PITSON TRANSMISSION TECHNOLOGIES
Gearing Solutions

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PITSON TRANSMISSION TECHNOLOGIES
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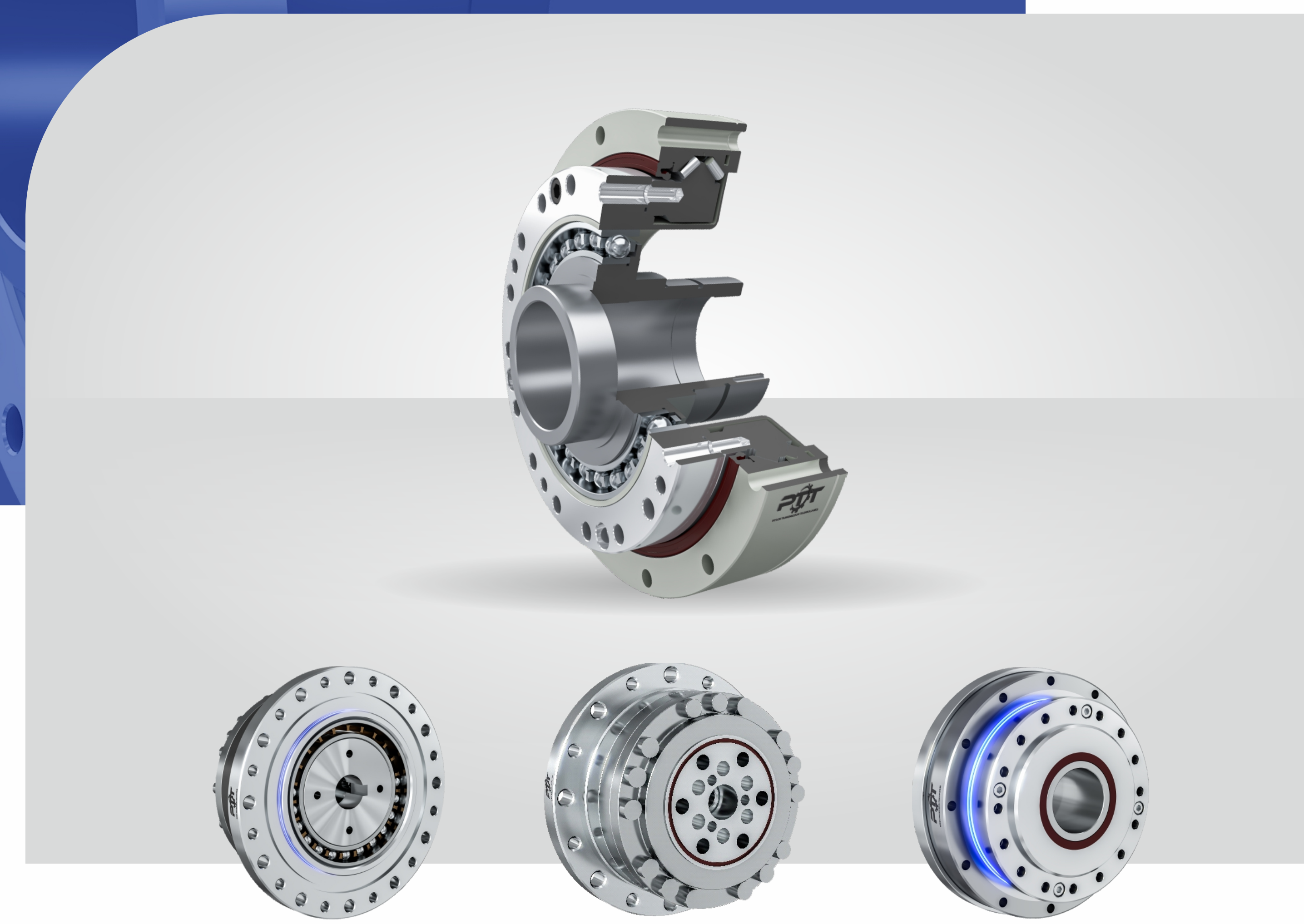
SW Series

Strain-wave Gearboxes With Higher Rigidity



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STANDARD & CUSTOMISED GEARING SOLUTIONS

ZERO BACKLASH GEARBOX SOLUTIONS WITH

HIGHER RIGIDITY

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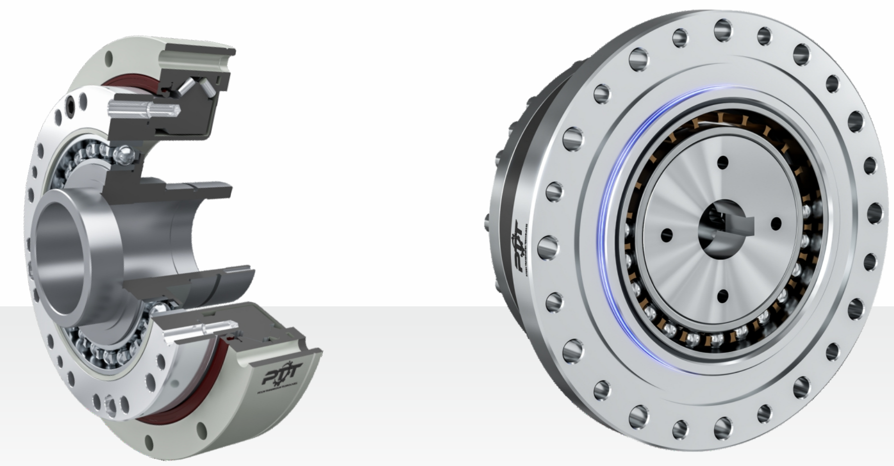
EXCELLENT TECHNOLOGY FOR EVOLVING INDUSTRIES

Harmonic Strain wave gears play critical roles in robotics, semiconductor manufacturing equipment, factory automation equipment, medical diagnostics and surgical robotics. Additionally, they are frequently used in mission-critical spaceflight applications which capture the human spirit.



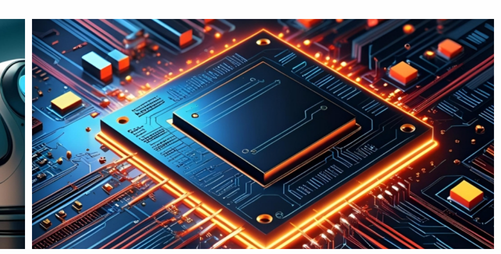
APPLICATIONS

DEFENSE - LAND SYSTEMS

AERO SPACE

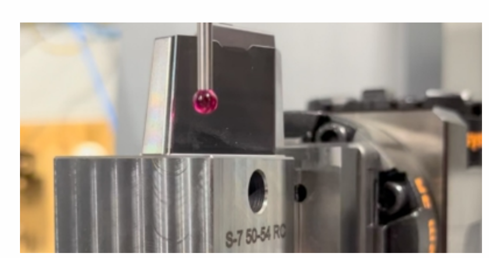
SATCOM SYSTEMS

SURGICAL ROBOTS



SEMI-CON SYSTEMS

MACHINE TOOLS



MEASURING MACHINES

FOOD & PACKAGING

ROBOTICS & COBOTS

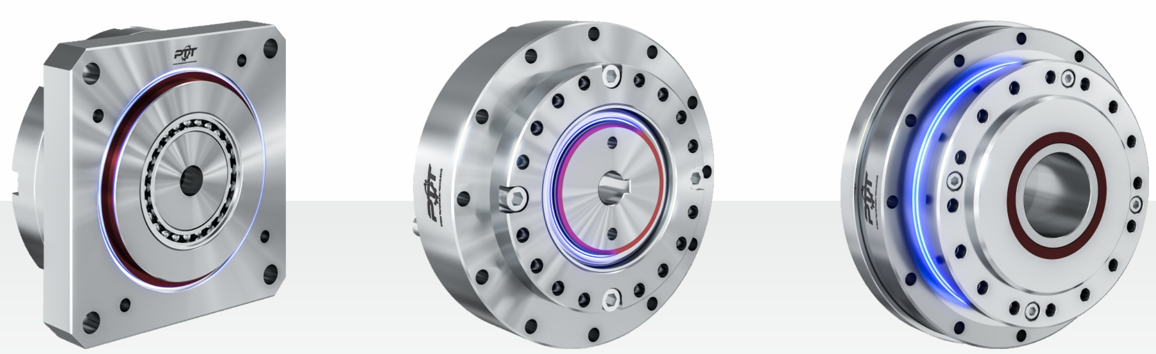
PRINCIPLE OF STRAIN WAVE GEARS

1. Composition of harmonic gearbox
harmonic gearbox has three basic components: a wave generator, a flexspline and a circular spline.
Wave generator: it is made up of a ball bearing and an elliptical cam. The wave generator is usually attached to the input end, the inner ring of the bearing is fixed around the cam causing the outer ring of the bearing deforms to an elliptical shape.

Fexspline: it is an elastic thin-walled component with gear teeth on outer surface. It is usually fitted to output end.
Circular spline: it is a rigid steel ring with internal teeth. It usually has two more teeth than the flexspline, and generally mounted onto a housing.

2. Principle of harmonic gearbox
As a reducer, the harmonic gearbox is often in a status as: the wave generator drives, the circular spline is fixed, the flexspline is output end. When the wave generator is put inside of the flexspline, the flexspline is forced into an elliptical shape causing the flexspline teeth to engage with the tooth profile of the circular spline along the major axis of the ellipse, with the teeth completely disengaged across the minor axis of the ellipse. The rotation of the wave generator makes the flexspline deform continuously, the teeth change operating state in the process of engagement and disengagement, thus the motion transmission between wave generator and flexspline is realized.

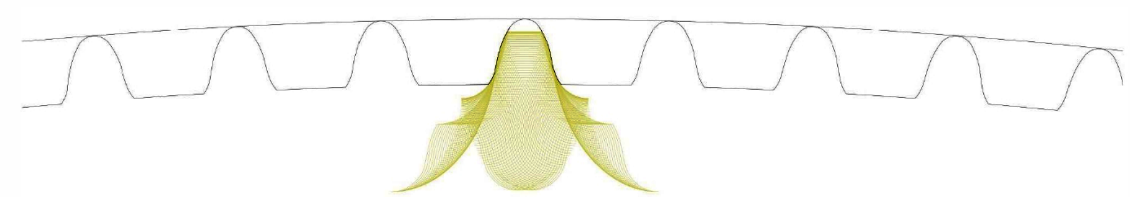
3. Characteristics of harmonic gearbox
1. High accuracy: a good percentage of its teeth are meshed at all times, and are engaged at two zones 180 degrees apart. This means influences of tooth pitch errors and accumulated pitch errors on rotational accuracy are neutralized, which assures high positional and rotational accuracy.
2. High speed reduction ratio: a harmonic gearbox has high single-stage reduction ratios of 1/30-1/500. Three basic components along same axle without complex structures can provide high reduction ratios.
3. High torque capacity: each tooth is subjected to a negligible amount of force yet provides a high torque capacity because of the way the teeth come into contact with each other and because a good percentage of the teeth in the flexspline are engaged at all times.
4. Small-sized and light weight: while being less the size of conventional gearing mechanisms and less the weight, the harmonic gearbox provides the same levels of torque and speed reduction ratios as its conventional counterparts enabling machinery and equipment to be made smaller and lighter.
5. Superior efficiency and long life time.
6. Quiet and minimal vibration operation.



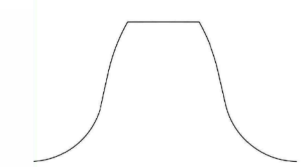
TOOTH PROFILE

Tooth Engagement - Step-by-Step Improvement
- Gear toothing capacity increased by 15%
- Temperature rise decreased by 8-10°C
- Reduced gear fatigue pitting contact area
- Service life exceeds 15,000 hours

About Tooth Profile
We have made some upgrades based on the traditional theoretical double arc profile. The tooth profile formed by :he original twocurve continuous arc curve is optimized as a continuous arc curve with multiple segments of curvature. To ensure that the gears of reducer are properly meshed, while protecting the risk of grease failure after grease is squeezed by reducing relative sliding friction. Based on the 5 tooth shape, the load capacity is increased by 15%, the temperature rise is reduced by 8-10°C, the gear fatigue piting contact area is reduced by more than 30%, the continuous running service life exceeds 15,000 hours, which improves the overall performance of the harmonic gearbox.



During development, the formation of flexspline tooth profile can be determined by the radial displacement of the genera tor. Different reduction ratios can be matched with various tooth profiles, and the mesh backlash can be conveniently adjusted according to actual conditions keeping the reducer in optimal working condition.



DEFINITIONS

Starting torque
It is the minimum torque value applied to the input: end at which the strain wave gear first starts to rotate with no load

Rated torque
It indicates allowable continuous load torque when the rated input speed is 2000r/min

Permissible peak torque for start and stop
It is the maximum torque as a result of the moment of inertia of the output load during acceleration and deceleration

Permissible maximum value for average load torque
It is the maximum torque when the strain wave gear keeps continuous operation

Permissible maximum momentary torque
It is the momentary peak torque the strain wave gear may be subjected to the event of a cllision or emergency stop

Maximum Input Speed
It is the maximum allowable input rotational speed.

Maximum Average Input Speed
It is the average value of input speed

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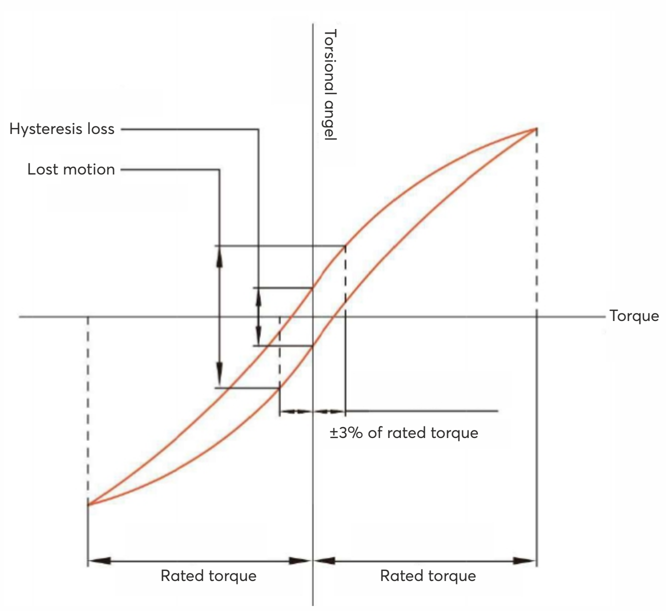
DEFINITIONS

Angle transmission accuracy

Angle transmission accuracy indicates the difference between the logical rotating angle and the actual rotating angle as the angle transmission error when any rotating angle is given as an input

Hysteresis Curve

From the stiffness graph, parameters such as backlash, stiffness, hysteresis loss, and lost motion can be obtained.



Backlash

Fix the circular spline and input end(wave generator) of the strain wave gear, and when ±2% rated torque is applied to the output end (flexspline), a small amount of angular displacement at the output end is observed, which is expressed as backlash.

Torsional stiffness(Spring Constant)

Fix the circular spline and input end(wave generator) of the strain wave gear, and apply torque to the output end (flexspline). The applied torque starts from 0 and increases or decreases to the rated torque on the positive and negative sides respectively. The change of the torsion angle at the output side can be slotted as 'stiffness curve", and the inclination of the stiffness curve can be expressed as the spring constant. (unit: Nm/rad)

KI... the spring constant for the torque from "0" to "T1"
K2... the spring constant for the torque from "T1" to "T2"
K3... the spring constant for the torque from "T2" to rated torque

Hysteresis loss

Fix the circular spline and input end(wave generator) of the harmonic reducer,and apply torque to the output end(flexspline) until the rated torque. when the torque returns to "0", the torsion angle does not become "0" completely, there will be a slight amount of clearance is left. This amount of clearance is called hysteresis loss.

Lost motion

At ±3% of rated torque, the torsion angle in the "stiffness curve" is expressed as a lost motion.

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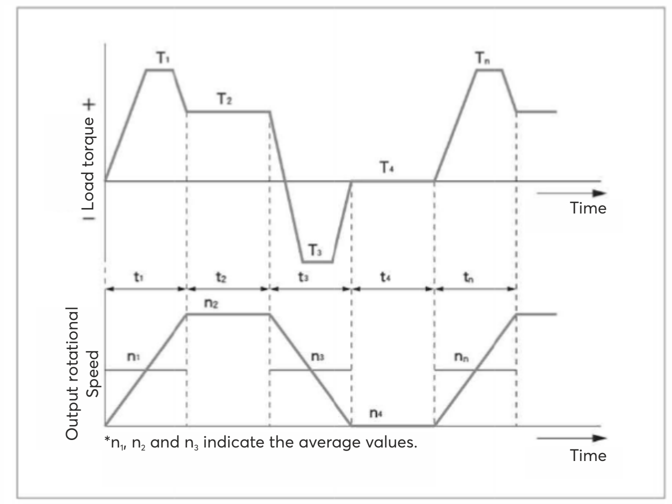
SELECTION PROCESS

In general, the servo system is rarely in a continuous constant loadstate. The input rotational speed, load torque change and comparatively large torque are applied at start and stop. Unexpected impact torque may be applied. These fluctuating load torques should be converted to the average load torque in selecting a model number. As an accurate cross roller bearing is built in the direct external load support (output flange) of the unit type, the maximu mmoment load, life of the cross roller bearing and the static safety coefficient should also be checked

Select a model number according to the following flowcha rt. If you find a value exceeding that from the ratings, you should review it with the upper-level model number or consider reduction of conditions including the load torque.



Obtain the value of each load torque pattern.

Load torque	Tn (Nm)
Time	tn (sec)
Output rotational speed	Nn (r/min)
<Normal operation pattern>	
Starting time	T_1, t_1, n_1
Steady operation time	T_2, t_2, n_2
Stopping (slowing) time	T_3, t_3, n_3
Break time	T_4, t_4, n_4
<Maximum rotational speed>	
Max. output rotational speed	no max
Max. input rotational speed (Restricted by motors)	ni max
<Impact torque>	
When impact tourque is applied	T_s, t_s, n_s
<Required life>	L1Ø=L(hours)

Review of the operation conditions and model number

Calculate the average load torque applied on the output side of strain wave gear @ from the load torque pattern: Tav (N.m.)

$$T_{av}=\sqrt[3]{\frac{n_1 \cdot t_1 \cdot |T_1|^3+n_2 \cdot t_2 \cdot |T_2|^3+\cdots n_n \cdot t_n \cdot |T_n|^3}{n_1 \cdot t_1 + n_2 \cdot t_2 + \cdots n_n \cdot t_n}}$$

Tav≤

Select a model number temporarily with the following conditions. Tav≤ Permissible maximum value of the average load torque

no *av*(r/min)

Calculate the average output rotational speed: no *av*(r/min)

$$no\,av = \frac{n_1 \cdot t_1 + n_2 \cdot t_2 + \cdots n_n \cdot t_n}{t_1 + t_2 + \cdots t_n}$$

(R)。ni *max*

Obtain the reduction ration (R) A limit is placed on "ni *max*" bymotors.

$$\frac{ni\,max}{no\,max} \geqq R$$

(no *av*,) (R)
ni *av*(r/min)

Calculate the average input rotational speed from the average output rotational speed (no av and the reduction ratio (R). ni *av*(r/min)

$$ni\,av = no\,av \cdot R$$

(no *max*,) (R)
ni *max*(r/min)

Calculate the maximum input rotational speed from the max. output rotational speed (no *max*) and the reduction ratio (R). ni *max* (r/min)

$$ni\,max = no\,max \cdot R$$

NG

(no *av*,) (r/min)
(no *max*,) (r/min)

Check whether the temporarily NI *av*≤ Permissible average input rotational selected model number speed (r/min)
Check whether the condition NI *max*≤ Permissible max. input rotational from the ratings.speed (r/min)

OK

NG

T_1, T_3,

Check whether T_1 and T_3 are equal to or less than the permissible peak torque (Nm) value at start and stop from the ratings.

OK

NG

TS

Check whether Ts is equal to or less than the permissible maximum momentary torque (Nm) value from the ratings.

OK

NG

ns ts,
(Ns);,

Calculate (Ns) the permissible number of times from output rotational speed n_s and time t_s when the impact torque is applied, and check whether it satisfied the usage conditions.

$$N_s = \frac{10^4}{2 \cdot \frac{n_s \cdot R}{60} \cdot t}\text{(times)} \cdot \cdot N_s \leqq 1.0 \times 10^4 \text{(times)}$$

OK

Calculate the lifetime

$$L_{10} = 7000 \cdot \left(\frac{T_r}{T_{av}}\right)^3 \cdot \left(\frac{\quad}{\quad}\right) \text{ (hours)}$$

NG

Check whether the calculated lifetime is equal to or more than the life of the wave generator

OK

The model number is determined.

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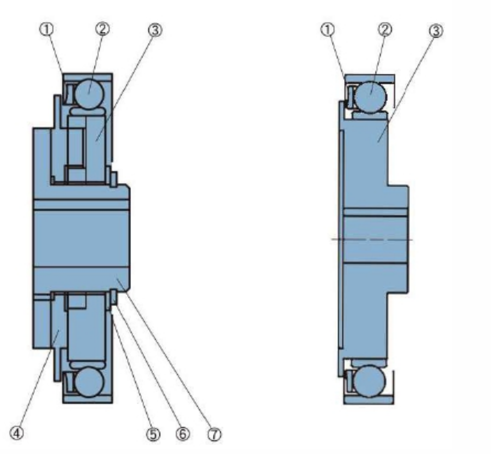
WAVE GENRATOR

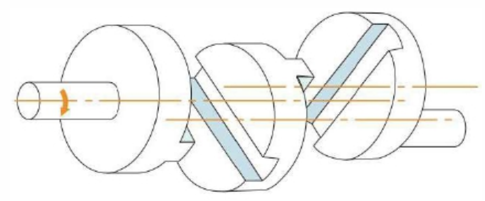
The wave generator ncludes a structure of a European-style coupling with a sef-aligning structure and an rigid type without an automatic self-aligning structure, and varies depending on the series. For details, please refer to the outline drawing of each series.

Basic structure and shape of wave generator shown as below



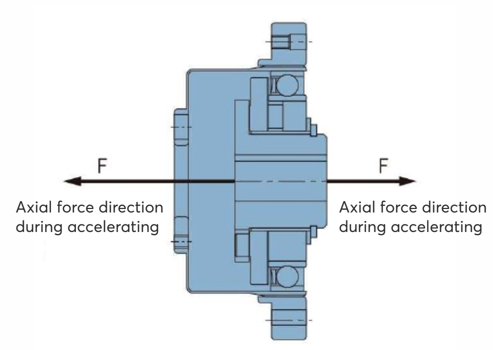
Oldham coupling   Rigid type

Oldham coupling Structure - Utilizing a European Style Coupling



Retainer
Flexible bearing
Wave Generator Plug
Oldham coupling
Rubwasher
Snap ring
Wave generator hub

Axial force direction o the wave generator



Axial force and Axial fixation of wave generator

The axial force on wave generator begins to work due to the elastic deformation of the flexspline. When used as a reducer,the axial force moves towards the inside of the flexspline. When used as a speed ircreaser, the axial forces movement is oppositeto the direction of the deceleration. The design to prevent axial force of the wave generator shall be adopted under any conditions of usage.

"Please make sure to coisult with the authorized distributor when setting the stop screw and fixing it to the input axial on the wave generator.

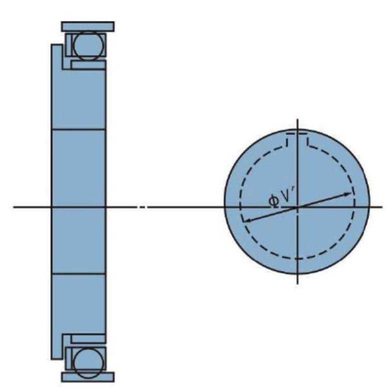
Maximum hole diameter of wave generator of Unit Type

The standard hole diameter of the wave generator is shown in the outline drawing and maybe changed in the range up to the maximum size range shown in the table. We recommend the dimension of keyway based on (GB) standard. It is lecessary that the dimension of keyways should be fully durable the transmission torque.

Hole diameter of wave generator unit:mm

Model	5	8	11	14	17	20	25	32	40	45	50	58
Standard size(H7)	3	5	5、6、8	6、8、	8、11、14	8、11、14	11、14、	14、19、22	14、19、22	19、22、	19、22、	\
Minimum size	\	\	5	6	8	8	11	14	14	19	19	
Maximum size	\	\	8	8	14	14	14	22	22	22	22	

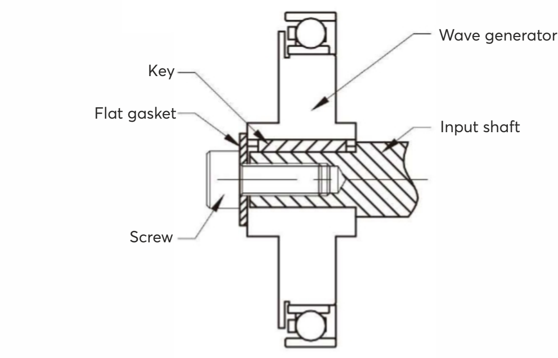
*The hole diameter of the Wave generator can be customized to customer requirements.



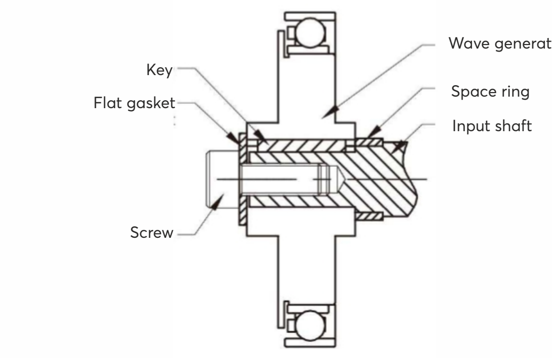
PRECAUTION ON ASSEMBLY

The connecting and fixing method of wave generator

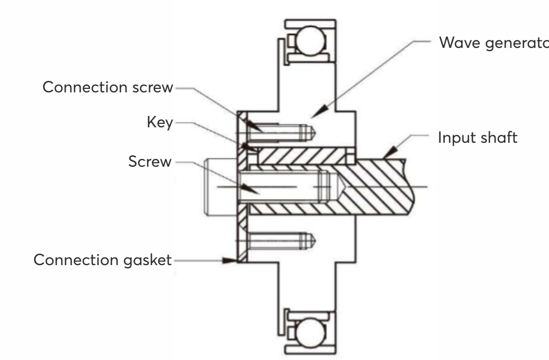
Input shaft has a shaft shoulder, it can be connected with wave generator directly. As shown in the figure.



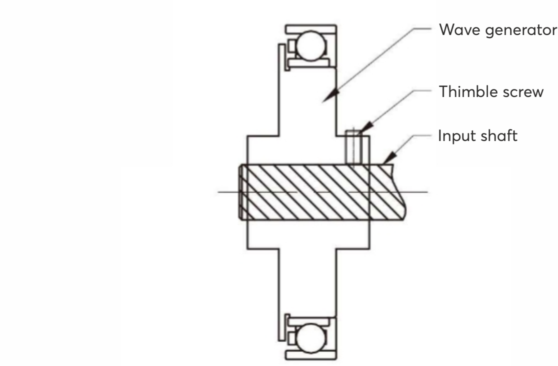
Input shaft has a shaft shoulder, but it's too long. You can add a space ring on the shaft(the parallelism of the spacer ring should be within 0.01mm), then connect and fix it through the thimble screw on the wave generator. As shown in the figure.



Input shaft has no shaft shoulder. Fix a connection gasket on the wave generator, then connect and fix with the input shaft. As shown in the figure.

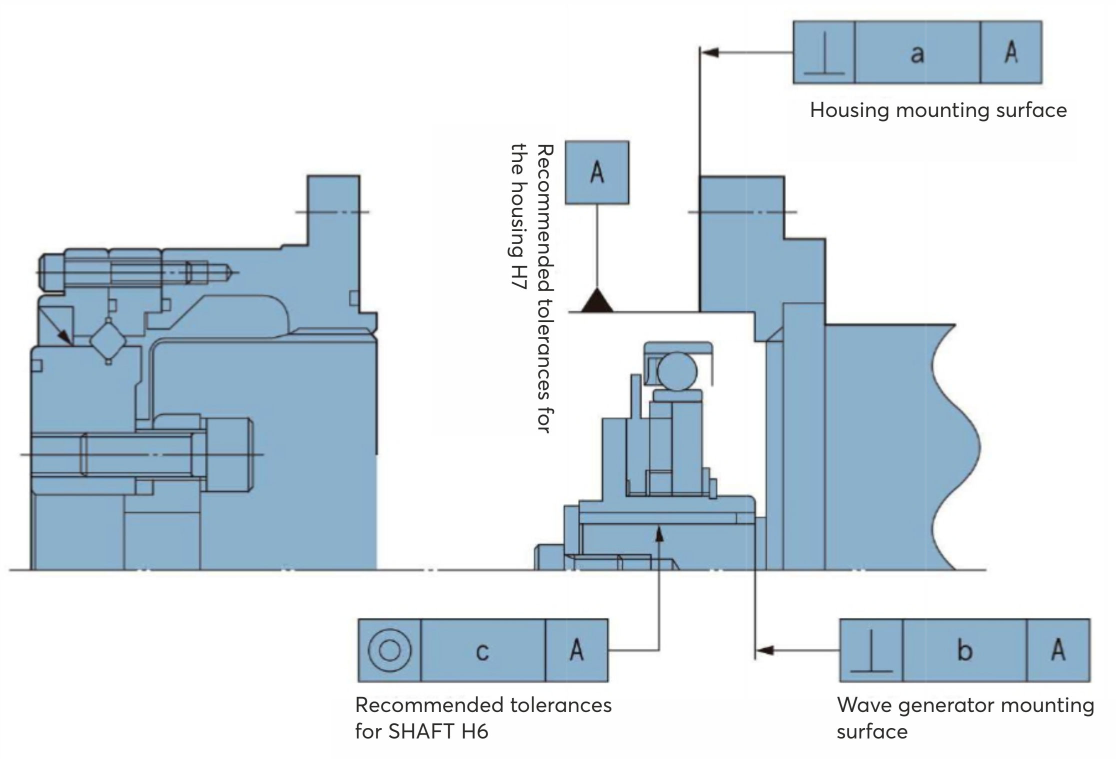


This fixing method is suitable for small models, optical axis input. Input shaft inserted into the wave generator, then connect and fix it through the thimble screw on wave generator. As shown in the figure.



PRECAUTION ON ASSEMBLY

Assembly accuracy of Cup Type Gearbox



Recommended accuracy of the assembled housing

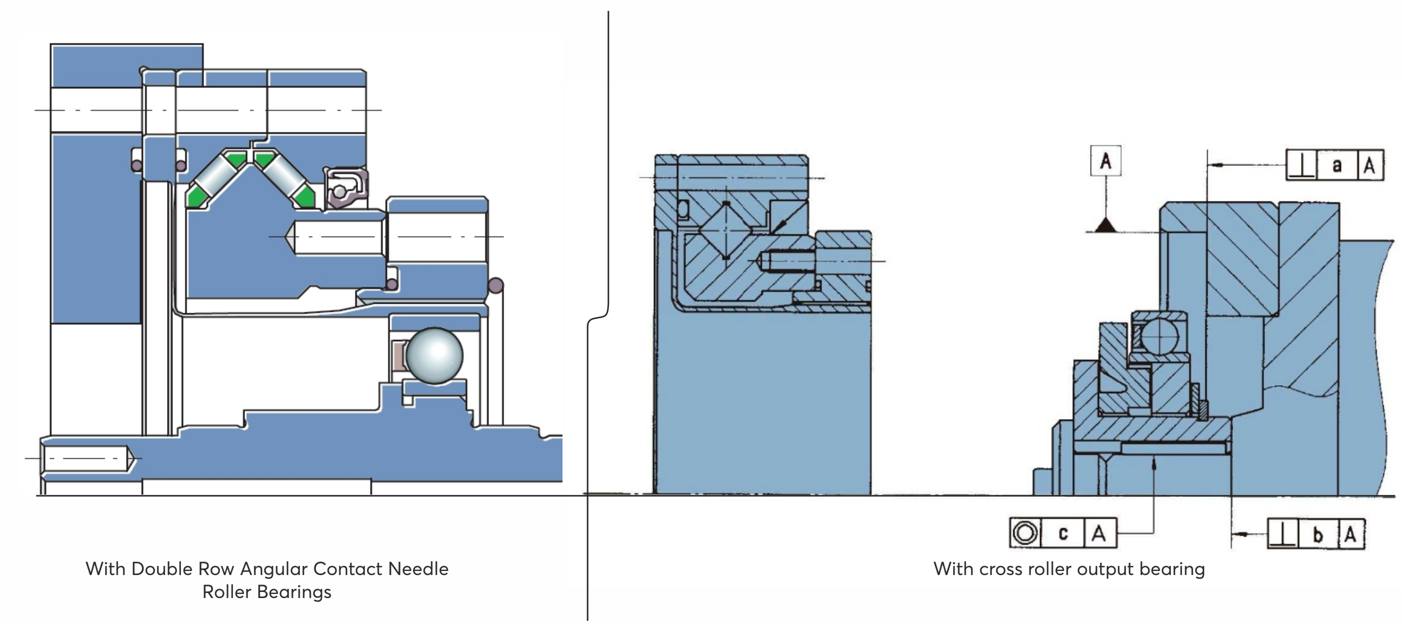
unit:mm

Model Symbol	5	8	11	14	17	20	25	32	40
a	0.008	0.01	0.011	0.011	0.015	0.017	0.024	0.026	0.026
b	-	-	-	0.017	0.02	0.02	0.024	0.024	0.032
	(0.005)	(0.006)	(0.007)	0.008	0.01	0.01	0.012	0.012	0.012
c	-	-	-	0.03	0.034	0.044	0.047	0.05	0.063
	(0.005)	(0.006)	(0.007)	0.016	0.018	0.019	0.022	0.022	0.024

b.c is the value of the rigid type generator (I series) and the oldham coupling generator(II series). The value in() is the value of the rigid type generator (I series).

PRECAUTION ON INSTALLATION

Assembly accuracy of Hat Type Gearbox



With Double Row Angular Contact Needle Roller Bearings

With cross roller output bearing

Recommended accuracy of the assembled housing

unit:mm

Model Symbol	8	11	14	17	20	25	32	40	45	50
a	0.01	0.011	0.011	0.015	0.017	0.024	0.026	0.026	0.027	0.028
b	-	-	0.017	0.02	0.02	0.024	0.024	0.032	0.032	0.032
	(0.006)	(0.007)	0.008	0.01	0.01	0.012	0.012	0.012	(0.012)	0.015
c	-	-	0.03	0.034	0.044	0.047	0.05	0.063	0.063	0.066
	(0.006)	(0.007)	0.016	0.018	0.019	0.022	0.022	0.024	(0.024)	0.03

b.c is the value of the rigid type generator (I series) and the oldham coupling generator(II series). The value in() is the value of the rigid type generator (I series).

CHECKING MAIN ROLLER BEARING

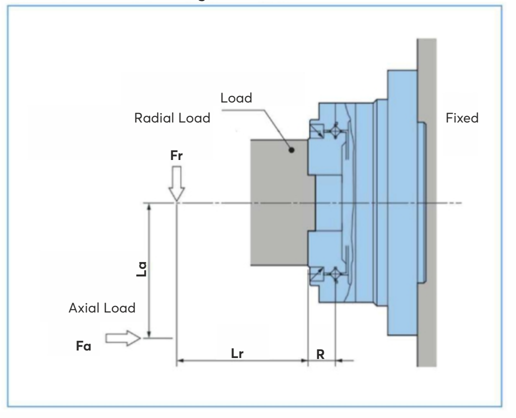
A precision cross roller bearing is built in the unit type and the gear head type to directly support the external load (output flange). Check the maximum load moment load, lifespan of the bearing and static safety coefficient to fully bring out the performance of the unit type.

Maximum load moment load (Mmax) is obtained as follows. Make sure that Mmax,,..Mc (Allowable static torque Mc refer to the main bearing specification table of each series).

$$M_{max} = Fr_{max}\,(Lr+R)\ \ +Fa_{max}\cdot La$$

Fr_{max}	Max. radial load	N (kgf)	Reference to right figure
Fa_{max}	Max. axial load	N (kgf)	Reference to right figure
Lr La	-	m	Reference to right figure
R	offset amount	m	Refer to the diagram on the right and the specification table for each series of main bearings

External load influence diagram



MODEL NOMENCLATURE

(STRAIN WAVE Gearbox Type) C= CUP TYPE H= HAT TYPE	STRAIN WAVE Gearbox Series	GEARBOX MODEL	UNIT TYPE: S = STANDARD; G = HIGH TORQUE; N = LIGHT WEIGHT; D = FLAT TYPE; F = ULTRA FLAT (cup type only)	RATIO	C = COMPONENTS ONLY; U = COMPLETE ASSEMBLY ENCLOSED	CONNECTION TYPE: 1= Standard Model -Rigid connection; 2= Old-ham coupling type connection; 3= Hollow type enclosed version with support bearings; 3a= Hollow type version without bearings and lower housing; 4= Solid Input Shaft type with wave generator on shaft	HIGHER RIGIDITY TYPE BEARING OPTION	CUSTOMIZATION / SPECIAL FEATURE
C / H	SW	3	S / G / N / D / F	-	C/U	1, 2, 3, 3a, 4	R	SP
		5		50, 100				
		8		30, 50, 100				
		11		30, 50, 80, 100				
		14		30, 50, 80, 100, 120				
		17		30, 50, 80, 100, 120				
		20		30, 50, 80, 100, 120, 160				
		25		30, 50, 80, 100, 120, 160				
		32		30, 50, 80, 100, 120, 160				
		40		50, 80, 100, 120, 160				
		45		80, 100, 120, 160				
		50		80, 100, 120, 160				
		58		80, 100, 120, 160				

PITSON TRANSMISSION TECHNOLOGIES
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STRAIN WAVE GEARBOX TYPES AND VERSIONS
CODES
MAIN TYPES
1. CUP TYPE
2. HAT TYPE
MAIN VERSIONS
1. COMPONENTS = C
2. UNIT = U

CUP TYPE	HAT TYPE
Types of Model	**Types of Model**
S = STANDARD MODEL	S = STANDARD MODEL
G = HIGH TORQUE MODEL	G = HIGH TORQUE MODEL
N = LIGHT WEIGHT MODEL	N = LIGHT WEIGHT MODEL
D = FLAT COMPACT MODEL	D = FLAT COMPACT MODEL
F = Ultra flat square	**Types of Transmission**
Types of Transmission	1. Standard Connection
1. Standard Connection	2. Old-halm coupling type
2. Old-halm coupling type	3. Hollow shaft type with bearing and lower housing
	3a. Hollow shaft type without bearing and lower housing
	4. With solid input shaft & bearings on it
R = High Rigidity type output bearing	
SP = Special OR Customized	

CUP TYPE

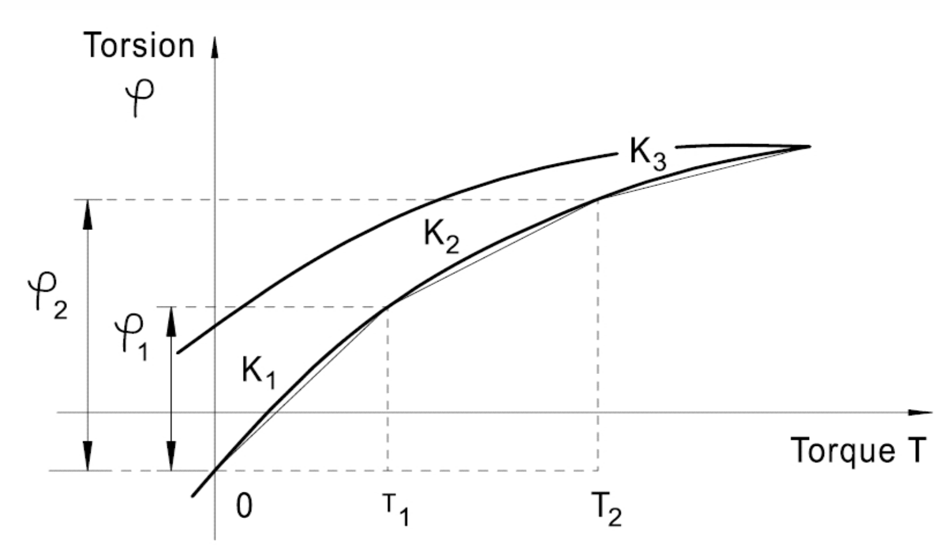
C-SW-N
Light Weight Models

Model	Reduction ratio	Rated torque at 2000r/min input	Permissible peak torque at start and stop	Permissible maximum value for average load torque	Permissible maximum momentary torque	Permissible maximum input rotational speed	Permissible average input rotational speed	Backlash	Weight (Model wise)	Design life	Allowable static Moment (Mc)	Pitch circle diameter of a roller -cross roller bearing	Offset R	Dynamic Load (a)	Static Load (b)	Angular Transmission Accuracy	Hysteresis loss	Starting Torque
		Nm	Nm	Nm	Nm	r/min	r/min	Arc Sec	kg	Hour	Nm	m	m	kN	kN	arc min	arc min	c Nm
5	50	0.4	0.9	0.53	1.8	10000	6500	<60	0.027	10000	0.089	0.0135	0.00485	0.914	0.763	3	3	0.4
	100	0.6	1.4	0.94	2.7					10000						2	3	0.3
8	50	1.8	3.3	2.3	6.6	8500	3500	≤30	0.08	10000	3.46	0.0205	0.0073	2.16	1.9	2	3	0.8
	100	2.4	4.8	3.3	9					10000						2	2	0.6
11	50	3.5	8.3	5.5	17	8500	3500	≤30	C-SW-11-S-1-U= 0.25	10000	6.6	0.02715	0.009	3.89	3.54	2	2	2
	80	4.5	9.9	8	22.5				C-SW-11-N-1-U =0.17	10000						2	2	1.8
	100	5	11	8.9	25					10000						2	2	1.5
14	50	5.4	18	6.9	35	8500	3500	≤20	C-SW-14-S-1/2-U= 0.51	10000	41	0.035	0.0095	4.7	6.07	1.5	2	4.1
	80	7.8	23	11	47				C-SW-14-S-1/2-E= 0.09	15000						1.5	1	2.8
	100	7.8	28	11	54				C-SW-14-N-1/2-U= 0.39	15000						1.5	1	2.5
	120	7.8	28	11	54					15000						1.5	1	2.3
17	50	16	34	26	70	7300	3500	≤20	C-SW-17-S-1/2-U= 0.67	10000	64	0.0425	0.0095	5.3	7.55	1.5	2	6.1
	80	22	43	27	87				C-SW-17-S-1/2-E= 0.15	15000						1.5	1	4
	100	24	54	39	108				C-SW-17-N-1/2-U= 0.52	15000						1.5	1	3.4
	120	24	54	39	86					15000						1.5	1	3.1
20	50	25	56	34	98	6500	3500	≤20	C-SW-20-S-1/2-U= 0.96	10000	91	0.05	0.0095	5.8	9	1	2	7.8
	80	34	74	47	127				C-SW-20-S-1/2-E= 0.28	15000						1	1	4.9
	100	40	82	49	147				C-SW-20-N-1/2-U= 0.74	15000						1	1	4.3
	120	40	87	49	147					15000						1	1	3.8
	160	40	92	49	147					15000						1	1	3.3
25	50	39	98	55	186	5600	3500	≤20	C-SW-25-S-1/2-U= 1.96	10000	156	0.062	0.0115	9.6	15	1	2	15
	80	63	137	87	255				C-SW-25-S-1/2-E= 0.42	15000						1	1	9.2
	100	67	157	108	284				C-SW-25-N-1/2-U= 1.14	15000						1	1	8
	120	67	167	108	304					15000						1	1	7.3
	160	67	176	108	314					15000						1	1	7.3
32	50	76	216	108	382	4800	3500	≤20	C-SW-32-S-1/2-U= 3.11	10000	313	0.08	0.013	15	25	1	2	31
	80	118	304	167	568				C-SW-32-S-1/2-E= 0.89	15000						1	1	19
	100	137	333	216	647				C-SW-32-N-1/2-U= 2.47	15000						1	1	18
	120	137	353	216	686					15000						1	1	15
	160	137	372	216	686					15000						1	1	14
40	50	137	402	196	686	4000	3000	≤20	C-SW-40-S-1/2-U= 4.6	10000	450	0.096	0.0145	21	36	1	2	55
	80	206	519	284	980				C-SW-40-S-1/2-E= 1.7	15000						1	1	35
	100	265	568	372	1080				C-SW-40-N-1/2-U= 3.64	15000						1	1	31
	120	294	617	451	1180					15000						1	1	28
	160	294	647	451	1180					15000						1	1	24

Torsional Stiffness

Model / Ratio		Type Unit	5	8	11	14	17	20	25	32	40
Limit Torques	T1	Nm	0.075	0.29	0.8	2	3.9	7	14	29	54
	T2	Nm	0.22	0.75	2	6.9	12	25	48	108	196
Reduction 50	K1	× 10₄ Nm/rad	0.013	0.044	0.221	0.34	0.81	1.3	2.5	5.4	10
	K2	× 10₄ Nm/rad	0.018	0.067	0.3	0.47	1.1	1.8	3.4	7.8	14
	K3	× 10₄ Nm/rad	0.025	0.084	0.32	0.57	1.3	2.3	4.4	9.8	18
Reduction ratio above 50	K1	× 10₄ Nm/rad	0.02	0.09	0.267	0.47	1	1.6	3.1	6.7	13
	K2	× 10₄ Nm/rad	0.027	0.104	0.333	0.61	1.4	2.5	5	11	20
	K3	× 10₄ Nm/rad	0.03	0.12	0.432	0.71	1.6	2.9	5.7	12	23

K1= LOW TORQUE AREA
K2 = MEDIUM TORQUE AREA
K3 = HIGH TORQUE AREA

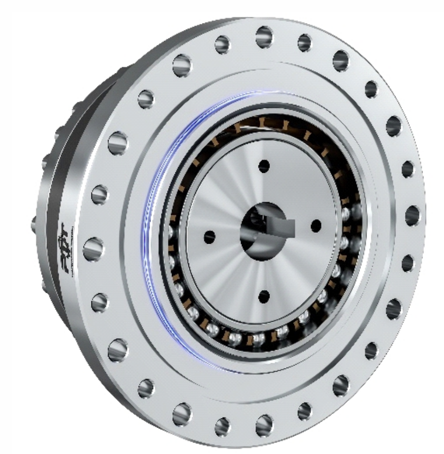


K_1, K_2, K_3 = Torsional stiffness, w = Output angle
φ1 = Torsion angle, with output torque T_1
φ2 = Torsion angle, with output torque T_2

1. The Dynamic load refers to the constant radial load under which the bearing is expected to achieve a basic rating life of 1 million revolutions.
2. The Static load refers to the static load that produces a specified level of contact stress (4 kN/mm²) at the central contact point between the location of maximum bearing load and the raceway surface.
3. The allowable static moment refers to the maximum permissible torque applied to the output bearing, within which the bearing can operate properly and maintain its basic performance.

PITSON TRANSMISSION TECHNOLOGIES
Gearing Solutions

CUP TYPE



C-SW-G
HIGH TORQUE MODELS

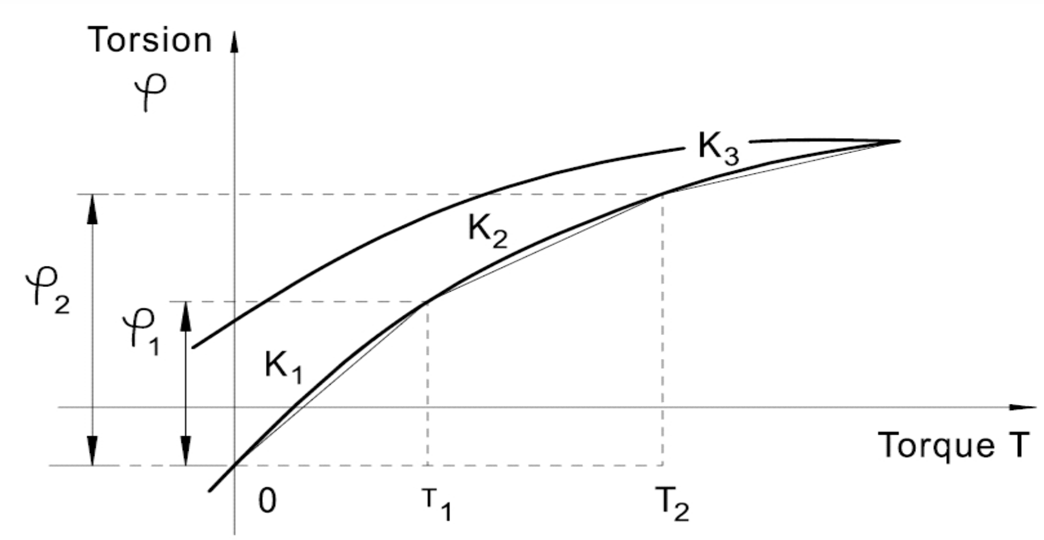
Model	Reduction ratio	Rated torque at 2000r/min input	Permissible peak torque at start and stop	Permissible maximum value for average load torque	Permissible maximum momentary torque	Permissible maximum input rotational speed	Permissible average input rotational speed	Backlash	Weight (Model wise)	Design life	Allowable static Moment (Mc)	Pitch circle diameter of a roller -cross roller bearing	Offset R	Dynamic Load (a)	Static Load (b)	Angular Transmission Accuracy	Hysteresis loss	Starting Torque
		Nm	Nm	Nm	Nm	r/min	r/min	Arc Sec	kg	Hour	Nm	m	m	kN	kN	arc min	arc min	c Nm
14	50	7	23	9	46	8500	3500	<20	C-SW-14-G-1/2= 0.51	10000	41	0.035	0.0095	4.7	6.07	1.5	2	4.5
	80	10	30	14	58[*]					15000						1.5	1	3.1
	100	10	36	14	58[*]					15000								2.8
17	50	21	44	34	91	7300	3500	≤20	C-SW-17-G-1/2= 0.67	10000	64	0.0425	0.0095	5.3	7.55	1.5	2	6.7
	80	29	56	35	109[*]					15000						1.5	1	4.4
	100	31	70	51	109[*]					15000								3.7
	120	31	70	51	109[*]					15000								3.4
20	50	33	73	44	127	6500	3500	≤20	C-SW-20-G-1/2= 0.96	10000	91	0.05	0.0095	5.8	9	1	2	8.6
	80	44	96	61	165					15000						1	1	5.4
	100	52	107	64	191					15000								4.7
	120	52	113	64	191					15000								4.2
	160	52	120	64	191					15000								3.6
25	50	51	127	72	242	5600	3500	≤20	C-SW-25-G-1/2= 1.46	10000	156	0.062	0.0115	9.6	15	1	2	17
	80	82	178	113	332					15000						1	1	10
	100	87	204	140	369					15000								8.8
	120	87	217	140	395					15000								8
	160	87	229	140	408					15000								6.9
32	50	99	281	140	497	4800	3500	≤20	C-SW-32-G-1/2= 3.11	10000	313	0.08	0.013	15	25	1	2	34
	80	153	395	217	738					15000						1	1	21
	100	178	433	281	841					15000								20
	120	178	459	281	892					15000								17
40	50	178	523	255	892	4000	3000	≤20	C-SW-40-G-1/2= 4.6	10000	450	0.096	0.0145	21	36	1	2	61
	80	268	675	369	1270					15000						1	1	39
	100	345	738	484	1400					15000								34
	120	382	802	586	1510[*]					15000								31

[*]The permissible maximum torque is limited by the driving torque of the coupling screw at the output end

Torsional Stiffness										
Model / Ratio		Type Unit	5	8	11	14	17	20	25	32
Limit Torques	T1	Nm	0.075	0.29	0.8	2	3.9	7	14	29
	T2	Nm	0.22	0.75	2	6.9	12	25	48	108
Reduction 50	K1	× 10⁴ Nm/rad	0.013	0.044	0.221	0.34	0.81	1.3	2.5	5.4
	K2	× 10⁴ Nm/rad	0.018	0.067	0.3	0.47	1.1	1.8	3.4	7.8
	K3	× 10⁴ Nm/rad	0.025	0.084	0.32	0.57	1.3	2.3	4.4	9.8
Reduction ratio above 50	K1	× 10⁴ Nm/rad	0.02	0.09	0.267	0.47	1	1.6	3.1	6.7
	K2	× 10⁴ Nm/rad	0.027	0.104	0.333	0.61	1.4	2.5	5	11
	K3	× 10⁴ Nm/rad	0.03	0.12	0.432	0.71	1.6	2.9	5.7	12

K1= LOW TORQUE AREA
K2 = MEDIUM TORQUE AREA
K3 = HIGH TORQUE AREA

1. The Dynamic load refers to the constant radial load under which the bearing is expected to achieve a basic rating life of 1 million revolutions.
2. The Static load refers to the static load that produces a specified level of contact stress (4 kN/mm²) at the central contact point between the location of maximum bearing load and the raceway surface.
3. The allowable static moment refers to the maximum permissible torque applied to the output bearing, within which the bearing can operate properly and maintain its basic performance.



K_1, K_2, K_3 = Torsional stiffness, w = Output angle
φ1 = Torsion angle, with output torque T_1
φ2 = Torsion angle, with output torque T_2

PITSON TRANSMISSION TECHNOLOGIES
Gearing Solutions

CUP TYPE

C-SW-D
THIN COMPACT MODEL

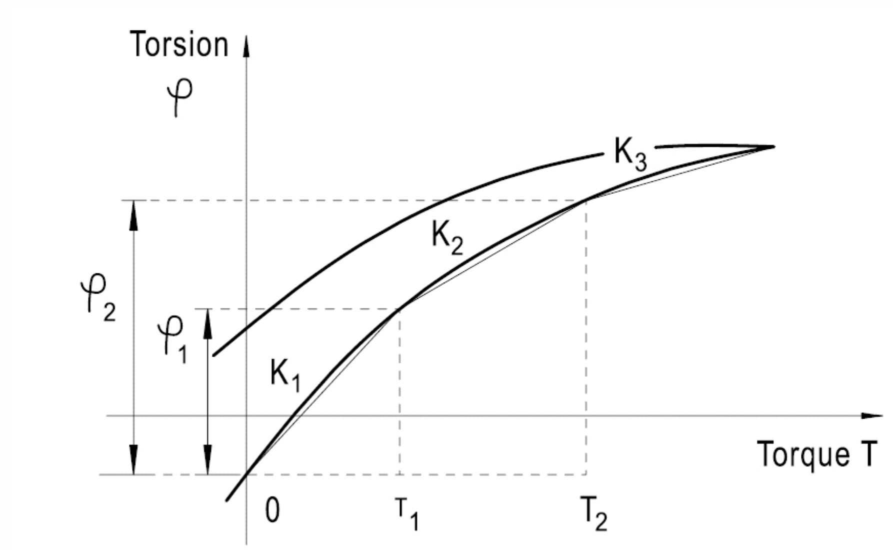
Model	Reduction ratio	Rated torque at 2000r/min input	Permissible peak torque at start and stop	Permissible maximum value for average load torque	Permissible maximum momentary torque	Permissible maximum input rotational speed	Permissible average input rotational speed	Backlash	Weight	Design life	Allowable static Moment (Mc)	Pitch circle diameter of a roller -cross roller bearing	Offset R	Dynamic Load (a)	Static Load (b)	Angular Transmission Accuracy	Hysteresis loss	Starting Torque
		Nm	Nm	Nm	Nm	r/min	r/min	Arc Sec	kg	Hour	Nm	m	m	kN	kN	arc min	arc min	c Nm
14	50	3.7	12	4.8	24	8500	3500	<20	0.37	9000	41	0.035	0.0095	4.7	6.07	1.5	2.5	4.4
	80	5.4	16	7.7	35					10000						1.5	1	3.2
	100	5.4	19	7.7	35					10000						1.5	1	2.8
17	50	11	23	18	48	7300	3500	≤20	0.49	9000	64	0.0425	0.0099	5.3	7.55	1.5	2	6.7
	80	15	29	19	61					10000						1.5	1	4.4
	100	16	37	27	71					10000						1.5	1	3.8
20	50	17	39	24	69	6500	3500	≤20	0.68	9000	91	0.05	0.0102	5.8	9	1	2	8.9
	80	24	51	33	89					10000						1	1	5.7
	100	28	57	34	95					10000						1	1	5.1
25	50	27	69	38	127	5600	3500	≤20	1.25	9000	156	0.062	0.013	9.6	15.1	1	2	16
	80	44	96	60	179					10000						1	1	10
	100	47	110	75	184					10000						1	1	9.1
32	50	53	151	75	268	4800	3500	≤20	2.48	9000	313	0.08	0.0144	15	25	1	2	32
	80	83	213	117	398					10000						1	1	22
	100	96	233	151	420					10000						1	1	20

Torsional Stiffness

Model / Ratio		Type Unit	14	17	20	25	32
T1		Nm	2	3.9	7	14	29
T2		Nm	6.9	12	25	48	108
Reduction 50	K1	× 10₄ Nm/rad	0.29	0.67	1.1	2	4.7
	K2	× 10₄ Nm/rad	0.37	0.88	1.3	2.7	6.1
	K3	× 10₄ Nm/rad	0.47	1.2	2	3.7	8.4
Reduction ratio above 50	K1	× 10₄ Nm/rad	0.4	0.84	1.3	2.7	6.1
	K2	× 10₄ Nm/rad	0.44	0.94	1.7	3.7	7.8
	K3	× 10₄ Nm/rad	0.61	1.3	2.5	4.7	11

K1= LOW TORQUE AREA
K2 = MEDIUM TORQUE AREA
K3 = HIGH TORQUE AREA

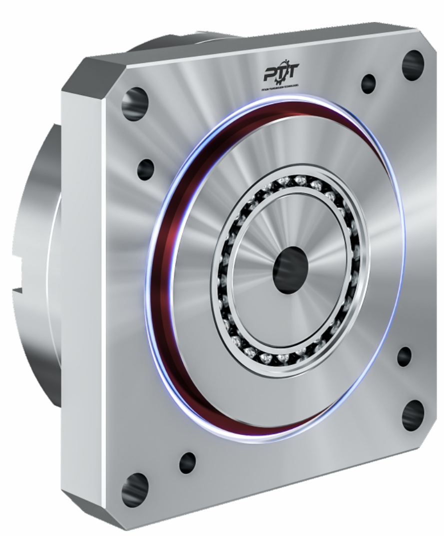
1. The Dynamic load refers to the constant radial load under which the bearing is expected to achieve a basic rating life of 1 million revolutions.
2. The Static load refers to the static load that produces a specified level of contact stress (4 kN/mm^2) at the central contact point between the location of maximum bearing load and the raceway surface.
3. The allowable static moment refers to the maximum permissible torque applied to the output bearing, within which the bearing can operate properly and maintain its basic performance.



K_1, K_2, K_3 = Torsional stiffness, w = Output angle
φ1 = Torsion angle, with output torque T_1
φ2 = Torsion angle, with output torque T_2

PITSON TRANSMISSION TECHNOLOGIES
Gearing Solutions

CUP TYPE



C-SW-F-U
ULTRA FLAT SQUARE TYPE

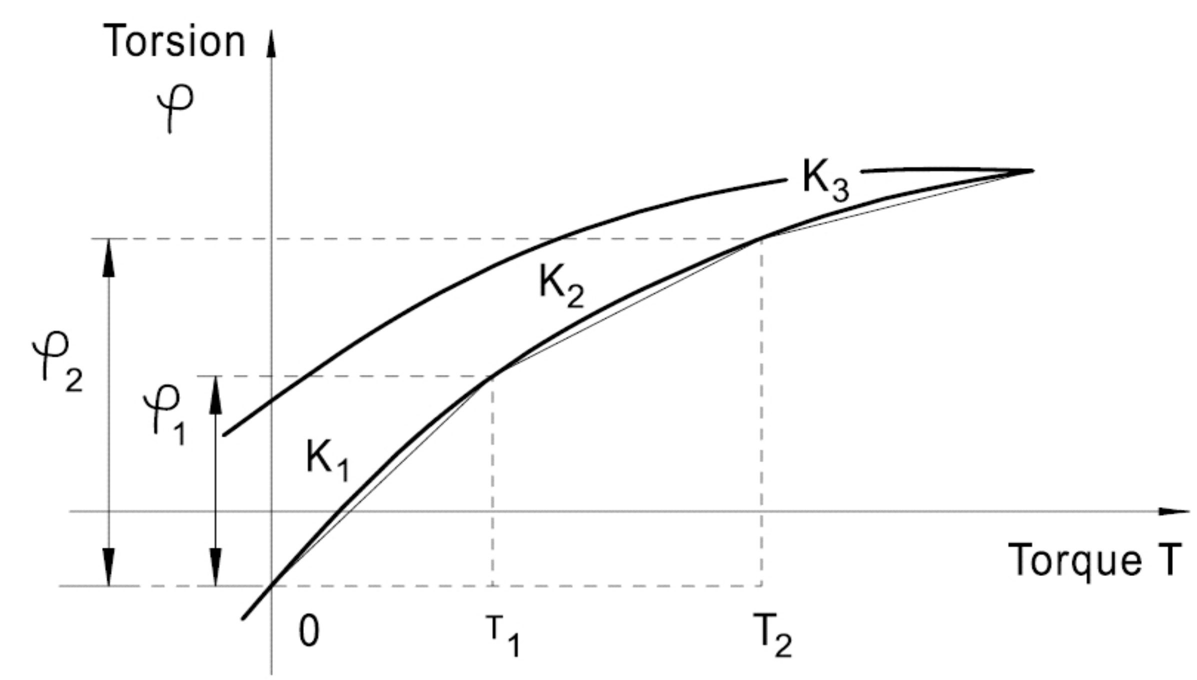
Model	Reduction ratio	Rated torque at 2000r/min input	Permissible peak torque at start and stop	Permissible maximum value for average load torque	Permissible maximum momentary torque	Permissible maximum input rotational speed	Permissible average input rotational speed	Backlash	Weight	Design life	Allowable static Moment (Mc)	Pitch circle diameter of a roller -cross roller bearing	Offset R	Dynamic Load (a)	Static Load (b)	Angular Transmission Accuracy	Hysteresis loss	Starting Torque
		Nm	Nm	Nm	Nm	r/min	r/min	Arc Sec	kg	Hour	Nm	m	m	kN	kN	arc min	arc min	c Nm
11	50	3.5	8.3	55	17	8500	3000	<20	0.35	7000	40	0.0425	0.014	6.5	9.9	2	2	2
	80	4.5	9.9	8	22.5					7000						2	2	2
	100	5	11	8.9	25					7000						2	2	1.5
14	50	5.4	18	6.9	35	8500	3000	≤20	0.63	10000	75	0.0541	0.014	7.4	12.8	1.5	2	4.1
	80	7.8	23	11	47					10000						1.5	1	2.8
	100	7.8	28	11	54					10000						1.5	1	2.5

Torsional Stiffness

Model / Ratio		Type Unit	11	14
Limit Torques	T1	Nm	0.8	2
	T2	Nm	2	6.9
Reduction 50	K1	$\times 10_4$ Nm/rad	0.221	0.34
	K2	$\times 10_4$ Nm/rad	0.3	0.47
	K3	$\times 10_4$ Nm/rad	0.32	0.57
Reduction ratio above 50	K1	$\times 10_4$ Nm/rad	0.267	0.47
	K2	$\times 10_4$ Nm/rad	0.333	0.61
	K3	$\times 10_4$ Nm/rad	0.432	0.71

K1= LOW TORQUE AREA
K2 = MEDIUM TORQUE AREA
K3 = HIGH TORQUE AREA

1. The Dynamic load refers to the constant radial load under which the bearing is expected to achieve a basic rating life of 1 million revolutions.
2. The Static load refers to the static load that produces a specified level of contact stress (4 kN/mm²) at the central contact point between the location of maximum bearing load and the raceway surface.
3. The allowable static moment refers to the maximum permissible torque applied to the output bearing, within which the bearing can operate properly and maintain its basic performance.



K_1, K_2, K_3 = Torsional stiffness, w = Output angle
$\varphi 1$ = Torsion angle, with output torque T_1
$\varphi 2$ = Torsion angle, with output torque T_2

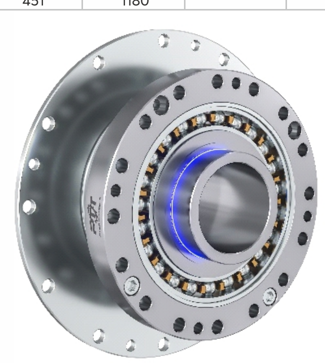
PITSON TRANSMISSION TECHNOLOGIES
Gearing Solutions

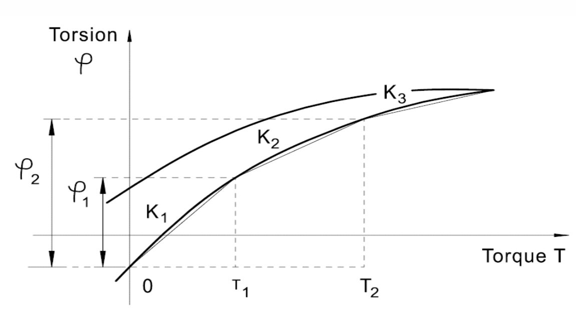
HAT TYPE

H-SW-S
STANDARD UNIT

H-SW-N
LIGHT WEIGHT UNIT

											Standard bearing cross roller											With Special higher rigidity bearing										
Model	Reduction ratio	Rated torque at 2000r/min input	Permissible peak torque at start and stop	Permissible maximum value for average load torque	Permissible maximum momentary torque	Permissible maximum input rotational speed	Permissible average input rotational speed	Backlash	Weight	Design life	Allowable static Moment (Mc)	Pitch circle diameter of a roller -cross roller bearing		Offset R	Dynamic Load (a)	Static Load (b)	Angular Transmission Accuracy	Hysteresis loss	Starting Torque (Transmission Type: 1,2,4)	Starting Torque (Transmission Type: 3)	Starting Torque (Transmission Type: 3a)	Pitch Circle diameter of roller	Offset R 4)	Basic Radial dynamic load rating C 5)	Basic Radial static load rating CO	Basic axial dynamic load rating Ca	Basic axial static load rating C0a	Permissible dynamic tilting moment Mdyn max 6)	Permissible static tilting moment M0 7)	Permissible axial load FA 8)	Permissible radial load FR 8)	Titing rigidity KB 9)
		Nm	Nm	Nm	Nm	r/min	r/min	Arc Sec	kg	Hour	Nm	m			kN	kN	arc min	arc min	c Nm	c Nm	c Nm	m	m	kN	kN	kN	kN	Nm	Nm	kN	kN	Nm/arcmin
8	50	1.8	3.3	2.3	6.6	8500	3500	<40	H-SW-8-S-1= 0.06	10000	40	-		-	2	3	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	100	2.4	4.8	3.3	9					10000							2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	50	3.5	8.3	5.5	17	8500	3500	≤30	H-SW-11-S-1= 0.27	10000	74	0.043		0.018	5.29	7.55	2	2	2	7.1	-	-	-	-	-	-	-	-	-	-	-	-
	80	4.5	9.9	8	22.5					10000							2	2	1.8	-	-	-	-	-	-	-	-	-	-	-	-	-
	100	5	11	8.9	25					10000							2	2	1.5	5.9	-	-	-	-	-	-	-	-	-	-	-	-
14	30	4	9	6.8	17	8500	3500	≤20	H-SW-14-S-1/2-U= 0.4	10000	74	0.05		0.0217	5.8	8.6	1.5	1.5	-	-	-											
	50	5.4	18	6.9	35				H-SW-14-S-3-U= 0.7	10000							1.5	1.5	4.1	8.8	5.7	0.0545	0.0098	4.85	11.9	6.8	29.5	74	162	3.5	2.5	30
									H-SW-14-S-3a-U= 0.66								1.5	1.5														
									H-SW-14-S-4-U= 0.4								1.5	1.5														
									H-SW-14-S-C= 0.14								1.5	1.5														
	80	7.8	23	11	47				H-SW-14-N-3-U = 0.55	15000							1.5	1.5	2.8	7.5	4.4											
	100	7.8	28	11	54				H-SW-14-N-3a-U = 0.50	15000							1.5	1.5	2.5	6.9	3.7											
	120	7.8	28	11	54					15000							1.5	1.5	-	-	-											
17	30	8.8	16	12	30	7300	3500	≤20	H-SW-17-S-1/2-U= 0.54	10000	124	0.06		0.0239	10.4	16.3	1.5	1.5	-	-	-	0.0637	0.0107	8.8	21.9	12.4	55	124	348	6.4	4.55	55
	50	16	34	26	70				H-SW-17-S-3-U= 0.99	10000							1.5	1.5	6.1	27	9.7											
									H-SW-17-S-3a-U= 0.90								1.5	1.5														
									H-SW-17-S-4-U= 0.62								1.5	1.5														
									H-SW-17-S-C= 0.19								1.5	1.5														
	80	22	43	27	87				H-SW-17-N-3-U = 0.79	15000							1.5	1.5	4	25	7.2											
	100	24	54	39	110				H-SW-17-N-3a-U = 0.69	15000							1.5	1.5	3.4	24	6.5											
	120	24	54	39	86					15000							1.5	1.5	3.1	24	6.2											
20	50	25	56	34	98	6500	3500	≤20	H-SW-20-S-1/2-U= 0.72	10000	187	0.07		0.0255	14.6	22	1	1	7.8	36	14	0.0733	0.0115	10.5	27	14.8	68	187	494	7.6	5.4	91
									H-SW-20-S-3-U= 1.32								1	1														
									H-SW-20-S-3a-U= 1.29								1	1														
	80	34	74	47	127				H-SW-20-S-4-U= 0.82	15000							1	1	4.9	33	11											
	100	40	82	49	147				H-SW-20-S-C= 0.27	15000							1	1	4.3	32	9.9											
	120	40	87	49	147				H-SW-20-N-3-U = 1.04	15000							1	1	3.8	31	9.3											
	160	40	92	49	147				H-SW-20-N-3a-U = 0.98	15000							1	1	3.3	31	8.6											
25	50	39	98	55	186	5600	3500	≤20	H-SW-25-S-1/2-U= 1.22	10000	258	0.085		0.0296	21.8	35.8	1	1	15	56	22	0.0891	0.0134	13.3	35	18.8	88	258	778	9.7	6.8	150
									H-SW-25-S-3-U= 2.02								1	1														
									H-SW-25-S-3a-U= 1.99								1	1														
									H-SW-25-S-4-U= 1.4								1	1														
	80	63	137	87	255				H-SW-25-S-C= 0.46	15000							1	1	9.2	50	15											
	100	67	157	108	284				H-SW-25-N-3-U = 1.6	15000							1	1	8	49	14											
	120	67	167	108	304				H-SW-25-N-3a-U = 1.43	15000							1	1	7.3	48	13											
32	50	76	216	108	382	4800	3000	≤20	H-SW-32-S-1/2-U= 2.54	10000	580	0.111		0.0364	38.2	65.4	1	1	31	85	41	0.1164	0.0154	23.7	72	33	180	580	2090	17	12.2	460
									H-SW-32-S-3-U= 4.2								1	1														
									H-SW-32-S-3a-U= 4								1	1														
									H-SW-32-S-4-U= 2.7								1	1														
	80	118	304	167	568				H-SW-32-S-C= 1	15000							1	1	19	74	29											
	100	137	333	216	647				H-SW-32-N-3-U = 3.19	15000							1	1	18	72	27											
	120	137	353	216	686				H-SW-32-N-3a-U = 3.17	15000							1	1	15	68	24											
40	50	137	402	196	686	4000			H-SW-40-S-1/2-U= 4.4	10000	849	0.133		0.044	43.3	81.6	1	1	55	136	72	-	-	-	-	-	-	-	-	-	-	-
									H-SW-40-S-3-U= 7.2								1	1														
									H-SW-40-S-3a-U= 7								1	1														
	80	206	519	284	980				H-SW-40-S-4-U= 4.06	15000							1	1	35	117	52											
	100	265	568	372	1080				H-SW-40-S-C= 1.87	15000							1	1	31	112	47											
	120	294	617	451	1180				H-SW-40-N-3-U = 5.95	15000							1	1	28	110	44											





K_1, K_2, K_3 = Torsional stiffness, w = Output angle
φ1 = Torsion angle, with output torque T_1
φ2 = Torsion angle, with output torque T_2

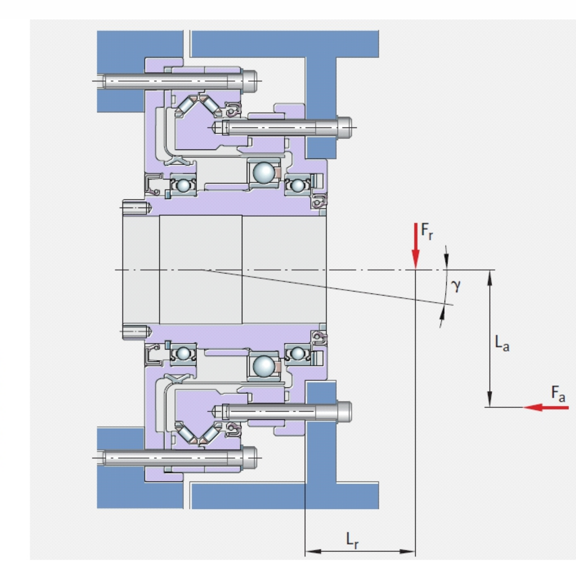
1. The Dynamic load refers to the constant radial load under which the bearing is expected to achieve a basic rating life of 1 million revolutions.
2. The Static load refers to the static load that produces a specified level of contact stress ($4\ kN/mm^2$) at the central contact point between the location of maximum bearing load and the raceway surface.
3. The allowable static moment refers to the maximum permissible torque applied to the output bearing, within which the bearing can operate properly and maintain its basic performance.
4. Distance between the centre of the bearing and the screw mounting surface on the inner ring.
5. For life calculation with dynamic equivalent radial load Pc.
6. Mdyn max describes the maximum permissible tilting moment in the dynamic state and does not refer to the service life of the bearing.
7. Valid for a static load and a safety factor of fs = 2.
8. Permissible load for Lh 10 = 10 000 h, at nav = 15 min–1, M = 0 and Fr or Fa = 0 in each case, pure axial or radial load.
9. Calculated values from simulation.

PITSON TRANSMISSION TECHNOLOGIES
Gearing Solutions

Torsional Stiffness									
Project		Type Unit	11	14	17	20	25	32	40
T1		Nm	0.8	2	3.9	7	14	29	54
T2		Nm	2	6.9	12	25	48	108	196
Reduction 50	K1	$\times 10^4$ Nm/rad	0.221	0.34	0.81	1.3	2.5	5.4	10
	K2	$\times 10^4$ Nm/rad	0.3	0.47	1.1	1.8	3.4	7.8	14
	K3	$\times 10^4$ Nm/rad	0.32	0.57	1.3	2.3	4.4	9.8	18
Reduction ratio above 50	K1	$\times 10^4$ Nm/rad	0.267	0.47	1	1.6	3.1	6.7	13
	K2	$\times 10^4$ Nm/rad	0.333	0.61	1.4	2.5	5	11	20
	K3	$\times 10^4$ Nm/rad	0.432	0.71	1.6	2.9	5.7	12	23

K1= LOW TORQUE AREA
K2 = MEDIUM TORQUE AREA
K3 = HIGH TORQUE AREA

F_r = radial force
γ = tilting angle
L_a = distance
F_a = axial force
L_r = distance



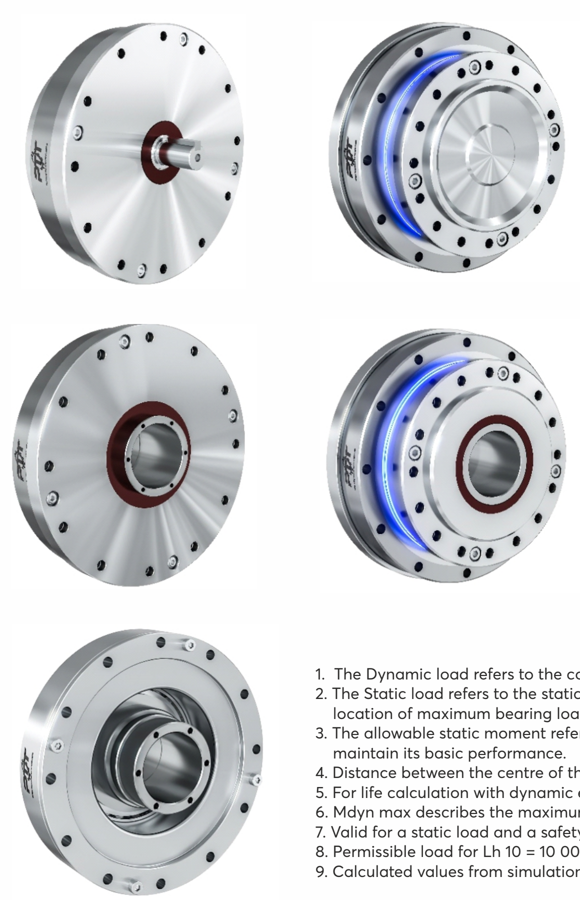
PITSON TRANSMISSION TECHNOLOGIES
Gearing Solutions

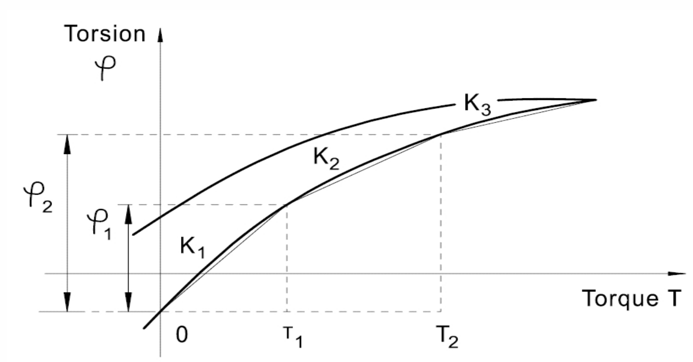
HAT TYPE

H-SW-G
HIGH TORQUE UNIT

Model	Reduction ratio	Rated torque at 2000r/min input	Permissible peak torque at start and stop	Permissible maximum value for average load torque	Permissible maximum momentary torque	Permissible maximum input rotational speed	Permissible average input rotational speed	Backlash	Weight	Design life	Standard bearing cross roller: Allowable static Moment (Mc) - Standard Bearing Cross Roller	Standard bearing cross roller: Pitch circle diameter of a roller -cross roller bearing	Standard bearing cross roller: Offset R	Standard bearing cross roller: Dynamic Load (a) Standard Bearing Cross Roller	Standard bearing cross roller: Static Load (b) Standard Bearing Cross Roller
		Nm	Nm	Nm	Nm	r/min	r/min	Arc Sec	kg	Hour	Nm	m	m	kN	kN
14	50	50	23	9	46	8500	3500	≤20	H-SW-14-G-1/2-U= 0.4	10000	74	0.05	0.0217	5.8	8.6
	80	80	30	14	61				H-SW-14-G-3-U= 0.7	15000					
	100	100	36	14	70				H-SW-14-G-3a-U= 0.66	15000					
	120	120	36	14	70				H-SW-14-G-4-U= 0.4	15000					
17	50	50	44	34	91	7300	3500	≤20	H-SW-17-G-1/2-U= 0.54	10000	124	0.06	0.0239	10.4	16.3
	80	80	56	35	113				H-SW-17-G-3-U= 0.99	15000					
	100	100	70	51	143				H-SW-17-G-3a-U= 0.90	15000					
	120	120	70	51	112				H-SW-17-G-4-U= 0.62	15000					
20	50	50	73	44	127	6500	3500	≤20	H-SW-20-G-1/2-U= 0.72	10000	187	0.07	0.0255	14.6	22
	80	80	96	61	165				H-SW-20-G-3-U= 1.32	15000					
	100	100	107	64	191				H-SW-20-G-3a-U= 1.29	15000					
	120	120	113	64	191				H-SW-20-G-4-U= 0.82	15000					
	160	160	120	64	191					15000					
25	50	50	127	72	242	5600	3500	≤20	H-SW-25-G-1/2-U= 1.22	10000	285	0.085	0.0296	21.8	35.8
	80	80	178	113	332				H-SW-25-G-3-U= 2.02	15000					
	100	100	204	140	369				H-SW-25-G-3a-U= 1.99	15000					
	120	120	217	140	395				H-SW-25-G-4-U= 1.4	15000					
	160	160	229	140	408					15000					
32	50	50	281	140	497	4800	3500	≤20	H-SW-32-G-1/2-U= 2.54	10000	580	0.111	0.0364	38.2	65.4
	80	80	395	217	738				H-SW-32-G-3-U= 4.2	15000					
	100	100	433	281	841				H-SW-32-G-3a-U= 4	15000					
	120	120	459	281	892				H-SW-32-G-4-U= 2.7	15000					
	160	160	484	281	892					15000					
40	50	50	523	255	892	4000	3000	≤20	H-SW-40-G-1/2-U= 4.4	10000	849	0.133	0.044	43.3	81.6
	80	80	675	369	1270				H-SW-40-G-3-U= 7.2	15000					
	100	100	738	484	1400				H-SW-40-G-3a-U= 7	15000					
	120	120	802	586	1530				H-SW-40-G-4-U= 5.4	15000					
	160	160	841	586	1530					15000					
45	80	80	918	507	1651	3800	3000	≤20	H-SW-45-G-1-U= 6.5	15000	1127	0.154	0.0475	77.6	135
	100	100	982	650	2041				H-SW-45-G-3-U= 6.5	15000					
	120	120	1070	806	2288					15000					
50	80	80	1223	675	2418	3500	2500	≤20	H-SW-50-G-1-U= 9.6	15000	1487	0.17	0.0525	81.6	149
	100	100	1247	866	2678				H-SW-50-G-3-U= 14.5	15000					
	120	120	1404	1057	2678					15000					

Model	Reduction ratio	Angular Transmission Accuracy	Hysteresis loss	Starting Torque (Transmission Type: 1,2,4)	Starting Torque (Transmission Type: 3)	Starting Torque (Transmission Type: 3a)	With Special higher rigidity bearing: Pitch Circle diameter of a roller	With Special higher rigidity bearing: Offset R 4)	With Special higher rigidity bearing: Basic Radial dynamic load rating C 5)	With Special higher rigidity bearing: Basic Radial static load rating CO	With Special higher rigidity bearing: Basic axial dynamic load rating Ca	With Special higher rigidity bearing: Basic axial static load rating C0a	With Special higher rigidity bearing: Permissible dynamic tilting moment Mdyn max 6)	With Special higher rigidity bearing: Permissible static tilting moment M0 7)	With Special higher rigidity bearing: Permissible axial load FA 8)	With Special higher rigidity bearing: Permissible radial load FR 8)	With Special higher rigidity bearing: Titing rigidity KB 9)
		arc min	arc min	c Nm	c Nm	c Nm	m	m	kN	kN	kN	kN	Nm	Nm	kN	kN	Nm/arcmin
14	50	1.5	1.5	4.5	8.8	5.7	0.0545	0.0098	4.85	11.9	6.8	29.5	74	c	3.5	2.5	30
	80	1.5	1.5	3.1	7.5	4.4											
	100	1.5	1.5	2.8	6.9	3.7											
	120	1.5	1.5	-	-	-											
17	50	1.5	1.5	6.7	27	9.7	0.0637	0.0107	8.8	21.9	12.4	55	124	348	6.4	4.55	55
	80	1.5	1.5	4.4	25	7.2											
	100	1.5	1.5	3.7	24	6.5											
	120	1.5	1.5	3.4	24	6.2											
20	50	1	1	8.6	36	14	0.0733	0.0115	10.5	27	14.8	68	187	494	7.6	5.4	91
	80	1	1	5.4	33	11											
	100	1	1	4.7	32	9.9											
	120	1	1	4.2	31	9.3											
	160	1	1	3.6	31	8.6											
25	50	1	1	17	56	22	0.0891	0.0134	13.3	35	18.8	88	258	778	9.7	6.8	150
	80	1	1	10	50	15											
	100	1	1	8.8	49	14											
	120	1	1	8	48	13											
	160	1	1	6.9	47	12											
32	50	1	1	34	85	41	0.1164	0.0154	23.7	72	33	180	580	2090	17	12.2	460
	80	1	1	21	74	29											
	100	1	1	20	72	27											
	120	1	1	17	68	24											
	160	1	1	15	67	23											
40	50	1	1	61	136	72	-	-	-	-	-	-	-	-	-	-	-
	80	1	1	39	117	52	-	-	-	-	-	-	-	-	-	-	-
	100	1	1	34	112	47	-	-	-	-	-	-	-	-	-	-	-
	120	1	1	31	110	44	-	-	-	-	-	-	-	-	-	-	-
	160	1	1	26	105	39	-	-	-	-	-	-	-	-	-	-	-
45	80	1	1	54	138	-	-	-	-	-	-	-	-	-	-	-	-
	100	1	1	47	131	-	-	-	-	-	-	-	-	-	-	-	-
	120	1	1	43	126	-	-	-	-	-	-	-	-	-	-	-	-
50	80	1	1	73	179	-	-	-	-	-	-	-	-	-	-	-	-
	100	1	1	64	171	-	-	-	-	-	-	-	-	-	-	-	-
	120	1	1	57	165	-	-	-	-	-	-	-	-	-	-	-	-



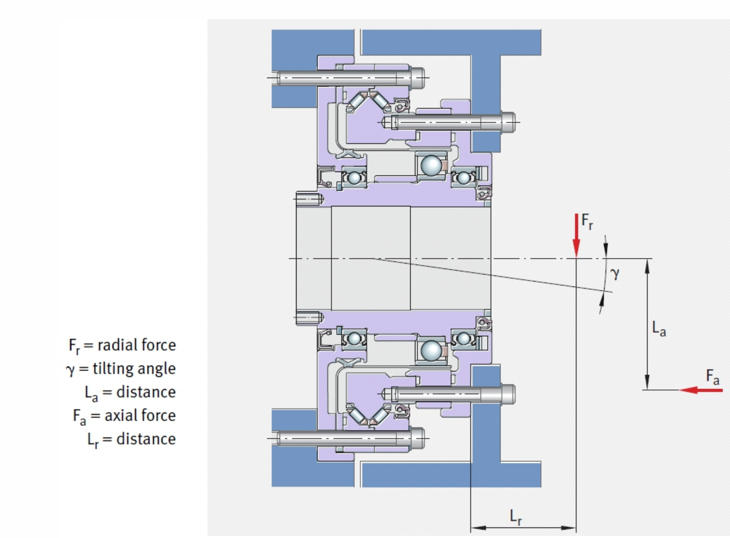


K_1, K_2, K_3 = Torsional stiffness, w = Output angle
$\varphi1$ = Torsion angle, with output torque T_1
$\varphi2$ = Torsion angle, with output torque T_2

1. The Dynamic load refers to the constant radial load under which the bearing is expected to achieve a basic rating life of 1 million revolutions.
2. The Static load refers to the static load that produces a specified level of contact stress (4 kN/mm²) at the central contact point between the location of maximum bearing load and the raceway surface.
3. The allowable static moment refers to the maximum permissible torque applied to the output bearing, within which the bearing can operate properly and maintain its basic performance.
4. Distance between the centre of the bearing and the screw mounting surface on the inner ring.
5. For life calculation with dynamic equivalent radial load Pc.
6. Mdyn max describes the maximum permissible tilting moment in the dynamic state and does not refer to the service life of the bearing.
7. Valid for a static load and a safety factor of fs = 2.
8. Permissible load for Lh 10 = 10 000 h, at nav = 15 min−1, M = 0 and Fr or Fa = 0 in each case, pure axial or radial load.
9. Calculated values from simulation.

Torsional Stiffness											
Project		Type Unit	11	14	17	20	25	32	40	45	50
T1		Nm	0.8	2	3.9	7	14	29	54	76	108
T2		Nm	2	6.9	12	25	48	108	196	275	382
Reduction 50	K1	× 10₄ Nm/rad	0.221	0.34	0.81	1.3	2.5	5.4	10	——	——
	K2	× 10₄ Nm/rad	0.3	0.47	1.1	1.8	3.4	7.8	14	——	——
	K3	× 10₄ Nm/rad	0.32	0.57	1.3	2.3	4.4	9.8	18	——	——
Reduction ratio above 50	K1	× 10₄ Nm/rad	0.267	0.47	1	1.6	3.1	6.7	13	18	25
	K2	× 10₄ Nm/rad	0.333	0.61	1.4	2.5	5	11	20	29	40
	K3	× 10₄ Nm/rad	0.432	0.71	1.6	2.9	5.7	12	23	33	44

K1= LOW TORQUE AREA
K2 = MEDIUM TORQUE AREA
K3 = HIGH TORQUE AREA



PITSON TRANSMISSION TECHNOLOGIES
Gearing Solutions

PITSON TRANSMISSION TECHNOLOGIES
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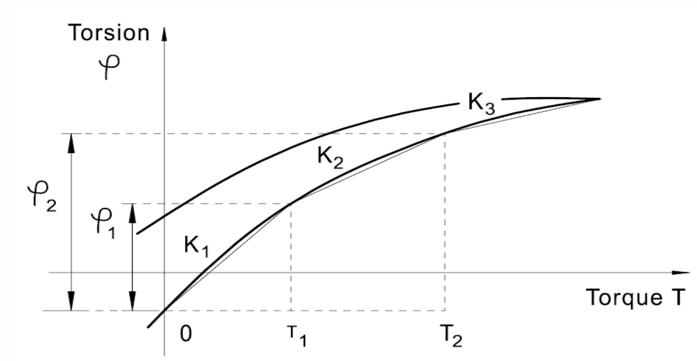
HAT TYPE

H-SW-D
THIN WIDTH UNIT

Model	Reduction ratio	Rated torque at 2000r/min input	Permissible peak torque at start and stop	Permissible maximum value for average load torque	Permissible maximum momentary torque	Permissible maximum input rotational speed	Permissible average input rotational speed	Backlash	Weight	Design life	Transmission Accuracy	Hysteresis loss	Standard bearing cross roller: Allowable static Moment (Mc)	Pitch circle diameter of a roller	Offset R	Dynamic Load (a)	Static Load (b)	Starting Torque (Transmission Type: 1)	Starting Torque (Transmission Type: 3)	With Special higher rigidity bearing: Pitch Circle diameter of a roller	Offset R 4)	Basic Radial dynamic load rating C 5)	Basic Radial static load rating CO	Basic axial dynamic load rating Ca	Basic axial static load rating C0a	Permissible dynamic tilting moment Mdyn max 6)	Permissible static tilting moment M0 7)	Permissible axial load FA 8)	Permissible radial load FR 8)	Titing rigidity KB 9)
		Nm	Nm	Nm	Nm	r/min	r/min	Arc Sec	kg	Hour	arc min	arc min	Nm	m	m	kN	kN	c Nm	c Nm	m	m	kN	kN	kN	kN	Nm	Nm	kN	kN	Nm/arcmin
8	50	1.25	2.3	1.6	4.6	8500	3500	≤40	0.06	8000	2	3.5	10	0.0309	0.0069	1.4	1.8	1	-	-	-	-	-	-	-	-	-	-	-	-
	100	1.65	3.3	2.3	6.3					8000	2	3						0.8	-	-	-	-	-	-	-	-	-	-	-	-
11	50	2.4	5.8	3.5	11.5	8500	3500	≤30	0.13	8000	2	3	30	0.0401	0.009	2.3	3.2	2.4	-	-	-	-	-	-	-	-	-	-	-	-
	100	2.5	7.7	6.2	17.5					8000	2	2.5						1.5	-	-	-	-	-	-	-	-	-	-	-	-
14	50	3.7	12	4.8	23	8500	3500	≤20	H-SW-14-D-1-U= 0.34	9000	1.5	2.5	37	0.0503	0.0111	37	37	6.2	11	0.0545	0.0098	4.85	11.9	6.8	29.5	74	162	3.5	2.5	30
	80	5.4	16	7.7	35				H-SW-14-D-3-U= 0.64	10000	1.5	2						5	9											
	100	5.4	19	7.7	35					10000	1.5	2						4.8	8.7											
17	50	11	23	18	48	7300	3500	≤20	H-SW-17-D-1-U= 0.42	9000	1.5	2	62	0.061	0.0115	62	62	19	39	0.0637	0.0107	8.8	21.9	12.4	55	124	348	6.4	4.55	55
	80	15	29	19	61				H-SW-17-D-3-U= 0.87	10000	1.5	1						16	34											
	100	16	37	27	71					10000	1.5	1						17	37											
20	50	17	39	24	69	6500	3500	≤20	H-SW-20-D-1-U= 0.54	9000	1	2	93	0.07	0.011	93	93	25	54	0.0733	0.0115	10.5	27	14.8	68	187	494	7.6	5.4	91
	80	24	51	33	89				H-SW-20-D-3-U= 1.14	10000	1	1						23	44											
	100	28	57	34	95					10000	1	1						22	49											
25	50	27	69	38	127	5600	3500	≤20	H-SW-25-D-1-U= 0.95	9000	1	2	129	0.086	0.0121	129	129	39	79	0.0891	0.0134	13.3	35	18.8	88	258	778	9.7	6.8	150
	80	44	96	60	179				H-SW-25-D-3-U= 1.75	10000	1	1						36	66											
	100	47	110	75	184					10000	1	1						34	73											
32	50	53	151	75	268	4000	3000	≤20	H-SW-32-D-1-U= 1.90	9000	1	2	290	0.112	0.0173	290	290	60	114	0.1164	0.0154	23.7	72	33	180	580	2090	17	12.2	460
	80	83	213	117	398				H-SW-32-D-3-U= 3.56	10000	1	1						55	108											
	100	96	233	151	420					10000	1	1						50	101											



K_1, K_2, K_3 = Torsional stiffness, w = Output angle
φ1 = Torsion angle, with output torque T_1
φ2 = Torsion angle, with output torque T_2

1. The Dynamic load refers to the constant radial load under which the bearing is expected to achieve a basic rating life of 1 million revolutions.
2. The Static load refers to the static load that produces a specified level of contact stress (4 kN/mm²) at the central contact point between the location of maximum bearing load and the raceway surface.
3. The allowable static moment refers to the maximum permissible torque applied to the output bearing, within which the bearing can operate properly and maintain its basic performance.
4. Distance between the centre of the bearing and the screw mounting surface on the inner ring.
5. For life calculation with dynamic equivalent radial load Pc.
6. Mdyn max describes the maximum permissible tilting moment in the dynamic state and does not refer to the service life of the bearing.
7. Valid for a static load and a safety factor of fs = 2.
8. Permissible load for Lh 10 = 10 000 h, at nav = 15 min–1, M = 0 and Fr or Fa = 0 in each case, pure axial or radial load.
9. Calculated values from simulation.

Torsional Stiffness									
Project		Type Unit	11	14	17	20	25	32	40
T1		Nm	0.29	0.8	2	3.9	7	14	29
T2		Nm	0.75	2	6.9	12	25	48	108
Reduction 50	K1	× 10₄ Nm/rad	0.037	0.19	0.29	0.67	1.1	2	4.7
	K2	× 10₄ Nm/rad	0.051	0.23	0.37	0.88	1.3	2.7	6.1
	K3	× 10₄ Nm/rad	0.071	0.27	0.47	1.2	2	3.7	8.4
Reduction ratio above 50	K1	× 10₄ Nm/rad	0.073	0.23	0.4	0.84	1.3	2.7	6.1
	K2	× 10₄ Nm/rad	0.077	0.26	0.44	0.94	1.7	3.7	7.8
	K3	× 10₄ Nm/rad	0.1	0.37	0.61	1.3	2.5	4.7	11

K1= LOW TORQUE AREA
K2 = MEDIUM TORQUE AREA
K3 = HIGH TORQUE AREA

F_r = radial force
γ = tilting angle
L_a = distance
F_a = axial force
L_r = distance