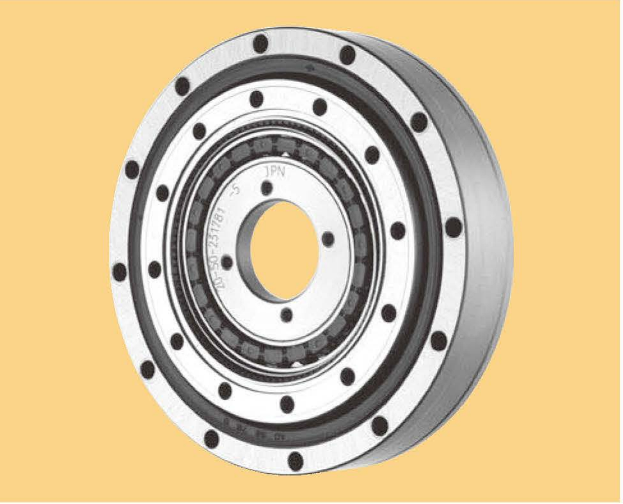
Features



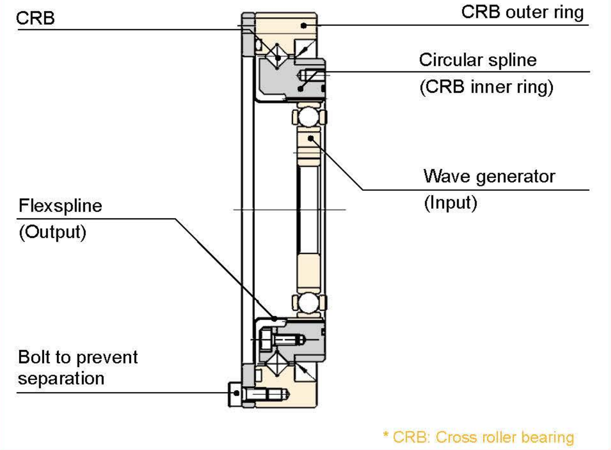
SHD series

Axially compact, these gear units feature a large hollow input shaft and a robust cross roller bearing so loads can be mounted directly to the unit without the need for additional support bearings

Features of SHD series

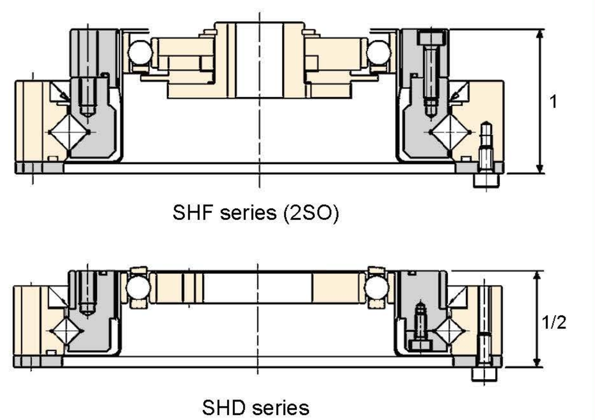
- Zero Backlash
- Ultra-flat design - 15% thinner than the SHF Series
- Large Hollow Input Shaft
- Accuracy <1 arc-min (most sizes)
- Rigid cross roller output bearing
- Lightweight - 30% lower weight than Standard SHF Series

Structure of SHD gear unit — Fig. 268-1



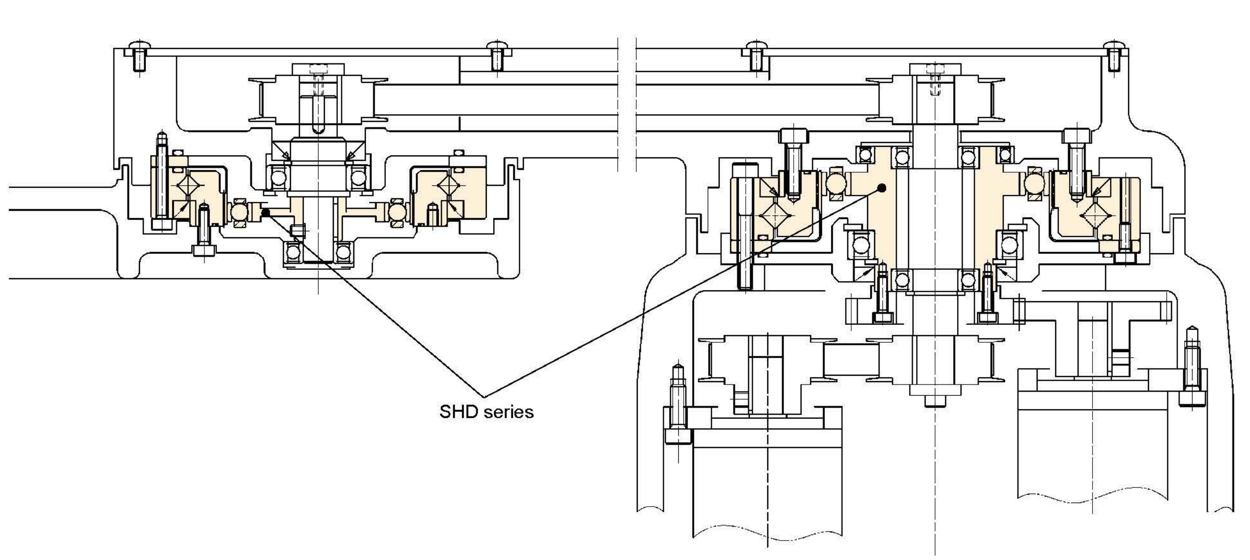
* CRB: Cross roller bearing

Shaft thickness — Fig. 268-2



Application example, SHD series — Fig. 269-1

SCARA robot
SHD is ideal when space is limited.



Ordering Code

SHD - 20 - 100 - 2SH - SP

Table 269-1

Series	Size	Ratio*1			Model	Special specification
SHD	14	50	100	—	2SH = Simplicity Unit 2UH = Gear Unit	LW = Lightweight SP= Special specification code Blank=Standard product
	17	50	100	—		
	20	50	100	160		
	25	50	100	160		
	32	50	100	160		
	40	50	100	160		

*1 The reduction ratio value is based on the following configuration:
Input: wave generator, fixed: circular spline, output: flexspline

Technical Data

Rating table

Table 270-1

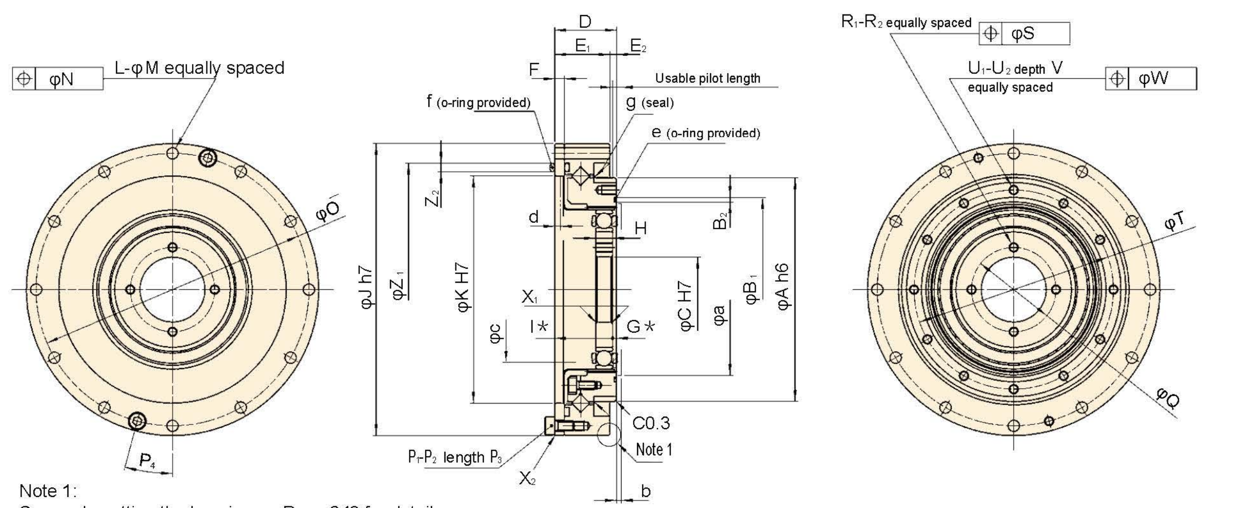
Size	Ratio	Rated Torque at 2000pm		Limit for Repeated Peak Torque		Limit for Average Torque		Limit for Momentary Peak Torque		Maximum Input Speed (rpm)	Limit for Average Input Speed (rpm)	Moment of Inertia	
		Nm	kgfm	Nm	kgfm	Nm	kgfm	Nm	kgfm	Grease lubricant	Grease lubricant	I $\times10^{-4}$ kgm²	J $\times10^{-5}$ kgfms²
14	50	3.7	0.38	12	1.2	4.8	0.49	23	2.3	8500	3500	0.021	0.021
	100	5.4	0.55	19	1.9	7.7	0.79	35	3.6				
17	50	11	1.1	23	2.3	18	1.9	48	4.9	7300	3500	0.054	0.055
	100	16	1.6	37	3.8	27	2.8	71	7.2				
20	50	17	1.7	39	4.0	24	2.4	69	7.0	6500	3500	0.090	0.092
	100	28	2.9	57	5.8	34	3.5	95	10				
	160	28	2.9	64	6.5	34	3.5	95	10				
25	50	27	2.8	69	7.0	38	3.9	127	13	5600	3500	0.282	0.288
	100	47	4.8	110	11	75	7.6	184	19				
	160	47	4.8	123	13	75	7.6	204	21				
32	50	53	5.4	151	15	75	7.6	268	27	4800	3500	1.09	1.11
	100	96	10	233	24	151	15	420	43				
	160	96	10	261	27	151	15	445	45				
40	50	96	10	281	29	137	14	480	49	4000	3000	2.85	2.91
	100	185	19	398	41	260	27	700	71				
	160	206	21	453	46	316	32	765	78				

(Note) 1. Moment of Inertia: $I=\frac{1}{4}GD^2$
2. See Rating Table Definitions on Page 12 for details of the terms.

Outline Dimensions SHD-2SH

You can download the CAD files from our website: harmonicdrive.net

Fig. 270-1



Note 1:
See undercutting the housing on Page 240 for details.
* Please refer to the confirmation drawing for detailed dimensions.
* See Fig. 040-3 on Page 040 for the shapes of the wave generator

Dimensions SHD-2SH

Table 271-1 Unit : mm

Symbol \ Size		14	17	20	25	32	40
φA h6		$49^{\ 0}_{-0.016}$	$59^{\ 0}_{-0.019}$	$69^{\ 0}_{-0.019}$	$84^{\ 0}_{-0.022}$	$110^{\ 0}_{-0.022}$	$132^{\ 0}_{-0.025}$
$φB_1$		$39.1^{+0.1}_{\ 0}$	$48^{+0.1}_{\ 0}$	$56.8^{+0.1}_{\ 0}$	$70.5^{+0.1}_{\ 0}$	$92^{+0.1}_{\ 0}$	$112.4^{+0.1}_{\ 0}$
B_2		$0.8^{+0.15}_{\ 0}$	$1.1^{+0.25}_{\ 0}$	$1.4^{+0.25}_{\ 0}$	$1.7^{+0.25}_{\ 0}$	$2^{+0.25}_{\ 0}$	$2.2^{+0.25}_{\ 0}$
φC H7		$11^{+0.018}_{\ 0}$	$15^{+0.018}_{\ 0}$	$20^{+0.021}_{\ 0}$	$24^{+0.021}_{\ 0}$	$32^{+0.025}_{\ 0}$	$40^{+0.025}_{\ 0}$
D		17.5 ±0.1	18.5 ±0.1	19 ±0.1	22 ±0.1	27.9 ±0.1	33 ±0.1
E_1		15.5	16.5	17	20	23.6	28
E_2		2	2	2	2	4.3	5
F		2.4	3	3	3.3	3.6	4
G*		1.8	1.6	1.2	0.4	0.6	0.8
H		$4^{\ 0}_{-0.1}$	$5^{\ 0}_{-0.1}$	$5.2^{\ 0}_{-0.1}$	$6.35^{\ 0}_{-0.1}$	$8.6^{\ 0}_{-0.1}$	$10.3^{\ 0}_{-0.1}$
I*		$15.7^{\ 0}_{-0.2}$	$16.9^{\ 0}_{-0.2}$	$17.8^{\ 0}_{-0.2}$	$21.6^{\ 0}_{-0.2}$	$27.3^{\ 0}_{-0.2}$	$32.2^{\ 0}_{-0.2}$
φJ h7		$70^{\ 0}_{-0.030}$	$80^{\ 0}_{-0.030}$	$90^{\ 0}_{-0.035}$	$110^{\ 0}_{-0.035}$	$142^{\ 0}_{-0.040}$	$170^{\ 0}_{-0.040}$
φK H7		$50^{+0.025}_{\ 0}$	$61^{+0.030}_{\ 0}$	$71^{+0.030}_{\ 0}$	$88^{+0.035}_{\ 0}$	$114^{+0.035}_{\ 0}$	$140^{+0.040}_{\ 0}$
L		8	12	12	12	12	12
φM		3.5	3.5	3.5	4.5	5.5	6.6
φN		0.25	0.25	0.25	0.25	0.25	0.3
φO		64	74	84	102	132	158
P_1		2	2	2	4	4	4
P_2		M3	M3	M3	M3	M4	M4
P_3		6	6	6	8	10	10
P_4		22.5°	15°	15°	15°	15°	15°
φQ		17	21	26	30	40	50
R_1		4	4	4	4	4	4
R_2		M3	M3	M3	M3	M4	M5
φS		0.25	0.25	0.25	0.25	0.25	0.25
φT		43	52	61.4	76	99	120
U_1		8	12	12	12	12	12
U_2		M3	M3	M3	M4	M5	M6
V		4.5	4.5	4.5	6	8	9
φW		0.25	0.25	0.25	0.25	0.25	0.3
X_1		C0.4	C0.4	C0.5	C0.5	C0.5	C0.5
X_2		C0.4	C0.4	C0.5	C0.5	C0.5	C0.5
Z_1		$57^{+0.1}_{\ 0}$	$68.1^{+0.1}_{\ 0}$	$78^{+0.1}_{\ 0}$	$94.8^{+0.1}_{\ 0}$	$123^{+0.1}_{\ 0}$	$148^{+0.1}_{\ 0}$
Z_2		$2^{+0.25}_{\ 0}$	$2^{+0.25}_{\ 0}$	$2.7^{+0.25}_{\ 0}$	$2.4^{+0.25}_{\ 0}$	$2.7^{+0.25}_{\ 0}$	$2.7^{+0.25}_{\ 0}$
Minimum housing clearance	φa	36.5	45	53	66	86	106
	b	1	1	1.5	1.5	2	2.5
	φc	31	38	45	56	73	90
	d	1.4	1.8	1.7	1.8	1.8	1.8
e		d37.1d0.6	d45.4d0.8	d53.28d0.99	d66.5d1.3	d87.5d1.5	d107.5d1.6
f		d54.38d1.19	d64.0d1.5	d72.0d2.0	d88.62d1.78	d117.0d2.0	d142d2.0
g		D49585	D59685	D69785	D84945	D1101226	D1321467
h		1.5	1.5	1.5	1.5	3.3	4
Mass (kg)		0.33	0.42	0.52	0.91	1.87	3.09

- The following dimensions can be modified to accommodate:
  Wave Generator: C
  Flexspline: O and P
  Circular Spline: X_1 and X_2
- *The G and I sizes indicated by an asterisk are the mounting positions in the shaft direction and allowance of the three parts (wave generator, flexspline, circular spline). Strictly observe these sizes as they affect the performance and strength.
- As the flexspline is subject to elastic deformation, the inner wall should be φa, b, c or more and it should not exceed φd to prevent possible contact with the housing.

Positional Accuracy

See "Engineering data" for a description of terms.

Table 273-1
Unit: $X10^{-4}$rad (arc·min)

Size		14	17	20	25	32	40
Positional Accuracy	$\times 10^{-4}$rad	4.4	4.4	2.9	2.9	2.9	2.9
	arc min	1.5	1.5	1.0	1.0	1.0	1.0

Hysteresis loss

See "Engineering data" for a description of terms.

Table 273-2

Ratio \ Size		14	17	20	25	32	40
50	$\times 10^{-4}$rad	7.3	5.8	5.8	5.8	5.8	5.8
	arc min	2.5	2.0	2.0	2.0	2.0	2.0
100 or more	$\times 10^{-4}$rad	5.8	2.9	2.9	2.9	2.9	2.9
	arc min	2.0	1.0	1.0	1.0	1.0	1.0

Torsional Stiffness

See "Engineering data" for a description of terms.

Table 273-3

Symbol \ Size			14	17	20	25	32	40
	T_1	Nm	2.0	3.9	7.0	14	29	54
		kgfm	0.2	0.4	0.7	1.4	3.0	5.5
	T_2	Nm	6.9	12	25	48	108	196
		kgfm	0.7	1.2	2.5	4.9	11	20
Ratio 50	K_1	$\times 10^4$Nm/rad	0.29	0.67	1.1	2.0	4.7	8.8
		kgfm/arc min	0.085	0.2	0.32	0.6	1.4	2.6
	K_2	$\times 10^4$Nm/rad	0.37	0.88	1.3	2.7	6.1	11
		kgfm/arc min	0.11	0.26	0.4	0.8	1.8	3.4
	K_3	$\times 10^4$Nm/rad	0.47	1.2	2.0	3.7	8.4	15
		kgfm/arc min	0.14	0.34	0.6	1.1	2.5	4.5
	$θ_1$	$\times 10^{-4}$rad	6.9	5.8	6.4	7.0	6.2	6.1
		arc min	2.4	2.0	2.2	2.3	2.1	2.1
	$θ_2$	$\times 10^{-4}$rad	19	14	19	18	18	18
		arc min	6.4	4.6	6.3	6.1	6.1	5.9
Ratio 100 or more	K_1	$\times 10^4$Nm/rad	0.4	0.84	1.3	2.7	6.1	11
		kgfm/arc min	0.12	0.25	0.4	0.8	1.8	3.2
	K_2	$\times 10^4$Nm/rad	0.44	0.94	1.7	3.7	7.8	14
		kgfm/arc min	0.13	0.28	0.5	1.1	2.3	4.2
	K_3	$\times 10^4$Nm/rad	0.61	1.3	2.5	4.7	11	20
		kgfm/arc min	0.18	0.39	0.75	1.4	3.3	5.8
	$θ_1$	$\times 10^{-4}$rad	5.0	4.6	5.4	5.2	4.8	4.9
		arc min	1.7	1.6	1.8	1.8	1.7	1.7
	$θ_2$	$\times 10^{-4}$rad	16	13	15	13	14	14
		arc min	5.4	4.3	5.0	4.5	4.8	4.8

* The values in this table are reference values. The minimum value is approximately 80% of the displayed value.

Simplicity unit (2SH) Starting torque

See "Engineering data" for a description of terms. The values are reference values.

Table 274-1
Unit: Ncm

Ratio \ Size	14	17	20	25	32	40
50	6.2	19	25	39	60	95
100	4.8	17	22	34	50	78
160	—	—	22	33	47	74

Simplicity unit (2SH) Backdriving torque

See "Engineering data" for a description of terms. The values are reference values.

Table 274-3
Unit: Ncm

Ratio \ Size	14	17	20	25	32	40
50	3.7	11	15	24	36	57
100	5.8	21	27	41	60	94
160	—	—	42	64	91	143

Ratcheting torque

See "Engineering data" for a description of terms.

Table 274-5
Unit: Nm

Ratio \ Size	14	17	20	25	32	40
50	88	150	220	450	980	1800
100	84	160	260	500	1000	2100
160	—	—	220	450	980	1800

Buckling torque

See "Engineering data" for a description of terms.

Table 274-6
Unit: Nm

Size	14	17	20	25	32	40
Total reduction ratio	130	260	470	850	1800	3600

Checking output bearing

A precision cross roller bearing is built in the unit type to directly support the external load (output flange).
Check the maximum moment load, life of the cross roller bearing and static safety coefficient to fully bring out the performance of the unit type.
See page 030 to 034 of "Engineering data" for each calculation formula.

■ Checking procedure

(1) Checking the maximum moment load (M max)

Calculate the maximum moment load (Mmax). → Maximum moment load (Mmax) ≦ allowable moment (Mc)

(2) Checking the life

Calculate the average radial load (Frav) and the average axial load (Faav). → Calculate the radial load coefficient (x) and the axial load coefficient (y). → Calculate the lifetime

(3) Checking the static safety coefficient

Calculate the static equivalent radial load coefficient (Po). → Check the static safety coefficient. (fs)

■ Output bearing specifications

The specifications of the cross roller are shown in Table 280-1.

Specifications

Table 280-1

Size	Pitch circle dia. of a roller	Offset	Basic rated load				Allowable moment load Mc		Moment stiffness Km	
	dp	R	Basic dynamic rated load C		Basic static rated load Co				×10⁴ Nm/rad	kgf m/arc min
	m	m	×10²N	kgf	×10²N	kgf	Nm	kgfm		
14	0.0503	0.0111	29	296	43	438	37	3.8	7.08	2.1
17	0.061	0.0115	52	530	81	826	62	6.3	12.7	3.8
20	0.070	0.011	73	744	110	1122	93	9.5	21	6.2
25	0.086	0.0121	109	1111	179	1825	129	13.2	31	9.2
32	0.112	0.0173	191	1948	327	3334	290	29.6	82.1	24.4
40	0.133	0.0195	216	2203	408	4160	424	43.2	145	43.0

(Note) * The basic dynamic rated load means a certain static radial load so that the basic dynamic rated life of the roller bearing is one million rotations.
* The basic static rated load means a static load that gives a certain level of contact stress (4 kN/mm ^{2}) in the center of the contact area between the rolling element receiving the maximum load and the orbit.
* The value of the moment stiffness is the average value.

* As the life of the cross roller bearing of the unit of the reduction ratio corresponding to the table below (Table 280-2) is shorter than that (note) of the gear during operation under the allowable moment load, consideration should be made in designing the load condition and the lifetime.

(Note) The life of the gear indicates the life (L_{10}=7000 hours) of the wave generator bearing when it operates at 2000rpm input rotational speed and the rated torque (see "Life of the wave generator" on Page 012).

Design Guide

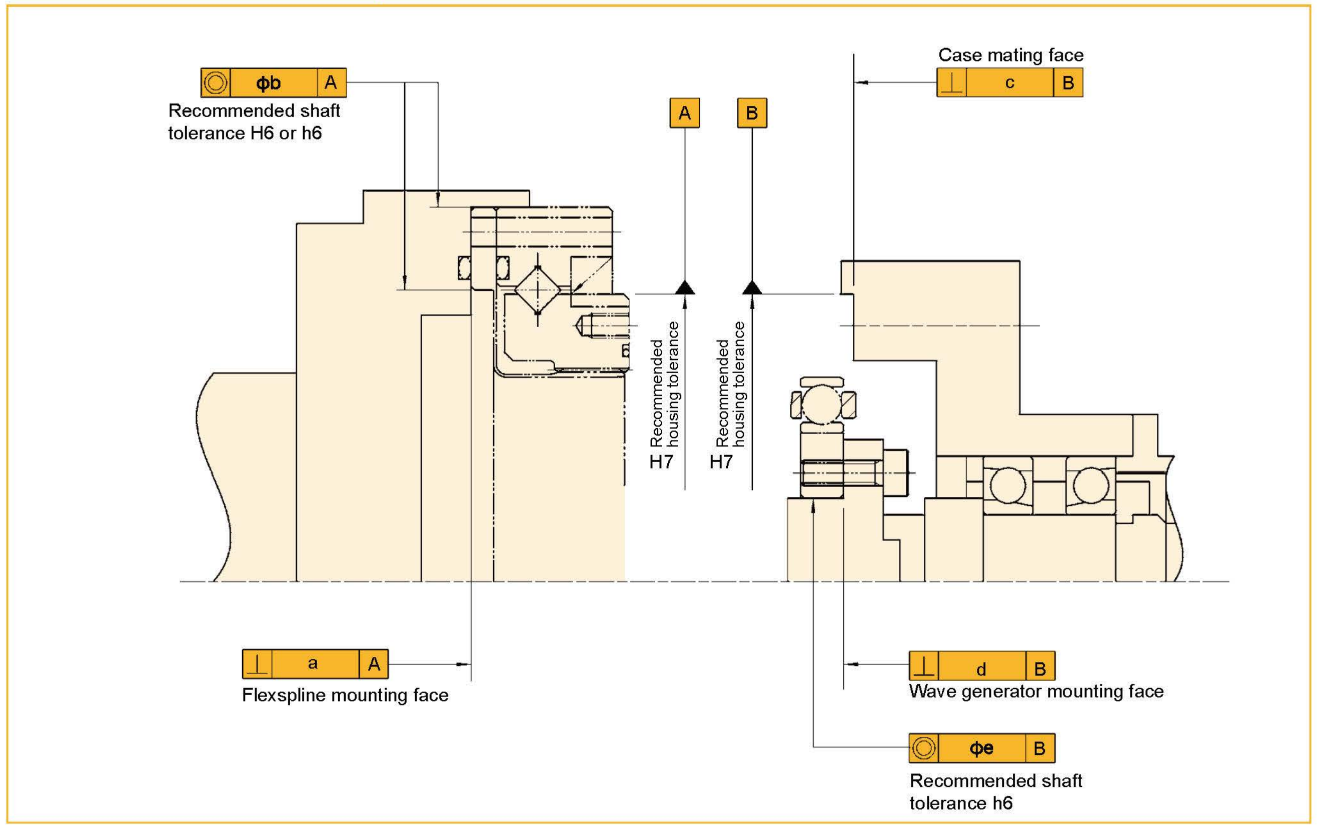
Installation accuracy

For peak performance of the gear, it is essential that the following tolerances be observed when assembly is complete.
Pay careful attention to the following points and maintain the recommended assembly tolerances to avoid grease leakage.

- Warp and deformation on the mounting surface
- Blocking of foreign matter
- Problems caused by burrs, raised surfaces and location around the tap area of the mounting holes
- Insufficient chamfering on the housing mount
- Insufficient radii on the housing mount

Recommended tolerances for assembly

Fig. 281-1



Recommended tolerances for assembly

Table 281-1

Unit: mm

Symbol \ Size	14	17	20	25	32	40
a	0.016	0.021	0.027	0.035	0.042	0.048
ϕb	0.015	0.018	0.019	0.022	0.022	0.024
c	0.011	0.012	0.013	0.014	0.016	0.016
d	0.008	0.010	0.012	0.012	0.012	0.012
ϕe	0.016	0.018	0.019	0.022	0.022	0.024

Installation and transmission torque

Installation and transmission torque on (A) side

Table 282-2

Item \ Size		14	17	20	25	32	40
Number of bolts		8	12	12	12	12	12
Bolt size		M3	M3	M3	M4	M5	M6
Pitch Circle Diameter	mm	64	74	84	102	132	158
Clamp torque	Nm	2.0	2.0	2.0	4.5	9.0	15.3
Transmission torque	Nm	108	186	210	431	892	1509

(Notes) 1. The material of the thread must withstand the clamp torque.
2. Recommended bolt: JIS B 1176 socket head cap screw. Strength range : JIS B 1051 over 12.9.
3. Torque coefficient: K=0.2
4. Tightening coefficient: A=1.4
5. Tightening friction coefficient μ=0.15

Installation and transmission torque on (B) side

Table 282-3

Item \ Size		14	17	20	25	32	40
Number of bolts		8	12	12	12	12	12
Bolt size		M3	M3	M3	M4	M5	M6
Pitch Circle Diameter	mm	43	52	61.4	76	99	120
Effective depth of screw part	mm	4.5	4.5	4.5	6	8	9
Clamp torque	Nm	2.0	2.0	2.0	4.5	9.0	15.3
Transmission torque	Nm	72	130	154	321	668	1148

(Notes) 1. The material of the thread must withstand the clamp torque.
2. Recommended bolt: JIS B 1176 socket head cap screw. Strength range : JIS B 1051 over 12.9.
3. Torque coefficient: K=0.2
4. Tightening coefficient: A=1.4
5. Tightening friction coefficient μ =0.15

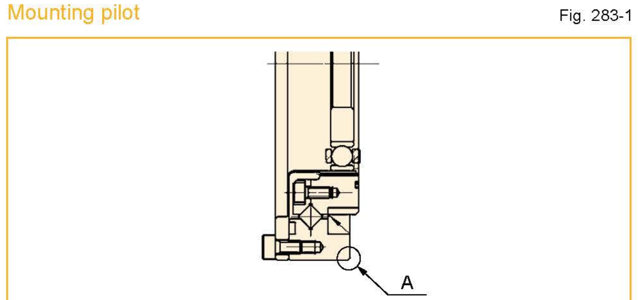
* Since the flange material on the case side is AL (aluminum), be sure to tighten the bolt to the specified torque as described above.
If the tightening torque exceeds the above value, the correct transmission torque may not be secured or the bolt may be loosened.
Use washers instead of putting the aluminum directly on the bolt-bearing surface when tightening with the bolt from the A side.

Recessing of the mounting pilot

When the housing interferes with corner "A" shown below, an undercut in the housing is recommended.

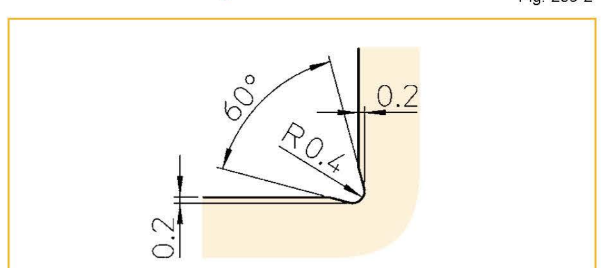
Mounting pilot

Fig. 283-1



Recommended housing undercut

Fig. 283-2



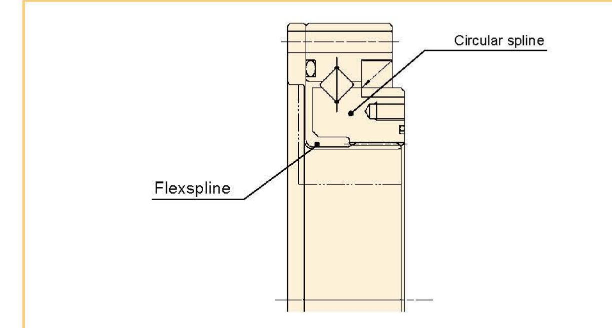
输出部和固定部

SHD系列的输出部会根据固定的位置而发生改变。
此外，减速比和旋转方向也会发生变化，其关系如下所示。

表216-1

固定部	输出部	旋转方向和减速比
柔轮	刚轮	第009页的②
刚轮	柔轮	第009页的①

图216-1



Lubrication

Standard lubrication for SHD series is grease lubrication.
See "Engineering data" on Page 016 for details of the lubricant .

Recommended minimum housing clearance

These dimensions must be maintained to prevent damage to the gear and to maintain a proper grease cavity.

Minimum housing clearance

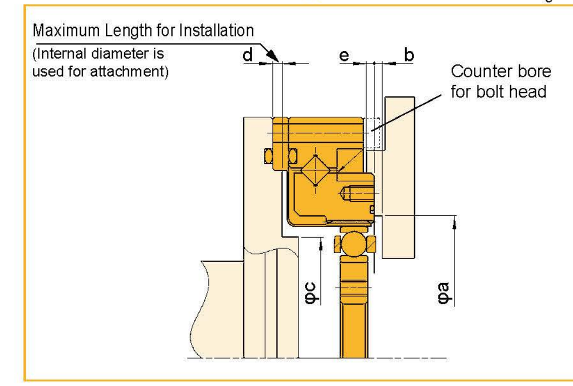
Table 283-5
Unit: mm

Symbol \ Size	14	17	20	25	32	40
φa	36.5	45	53	66	86	106
b	1(3)	1(3)	1.5(4.5)	1.5(4.5)	2(6)	2.5(7.5)
φc	31	38	45	56	73	90
d	1.4	1.8	1.7	1.8	1.8	1.8
e	1.5	1.5	1.5	1.5	3.3	4

(Note) The value in parenthesis is the value when the wave generator is facing upward.

Recommended minimum housing clearance

Fig. 283-4

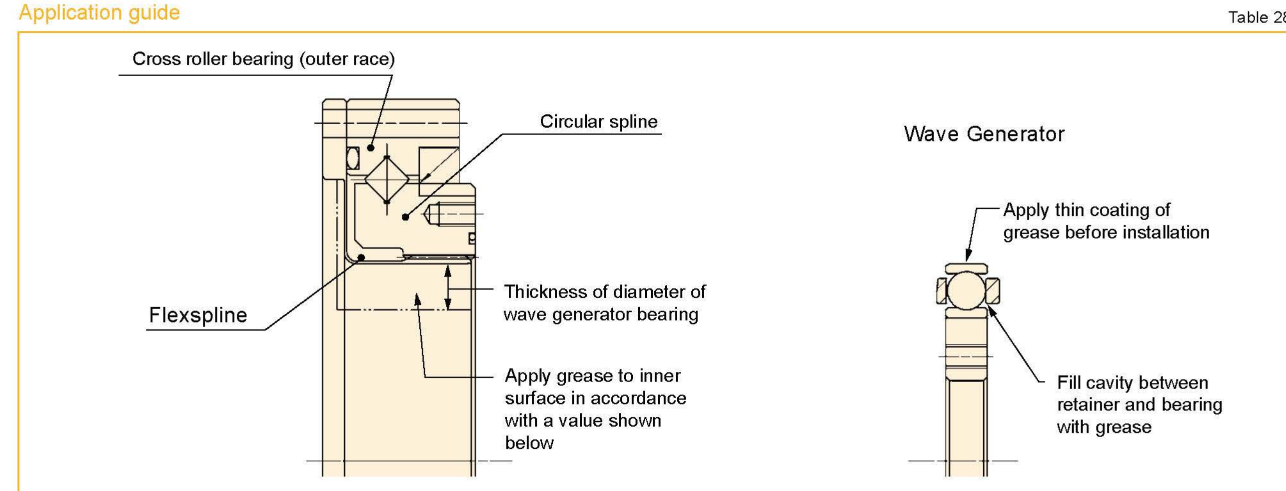


Application guide

As the SHD series is shipped with the outer race of the cross roller bearing and the flexspline temporarily bolted together, grease is applied to the gear teeth, the periphery of the flexspline and the tooth groove of the circular spline. Refer to the following application guide for grease application instructions.

Application guide

Table 284-1



Application quantity

Table 284-1
Unit: g

Size	14	17	20	25	32	40
Application qty	5	9	13	24	51	99

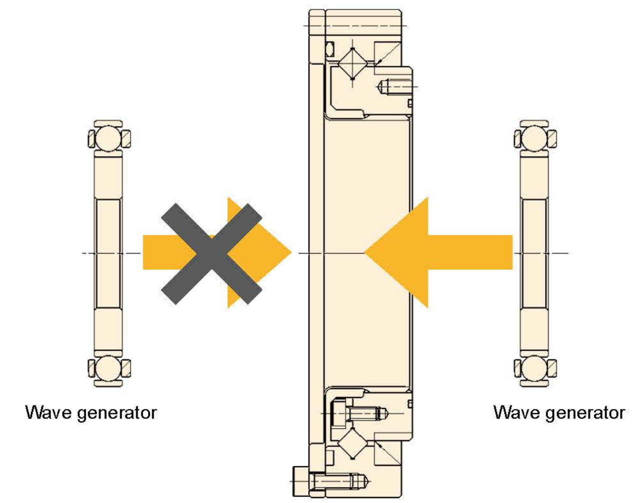
Precautions on installation

■ Assembly order of the three basic elements

The wave generator is installed after the flexspline and circular spline. If the wave generator is not inserted into the flexspline last, gear teeth scuffing damage or improper eccentric gear mesh may result. Installation resulting in an eccentric tooth mesh (Dedoidal) will cause noise and vibration, and can lead to early failure of the gear. For proper function, the teeth of the flexspline and Circular Spline mesh symmetrically.

Assembly order for basic three elements

Fig. 285-1



(Note)
Do not build in the wave generator from the diaphragm side of flexspline.

■ Precautions on assembly

It is extremely important to assemble the gear accurately and in proper sequence. For each of the three components, utilize the following precautions.

Wave generator

1. Avoid applying undue axial force to the wave generator during installation. Rotating the wave generator bearing while inserting it is recommended and will ease the process.
2. Extra care must be given to ensure that concentricity and inclination are within the specified limits (see page 281).
3. Installation bolts on the Wave Generator and Flexspline should not interfere each other.

Circular spline

The circular Spline must not be deformed in any way during the assembly. It is particularly important that the mounting surfaces are prepared correctly.

1. Mounting surfaces need to have adequate flatness, smoothness, and no distortion.
2. Especially in the area of the screw holes, burrs or foreign matter should not be present.
3. Adequate relief in the housing corners is needed to prevent interference with the corner of the circular spline.
4. The circular spline should be rotatable within the housing. Be sure there is not interference and that it does not catch on anything.
5. Bolts should not rotate freely when tightening and should not have any irregularity due to the bolt hole being misaligned or oblique.
6. Do not tighten the bolts with the specified torque all at once. Tighten the bolts temporarily with about half the specified torque, and then tighten them with the specified torque. Tighten them in an even, crisscross pattern.
7. Avoid pinning the circular spline if possible as it can reduce the rotational precision and smoothness of operation.

Flexspline

1. Mounting surfaces need to have adequate flatness, smoothness, and no distortion.
2. Especially in the area of the screw holes, burrs or foreign matter should not be present.
3. Adequate clearance with the housing is needed to ensure no interference especially with the major axis of flexspline
4. Bolts should rotate freely when installing through the mounting holes of the flexspline and should not have any irregularity due to the shaft bolt holes being misaligned or oblique.
5. Do not tighten the bolts with the specified torque all at once. Tighten the bolts temporarily with about half the specified torque, and then tighten them to the specified torque. Tighten them in an even, crisscross pattern.
6. The flexspline and circular spline are concentric after assembly. After installing the wave generator bearing, if it rotates in unbalanced way, check the mounting for dedoidal or non-concentric installation.
7. Care should be taken not to damage the flexspline diaphragm or gear teeth during assembly.

   Avoid hitting the tips of the flexpline teeth and circular spline teeth. Avoid installing the CS from the open side of the flexspline after the wave generator has been installed.

Rust prevention

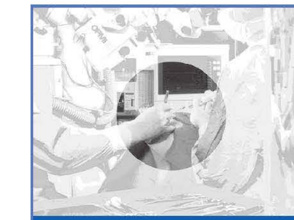
Although Harmonic Drive® gears come with some corrosion protection, the gear can rust if exposed to the environment. The gear external surfaces typically have only a temporary corrosion inhibitor and some oil applied. If an anti-rust product is needed, please contact us to review the options.

本公司产品的主要用途 Major Applications of Our Products

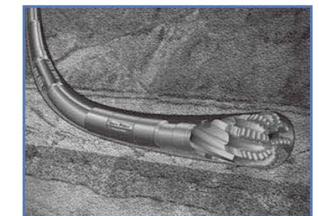

金属机床
Metal Working Machines

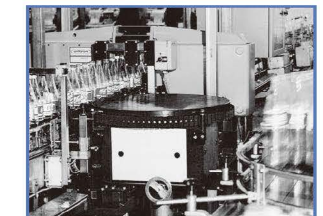

金属加工机械
Processing Machines


测定·分析·试验设备
Measurement, Analytical and Test Systems


医疗机械
Medical Equipments


望远镜
Telescopes

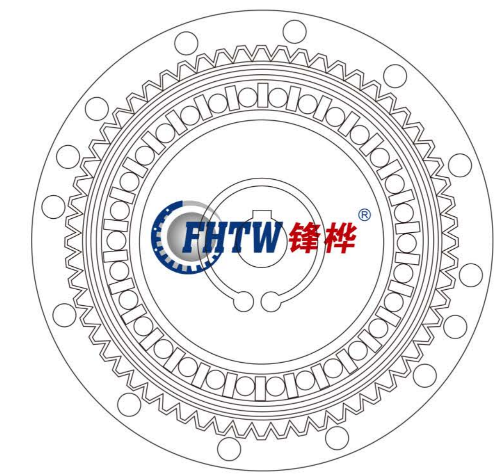

能源相关
Energy


包装·装箱设备
Crating and Packaging Machine


通信设备
Communication Equipments

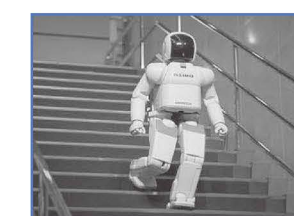

航天设备
Space Equipments

Rover Image created by Dan Maas, copyrighted to Cornell and provided courtesy NASA/ JPL–Caltech.




玻璃·陶瓷制造装置
Glass and Ceramic Manufacturing System


机器人
Robots


机器人
Humanoid Robots

提供：本田技研工业株式会社
Source: Honda Motor Co., Ltd.

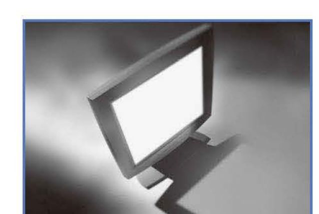

印刷·装订·纸品加工机械
Printing, Bookbinding and Paper Machine

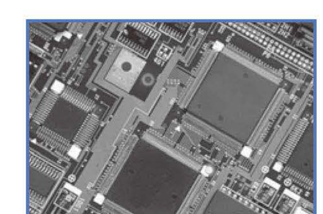

半导体制造装置
Semiconductor Manufacturing System


光学相关机械
Optical Machines


木材·轻金属·塑料加工机床
Wood, Light Metal and Plastic Machine Tool


制纸机械
Paper–making Machines


FPD制造装置
Flat Panel Display Manufacturing System


印刷电路制造装置
Printed Circuit Board Manufacturing Machine


航空器相关
AircraftTechnology