



Worm Gear Pair

- Spur Gears
- Helical Gears
- Internal Gears
- Flacks
- CP Racks & Pinions
- Miter Gears
- Bevel Gears
- Screw Gears
- Worm Gear Pair**
- Bevel Gearboxes
- Other Products



KWGDL · KWGDLs Duplex Worms m1.5 ~ 4 Page 348 Icons: RoHS, CE, etc.	AGDL Duplex Worm Wheels Reduction Ratio 10 ~ 60 m1.5 ~ 4 Page 348 Icons: RoHS, CE, etc.	KWG Ground Worm Shafts m0.5 ~ 6 Page 354 Icons: RoHS, CE, etc.	AG Worm Wheels Reduction Ratio 10 ~ 60 Newly added m0.5 ~ 1.5 Page 354 Icons: RoHS, CE, etc.	AGF Worm Wheels Reduction Ratio 10 ~ 60 m2 ~ 6 Page 358 Icons: RoHS, CE, etc.	SWG Ground Worms m1 ~ 6 Page 364 Icons: RoHS, CE, etc.	AG Worm Wheels Reduction Ratio 10 ~ 60 Newly added m1 ~ 6 Page 364 Icons: RoHS, CE, etc.
SW Steel Worms m0.5 ~ 6 Page 372 Icons: RoHS, CE, etc.	BG Bronze Worm Wheels Reduction Ratio 10 ~ 60 Newly added m0.5 ~ 6 Page 372 Icons: RoHS, CE, etc.	CG Gray Iron Worm Wheels Reduction Ratio 10 ~ 120 Newly added m1 ~ 6 Page 374 Icons: RoHS, CE, etc.	SUW Stainless Steel Worms m0.5 ~ 3 Page 388 Icons: RoHS, CE, etc.	DG Plastic Worm Wheels Reduction Ratio 10 ~ 60 m0.5, 0.8 Page 388 Icons: RoHS, CE, etc.	PG Plastic Worm Wheels Reduction Ratio 10 ~ 50 Newly added m1 ~ 3 Page 390 Icons: RoHS, CE, etc.	

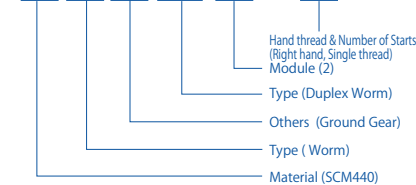
Catalog Number of KHK Stock Gears

The Catalog Number for KHK stock gears is based on the simple formula listed below. Please order KHK gears by specifying the Catalog Numbers.

(Example) Worm Gear Pair

Worms

K W G DL 2 - R1



Material

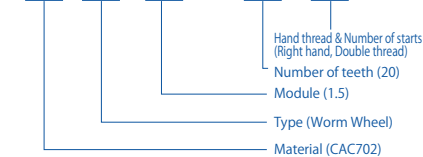
K	SCM440
S	S45C
SU	SUS303

Type

W	Worms
DL	Duplex Worms
Other Information	
G	Ground Gears
S	Worm Shafts

Worm Wheels

A G 1.5 - 20 R2



Material

A	CAC702(*A/B/C2)
B	CAC502(*PBC2)
C	FC200
D	Polyacetal
P	MC901

Type

G	Worm Wheels
GDL	Duplex Worm Wheels

* () indicates old JIS designation

Feature Icons

RoHS Compliant Product	Finished Product	Ground Gear	Resin Product	Injection Molded Product
Re-machinable Product	Heat Treated Product	Stainless Product	Copper Alloy Product	Black Oxide coated Product

Characteristics

The simplest way to obtain a large speed reduction with high torque in a compact space is with worm gear drives. KHK stock worms and worm wheels are available in modules 0.5 to 6 and in speed ratios of 1/10 to 1/120, made in a variety of materials and styles. We also offer stock duplex worms and worm wheels with which you can obtain a very low backlash, high rotational precision system. The following table lists the main features for easy selection.

Type	Catalog No.	Module	No. of threads or reduction ratio	Material (JIS)	Heat treatment	Tooth surface finish	Precision (KHK W 001, KHK W 002, NOTE 2)	Features	
Duplex Worms & Worm Wheels	Worm	KWGD L	2 ~ 4	Single thread	SCM440	Thermal refined, gear teeth induction hardened	Ground	1	High-precision duplex worms with superior strength. A range of backlash values can be obtained by moving the worm axially.
	Worm	KWGD LS	1.5 ~ 4	Single thread	SCM440	Thermal refined, gear teeth induction hardened	Ground	1	Duplex worms with a shaft, excellent in accuracy and strength. A range of backlash values can be obtained by moving the worm axially.
	Worm Wheel	AGD L	1.5 ~ 4	20 ~ 60	CAC702 (A & BC2)	—	Cut	1	Duplex worm wheels made of aluminum bronze, excellent in wear-resistance. The pitch accuracy is first grade.
Worms & Worm Wheels	Worm	KWG	0.5 ~ 6	Single thread - Double thread	SCM440	Thermal refined, gear teeth induction hardened	Ground	2	Grounded finished worms with a shaft, including tooth surface quenching treatment. Allows compact design due to having small reference diameters.
	Worm Wheel	AG NOTE 1	0.5 ~ 1.5	10 ~ 60	CAC702 (A & BC2)	—	Cut	2	Made of aluminum bronze, have excellent wear-resistance. Wide selection is available for this item.
	Worm Wheel	AGF NOTE 1	2 ~ 6	10 ~ 60	CAC702 (A & BC2)	—	Cut	2	Made of aluminum bronze, have excellent wear-resistance. Allows compact design.
	Worm	SWG	1 ~ 6	Single thread - Triple thread	S45C	Gear teeth induction hardened	Ground	2	Reasonably priced ground worms. Ready-to-use finished products from the J Series, are also available.
	Worm Wheel	AG NOTE 1	1 ~ 6	10 ~ 60	CAC702 (A & BC2)	—	Cut	2	Made of aluminum bronze, have excellent wear-resistance. Wide selection is available for this item.
	Worm	SW	0.5 ~ 6	Single thread - Double thread	S45C	—	Cut (Thread rolled)	4	Economical, commonly used worms that have broad utility. Ready-to-use finished products from the J Series are also available.
	Worm	SUW	0.5 ~ 3	Single thread - Double thread	SUS303	—	Cut	4	Rust-resistant worms made of stainless steel suitable for mating with DS or PG worm wheels. Finished products for the J Series are also available.
	Worm Wheel	BG	0.5 ~ 6	10 ~ 60	CAC502 (PBC2)	—	Cut	4	Phosphorous bronze worm wheels have excellent wear resistance. Interchangeable with CG Worm Wheels, and enhances strength.
	Worm Wheel	CG	1 ~ 6	10 ~ 120	FC200	—	Cut	4	Economical, commonly used worm wheels that have broad utility. Available with a large selection of modules and number of teeth.
	Worm Wheel	DG	0.5 ~ 0.8	10 ~ 60	Polyacetal	—	Cut	5	Fine pitch worm wheels made of polyacetal, a stable plastic material.
Worm Wheel	PG	1 ~ 3	10 ~ 50	MC901	—	Cut	5	Light weight and strong MC Nylon worm wheels. Suitable for use in food machinery, and can be used without lubricant.	

(NOTE 1) The material of cast hubs for AGF and AG worm wheels is FC200(Cast Iron). AG worm wheels mate primarily with SWG worms. But, for Modules 0.8 or smaller, AG worm wheels mate with KWG worms.

(NOTE 2) KHK stock worms and worm wheels are produced to KHK's own precision grades. See the "Precision of Worms and Worm Wheels" in the "Selection Hints" section.

Our precision gear cutting technology enables acceleration and noise reduction

Setting the proper tooth contact and the backlash is essential for using worm gears. Use KHK stock worm gears for safe, reliable use.



Worm Grinding Machine by Klingelberg



Worm gear testing machine by Klingelberg

1. Efficiency of Worm Gear Pair

The efficiency of power transmission varies somewhat with the conditions of assembly and lubricant, but is generally 30 ~ 90% (excludes losses from bearings and churning of lubricants). The efficiency of KHK stock worm gear pair is given below as a reference. To learn more about strength calculations, please refer to the technical information contained in the "Surface Durability of Cylindrical Worm Gearings" section on Page 96.

Efficiency of KWGDLS/AGDL Worm Gear Pair (%)

(rpm = Rotation of worm)

Catalog No. \ Worm rpm	100	300	600	900	1200	1800
KWGD1.5-R1	35	42	47	51	53	57
KWGD2-R1	38	45	51	55	56	61
KWGD2.5-R1	40	48	54	57	60	63
KWGD3-R1	41	49	55	58	62	65
KWGD3.5-R1	42	50	56	61	62	65
KWGD4-R1	42	51	56	61	63	67

Efficiency of KWG/AG, AGF Worm Gear Pair (%)

(rpm = Rotation of worm)

Catalog No. \ Worm rpm	100	300	600	900	1200	1800
KWG0.5-R1	30	34	38	41	43	46
KWG0.8-R1	35	40	44	47	49	53
KWG1-R1	34	40	45	48	51	54
KWG1.5-R1	35	42	47	51	53	57
KWG2-R1	45	51	56	60	62	65
KWG2.5-R1	44	51	57	61	62	67
KWG3-R1	44	52	58	61	64	67
KWG4-R1	50	58	64	66	70	72
KWG5-R1	51	60	66	69	71	73
KWG6-R1	53	61	66	70	72	75
KWG0.5-R2	46	50	54	58	60	63
KWG0.8-R2	51	56	61	64	66	69
KWG1-R2	51	56	62	64	67	70
KWG1.5-R2	52	59	64	67	69	73
KWG2-R2	61	67	71	74	76	78
KWG2.5-R2	60	67	72	75	76	80
KWG3-R2	61	68	73	75	78	80
KWG4-R2	66	73	77	79	82	84

Efficiency of SW, SUM / CG, BG, PG Worm Gear Pair (%)

The efficiency is approximately as follows, depending on the assembly, loading, lubrication and rotational speed.

Catalog No.	Thread	Efficiency (%)
SW/SUW	Single thread	40 ~ 50%
	Double thread	50 ~ 60%

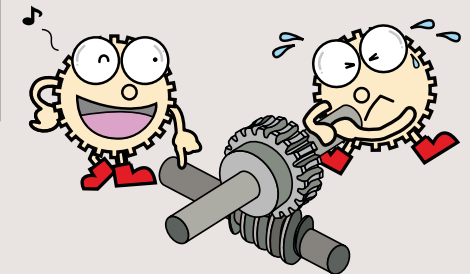
Efficiency of SWG/AG Worm Gear Pair (%)

(rpm = Rotation of worm)

Catalog No. \ Worm rpm	100	300	600	900	1200	1800
SWG1-R1	34	40	45	48	51	54
SWG1.5-R1	35	42	47	51	53	57
SWG2-R1	38	45	51	55	56	61
SWG2.5-R1	40	48	54	57	60	63
SWG3-R1	41	49	55	58	62	65
SWG4-R1	42	51	56	61	63	67
SWG5-R1	46	54	60	64	66	70
SWG6-R1	48	57	64	66	68	73
SWG1-R2	51	56	62	64	67	70
SWG1.5-R2	52	59	64	67	69	73
SWG2-R2	55	62	67	70	72	75
SWG2.5-R2	57	64	69	72	75	77
SWG3-R2	58	66	71	73	76	78
SWG4-R2	59	67	72	75	77	80
SWG5-R2	62	70	75	78	79	82
SWG6-R2	65	72	77	80	81	84
SWG3-R3	67	74	78	80	82	84
SWG4-R3	68	75	79	82	83	86

2. Self-Locking Feature of Worm Gear Pair

Self-locking is defined as the inability of worm wheels to drive the worms. Factors affecting the self-locking feature include the materials of the worm and worm wheel, lead angle, precision of manufacture, types of bearings, lubricant, etc. Thus, it is not dependent simply on the lead angle. But, in general, self-locking will occur when the lead angle in a single thread worm is less than 4°. For systems requiring fail-safe prevention of back drive, we recommend other braking mechanisms or one-way clutches.



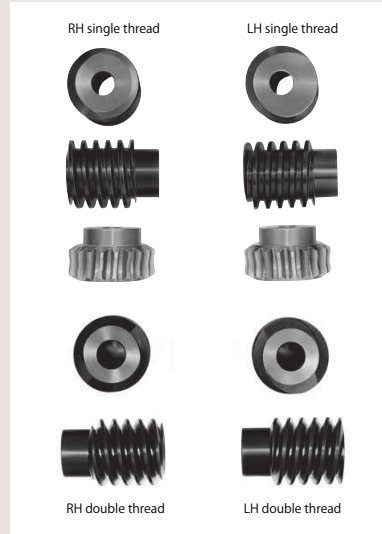
Selection Hints

Please select the most suitable products by carefully considering the characteristics of items and contents of the product tables. It is also important to read all applicable "CAUTION" notes shown below before the final selection. Use of catalog numbers when ordering will simplify and expedite the processing of your order.

1. Caution in Selecting the Mating Gears

Worms and worm wheels have either right-hand or left-hand helix. The same hand worms and worm wheels comprise sets. However, the number of threads and whether they use normal module or axial module system must also be matched. The table below shows available combinations of KHK stock worms and worm wheels.

The Helixes of Worms and Worm Wheels



Mating Worm Wheels Selection Chart

Worm	KWDG KWGDL	KWG	SWG			SW			SUW			
			R1	R2	R3	R1	R2	L1	L2	R1	R2	
Mating Worm Wheel NOTE 1	Helix/ Thread											
AGDL	R1	○										
AGD.5-1.5	R1		○									
AGF	R2			○								
AG	R1				○							
	R2					○						
	R3						○					
BG	R1						○					○
	R2							○				○
	L1								○			○
	L2									○		○
CG	R1									○		○
	R2										○	○
	L1											○
PG	R1											○
	R2											○
DG	R1											○
	R2											○

(NOTE 1) Select the same module for both members.

2. Caution in Selecting Gears Based on Gear Strength

The gear strength values shown in the product pages were computed by assuming a certain application environment as shown below. Therefore, they should be used as reference only. We recommend that each user computes their own values by applying the actual usage conditions.

Calculation assumptions for Surface Durability

Item	Catalog No.	KWGDL · KWGDL5/AGDL KWG/AGF, SWG/AG	SW/BG	SW/CG	SUW/PG	SUW/DG
Rotations of worm		600rpm		100rpm	Allowable bending stress (kgf/mm ²)	
Lubricant		Lubricant for gears with proper viscosity and with anti-pressure additives				
Lubrication		Oil bath				
Starting condition		Starting torque less than 200% of rated torque. Less than 2 starts per hour				
Durability		26000 hours		1.15 (40°C with No Lubrication)		
Impact from motor		Uniform load				
Impact from load		Uniform load				
Allowable stress factor S _{lim}		0.67	0.70	0.42	NOTE 3 1 (40°C with No Lubrication)	

(NOTE 2) The gear strength formula is based on JGMA (Japanese Gear Manufacturer's Association) specifications and "MC Nylon Technical Data" by Nippon Polyenco Limited. The units for the rotational speed (rpm) and the stress (kgf/mm²) are adjusted to the units needed in the formula.

(NOTE 3) Allowable bending stress of DG worm wheel is the value we estimated.

The Maximum Allowable Sliding Speed Due to Heat

The maximum allowable sliding speed for each series of worm wheels is given on the right. Select the appropriate part by calculating the sliding speed.

Sliding speed v_s (m/s)

$$v_s = \frac{dn}{19100 \cos \gamma}$$

d : Worm pitch dia.
 n : Worm speed (rpm)
 γ : Worm nominal lead angle

Catalog No.	Max. Sliding Speed (m/s)
AGDL	* 15
AGF	* 15
AG	* 15
BG	* 10
CG	* 2.5
PG	1 (no lubrication)

*JGMA405-01



3. Selecting Worms and Worm Wheels by Precision

The precision standards of KHK stock worms and worm wheels are established by us. The table below indicates the tolerance ranges for our products.

1 Precision of worms (KHK W 001)

KHK established allowable profile and lead errors of worms with precision grades 1 to 4, by using the JIS Standard as reference. Lead errors are measured over one full revolution.

Precision Grades of Worms (KHK W 001) (Unit: μm)

Grade	Error	Module				
		over m0.4 up to 1	over m1 up to 1.6	over m1.6 up to 2.5	over m2.5 up to 4	over m4 up to 6
1	Tooth profile error	8	12	16	20	25
	Lead error	7	9	11	13	16
2	Tooth profile error	12	16	20	24	29
	Lead error	15	18	21	25	28
3	Tooth profile error	16	23	30	37	50
	Lead error	20	23	27	33	37
4	Tooth profile error	20	30	40	50	70
	Lead error	30	32	38	46	52

2 Precision of worm wheels (KHK W 002)

We have established standard grades 1 to 5 of worm wheels using the JIS Standard as reference. The allowable values of Single Pitch Error and Runout Error are defined for each module size and pitch diameter.

Precision Grades of Worm Wheels (KHK W 002)

Grade	Error	Unit: μm																								
		Over m0.4 up to 1					Over m1 up to 1.6					Over m1.6 up to 2.5					Over m2.5 up to 4					Over m4 up to 6				
		Pitch diameter (mm)																								
		6 up to 12	12 up to 25	25 up to 50	50 up to 100	100 up to 200	12 up to 25	25 up to 50	50 up to 100	100 up to 200	200 up to 400	12 up to 25	25 up to 50	50 up to 100	100 up to 200	200 up to 400	25 up to 50	50 up to 100	100 up to 200	200 up to 400	400 up to 800	25 up to 50	50 up to 100	100 up to 200	200 up to 400	400 up to 800
1	Single pitch error	5	6	7	7	9	6	7	8	9	10	7	7	8	9	11	8	9	10	11	13	9	10	11	13	14
	Total composite error	21	24	26	30	34	25	28	31	35	41	27	30	33	37	43	33	36	40	46	53	37	40	45	50	57
2	Single pitch error	8	8	9	10	12	9	10	11	12	14	9	10	12	13	15	11	13	14	16	18	13	14	16	18	20
	Total composite error	30	33	37	42	48	35	39	44	50	57	38	42	46	52	60	46	51	57	64	74	52	57	63	71	80
3	Single pitch error	11	12	13	15	17	12	14	16	18	20	13	15	16	19	21	16	18	20	23	26	19	20	22	25	29
	Total composite error	43	47	53	60	68	50	55	62	71	81	53	59	66	74	85	65	72	81	91	105	74	81	90	100	115
4	Single pitch error	15	17	19	21	24	18	19	22	25	29	19	21	23	26	30	23	25	28	32	37	26	28	32	35	40
	Total composite error	60	66	74	83	95	70	77	87	99	115	75	83	92	105	120	91	100	115	130	145	105	115	125	140	160
5	Single pitch error	21	24	26	30	34	25	28	31	35	41	27	30	33	37	43	33	36	40	46	53	37	40	45	50	57
	Total composite error	86	94	105	120	135	100	110	125	140	165	105	120	130	150	170	130	145	160	185	210	150	160	180	200	230

Application Hints

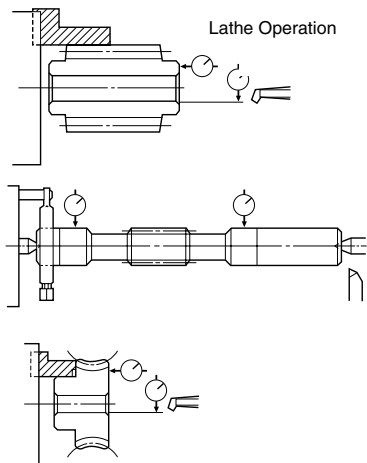


In order to use KHK stock worms and worm wheels safely, carefully read the Application Hints before proceeding. If there are questions or you require clarifications, please contact our technical department or your nearest distributor.

KHK Co., Ltd.
PHONE: 81-48-254-1744 FAX: 81-48-254-1765
E-mail: export@khkgears.co.jp

1. Caution on Performing Secondary Operations

- If you are re boring, it is important to pay special attention to locating the center in order to avoid runout. (Fig.1) The reference datum for gear cutting or grinding is the bore. (For worm shafts, it is ground portion of the shaft.) Therefore, use the bore or shaft for locating the center. If it is too difficult to do for small bores, the alternative is to use one spot on the bore and the runout of the side surface.



If chucking operation using scroll chucks is to be done, we recommend the use of new or re bored jaws for improved precision.

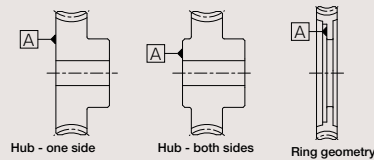
Fig.1

- To open up the bore to its maximum, calculate the bore size so that the tooth strength is weaker than the strength of the remaining material. For machining the maximum bore diameter, it should be designed so that the thickness between hub diameter (or root diameter) to bore diameter has more strength than the gear strength. As a guide, the maximum machined bore diameter should be within 60% to 70% of the hub diameter (or root diameter). When the keyway is processed, it should be 50% to 60%. In the case FC material is used, it should be lower by 10% or more.
- Since worm wheels are molded products, they may have air bubbles inside the material. In case you find air bubbles inside when performing secondary operations, and if the bubbles are found to be troublesome, please contact your KHK distributor.

2. Points of Caution in Assembling

- KHK stock worms and worm wheels are designed such that when assembled according to the specified mounting distance with a tolerance of H7 to H8, the backlash shown in the product tables is obtained. Do not attempt to eliminate backlash by pushing worms into worm wheels or operate with the worm shifted in the direction along the tooth.
- The figure below shows the datum clamp face of a worm wheel. When assembling worm gears, be sure that the worm axis is in the center of the worm wheel face width.

Datum Clamp Face



- Because of the helix of the gear teeth, worms and worm wheels produce axial thrust forces. The directions of thrust depend on the hand of the helix and the direction of rotation. This is illustrated below in Fig.2. The bearings must be selected properly to be able to handle these thrust forces. See the "Gear Forces" section in separate technical reference book for more details (Page 107).

Direction of rotation and thrust force

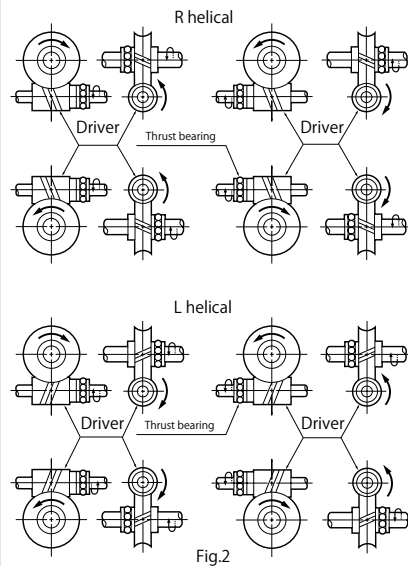


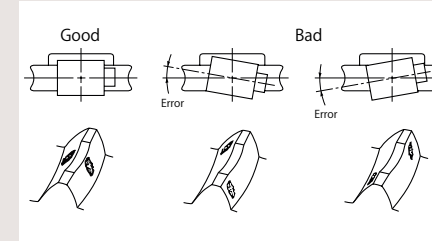
Fig.2

- Because large thrust forces act on worms, if they are not secured to the shaft firmly, they tend to shift. Use of step shafts, set screws, dowel pins, etc., are recommended. Also, check for loosening of bearings due to thrust forces.

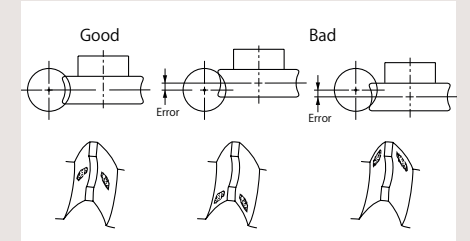
3. Verifying the orientation of assembly

How well the worms and worm wheels are assembled has large effects on the friction of the unit. The tooth contact at the time of assembly must be checked for correctness as shown below. See the "Tooth Contact of a Worm Gear Pair" section in separate technical reference book for more details (Page 67).

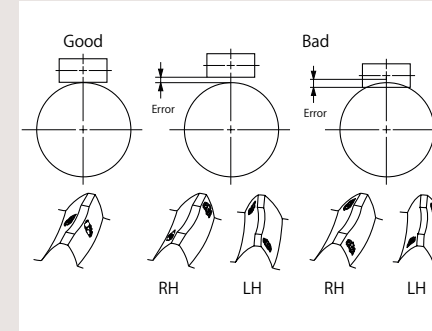
- Verify that the worm axis is perpendicular to the worm wheel axis.



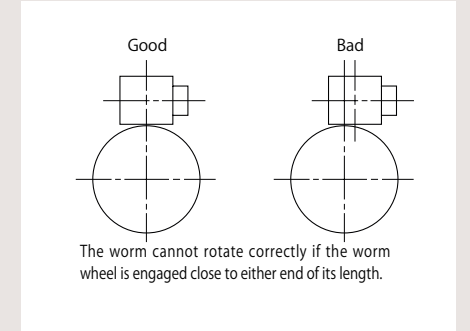
- Check that the worm axis is in the center of the worm wheel face width.



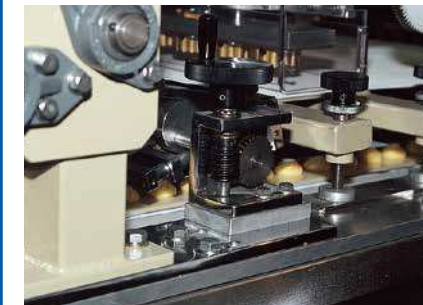
- Check the mounting distance (allowable mounting distance H7 ~ H8).



- Confirm that the center of the worm wheel goes through the midpoint of the worm length.



Application Examples



SW Worms and CG Worm Wheels used in a rotating comb device



SW Worms and BG Worm Wheels used in adjusting a cloth feeding device