49	0,55	0,42	0,48	0,54	0,4	0,46	0,52	0,39	0,45	0,51
Ü25	0,49	0,55	0,61	0,45	0,51	0,57	0,44	0,5	0,55	0,42	0,48	0,54	0,41	0,47	0,53
Ü28	0,44	0,5	0,56	0,4	0,46	0,51	0,38	0,44	0,5	0,37	0,42	0,48	0,36	0,41	0,47
Ü30	0,47	0,53	0,59	0,43	0,49	0,55	0,41	0,47	0,53	0,4	0,46	0,52	0,39	0,45	0,51
Ü32	0,45	0,51	0,57	0,41	0,47	0,53	0,4	0,45	0,51	0,38	0,44	0,5	0,38	0,43	0,49
Ü38	0,46	0,52	0,57	0,42	0,48	0,54	0,4	0,46	0,52	0,39	0,45	0,51	0,39	0,45	0,51
Ü45	0,37	0,43	0,49	0,34	0,39	0,45	0,32	0,37	0,43	0,31	0,36	0,42	0,3	0,36	0,41
Ü50	0,35	0,4	0,46	0,31	0,37	0,42	0,3	0,35	0,4	0,29	0,34	0,39	0,28	0,33	0,39
Ü55	0,4	0,46	0,52	0,37	0,43	0,48	0,36	0,41	0,47	0,35	0,41	0,46	0,35	0,41	0,46
Ü60	0,31	0,36	0,42	0,28	0,32	0,38	0,26	0,31	0,36	0,25	0,3	0,35	0,25	0,29	0,34
Ü70	0,34	0,39	0,45	0,31	0,36	0,41	0,29	0,34	0,4	0,29	0,34	0,39	0,29	0,34	0,39
Ü75	0,26	0,31	0,36	0,23	0,28	0,33	0,22	0,26	0,31	0,21	0,25	0,3	0,21	0,25	0,3
Ü90	0,23	0,27	0,32	0,2	0,24	0,29	0,19	0,23	0,27	0,18	0,22	0,26	0,18	0,22	0,26
Ü100	0,28	0,33	0,38	0,25	0,3	0,35	0,24	0,29	0,34	0,24	0,28	0,33	0,24	0,28	0,33

The stated values are approximate values

\* module m = 0,75

\*\* module m = 1,15

## Operative efficiency

Efficiency factors depending on input (worm) speed and lubrication (mineral grease 'MG', mineral oil 'MO' or synthetic grease, synthetic oil 'SO')

### A33

	n <sub>1</sub> = 2800 rpm			n <sub>1</sub> = 1400 rpm			n <sub>1</sub> = 950 rpm			n <sub>1</sub> = 700 rpm			n <sub>1</sub> = 500 rpm		
	MG	MO	SO	MG	MO	SO	MG	MO	SO	MG	MO	SO	MG	MO	SO
Ü3,5	0,79	0,83	0,86	0,77	0,81	0,84	0,75	0,79	0,83	0,74	0,78	0,82	0,72	0,77	0,81
Ü5	0,77	0,81	0,84	0,74	0,78	0,82	0,72	0,76	0,81	0,71	0,75	0,8	0,69	0,74	0,79
Ü7	0,72	0,77	0,81	0,69	0,74	0,78	0,67	0,72	0,77	0,66	0,71	0,76	0,65	0,7	0,75
Ü10	0,69	0,74	0,78	0,65	0,7	0,75	0,64	0,69	0,74	0,62	0,68	0,73	0,61	0,67	0,72
Ü11	0,65	0,7	0,75	0,61	0,67	0,72	0,6	0,65	0,7	0,58	0,64	0,69	0,57	0,63	0,68
Ü12	0,66	0,71	0,75	0,62	0,67	0,72	0,6	0,66	0,71	0,59	0,64	0,7	0,58	0,63	0,69
Ü14	0,57	0,63	0,68	0,53	0,59	0,65	0,51	0,57	0,63	0,5	0,56	0,62	0,49	0,54	0,6
Ü15	0,6	0,65	0,7	0,56	0,62	0,67	0,54	0,6	0,65	0,53	0,58	0,64	0,51	0,57	0,63
Ü16	0,63	0,68	0,73	0,59	0,64	0,7	0,57	0,63	0,68	0,56	0,62	0,67	0,55	0,61	0,66
Ü17	0,61	0,66	0,71	0,57	0,62	0,68	0,55	0,61	0,66	0,54	0,6	0,65	0,53	0,59	0,64
Ü18	0,55	0,61	0,67	0,51	0,57	0,63	0,5	0,55	0,61	0,48	0,54	0,6	0,47	0,53	0,59
Ü20	0,54	0,6	0,66	0,5	0,56	0,62	0,49	0,54	0,6	0,47	0,53	0,59	0,46	0,52	0,58
Ü24	0,49	0,55	0,61	0,45	0,51	0,57	0,44	0,5	0,55	0,42	0,48	0,54	0,41	0,47	0,53
Ü28	0,4	0,46	0,52	0,37	0,42	0,48	0,35	0,4	0,46	0,33	0,39	0,45	0,32	0,38	0,43
Ü30	0,43	0,49	0,55	0,39	0,45	0,51	0,37	0,43	0,49	0,36	0,42	0,47	0,35	0,4	0,46
Ü32	0,46	0,52	0,58	0,42	0,48	0,54	0,4	0,46	0,52	0,39	0,45	0,51	0,38	0,44	0,5
Ü38	0,41	0,47	0,53	0,37	0,43	0,49	0,36	0,41	0,47	0,34	0,4	0,46	0,33	0,39	0,45
Ü50	0,31	0,36	0,42	0,28	0,33	0,38	0,26	0,31	0,38	0,25	0,3	0,35	0,24	0,29	0,34
Ü56	0,29	0,34	0,39	0,25	0,3	0,35	0,24	0,29	0,34	0,23	0,27	0,32	0,22	0,26	0,31
Ü60	0,31	0,36	0,42	0,28	0,33	0,38	0,26	0,31	0,37	0,25	0,3	0,35	0,25	0,29	0,35
Ü72	0,22	0,26	0,31	0,19	0,23	0,28	0,18	0,22	0,26	0,17	0,21	0,25	0,17	0,2	0,24
Ü75	0,24	0,28	0,33	0,21	0,25	0,29	0,2	0,24	0,28	0,19	0,23	0,27	0,18	0,22	0,26

### A35

	n <sub>1</sub> = 2800 rpm			n <sub>1</sub> = 1400 rpm			n <sub>1</sub> = 950 rpm			n <sub>1</sub> = 700 rpm			n <sub>1</sub> = 500 rpm		
	MG	MO	SO	MG	MO	SO	MG	MO	SO	MG	MO	SO	MG	MO	SO
Ü2,78	0,81	0,85	0,87	0,79	0,83	0,86	0,77	0,81	0,84	0,76	0,8	0,84	0,75	0,79	0,83
Ü5	0,78	0,82	0,85	0,75	0,79	0,83	0,73	0,78	0,82	0,72	0,77	0,81	0,71	0,76	0,8
Ü7,25	0,71	0,75	0,8	0,68	0,73	0,77	0,65	0,71	0,75	0,64	0,69	0,74	0,63	0,68	0,73
Ü8	0,71	0,76	0,8	0,68	0,73	0,77	0,66	0,71	0,76	0,65	0,7	0,75	0,63	0,69	0,74
Ü10	0,66	0,71	0,76	0,62	0,68	0,73	0,6	0,66	0,71	0,59	0,64	0,7	0,57	0,63	0,68
Ü11	0,65	0,7	0,75	0,62	0,67	0,72	0,6	0,65	0,7	0,58	0,64	0,69	0,57	0,63	0,68
Ü12	0,63	0,68	0,73	0,59	0,64	0,7	0,57	0,62	0,68	0,55	0,61	0,66	0,54	0,6	0,65
Ü15	0,57	0,62	0,68	0,53	0,59	0,64	0,5	0,56	0,62	0,49	0,55	0,61	0,48	0,54	0,59
Ü20	0,51	0,57	0,62	0,47	0,53	0,59	0,45	0,51	0,56	0,43	0,49	0,55	0,42	0,48	0,54
Ü25	0,44	0,5	0,56	0,4	0,46	0,52	0,38	0,44	0,5	0,37	0,42	0,48	0,35	0,41	0,47
Ü30	0,4	0,45	0,51	0,36	0,42	0,47	0,34	0,39	0,45	0,33	0,38	0,44	0,31	0,37	0,42
Ü35	0,41	0,47	0,53	0,37	0,43	0,49	0,36	0,41	0,47	0,34	0,4	0,46	0,33	0,39	0,44
Ü40	0,34	0,4	0,45	0,31	0,36	0,42	0,29	0,34	0,4	0,28	0,33	0,38	0,27	0,32	0,37
Ü50	0,28	0,33	0,39	0,25	0,3	0,35	0,24	0,28	0,33	0,23	0,27	0,32	0,22	0,26	0,31
Ü58	0,3	0,35	0,41	0,27	0,32	0,37	0,26	0,3	0,35	0,24	0,29	0,34	0,24	0,28	0,33
Ü90	0,18	0,22	0,26	0,16	0,19	0,23	0,15	0,18	0,22	0,14	0,17	0,21	0,13	0,16	0,2

The stated values are approximate values

**Operative efficiency**

Efficiency factors depending on input (worm) speed and lubrication (mineral grease 'MG', mineral oil 'MO' or synthetic grease, synthetic oil 'SO')

**A40**

	n <sub>1</sub> = 2800 rpm			n <sub>1</sub> = 1400 rpm			n <sub>1</sub> = 950 rpm			n <sub>1</sub> = 700 rpm			n <sub>1</sub> = 500 rpm		
	MG	MO	SO	MG	MO	SO	MG	MO	SO	MG	MO	SO	MG	MO	SO
Ü6,75	0,77	0,81	0,84	0,74	0,78	0,82	0,72	0,77	0,81	0,71	0,76	0,8	0,7	0,75	0,79
Ü8	0,74	0,78	0,82	0,7	0,75	0,79	0,68	0,73	0,78	0,67	0,72	0,77	0,66	0,71	0,76
Ü10	0,72	0,77	0,81	0,69	0,74	0,78	0,67	0,72	0,77	0,66	0,71	0,76	0,65	0,7	0,75
Ü12	0,65	0,7	0,75	0,62	0,67	0,72	0,6	0,65	0,7	0,58	0,64	0,69	0,57	0,62	0,68
Ü15	0,64	0,69	0,74	0,6	0,65	0,71	0,58	0,64	0,69	0,57	0,62	0,68	0,55	0,61	0,66
Ü20	0,61	0,66	0,71	0,57	0,63	0,68	0,55	0,61	0,66	0,54	0,6	0,65	0,53	0,59	0,64
Ü25	0,52	0,58	0,64	0,48	0,54	0,6	0,46	0,52	0,58	0,45	0,51	0,56	0,43	0,49	0,55
Ü28	0,47	0,53	0,59	0,43	0,49	0,55	0,41	0,47	0,53	0,4	0,46	0,52	0,39	0,44	0,5
Ü30	0,51	0,57	0,62	0,47	0,53	0,59	0,45	0,51	0,57	0,44	0,5	0,55	0,43	0,48	0,54
Ü35	0,49	0,55	0,6	0,45	0,51	0,57	0,43	0,49	0,55	0,42	0,48	0,54	0,41	0,47	0,53
Ü36	0,39	0,45	0,5	0,35	0,41	0,47	0,33	0,39	0,44	0,32	0,37	0,43	0,31	0,36	0,42
Ü38	0,41	0,47	0,53	0,37	0,43	0,49	0,36	0,41	0,47	0,34	0,4	0,45	0,33	0,38	0,44
Ü40	0,44	0,5	0,56	0,4	0,46	0,52	0,38	0,44	0,5	0,37	0,43	0,48	0,36	0,41	0,47
Ü50	0,42	0,48	0,54	0,38	0,44	0,5	0,37	0,42	0,48	0,35	0,41	0,47	0,35	0,4	0,46
Ü56	0,31	0,36	0,42	0,28	0,33	0,38	0,26	0,31	0,36	0,25	0,3	0,35	0,24	0,29	0,34
Ü60	0,28	0,33	0,38	0,25	0,29	0,34	0,23	0,28	0,32	0,22	0,26	0,31	0,21	0,25	0,3
Ü70	0,35	0,4	0,46	0,31	0,37	0,42	0,3	0,35	0,4	0,29	0,34	0,39	0,28	0,33	0,39
Ü75	0,25	0,3	0,35	0,23	0,27	0,32	0,21	0,25	0,3	0,2	0,24	0,29	0,19	0,23	0,28
Ü80	0,28	0,33	0,39	0,25	0,3	0,35	0,24	0,28	0,33	0,23	0,27	0,32	0,22	0,26	0,31
Ü90	0,29	0,34	0,4	0,36	0,31	0,36	0,25	0,29	0,35	0,24	0,28	0,33	0,23	0,28	0,33

**A50**

	n <sub>1</sub> = 2800 rpm			n <sub>1</sub> = 1400 rpm			n <sub>1</sub> = 950 rpm			n <sub>1</sub> = 700 rpm			n <sub>1</sub> = 500 rpm		
	MG	MO	SO	MG	MO	SO	MG	MO	SO	MG	MO	SO	MG	MO	SO
Ü4,25	0,8	0,84	0,87	0,78	0,82	0,85	0,76	0,8	0,84	0,75	0,79	0,83	0,74	0,78	0,82
Ü6	0,77	0,81	0,84	0,74	0,78	0,82	0,72	0,77	0,81	0,71	0,76	0,8	0,7	0,74	0,79
Ü8	0,72	0,76	0,8	0,69	0,74	0,78	0,67	0,72	0,76	0,65	0,7	0,75	0,64	0,69	0,74
Ü12	0,66	0,71	0,76	0,63	0,68	0,73	0,61	0,66	0,71	0,59	0,65	0,7	0,58	0,63	0,69
Ü13,5	0,65	0,7	0,74	0,61	0,67	0,72	0,59	0,64	0,7	0,57	0,63	0,68	0,56	0,62	0,67
Ü19	0,55	0,61	0,66	0,52	0,57	0,63	0,49	0,55	0,61	0,48	0,54	0,59	0,46	0,52	0,58
Ü23	0,52	0,58	0,64	0,49	0,55	0,6	0,46	0,52	0,58	0,45	0,51	0,57	0,43	0,49	0,55
Ü27	0,48	0,54	0,59	0,44	0,5	0,56	0,42	0,48	0,54	0,4	0,46	0,52	0,39	0,45	0,51
Ü35	0,43	0,49	0,55	0,4	0,45	0,51	0,37	0,43	0,49	0,36	0,41	0,47	0,34	0,4	0,46
Ü46	0,36	0,41	0,47	0,32	0,38	0,43	0,3	0,36	0,41	0,29	0,34	0,4	0,28	0,33	0,38
Ü55	0,31	0,37	0,42	0,29	0,34	0,39	0,27	0,31	0,37	0,25	0,3	0,35	0,24	0,29	0,34
Ü69	0,27	0,32	0,37	0,24	0,29	0,34	0,23	0,27	0,32	0,21	0,26	0,3	0,2	0,25	0,29

The stated values are approximate values

## Operative efficiency

Efficiency factors depending on input (worm) speed and lubrication (mineral grease 'MG', mineral oil 'MO' or synthetic grease, synthetic oil 'SO')

### A53

	n <sub>1</sub> = 2800 rpm			n <sub>1</sub> = 1400 rpm			n <sub>1</sub> = 950 rpm			n <sub>1</sub> = 700 rpm			n <sub>1</sub> = 500 rpm		
	MG	MO	SO	MG	MO	SO	MG	MO	SO	MG	MO	SO	MG	MO	SO
<b>Ü4,75</b>	0,8	0,84	0,87	0,78	0,82	0,85	0,76	0,8	0,84	0,75	0,79	0,83	0,74	0,78	0,82
<b>Ü6,67</b>	0,77	0,81	0,84	0,74	0,78	0,82	0,72	0,77	0,81	0,71	0,76	0,8	0,7	0,74	0,79
<b>Ü9,67</b>	0,72	0,76	0,8	0,69	0,74	0,78	0,67	0,72	0,76	0,65	0,7	0,75	0,64	0,69	<b>0,74</b>
<b>Ü13,5</b>	0,66	0,71	0,76	0,63	0,68	0,73	0,61	0,66	0,71	0,59	0,65	0,7	0,58	0,63	0,69
<b>Ü15</b>	0,65	0,7	0,74	0,61	0,67	0,72	0,59	0,64	0,7	0,57	0,63	0,68	0,56	0,62	0,67
<b>Ü21</b>	0,55	0,61	0,66	0,52	0,57	0,63	0,49	0,55	0,61	0,48	0,54	0,59	0,46	0,52	0,58
<b>Ü25</b>	0,52	0,58	0,64	0,49	0,55	0,6	0,46	0,52	0,58	0,45	0,51	0,57	0,43	0,49	0,55
<b>Ü28</b>	0,44	0,5	0,56	0,41	0,47	0,53	0,39	0,45	0,51	0,37	0,43	0,49	0,36	0,42	0,47
<b>Ü30</b>	0,48	0,54	0,59	0,44	0,5	0,56	0,42	0,48	0,54	0,4	0,46	0,52	0,39	0,45	0,51
<b>Ü38</b>	0,43	0,49	0,55	0,4	0,45	0,51	0,37	0,43	0,49	0,36	0,41	0,47	0,34	0,4	0,46
<b>Ü50</b>	0,36	0,41	0,47	0,32	0,38	0,43	0,3	0,36	0,41	0,29	0,34	0,4	0,28	0,33	0,38
<b>Ü60</b>	0,31	0,37	0,42	0,29	0,34	0,39	0,27	0,31	0,37	0,25	0,3	0,35	0,24	0,29	0,34
<b>Ü75</b>	0,27	0,32	0,37	0,24	0,29	0,34	0,23	0,27	0,32	0,21	0,26	0,3	0,2	0,25	0,29

### A63

	n <sub>1</sub> = 2800 rpm			n <sub>1</sub> = 1400 rpm			n <sub>1</sub> = 950 rpm			n <sub>1</sub> = 700 rpm			n <sub>1</sub> = 500 rpm		
	MG	MO	SO	MG	MO	SO	MG	MO	SO	MG	MO	SO	MG	MO	SO
<b>Ü6</b>	0,8	0,84	0,87	0,78	0,82	0,85	0,76	0,8	0,84	0,75	0,79	0,83	0,74	0,78	0,82
<b>Ü12</b>	0,72	0,76	0,8	0,69	0,74	0,78	0,67	0,72	0,76	0,65	0,7	0,75	0,64	0,69	0,74
<b>Ü19</b>	0,65	0,71	0,75	0,62	0,67	0,72	0,6	0,65	0,7	0,58	0,64	0,69	0,57	0,62	0,68
<b>Ü26</b>	0,55	0,61	0,66	0,52	0,57	0,63	0,49	0,55	0,61	0,48	0,54	0,59	0,46	0,52	0,58
<b>Ü34</b>	0,5	0,56	0,62	0,47	0,53	0,58	0,44	0,5	0,56	0,43	0,49	0,54	0,41	0,47	0,53
<b>Ü48</b>	0,43	0,49	0,55	0,4	0,45	0,51	0,37	0,43	0,49	0,36	0,41	0,47	0,34	0,4	0,46
<b>Ü63</b>	0,36	0,41	0,47	0,32	0,38	0,43	0,3	0,36	0,41	0,29	0,34	0,4	0,28	0,33	0,38
<b>Ü70</b>	0,29	0,34	0,39	0,26	0,31	0,36	0,24	0,29	0,34	0,23	0,28	0,32	0,22	0,26	0,3

The stated values are approximate values

**Operative efficiency**

Efficiency factors depending on input (worm) speed and lubrication (mineral grease 'MG', mineral oil 'MO' or synthetic grease, synthetic oil 'SO')

**A65**

	n <sub>1</sub> = 2800 rpm			n <sub>1</sub> = 1400 rpm			n <sub>1</sub> = 950 rpm			n <sub>1</sub> = 700 rpm			n <sub>1</sub> = 500 rpm		
	MG	MO	SO	MG	MO	SO	MG	MO	SO	MG	MO	SO	MG	MO	SO
<b>Ü6,25</b>	0,8	0,84	0,87	0,78	0,82	0,85	0,76	0,8	0,84	0,75	0,79	0,83	0,74	0,78	0,82
<b>Ü12,66</b>	0,72	0,76	0,8	0,69	0,74	0,78	0,67	0,72	0,76	0,65	0,7	0,75	0,64	0,69	0,74
<b>Ü20</b>	0,65	0,71	0,75	0,62	0,67	0,72	0,6	0,65	0,7	0,58	0,64	0,69	0,57	0,62	0,68
<b>Ü28</b>	0,55	0,61	0,66	0,52	0,57	0,63	0,49	0,55	0,61	0,48	0,54	0,59	0,46	0,52	0,58
<b>Ü36</b>	0,5	0,56	0,62	0,47	0,53	0,58	0,44	0,5	0,56	0,43	0,49	0,54	0,41	0,47	0,53
<b>Ü50</b>	0,43	0,49	0,55	0,4	0,45	0,51	0,37	0,43	0,49	0,36	0,41	0,47	0,34	0,4	0,46
<b>Ü66</b>	0,36	0,41	0,47	0,32	0,38	0,43	0,3	0,36	0,41	0,29	0,34	0,4	0,28	0,33	0,38
<b>Ü75</b>	0,29	0,34	0,39	0,26	0,31	0,36	0,24	0,29	0,34	0,23	0,28	0,32	0,22	0,26	0,31

**A80**

	n <sub>1</sub> = 2800 rpm			n <sub>1</sub> = 1400 rpm			n <sub>1</sub> = 950 rpm			n <sub>1</sub> = 700 rpm			n <sub>1</sub> = 500 rpm		
	MG	MO	SO	MG	MO	SO	MG	MO	SO	MG	MO	SO	MG	MO	SO
<b>Ü6,75</b>	0,79	0,83	0,86	0,78	0,82	0,85	0,76	0,8	0,84	0,75	0,79	0,83	0,73	0,78	0,82
<b>Ü12</b>	0,75	0,79	0,83	0,72	0,77	0,81	0,7	0,75	0,79	0,69	0,74	0,78	0,68	0,73	0,77
<b>Ü20</b>	0,63	0,69	0,74	0,61	0,66	0,71	0,59	0,64	0,7	0,57	0,63	0,68	0,55	0,61	0,67
<b>Ü30</b>	0,53	0,59	0,64	0,51	0,57	0,62	0,49	0,55	0,6	0,47	0,53	0,58	0,45	0,51	0,57
<b>Ü50</b>	0,45	0,51	0,57	0,42	0,48	0,53	0,4	0,45	0,51	0,38	0,44	0,49	0,37	0,42	0,48
<b>Ü80</b>	0,3	0,35	0,41	0,28	0,33	0,38	0,27	0,31	0,37	0,25	0,3	0,35	0,24	0,28	0,33

The stated values are approximate values

## Tolerance

### Backlash tolerances for worm gears (valid for gears with a pressure angle of 15°)

$\beta_0$  corresponds to  $\gamma_m$  of the worm

Pitch diameter of the worm gear $d_{m2}$	Module $m_n$	Backlash tol. at pitch diameter [mm]			
		$\beta_0$ up to 24°		$\beta_0$ over 24°	
		min.	max.	min.	max.
over 12 up to 25	0,4 - 0,6	0,07	0,092	0,077	0,102
	>0,6 - 1,3	0,075	0,099	0,083	0,109
	>1,3 - 2,0	0,08	0,106	0,089	0,117
over 25 up to 50	0,4 - 0,6	0,075	0,099	0,083	0,108
	>0,6 - 1,3	0,08	0,106	0,089	0,117
	>1,3 - 2,0	0,086	0,114	0,095	0,125
	>2,0 - 4,0	0,094	0,124	0,103	0,137
over 50 up to 100	0,4 - 0,6	0,08	0,106	0,089	0,117
	>0,6 - 1,3	0,086	0,114	0,095	0,125
	>1,3 - 2,0	0,094	0,124	0,103	0,137
	>2,0 - 4,0	0,102	0,134	0,112	0,148

The backlash values are based on an ideal center distance. More backlash will appear if the center distance is actually at the upper tolerance. 0.05mm above ideal center distance will result in 0.027 mm more backlash.

## Lubrication

Lubrication has an essential influence on efficiency, heat generation and life time. A good choice is a synthetic oils on the basis of polyglykol and synthetic oil or grease on the basis of polyalphaolefin. Moreover polyalphaolefin has a high compatibility to common sealing materials.

High viscosity synthetic oils (ISO VG 680 bzw. ISO VG 1000) are used preferably for worm gear sets. In case of smaller center distances mineral or synthetic grease in consistency-class 0 up to 00 can be used as well.

## Comparison of the different basis oils

Characteristics	Mineral oil	Polyalphaolefin synth.	Polyglykol synth.
Viscosity at low temp.	4	3	3
Wear protection	4	2	1
Frictional behaviour	3	2	1
High temp. Oxidation stability	4	2	1
Water separation ability	4	2	5
Air release ability	3	2	4
Rust protection	1	1	3
Mix with mineral oil	-	1	5
Laquer compatibility	1	1	3
Seal compatibility	1	1	3
Low evaporation losses	4	1	3

1=excellent

2=very good

3=good

4=sufficient

5=bad

**Lubrication table (selection)**

	Viskosity ISO-VG DIN 51519	ARAL	BP	ESSO	Klüber	Mobil	SHELL	TEXACO	Tribol
Synthetic oils	VG 1000				Syntheso D 1000				Tribol 1300 ISO 1000
	VG 680				Syntheso D 680 EP				Tribol 1300 ISO 680
	VG 460	Degol GS 460	Energol SG-XP 460		Syntheso D 460 EP	Glygoyle 80	Tivela Oil SD		Tribol 1300 ISO 460
	VG 320				Syntheso D 320 EP				Tribol 1300 ISO 320
Mineral oils	VG 1000								
	VG 680	Degol GS 680	Energol GR-XP 680	Spartan EP 680	Klüberoil GEM 1-680	Mobilgear 636	Omala Oil 680	Meropa 680	
	VG 460	Degol GS 460	Energol GR-XP 460	Spartan EP 460	Klüberoil GEM 1-460	Mobilgear 634	Omala Oil 460	Meropa 460	
	VG 320	Degol GS 320	Energol GR-XP 320	Spartan EP 320	Klüberoil GEM 1-320	Mobilgear 632	Omala Oil 320	Meropa 320	
	Consistency NLGI-class DIN 51814								
Synth. grease	00	Renolit GLS00 from Fuchs Temperature range -50°C up to 120°C				Klübersynth G34-130 from Klüber Temperature range -35°C up to 150°C			
Mineral grease	0 bis 00	all oil- and grease supplier							

The data in this catalog was thoroughly produced and checked carefully. Nevertheless we can't accept liability for possible wrong or incomplete specifications.