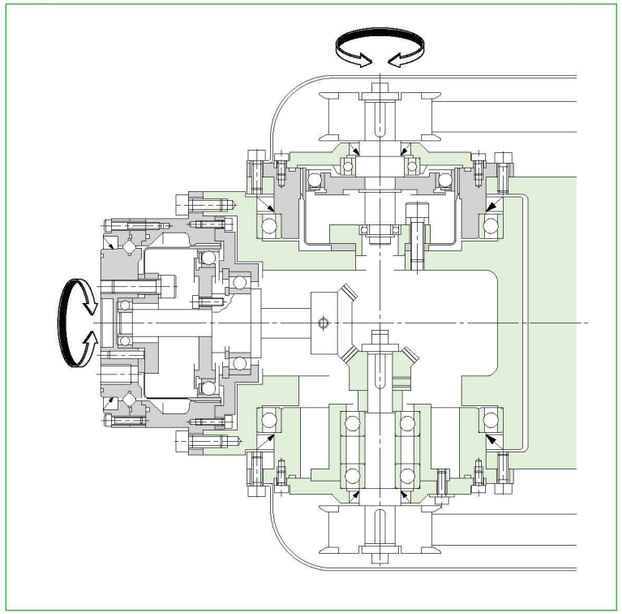
Application

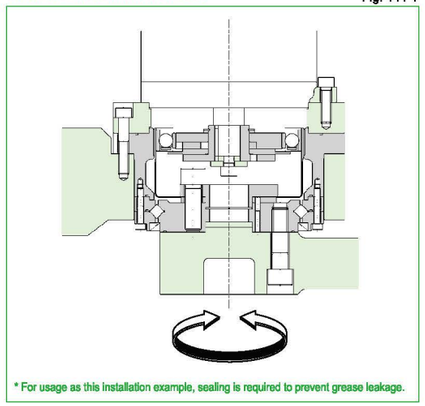
Multi-joint Robot

Fig. 143-1



Horizontal Multi Arm Robot

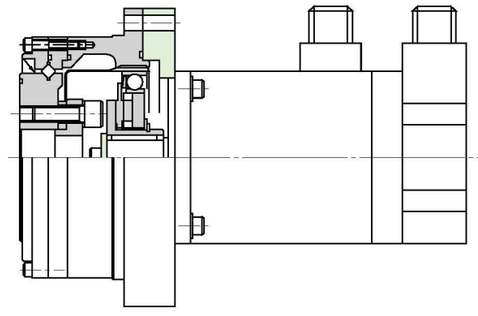
Fig. 144-1



* For usage as this installation example, sealing is required to prevent grease leakage.

Direct Connection to a Servomotor

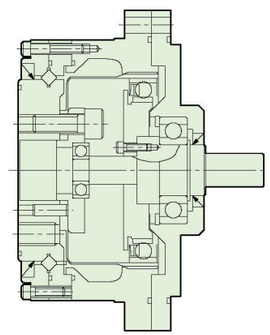
Fig. 144-2



Optional Input Shaft

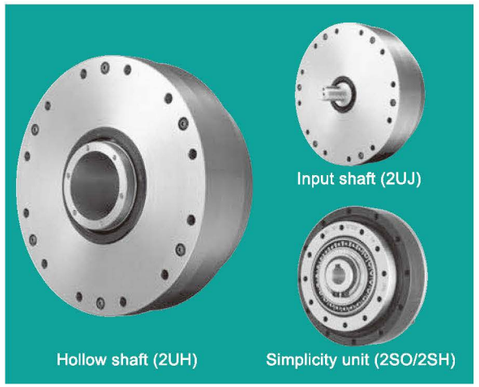
Fig. 144-3

CSF/CSG-2UJ with optional input shaft



* Contact us for details

Features



SHG/SHF series gear units

The SHG/SHF series gear unit is an easy-to-use gearhead solution. An accurate, highly rigid cross roller bearing is built in to directly support the external load.

Features

- Zero backlash
- Large bore with hollow through hole
- Input shaft option available
- Flat shape, compact and simple design
- High-torque capacity
- High stiffness
- High-positional and rotational accuracies
- Coaxial input and output

Configurations

The SHG/SHF gearheads are available in 4 variations allowing the customer to choose the best configuration for their application.

- Large-diameter hollow shaft: (2UH)
- Input shaft (2UJ)
- Easier to use: Simplicity unit (2SO)
  Hollow shaft simplicity unit (2SH)

Series

SHG: high torque
- Torque capacity has been improved by 30% compared to the SHF series.
- The life has been improved by 43% (10,000 hours) compared to the SHF series.

SHF: standard torque
- Reduction ratio of 30:1 added for high speed.

Structure of the SHG/SHF series gear unit

Fig. 228-1

* CRB: Cross roller bearing

Ordering Code

SHG - 25 - 100 - 2UH - SP

Table 229-1

Series	Size	Ratio *1					Model	Special specification
SHG	14	50	80	100	—	—	2A-GR = Component set (2A-R for sizes 14, 17) 2UH = Hollow shaft 2UJ = Input shaft 2SO = Simplicity unit (Std. structure) 2SH = Simplicity unit (Hollow shaft)	LW = Lightweight SP = Special specification code Blank = Standard product
	17	50	80	100	120	—		
	20	50	80	100	120	160		
	25	50	80	100	120	160		
	32	50	80	100	120	160		
	40	50	80	100	120	160		
	45	50	80	100	120	160		
	50	—	80	100	120	160		
	58	—	80	100	120	160		
	65	—	80	100	120	160		

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

Technical Data

Rating table

■ SHG series

Table 230-1

Size	Ratio	Rated torque at 2000rpm		Limit for repeated peak torque		Limit for average torque		Limit for momentary peak torque		Maximum input speed (rpm)		Limit for average input speed (rpm)	
		Nm	kgfm	Nm	kgfm	Nm	kgfm	Nm	kgfm	Oil lubricant	Grease lubricant	Oil lubricant	Grease lubricant
14	50	7.0	0.7	23	2.3	9	0.9	46	4.7	14000	8500	6500	3500
	80	10	1.0	30	3.1	14	1.4	61	6.2				
	100	10	1.0	36	3.7	14	1.4	70	7.2				
17	50	21	2.1	44	4.5	34	3.4	91	9	10000	7300	6500	3500
	80	29	2.9	56	5.7	35	3.6	113	12				
	100	31	3.2	70	7.2	51	5.2	143	15				
	120	31	3.2	70	7.2	51	5.2	112	11				
20	50	33	3.3	73	7.4	44	4.5	127	13	10000	6500	6500	3500
	80	44	4.5	96	9.8	61	6.2	165	17				
	100	52	5.3	107	10.9	64	6.5	191	20				
	120	52	5.3	113	11.5	64	6.5	191	20				
	160	52	5.3	120	12.2	64	6.5	191	20				
25	50	51	5.2	127	13	72	7.3	242	25	7500	5600	5600	3500
	80	82	8.4	178	18	113	12	332	34				
	100	87	8.9	204	21	140	14	369	38				
	120	87	8.9	217	22	140	14	395	40				
	160	87	8.9	229	23	140	14	408	42				
32	50	99	10	281	29	140	14	497	51	7000	4800	4600	3500
	80	153	16	395	40	217	22	738	75				
	100	178	18	433	44	281	29	841	86				
	120	178	18	459	47	281	29	892	91				
	160	178	18	484	49	281	29	892	91				
40	50	178	18	523	53	255	26	892	91	5600	4000	3600	3000
	80	268	27	675	69	369	38	1270	130				
	100	345	35	738	75	484	49	1400	143				
	120	382	39	802	82	586	60	1530	156				
	160	382	39	841	86	586	60	1530	156				
45	50	229	23	650	66	345	35	1235	126	5000	3800	3300	3000
	80	407	41	918	94	507	52	1651	168				
	100	459	47	982	100	650	66	2041	208				
	120	523	53	1070	109	806	82	2288	233				
	160	523	53	1147	117	819	84	2483	253				
50	80	484	49	1223	125	675	69	2418	247	4500	3500	3000	2500
	100	611	62	1274	130	866	88	2678	273				
	120	688	70	1404	143	1057	108	2678	273				
	160	688	70	1534	156	1096	112	3185	325				
58	80	714	73	1924	196	1001	102	3185	325	4000	3000	2700	2200
	100	905	92	2067	211	1378	141	4134	422				
	120	969	99	2236	228	1547	158	4329	441				
	160	969	99	2392	244	1573	160	4459	455				
65	80	969	99	2743	280	1352	138	4836	493	3500	2800	2400	1900
	100	1236	126	2990	305	1976	202	6175	630				
	120	1236	126	3263	333	2041	208	6175	630				
	160	1236	126	3419	349	2041	208	6175	630				

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

Ordering Code

SHF - 25 - 100 - 2UH - SP

Table 229-2

Series	Size	Ratio *1						Model	Special specification
SHF	11*2	—	50	—	100	—	—	2A-GR = Component set (2A-R for sizes 14, 17) 2UH = Hollow shaft 2UJ = Input shaft 2SO = Simplicity unit (Std. structure) 2SH = Simplicity unit (Hollow shaft)	LW = Lightweight SP = Special specification code Blank = Standard product
	14	30	50	80	100	—	—		
	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	—	50	80	100	120	160		
	50	—	50	80	100	120	160		
	58	—	50	80	100	120	160		

*1: The reduction ratio value is based on the following configuration: Input: wave generator, fixed: circular spline, output: flexspline
*2: Size 11 is only available in SHF-2UH

Rating table

■ SHF series

Table 231-1

Size	Ratio	Rated torque at 2000rpm		Limit for repeated peak torque		Limit for average torque		Limit for momentary peak torque		Maximum input speed (rpm)		Limit for average input speed (rpm)	
		Nm	kgfm	Nm	kgfm	Nm	kgfm	Nm	kgfm	Oil lubricant	Grease lubricant	Oil lubricant	Grease lubricant
11	50	3.5	0.36	8.3	0.85	5.5	0.56	17	1.73	14000	8500	6500	3500
	100	5	0.51	11	1.12	8.9	0.91	25	2.55				
14	30	4.0	0.41	9.0	0.92	6.8	0.69	17	1.7	14000	8500	6500	3500
	50	5.4	0.55	18	1.8	6.9	0.70	35	3.6				
	80	7.8	0.80	23	2.4	11	1.1	47	4.8				
	100	7.8	0.80	28	2.9	11	1.1	54	5.5				
17	30	8.8	0.90	16	1.6	12	1.2	30	3.1	10000	7300	6500	3500
	50	16	1.6	34	3.5	26	2.6	70	7.1				
	80	22	2.2	43	4.4	27	2.7	87	8.9				
	100	24	2.4	54	5.5	39	4.0	110	11				
	120	24	2.4	54	5.5	39	4.0	86	8.8				
20	30	15	1.5	27	2.8	20	2.0	50	5.1	10000	6500	6500	3500
	50	25	2.5	56	5.7	34	3.5	98	10				
	80	34	3.5	74	7.5	47	4.8	127	13				
	100	40	4.1	82	8.4	49	5.0	147	15				
	120	40	4.1	87	8.9	49	5.0	147	15				
	160	40	4.1	92	9.4	49	5.0	147	15				
25	30	27	2.8	50	5.1	38	3.9	95	9.7	7500	5600	5600	3500
	50	39	4.0	98	10	55	5.6	186	19				
	80	63	6.4	137	14	87	8.9	255	26				
	100	67	6.8	157	16	108	11	284	29				
	120	67	6.8	167	17	108	11	304	31				
	160	67	6.8	176	18	108	11	314	32				
32	30	54	5.5	100	10	75	7.7	200	20	7000	4800	4600	3500
	50	76	7.8	216	22	108	11	382	39				
	80	118	12	304	31	167	17	568	58				
	100	137	14	333	34	216	22	647	66				
	120	137	14	353	36	216	22	686	70				
	160	137	14	372	38	216	22	686	70				
40	50	137	14	402	41	196	20	686	70	5600	4000	3600	3000
	80	206	21	519	53	284	29	980	100				
	100	265	27	568	58	372	38	1080	110				
	120	294	30	617	63	451	46	1180	120				
	160	294	30	647	66	451	46	1180	120				
45	50	176	18	500	51	265	27	950	97	5000	3800	3300	3000
	80	313	32	706	72	390	40	1270	130				
	100	353	36	755	77	500	51	1570	160				
	120	402	41	823	84	620	63	1760	180				
	160	402	41	882	90	630	64	1910	195				
50	50	122	12	715	73	175	18	1430	146	4500	3500	3000	2500
	80	372	38	941	96	519	53	1860	190				
	100	470	48	980	100	666	68	2060	210				
	120	529	54	1080	110	813	83	2060	210				
	160	529	54	1180	120	843	86	2450	250				
58	50	176	18	1020	104	260	27	1960	200	4000	3000	2700	2200
	80	549	56	1480	151	770	79	2450	250				
	100	696	71	1590	162	1060	108	3180	325				
	120	745	76	1720	176	1190	121	3330	340				
	160	745	76	1840	188	1210	123	3430	350				

(Note) 1. Oil lubrication is standard for gear units size 50 or larger with a reduction ratio of 50. Use grease lubrication within half the rated torque.
2. Moment of inertia : $I = \frac{1}{4}GD^2$
3. See Rating Table Definitions on Page 12 for details of the terms.
4. Size 11 is only available in 2UH.

Positional accuracy

See "Engineering data" for a description of terms.

Table 232-1

Ratio	Specification	Size / Unit	11	14	17	20	25	32	40 or more
30	Standard product	× 10^{-4}rad	—	5.8	4.4	4.4	4.4	4.4	—
		arc min	—	2	1.5	1.5	1.5	1.5	—
	Special product	× 10^{-4}rad	—	—	—	2.9	2.9	2.9	—
		arc min	—	—	—	1	1	1	—
50 or more	Standard product	× 10^{-4}rad	5.8(4.4)	4.4	4.4	2.9	2.9	2.9	2.9
		arc min	2(1.5)	1.5	1.5	1	1	1	1
	Special product	× 10^{-4}rad	—	2.9	2.9	1.5	1.5	1.5	1.5
		arc min	—	1	1	0.5	0.5	0.5	0.5

Note 1: * The parenthesized value of size 11 indicates the value for reduction ratio 100.

Hysteresis loss

See "Engineering data" for a description of terms.

Table 232-2

Ratio	Size / Unit	11	14	17	20	25	32	40 or more
30	× 10^{-4}rad	—	8.7	8.7	8.7	8.7	8.7	—
	arc min	—	3.0	3.0	3.0	3.0	3.0	—
50	× 10^{-4}rad	5.8	5.8	5.8	5.8	5.8	5.8	5.8
	arc min	2.0	2.0	2.0	2.0	2.0	2.0	2.0
80 or more	× 10^{-4}rad	5.8	2.9	2.9	2.9	2.9	2.9	2.9
	arc min	2.0	1.0	1.0	1.0	1.0	1.0	1.0

Backlash

See "Engineering data" for a description of terms.

Table 232-3

Ratio	Size / Unit	11	14	17	20	25	32	40	45	50	58	65
30	× 10^{-5}rad	—	29.1	16.0	13.6	13.6	11.2	—	—	—	—	—
	arc sec	—	60	33	28	28	23	—	—	—	—	—
50	× 10^{-5}rad	Note 1	17.5	9.7	8.2	8.2	6.8	6.8	5.8	5.8	4.8	—
	arc sec	Note 1	36	20	17	17	14	14	12	12	10	—
80	× 10^{-5}rad	—	11.2	6.3	5.3	5.3	4.4	4.4	3.9	3.9	2.9	2.9
	arc sec	—	23	13	11	11	9	9	8	8	6	6
100	× 10^{-5}rad	Note 1	8.7	4.8	4.4	4.4	3.4	3.4	2.9	2.9	2.4	2.4
	arc sec	Note 1	18	10	9	9	7	7	6	6	5	5
120	× 10^{-5}rad	—	—	3.9	3.9	3.9	2.9	2.9	2.4	2.4	1.9	1.9
	arc sec	—	—	8	8	8	6	6	5	5	4	4
160	× 10^{-5}rad	—	—	—	2.9	2.9	2.4	2.4	1.9	1.9	1.5	1.5
	arc sec	—	—	—	6	6	5	5	4	4	3	3

Note 1: For size 11, the wave generator is a solid wave generator. See "Engineering data" for details.

Torsional stiffness

See "Engineering data" for a description of terms.

Table 232-4

Symbol		Size / Unit	11	14	17	20	25	32	40	45	50	58	65
T_1		Nm	0.8	2.0	3.9	7.0	14	29	54	76	108	168	235
		kgfm	0.082	0.2	0.4	0.7	1.4	3.0	5.5	7.8	11	17	24
T_2		Nm	2.0	6.9	12	25	48	108	196	275	382	598	843
		kgfm	0.2	0.7	1.2	2.5	4.9	11	20	28	39	61	86
Reduction ratio 30	K_1	× 10^4Nm/rad	—	0.19	0.34	0.57	1.0	2.4	—	—	—	—	—
		kgfm/arc min	—	0.056	0.10	0.17	0.30	0.70	—	—	—	—	—
	K_2	× 10^4Nm/rad	—	0.24	0.44	0.71	1.3	3.0	—	—	—	—	—
		kgfm/arc min	—	0.07	0.13	0.21	0.40	0.89	—	—	—	—	—
	K_3	× 10^4Nm/rad	—	0.34	0.67	1.1	2.1	4.9	—	—	—	—	—
		kgfm/arc min	—	0.10	0.20	0.32	0.62	1.5	—	—	—	—	—
	θ_1	× 10^{-4}rad	—	10.5	11.5	12.3	14	12.1	—	—	—	—	—
		arc min	—	3.6	4.0	4.1	4.7	4.3	—	—	—	—	—
	θ_2	× 10^{-4}rad	—	31	30	38	40	38	—	—	—	—	—
		arc min	—	10.7	10.2	12.7	13.4	13.3	—	—	—	—	—
Reduction ratio 50	K_1	× 10^4Nm/rad	0.22	0.34	0.81	1.3	2.5	5.4	10	15	20	31	—
		kgfm/arc min	0.066	0.1	0.24	0.38	0.74	1.6	3.0	4.3	5.9	9.3	—
	K_2	× 10^4Nm/rad	0.3	0.47	1.1	1.8	3.4	7.8	14	20	28	44	—
		kgfm/arc min	0.09	0.14	0.32	0.52	1.0	2.3	4.2	6.0	8.2	13	—
	K_3	× 10^4Nm/rad	0.32	0.57	1.3	2.3	4.4	9.8	18	26	34	54	—
		kgfm/arc min	0.096	0.17	0.4	0.67	1.3	2.9	5.3	7.6	10	16	—
	θ_1	× 10^{-4}rad	3.6	5.8	4.9	5.2	5.5	5.5	5.2	5.2	5.5	5.2	—
		arc min	1.2	2.0	1.7	1.8	1.9	1.9	1.8	1.8	1.9	1.8	—
	θ_2	× 10^{-4}rad	8.0	16	12	15.4	15.7	15.7	15.4	15.1	15.4	15.1	—
		arc min	2.6	5.6	4.2	5.3	5.4	5.4	5.3	5.2	5.3	5.2	—

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

Table 233-1

Symbol		Size / Unit	11	14	17	20	25	32	40	45	50	58	65
T_1		Nm	0.8	2.0	3.9	7.0	14	29	54	76	108	168	235
		kgfm	0.82	0.2	0.4	0.7	1.4	3.0	5.5	7.8	11	17	24
T_2		Nm	2	6.9	12	25	48	108	196	275	382	598	843
		kgfm	0.2	0.7	1.2	2.5	4.9	11	20	28	39	61	86
Reduction ratio 80 or more	K_1	× 10^4Nm/rad	0.27	0.47	1	1.6	3.1	6.7	13	18	25	40	54
		kgfm/arc min	0.08	0.14	0.3	0.47	0.92	2.0	3.8	5.4	7.4	12	16
	K_2	× 10^4Nm/rad	0.34	0.61	1.4	2.5	5.0	11	20	29	40	61	88
		kgfm/arc min	0.1	0.18	0.4	0.75	1.5	3.2	6.0	8.5	12	18	26
	K_3	× 10^4Nm/rad	0.44	0.71	1.6	2.9	5.7	12	23	33	44	71	98
		kgfm/arc min	0.13	0.21	0.46	0.85	1.7	3.7	6.8	9.7	13	21	29
	θ_1	× 10^{-4}rad	3	4.1	3.9	4.4	4.4	4.4	4.1	4.1	4.4	4.1	4.4
		arc min	1	1.4	1.3	1.5	1.5	1.5	1.4	1.4	1.5	1.4	1.5
	θ_2	× 10^{-4}rad	6	12	9.7	11.3	11.1	11.6	11.1	11.1	11.1	11.1	11.3
		arc min	2.2	4.2	3.3	3.9	3.8	4.0	3.8	3.8	3.8	3.8	3.9

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

Ratcheting torque

See "Engineering data" for a description of terms.

■ SHG series

Table 233-2
Unit:Nm

Ratio \ Size	14	17	20	25	32	40	45	50	58	65
50	110	190	280	580	1200	2300	3500	—	—	—
80	140	260	450	880	1800	3600	5000	7000	10000	14000
100	100	200	330	650	1300	2700	4000	5300	8300	12000
120	—	150	310	610	1200	2400	3600	4900	7500	10000
160	—	—	280	580	1200	2300	3300	4600	7200	10000

■ SHF series

Table 233-3
Unit:Nm

Ratio \ Size	11	14	17	20	25	32	40	45	50	58
30	—	59	100	170	340	720	—	—	—	—
50	34	88	150	220	450	980	1800	2700	3700	5800
80	—	110	200	350	680	1400	2800	3900	5400	8200
100	43	84	160	260	500	1000	2100	3100	4100	6400
120	—	—	120	240	470	980	1900	2800	3800	5800
160	—	—	—	220	450	980	1800	2600	3600	5600

Buckling torque

See "Engineering data" for a description of terms.

■ SHG series

Table 233-4
Unit: Nm

Size	14	17	20	25	32	40	45	50	58	65
Total reduction ratio	210	420	700	1300	2800	5200	7600	10400	16200	22800

■ SHF series

Table 233-5
Unit: Nm

Size	11	14	17	20	25	32	40	45	50	58
Total reduction ratio	90	140	270	440	890	1750	3750	5400	7500	11800

Checking output bearing

A precision cross roller bearing is built in the unit type to directly support the external load (output flange).
Please calculate maximum moment load, life of cross roller bearing,
and static safety factor to fully maximize the performance of housed unit (gearhead).

See Pages 030 to 034 of "Engineering data" for each calculation formula.

■ Checking procedure

(1) Checking the maximum moment load (Mmax)

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

(2) Checking the life

Calculate the radial load (Fαv) 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 234-1.

Specifications

Table 234-1

Size	Pitch circle dp	Offset R	Basic rated load: Basic dynamic rated load C		Basic rated load: Basic static rated load Co		Allowable moment load Mc		Moment stiffness Km	
	m	m	×10 ^{3}N	kgf	×10 ^{3}N	kgf	Nm	kgfm	×10 ^{4} Nm/rad	kgfm/arc min
11	0.043	0.018	52.9	540	75.5	770	74	7.6	6.5	1.8
14	0.050	0.0217	58	590	86	880	※ 74	7.6	8.5	2.5
17	0.060	0.0239	104	1060	163	1670	※ 124	12.6	15.4	4.6
20	0.070	0.0255	146	1490	220	2250	※ 187	19.1	25.2	7.5
25	0.085	0.0296	218	2230	358	3660	258	26.3	39.2	11.6
32	0.111	0.0364	382	3900	654	6680	580	59.1	100	29.6
40	0.133	0.044	433	4410	816	8330	849	86.6	179	53.2
45	0.154	0.0475	776	7920	1350	13800	1127	115	257	76.3
50	0.170	0.0525	816	8330	1490	15300	1487	152	351	104
58	0.195	0.0622	874	8920	1710	17500	2180	222	531	158
65	0.218	0.072	1300	13300	2230	22700	2740	280	741	220

* The basic dynamic rated load means a certain static radial load so that the basic dynamic rated life of the roller bearing is a 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.

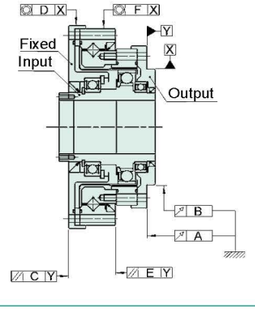
Recommended tolerances for assembly

Recommended tolerances for assembly shown below.

■ Flexspline fixed

Input: Wave generator
Output: Circular spline
Fixed: Flexspline

Hollow Shaft (2UH) Fig. 235-1



Input shaft (2UJ) Fig. 235-2

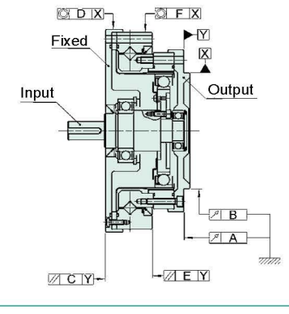


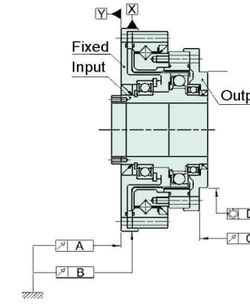
Table 235-1
Unit: mm

Symbol \ Size	11	14	17	20	25	32	40	45	50	58	65
A	0.033	0.033	0.038	0.040	0.046	0.054	0.057	0.057	0.063	0.063	0.067
B	0.035	0.035	0.035	0.039	0.041	0.047	0.050	0.053	0.060	0.063	0.063
C	0.053	0.064	0.071	0.079	0.085	0.104	0.111	0.118	0.121	0.121	0.131
D	0.053	0.053	0.050	0.059	0.061	0.072	0.075	0.078	0.085	0.088	0.089
E	0.039	0.040	0.045	0.051	0.057	0.065	0.071	0.072	0.076	0.076	0.082
F	0.038	0.038	0.038	0.047	0.049	0.054	0.060	0.065	0.067	0.070	0.072

■ Circular spline fixed

Input: Wave generator
Output: Flexspline
Fixed: Circular spline

Hollow shaft (2UH) Fig. 235-3



Input shaft (2UJ) Fig. 235-4

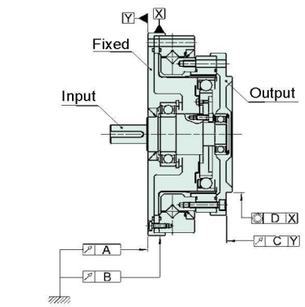


Table 171-2
Unit: mm

Symbol \ Size	11	14	17	20	25	32	40	45	50	58	65
A	0.027	0.037	0.039	0.046	0.047	0.059	0.060	0.070	0.070	0.070	0.076
B	0.031	0.031	0.031	0.038	0.038	0.045	0.048	0.050	0.050	0.050	0.054
C	0.053	0.064	0.071	0.079	0.085	0.104	0.111	0.118	0.121	0.121	0.131
D	0.053	0.053	0.053	0.059	0.061	0.072	0.075	0.078	0.085	0.088	0.089

Rotational direction and reduction ratio of a unit type

The rotational direction and the reduction ratio vary depending on the flange to be fixed for the unit type.

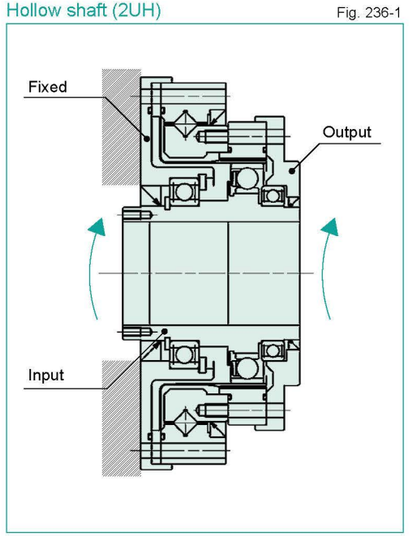
■ Flexspline fixed

Input: Wave generator
Output: Circular spline
Fixed: Flexspline

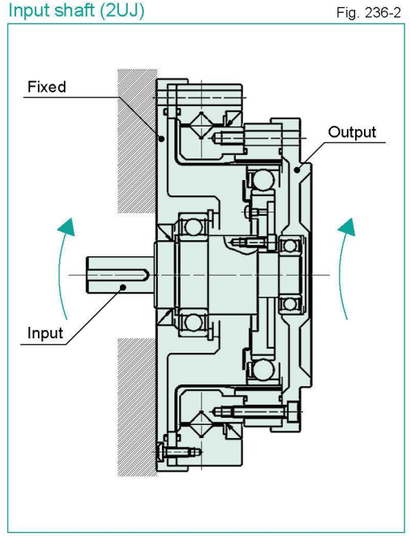
Output rotational direction: Same rotational direction as the input

Reduction ratio (i): $i = \frac{1}{R+1}$

Hollow shaft (2UH) Fig. 236-1



Input shaft (2UJ) Fig. 236-2



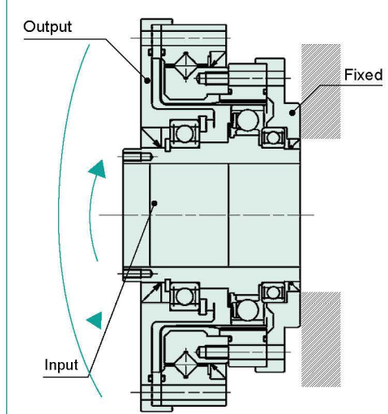
■ Circular spline fixed

Input: Wave generator
Output: Flexspline
Fixed: Circular spline

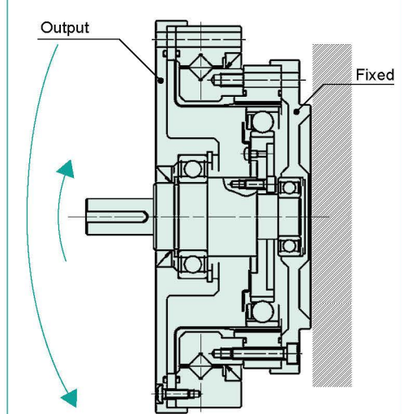
Output rotational direction: Opposite rotational direction to the input

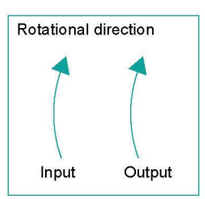
Reduction ratio (i): $i = \frac{-1}{R}$

Hollow shaft (2UH) Fig. 236-3



Input shaft (2UJ) Fig. 236-4





Design Guide

Lubrication

The standard lubricant for Harmonic Drive® gear units is Harmonic Grease SK-1A and SK-2 (Harmonic Grease 4B No.2 for the cross roller bearing). Harmonic Grease 4B No.2 is also available for long-life. The specifications of the grease are described on Page 016.

■ Sealing mechanism

- Rotating and sliding area ····· Oil seal (with a spring). Take care regarding flaws on the shaft.
- Flange mating face and mating ····· O-ring and seal adhesive. distortion on the plane and how the O-ring is engaged.
- Screw hole area ····· Use a screw lock agent (LOCKTITE 242 is recommended) or seal tape.

(Note) If you use Harmonic Grease 4BNo.2, strict sealing is required.

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.

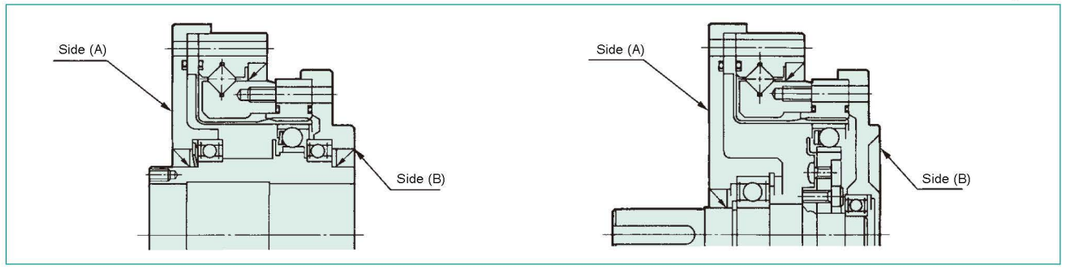
Installation accuracy

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.
In addition, perform the appropriate installation according to each series, because the torque capacity of SHG series is larger than SHF series.

- 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

Installation and transmission torque

Fig. 238-1



SHG series: (A) Side-installation and Torque Transmission Capacity Table 238-1

Item \ Size		14	17	20	25	32	40	45	50	58	65
Number of bolts		8	12	12	12	12	12	18	12	16	16
Bolt size		M3	M3	M3	M4	M5	M6	M6	M8	M8	M10
Pitch circle	mm	64	74	84	102	132	158	180	200	226	258
Clamp torque	Nm	2.4	2.4	2.4	5.4	10.8	18.4	18.4	44	44	74
Transmission torque	Nm	128	222	252	516	1069	1813	3098	4163	6272	9546

SHF series: (A) Side-installation and Torque Transmission Capacity

Table 238-2

Item \ Size		11	14	17	20	25	32	40	45	50	58
Number of bolts		4	8	12	12	12	12	12	18	12	16
Bolt size		M3	M3	M3	M3	M4	M5	M6	M6	M8	M8
Pitch circle	mm	56.4	64	74	84	102	132	158	180	200	226
Clamp torque	Nm	2.0	2.0	2.0	2.0	4.5	9.0	15.3	15.3	37	37
Transmission torque	Nm	47	108	186	206	431	892	1509	2578	3489	5236

(Table 238-1, 238-2/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 12.9 or more
3. Torque coefficient: K=0.2
4. Clamp coefficient: A=1.4
5. Friction coefficient on the surface contacted: μ=0.15
6. Use washers for SHG/SHF-LW.

SHG series: (B) Side-installation and Torque Transmission Capacity

Table 239-1

Item \ Size		14	17	20	25	32	40	45	50	58	65
Number of bolts		8	16	16	16	16	16	12	16	12	16
Bolt size		M3	M3	M3	M4	M5	M6	M8	M8	M10	M10
Pitch circle	mm	44	54	62	77	100	122	140	154	178	195
Clamp torque	Nm	2.4	2.4	2.4	5.4	10.8	18.36	44	44	89	89
Transmission torque	Nm	88	216	248	520	1080	1867	2914	4274	5927	8658

SHF series: (B) Side-installation and Torque Transmission Capacity

Table 239-2

Item \ Size		11	14	17	20	25	32	40	45	50	58
Number of bolts		6	8	16	16	16	16	16	12	16	12
Bolt size		M3	M3	M3	M3	M4	M5	M6	M8	M8	M10
Pitch circle	mm	37	44	54	62	77	100	122	140	154	178
Clamp torque	Nm	2	2.0	2.0	2.0	4.5	9.0	15.3	37	37	74
Transmission torque	Nm	46	72	176	206	431	902	1558	2440	3587	4910

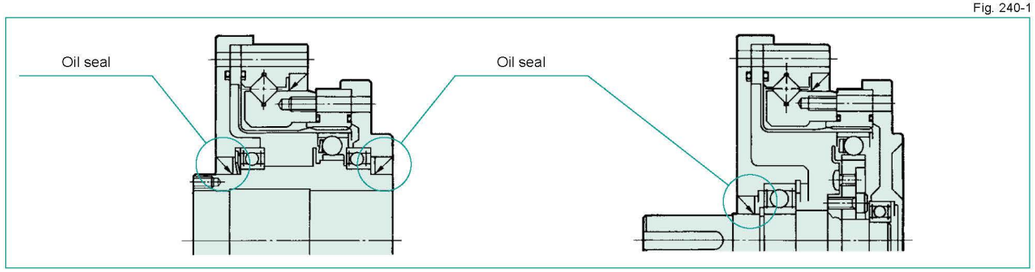
(Table 239-1, 239-2/Notes)
1. The material of the thread must withstand the clamp torque.
2. Recommended bolt: JIS B 1176 hexagonal bolt / Strength: JIS B 1051 12.9 or more
3. Torque coefficient: K=0.2
4. Clamp coefficient A=1.4
5. Friction coefficient on the surface contacted: μ=0.15

Installation Recommendations

■ Installation on the periphery of the oil seal

Install an oil seal on the mounting face so that they have a space of at least 1 mm between them to avoid interference with each other.

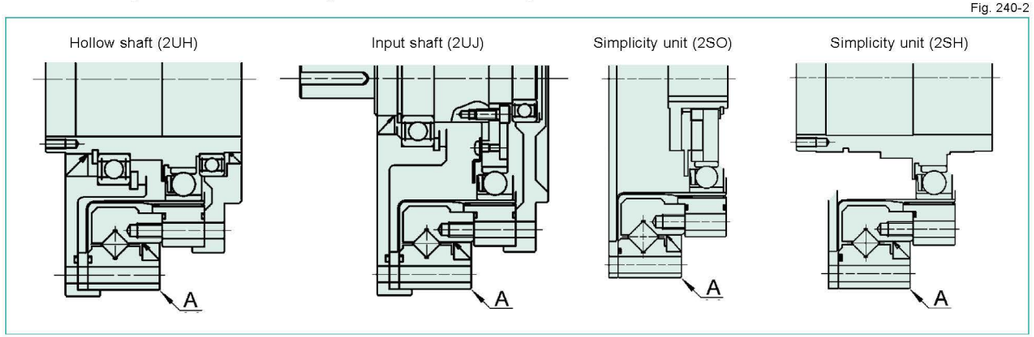
Fig. 240-1



■ Manufacturing for Mating Part and Housing

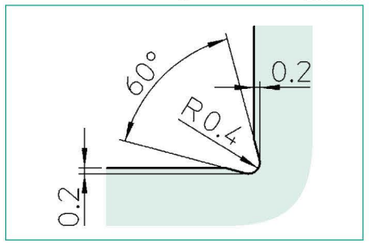
When the housing interferes with corner “A”, an undercut in the housing is recommended as shown below.

Fig. 240-2



Recommended Housing Undercut

Fig. 240-3
Unit: mm



Main markets

Industrial robot

Various mechanical equipment

Vertical multi-joint robot

Multi-joint robot

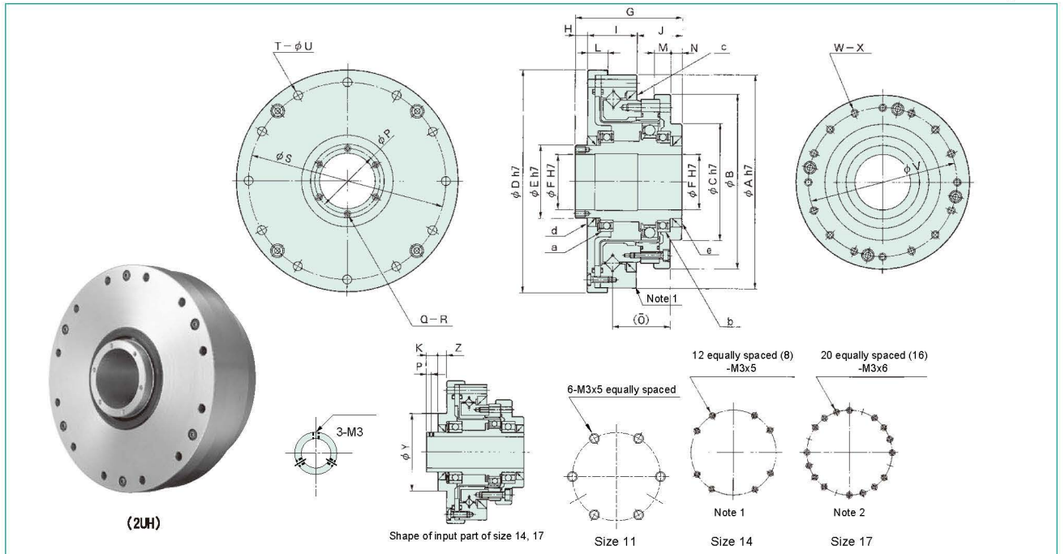
Wafer adsorption handling device

Outline Dimensions (2UH)

Outline dimensions (2UH)

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

Fig. 241-1



Note 1: See recommended housing undercut on previous page. The dimension tolerances that are not specified vary depending on the manufacturing method. Please check the co nfirmation drawi ng or contact us for dimension tolerances not shown on the drawing.

* Please refer to the confirmation drawing for detailed dimensions.

Dimensions (2UH)

Table 241-1 Unit: mm

Symbol \ Size		11	14	17	20	25	32	40	45	50	58	65
φ A h7		62	70	80	90	110	142	170	190	214	240	276
φ B	SHG/SHF Series	45.3	54	64	75	90	115	140	160	175	201	221
	SHG/SHF-LW Series	—	52	62	73	88	115	140	160	168	195	213
φC h7		30.5	36	45	50	60	85	100	120	130	150	160
φD h7		64	74	84	95	115	147	175	195	220	246	284
φE h7		18	20	25	30	38	45	59	64	74	84	96
φF H7		14	14	19	21	29	36	46	52	60	70	80
G		48	52.5	56.5	51.5	55.5	65.5	79	85	93	106	128
H		14	12	12	5	6	7	8	8	9	10	14
I		19	20.5	23	25	26	32	38	42	45	52	56.5
J		15	20	21.5	21.5	23.5	26.5	33	35	39	44	57.5
K		6.5	6.5	6.5	—	—	—	—	—	—	—	—
L		8	9	10	10.5	10.5	12	14	15	16	17	18
M	SHG/SHF Series	6.5	8	8.5	9	8.5	9.5	13	12	12	15	19.5
	SHG/SHF-LW Series	—	11.5	12	13.5	15.5	20.5	25	27	30	35	42.5
N		6.5	7.5	8.5	7	6	5	7	7	7	7	12
O		17.5	21.7	23.9	25.5	29.6	36.4	44	47.5	52.5	62.2	72
φP（P）		—	（2.5）	（2.5）	25.5	33.5	40.5	52	58	67	77	88
Q		—	3	3	6	6	6	6	6	6	8	6
R		—	M3	M3	M3×6	M3×6	M3×6	M4×8	M4×8	M4×8	M4×8	M5×10
φS		56.4	64	74	84	102	132	158	180	200	226	258
T		4	8	12	12	12	12	12	18	12	16	16
φU		3.5	3.5	3.5	3.5	4.5	5.5	6.6	6.6	9	9	11
φV		37	44	54	62	77	100	122	140	154	178	195
W		6	12 E. A. 8	20 E. A. 16	16	16	16	16	12	16	12	16
X	SHG/SHF Series	M3X5	M3×5	M3×6	M3×6	M4×7	M5×8	M6×10	M8×10	M8×11	M10×15	M10×15
		φ3.4X4	φ3.5×11.5	φ3.5×12	φ3.5×13.5	φ4.5×15.5	φ5.5×20.5	φ6.6×25	φ9×28	φ9×30	φ11×35	φ11×42.5
	SHG/SHF-LW Series	—	M3×5	M3×6	M3×6	M4×7	M5×8	M6×10	M8×10	M8×11	M10×15	M10×15
		—	φ3.5×11.5	φ3.5×12	φ3.5×13.5	φ5×15.5	φ6×20.5	φ7×25	φ9×27	φ9×30	φ11×35	φ11×42.5
φY		36	36	45	—	—	—	—	—	—	—	—
Z		7.5	5.5	5.5	—	—	—	—	—	—	—	—
a		6804 ZZ	6804 ZZ	6805 ZZ	6806 ZZ	6808 ZZ	6909 ZZ	6912 ZZ	6913 ZZ	6915 ZZ	6917 ZZ	6920 ZZ
b	SHG/SHF Series	6704 ZZ	6804 ZZ	6805 ZZ	6806 ZZ	6808 ZZ	6809 ZZ	6812 ZZ	6813 ZZ	6815 ZZ	6817 ZZ	6820 ZZ
	SHG/SHF-LW Series	—	6804 ZZ	6805 ZZ	6806 ZZ	6808 ZZ	6809 ZZ	6812 ZZ	6813 ZZ	6815 ZZ	6817 ZZ	6820 ZZ
c		D41.950.95	D49585	D59685	D69785	D84945	D1101226	D1321467	D1521707	D1681868	D1932129	D21623811
d	SHG/SHF Series	S18274	S20304.5	S25356	S30405	S38475	S45607	S60789	S658510	S759510	S8511012	S10012513
	SHG/SHF-LW Series	—	S20304.5	S25356	S30405	S38475	S45607	S60789	S658510	S759510	S8511012	S10012513
e	SHG/SHF Series	S18274	S20304.5	S25356	S30405	S38475	S45555	S59685	S59685	S69785	S84945	S961128
	SHG/SHF-LW Series	—	S20304.5	S25356	S30405	S38475	S45555	S59685	S59685	S69785	S84945	S961128

Mass (2UH)

Table 242-1
Unit: kg

Symbol \ Size	11	14	17	20	25	32	40	45	50	58	65
2UH	0.53	0.71	1.00	1.38	2.1	4.5	7.7	10.0	14.5	20.0	28.5
2UH-LW (Lightweight)	--	0.55	0.8	1.1	1.6	3.6	6.2	8	11.8	16.4	23.3

Moment of Inertia (2UH)

Table 242-2

Symbol \ Size			11	14	17	20	25	32	40	45	50	58	65
Moment of inertia	I	× 10^{-4}kgm^2	0.080	0.091	0.193	0.404	1.070	2.85	9.28	13.8	25.2	49.5	94.1
	J	× 10^{-3}kgfms^2	0.082	0.093	0.197	0.412	1.090	2.91	9.47	14.1	25.7	50.5	96.0

Starting torque (2UH)

See "Engineering data" for a description of terms. Please use as reference values; the values vary based on use conditions.

Table 242-3
Unit: Ncm

Ratio \ Size	11	14	17	20	25	32	40	45	50	58	65
30	—	11	30	43	64	112	—	—	—	—	—
50	7.1	8.8	27	36	56	85	136	165	216	297	—
80	—	7.5	25	33	50	74	117	138	179	244	314
100	5.9	6.9	24	32	49	72	112	131	171	231	297
120	—	—	24	31	48	68	110	126	165	223	287
160	—	—	—	31	47	67	105	122	156	213	276

Backdriving torque (2UH)

See "Engineering data" for a description of terms. Please use as reference values; the values vary based on use conditions.

Table 242-4
Unit: Nm

Ratio \ Size	11	14	17	20	25	32	40	45	50	58	65
30	—	5.4	17	23	35	57	—	—	—	—	—
50	4.6	5.3	16	22	34	51	82	99	129	178	—
80	—	7.2	24	31	48	70	112	133	172	234	301
100	7.6	8.2	29	38	59	86	134	158	205	278	356
120	—	—	34	45	69	97	158	182	237	322	413
160	—	—	—	59	90	128	201	233	299	408	530

Continuous Operating Time (2UH)

The internal temperature rises due to the effect of the oil seal and the supporting bearing used for the input shaft (high-speed rotation side) for SHF-2UH. Observe the operating time shown in Table 246-2 for continuous operation.
The operating time shown in Table 246-2 is calculated based on the time required for the temperature inside the unit to rise to 80ºC and for the oil seal temperature to rise to 100ºC. Take care not to exceed the temperature given above in conducting continuous operation. The following review will be necessary if the temperature exceeds the value given above.
Contact us in such an event.

- Change of timing to replace lubricant
- Change of lubricant
- Measures against lubricant leakage accompanied by the pressure rise inside the unit
- Measures against deterioration due to heat on the oil seal area

Continuous operating time

Table246-2

Size \ Operating time	Continuous operating time at no-load operation (min)	Continuous operating time at the rated load (min)
11	90	60
14	90	60
17	90	60
20	90	60
25	60	45
32	45	35
40	40	30
45	35	25
50	30	20
58	20	15
65	15	10

* Contact us as the continuous operating time may vary significantly depending on the operating condition.

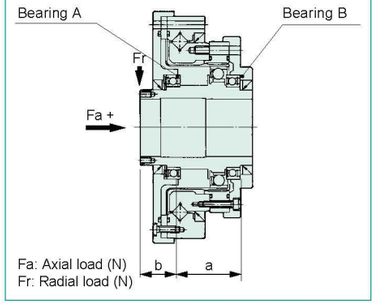
Performance Data for the Input Bearing for Hollow Shaft (2UH)

The internal temperature rises due to the effect of the oil seal and the supporting bearing used for the input shaft (high-speed rotation side) for SHF-2UH. Observe the operating time shown in Table 246-2 for continuous operation.The operating time shown in Table 246-2 is calculated based on the time required for the temperature inside the unit to rise to 80ºC and for the oil seal temperature to rise to 100ºC. Take care not to exceed the temperature given above in conducting continuous operation. The following review will be necessary ifthe temperature exceeds the value given above. Contact us insuch an event.

Input bearing specifications

Table 247-1 Fig 247-1

Size	Bearing A Model	Bearing A Basic dynamic rated load Cr(N)	Bearing A Basic static rated load Cor(N)	Bearing B Model	Bearing B Basic dynamic rated load Cr(N)	Bearing B Basic static rated load Cor(N)	a (mm)	b (mm)	Maximum radial load Fr(N)
11	6804ZZ	4000	2470	6704ZZ	1400	720	25.7	15.5	--
14	6804ZZ	4000	2470	6804ZZ	4000	2470	27	16.5	230
17	6805ZZ	4300	2950	6805ZZ	4300	2950	29	17.5	250
20	6806ZZ	4500	3450	6806ZZ	4500	3450	27	15.5	275
25	6808ZZ	4900	4350	6808ZZ	4900	4350	29.5	16.5	250
32	6909ZZ	14100	10900	6809ZZ	5350	5250	33	23	770
40	6912ZZ	19400	16300	6812ZZ	11500	10900	39.5	27.5	1060
45	6913ZZ	17400	16100	6813ZZ	11900	12100	44	28.5	900
50	6915ZZ	24400	22600	6815ZZ	12500	13900	49	31.5	1370
58	6917ZZ	32000	29600	6817ZZ	18700	20000	56.2	36.5	1720
65	6920ZZ	42500	36500	6820ZZ	19600	21200	67	44.5	2300

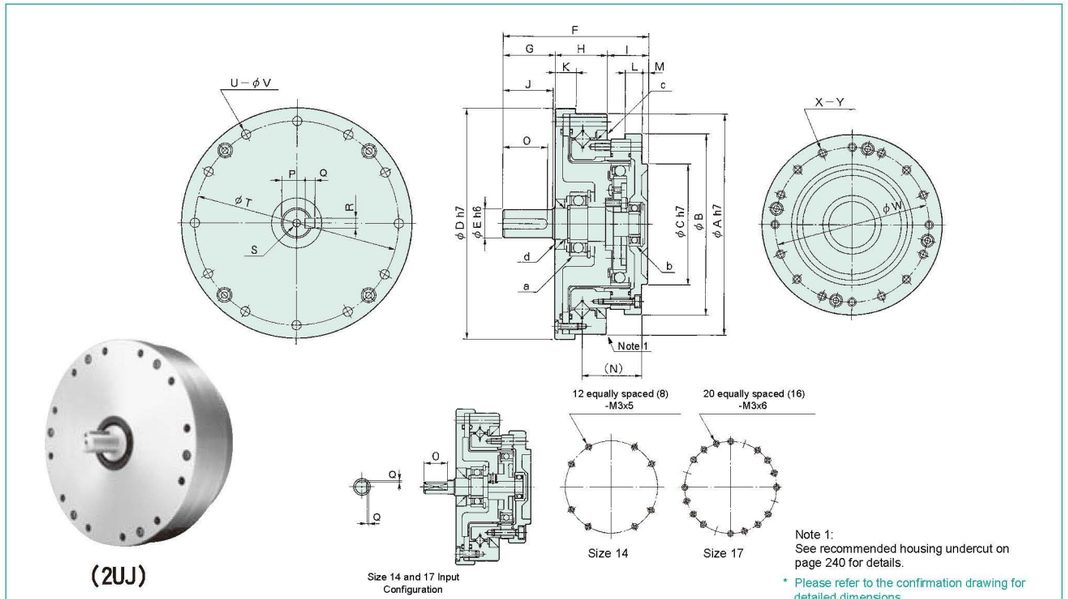


Outline Dimensions (2UJ)

Outline Dimensions (2UJ)

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

Fig. 248-1



Note 1:
See recommended housing undercut on page 240 for details.

* Please refer to the confirmation drawing for detailed dimensions.

Dimensions (2UJ)

Table 248-1 Unit: mm

Symbol \ Size	14	17	20	25	32	40	45	50	58	65
φA h7	70	80	90	110	142	170	190	214	240	276
φB	54	64	75	90	115	140	160	175	201	221
φC h7	36	45	50	60	85	100	120	130	150	160
φD h7	74	84	95	115	147	175	195	220	246	284
φE h6	6	8	10	14	14	16	19	22	22	25
F	50.5	56	63.5	72.5	84.5	100	108	121	133	156
G	15	17	21	26	26	31	31	37	37	42
H	20.5	23	25	26	32	38	42	45	52	56.5
I	15	16	17.5	20.5	26.5	31	35	39	44	57.5
J	14	16	20	25	25	30	30	35	35	40
K	9	10	10.5	10.5	12	14	15	16	17	18
L	8	8.5	9	8.5	9.5	13	12	12	15	19.5
M	2.5	3	3	3	5	5	7	7	7	12
N	21.7	23.9	25.5	29.6	36.4	44	47.5	52.5	62.2	72
O	11	12	16.5	22.5	22.5	27.5	28	33	33	39
P	—	—	8.2 -0.1	11 -0.1	11 -0.1	13 -0.1	15.5 -0.1	18.5 -0.1	18.5 -0.1	21 -0.1
Q	0.5	0.5	3 -0.025	5 -0.030	5 -0.030	5 -0.030	6 -0.030	6 -0.030	6 -0.030	7 -0.036
R	—	—	3 -0.025	5 -0.030	5 -0.030	5 -0.030	6 -0.030	6 -0.030	6 -0.030	8 -0.036
S	—	—	M3×6	M5×10	M5×10	M5×10	M6×12	M6×12	M6×12	M8×16
φT	64	74	84	102	132	158	180	200	226	258
U	8	12	12	12	12	12	18	12	16	16
φV	3.5	3.5	3.5	4.5	5.5	6.6	6.6	9	9	11
φW	44	54	62	77	100	122	140	154	178	195
X	12 E. A. 8	20 E. A. 16	16	16	16	16	12	16	12	16
Y	M3×5	M3×6	M3×6	M4×7	M5×8	M6×10	M8×10	M8×11	M10×15	M10×15
	φ3.5×11.5	φ3.5×12	φ3.5×13.5	φ4.5×15.5	φ5.5×20.5	φ6.6×25	φ9×28	φ9×30	φ11×35	φ11×42.5
a	698 ZZ	6900 ZZ	6902 ZZ	6002 ZZ	6004 ZZ	6006 ZZ	6206 ZZ	6207 ZZ	6208 ZZ	6209 ZZ
b	695 ZZ	697 ZZ	698 ZZ	6900 ZZ	6902 ZZ	6003 ZZ	6004 ZZ	6005 ZZ	6006 ZZ	6007 ZZ
c	D49585	D59685	D69785	D84945	D1101226	D1321467	D1521707	D1681868	D1932129	D21623811
d	G8184	D10205	D15255	D15255	D20355	D30457	D30457	D35557	D40607	D45607

Mass (2UJ)

Table 249-1
Unit: kg

Symbol \ Size	14	17	20	25	32	40	45	50	58	65
Mass (kg)	0.66	0.94	1.38	2.1	4.4	7.3	9.8	13.9	19.4	26.5

Moment of Inertia (2UJ)

Table 249-2

Symbol \ Size			14	17	20	25	32	40	45	50	58	65
Moment of inertia	I	$\times10^{-4}kgm^2$	0.025	0.059	0.137	0.320	1.20	3.41	5.80	9.95	20.5	35.5
	J	$\times10^{-5}kgfms^2$	0.026	0.060	0.140	0.327	1.22	3.48	5.92	10.2	20.9	36.2

Starting torque (2UJ)

See "Engineering data" for a description of terms. Please use the values vary based on use conditions. as reference values;

Table 249-3
Unit: Ncm

Ratio \ Size	14	17	20	25	32	40	45	50	58	65
30	6.8	11	19	26	63	—	—	—	—	—
50	5.7	9.7	14	22	41	72	94	125	178	—
80	4.4	7.2	11	15	29	52	68	88	125	163
100	3.7	6.5	9.9	14	27	47	60	80	113	147
120	—	6.2	9.3	13	24	44	55	74	105	137
160	—	—	8.6	12	23	39	50	66	94	122

Backdriving torque (2UJ)

See "Engineering data" for a description of terms. Please use as reference values; the values vary based on use conditions.

Table 249-4
Unit: Nm

Ratio \ Size	14	17	20	25	32	40	45	50	58	65
30	3.5	5.9	10	16	31	—	—	—	—	—
50	3.4	5.8	8.4	13	25	43	56	75	107	—
80	4.2	6.9	10	15	28	50	65	85	120	154
100	4.5	7.8	12	17	33	56	72	96	135	176
120	—	8.9	13	19	34	63	79	106	151	198
160	—	—	17	23	43	75	96	126	181	235

Performance Data for the Input bearing (2UJ)

The input shaft of the 2UJ is supported by two single-row deep-groove bearings. For peak performance of the SHF-2UJ it is essential that the following Specification for Input Bearing be observed -Figure 254-1 shows the points of application of forces. See Table 254-1 for the dimensions (a) and (b). Graphs 254-1 and 254-2 show the Maximum Allowable Radial and Axial Loads. The values in Graph 254-1 and 254-2 are based on an average input speed of 2,000 rpm and a mean bearing life of L10=7,000h.

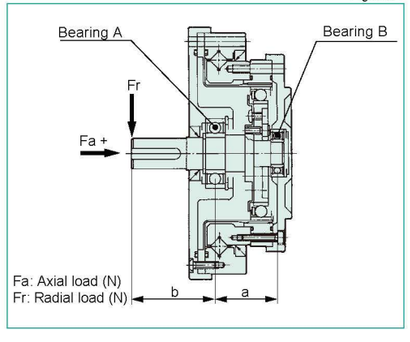
Example: If the input shaft of a SHF-40-2UJ unit is subjected to an axial load (Fa) of 500 N. The maximum allowable radial force will be 400 N.

Input bearing specifications

Table 254-1

Size	Bearing A			Bearing B			a	b	Maximum radial load
	Model	Basic dynamic rated load	Basic static rated load	Model	Basic dynamic rated load	Basic static rated load			
		Cr(N)	Cor(N)		Cr(N)	Cor(N)	(mm)	(mm)	Fr(N)
14	698ZZ	2240	910	695ZZ	1080	430	20	14	110
17	6900ZZ	2700	1270	697ZZ	1610	710	23.5	21	135
20	6902ZZ	4350	2260	698ZZ	2240	910	26.5	23.3	210
25	6002ZZ	5600	2830	6900ZZ	2700	1270	28	28	270
32	6004ZZ	9400	5000	6902ZZ	4350	2260	36	27	490
40	6006ZZ	13200	8300	6003ZZ	6000	3250	43	32.5	660
45	6206ZZ	19500	11300	6004ZZ	9400	5000	47.5	34.5	1030
50	6207ZZ	25700	15300	6005ZZ	10100	5850	53	39	1330
58	6208ZZ	29100	17800	6006ZZ	13200	8300	62.5	40	1600
65	6209ZZ	32500	20500	6007ZZ	16000	10300	79	63	1650

Fig 255-1



Outline Dimensions(2SO、2SH)

Outline Dimensions (2SO)

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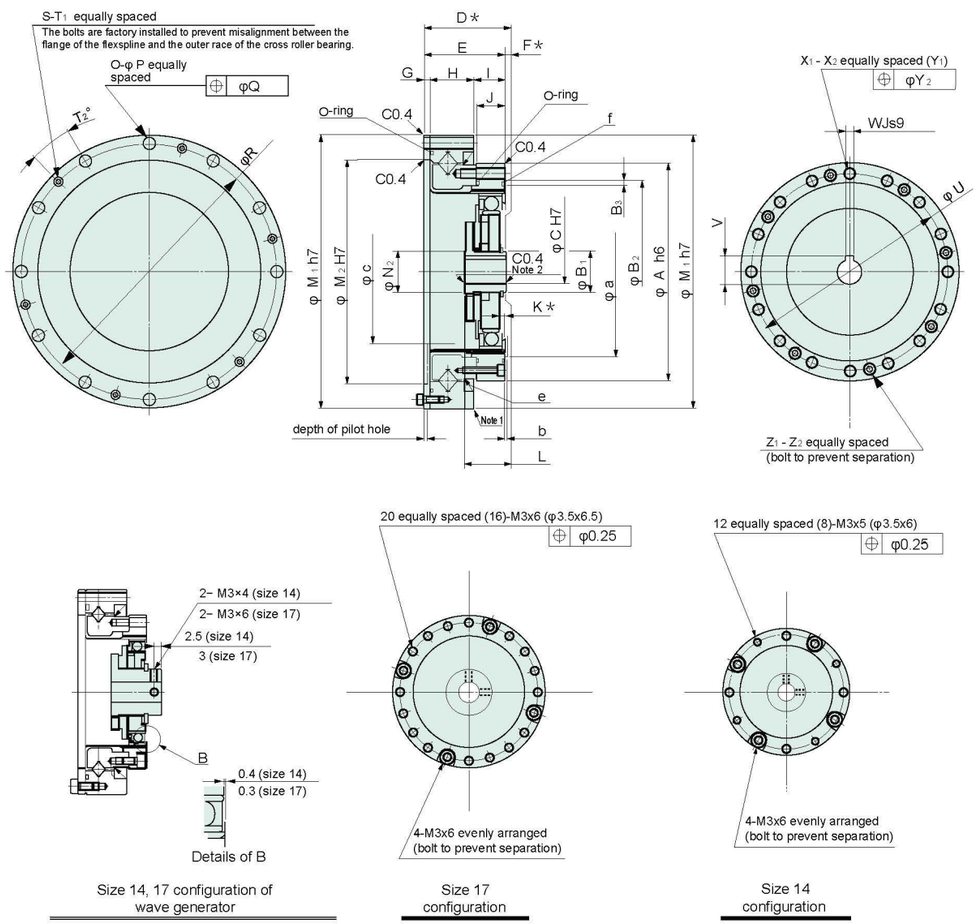
Fig. 255-1



(2SO/2SH)

Note 1: See undercutting the housing on Page 240 for details.
Note 2: For size 14, C0.5.

* Refer to the confirmation drawing for detailed dimensions
* See Fig. 084-2 on Page 084 for the configurations of the wave generator.

Dimensions (2SO)

Table 256-1
Unit : mm

Symbol \ SIZE		14	17	20	25	32	40	45	50	58	65
φA h6		50	60	70	85	110	135	155	170	195	215
φB1		14	18	21	26	26	32	32	32	40	48
φB2		—	—	—	—	—	—	128	141	163	180.4
φB3		—	—	—	—	—	—	2.7	2.7	2.7	2.7
φC	Standard (H7)	6	8	9	11	14	14	19	19	22	24
	Max. dimen.	8	10	13	15	15	20	20	20	25	30
D∗	SHF Series	28.5 $^{0}_{-0.8}$	32.5 $^{0}_{-0.9}$	33.5 $^{0}_{-1.0}$	37 $^{0}_{-1.1}$	44 $^{0}_{-1.1}$	53 $^{0}_{-1.1}$	58 $^{0}_{-1.2}$	64 $^{0}_{-1.3}$	75.5 $^{0}_{-1.3}$	—
	SHG Series	28.5 $^{0}_{-0.4}$	32.5 $^{0}_{-0.4}$	33.5 $^{0}_{-0.4}$	37 $^{0}_{-0.5}$	44 $^{0}_{-0.6}$	53 $^{0}_{-0.6}$	58 $^{0}_{-0.6}$	64 $^{0}_{-0.7}$	75.5 $^{0}_{-0.7}$	83 $^{0}_{-0.7}$
E		23.5	26.5	29	34	42	51	56.5	63	73	81.5
F∗		5	6	4.5	3	2	2	1.5	1	2.5	1.5
G		2.4	3	3	3.3	3.6	4	4.5	5	5.8	6.5
H		14.1	16	17.5	18.7	23.4	29	32	34	40.2	43
I		7	7.5	8.5	12	15	18	20	24	27	32
J		6	6.5	7.5	10	14	17	19	22	25	29
K∗	SHF Series	0.4	0.3	0.1	2.1	2.5	3.3	3.7	4.2	4.8	—
	SHG Series	1.4	1.6	1.5	3.5	4.2	5.6	6.3	7	8.2	9.5
L	SHF Series	17.6 $^{0}_{-0.1}$	19.5 $^{0}_{-0.1}$	20.1 $^{0}_{-0.1}$	20.2 $^{0}_{-0.1}$	22 $^{0}_{-0.1}$	27.5 $^{0}_{-0.1}$	27.9 $^{0}_{-0.1}$	32 $^{0}_{-0.1}$	34.9 $^{0}_{-0.1}$	—
	SHG Series	18.5 $^{0}_{-0.1}$	20.7 $^{0}_{-0.1}$	21.5 $^{0}_{-0.1}$	21.6 $^{0}_{-0.1}$	23.6 $^{0}_{-0.1}$	29.7 $^{0}_{-0.1}$	30.5 $^{0}_{-0.1}$	34.8 $^{0}_{-0.1}$	38.3 $^{0}_{-0.1}$	44.6 $^{0}_{-0.1}$
φM1 h7		70	80	90	110	142	170	190	214	240	276
φM2 H7		48	60	70	88	114	140	158	175	203	232
φN2		—	—	—	—	—	32	—	32	—	48
O		8	12	12	12	12	12	18	12	16	16
φP		3.5	3.5	3.5	4.5	5.5	6.6	6.6	9	9	11
φQ		0.25	0.25	0.25	0.25	0.25	0.3	0.3	0.5	0.5	0.5
φR		64	74	84	102	132	158	180	200	226	258
S		2	4	4	4	4	6	6	6	8	8
T1		M3×6	M3×6	M3× 8	M3× 8	M4× 8	M4× 10	M4× 8	M5× 12	M5× 12	M6× 16
T2 (angle)		22.5°	15°	15°	15°	15°	15°	10°	15°	11.25°	11.25°
φU		44	54	62	77	100	122	140	154	178	195
V		—	—	10.4	12.8	16.3	16.3	21.8	21.8	24.8	27.3
W Js9		—	—	3	4	5	5	6	6	6	8
X1		12 E. A. 8	12E. A. 16	16	16	16	16	12	16	12	16
X2		M3×5	M3×6	M3× 6	M4× 7	M5× 8	M6× 10	M8× 10	M8× 11	M10× 15	M10× 15
Y1		φ3.5×6	φ3.5×6.5	φ 3.5× 7.5	φ 4.5× 10	φ 5.5× 14	φ 6.6× 17	φ 9× 19	φ 9× 22	φ 11× 25	φ 11× 29
Y2		0.25	0.25	0.25	0.25	0.25	0.3	0.5	0.5	0.5	0.5
Z1		4	4	4	4	4	4	4	8	6	8
Z2		M3×6	M3×6	M3× 8	M3× 10	M4× 16	M5× 20	M5× 20	M5× 25	M6× 25	M6× 30
Minimum housing clearance	φa	38	45	53	66	86	106	119	133	154	172
	b	1	1	1.5	1.5	1.5	2	2	2	2.5	2.5
	φc	31	38	45	56	73	90	101	113	131	150
d		1.7	2.1	2	2	2	2	2.3	2.5	2.9	3.5
e		D49585	D59685	D69785	D84945	D1101226	D1321467	D1521707	D1681868	D1932129	D21623811
f		—	—	—	—	—	—	d1 121.5 d2 2.0	S135	d1 157.0 d2 2.0	S175

● The following dimensions can be modified to accommodate customer-specific requirements.

Wave Generator : C
Flexspline : O and P
Circular Spline : X1 and X2

● *The D, F and K values indicate relative position of individual gearing components (wave generator, flexpline, circular spline). Please strictly adhere to these values when designing your housing and mating parts.
● Please note that the circular spline face of sizes 14 through 40 does not incorporate an O-ring groove. Please provide alternate sealing arrangements.
● Due to the deformation of the Flexspline during operation, it is necessary to provide a minimum housing clearance, dimensions φa, b, c.

Wave generator is removed when the product is delivered.

Mass (2SO)

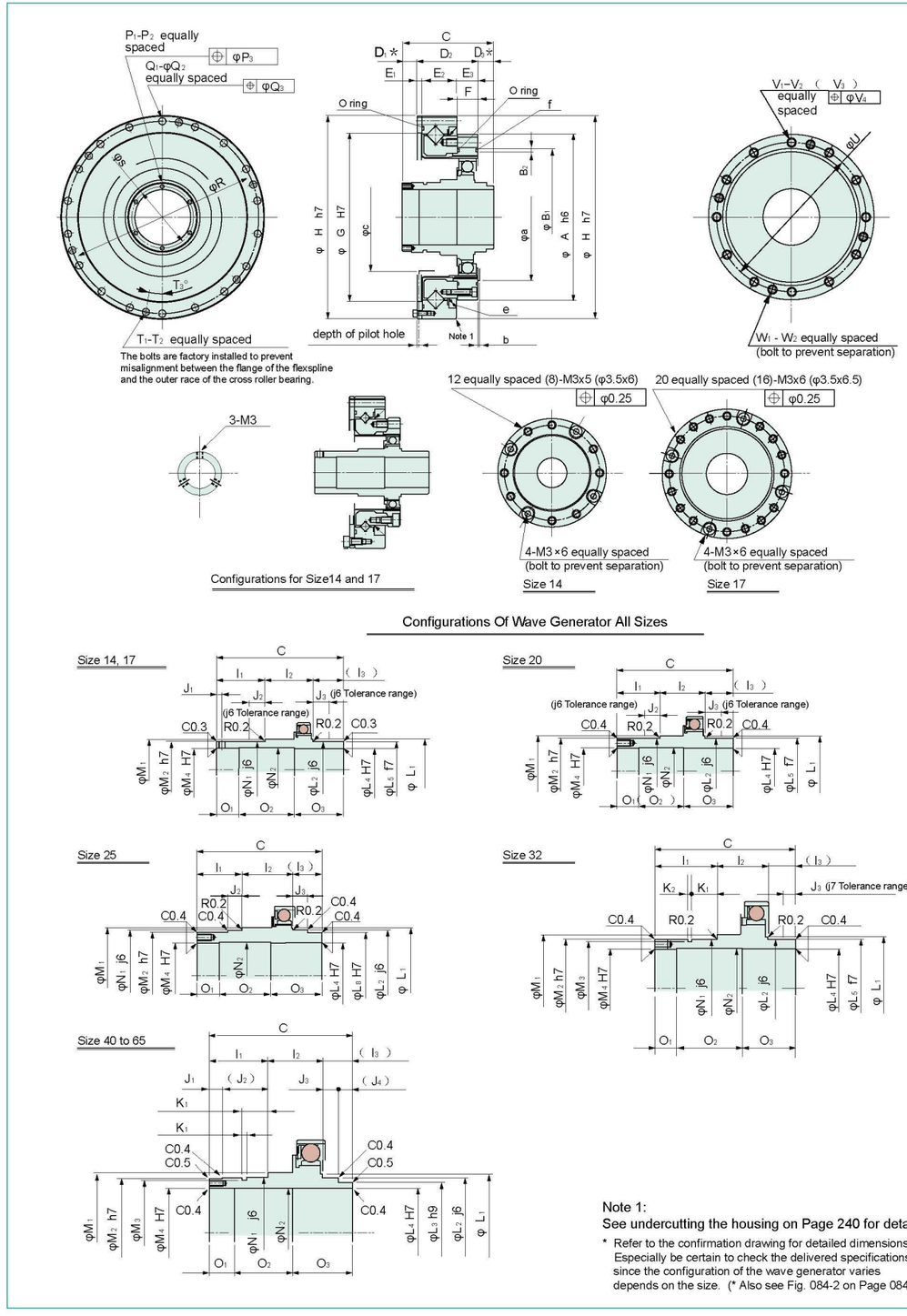
Table 256-2
Unit: kg

Symbol \ Size	14	17	20	25	32	40	45	50	58	65
Mass (kg)	0.41	0.57	0.81	1.31	2.94	5.1	6.5	9.6	13.5	19.5

Outline Dimensions (2SH)

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

Fig. 257-1



Configurations Of Wave Generator All Sizes

Note 1:
See undercutting the housing on Page 240 for details.

* Refer to the confirmation drawing for detailed dimensions. Especially be certain to check the delivered specifications since the configuration of the wave generator varies depends on the size. (* Also see Fig. 084-2 on Page 084.)

Dimensions (2SH)

Table 258-1
Unit : mm

Symbol \ Size		14	17	20	25	32	40	45	50	58	65
φA h6		50	60	70	85	110	135	155	170	195	215
φB1		—	—	—	—	—	—	128	141	163	180.4
B2		—	—	—	—	—	—	2.7	2.7	2.7	2.7
C		52.5 $^{0}_{-0.1}$	56.5 $^{0}_{-0.1}$	51.5 $^{0}_{-0.1}$	55.5 $^{0}_{-0.1}$	65.5 $^{0}_{-0.1}$	79 $^{0}_{-0.1}$	85 $^{0}_{-0.1}$	93 $^{0}_{-0.1}$	106 $^{0}_{-0.1}$	128 $^{0}_{-0.1}$
D1 *	SHF	16 $^{+0.8}_{0}$	16 $^{+0.8}_{0}$	9.5 $^{+1.0}_{0}$	10 $^{+1.1}_{0}$	12 $^{+1.1}_{0}$	13 $^{+1.1}_{0}$	13.5 $^{+1.2}_{0}$	15 $^{+1.3}_{0}$	16 $^{+1.3}_{0}$	21 $^{+1.3}_{0}$
	SHG	16 $^{+0.4}_{0}$	16 $^{+0.4}_{0}$	9.5 $^{+0.4}_{0}$	10 $^{+0.5}_{0}$	12 $^{+0.6}_{0}$	13 $^{+0.6}_{0}$	13.5 $^{+0.6}_{0}$	15 $^{+0.7}_{0}$	16 $^{+0.7}_{0}$	21 $^{+0.7}_{0}$
D2		23.5	26.5	29	34	42	51	56.5	63	73	81.5
D3 *		13	14	13	11.5	11.5	15	15	15	17	25.5
E1		2.4	3	3	3.3	3.6	4	4.5	5	5.8	6.5
E2		14.1	16	17.5	18.7	23.4	29	32	34	40.2	43
E3		7	7.5	8.5	12	15	18	20	24	27	32
F		6	6.5	7.5	10	14	17	19	22	25	29
φG H6		48	60	70	88	114	140	158	175	203	232
φH h6		70	80	90	110	142	170	190	214	240	276
Wave generator dimensions	I1	20 ±0.1	21.5 ±0.1	19 ±0.1	20 ±0.1	29 ±0.1	34 ±0.1	35 ±0.1	39.5 ±0.1	45.3 ±0.1	54.5 ±0.1
	I2	20 ±0.1	21.5 ±0.1	20 ±0.1	22.5 ±0.1	23.5 ±0.1	28 ±0.1	32.5 ±0.1	36 ±0.1	40.7 ±0.1	—
	I3	(12.5)	(13.5)	(12.5)	(13)	(13)	(17)	(17.5)	(17.5)	(20)	—
	J1	2.5	2.5	—	—	—	—	8	9	10	14
	J2	7	7	7	6.5	—	—	(27)	(30.5)	(35.3)	(40.5)
	J3	7	7	7	6.5	—	9.5	9.5	9.5	12.5	11.5
	J4	—	—	—	—	—	(7.5)	(8)	(8)	(7.5)	(11.5)
	K1	—	—	—	—	13.9	15.1	15.6	18.6	21.1	23.1
	K2	—	—	—	—	1.9	2.2	2.7	2.7	3.2	3.1
	φL1	22	27	32	42	47	62	69	79	90	106
	φL2 j6	20	25	30	40	45	60	65	75	85	100
	φL3 h9	—	—	—	38	—	59	59	69	84	96
	φL4 H7	14	19	21	29	36	46	52	60	70	80
	φL5 f7	20	25	30	—	45	—	—	—	—	—
	φM1	22	27	32	42	49	65	70	80	91.5	111
	φM2 h7	20	25	30	38	45	59	64	74	84	96
	φM3	—	—	—	—	42.5	57	62	72	81.5	96.5
	φM4 H7	14	19	21	29	36	46	52	60	70	80
	φN1 j6	20	25	30	40	45	60	65	75	85	100
	φN2	14.5	19.5	21.5	29.5	36.5	46.5	52.5	60.5	70.5	80.5
	O1	10	10	10	10	10	12	15	15	15	20
	O2	22.5	24.5	(19.5)	22.5	(30.5)	(35)	35	41	48	54
	O3	20	22	22	23	25	32	35	37	43	54
	P1	3	3	6	6	6	6	6	6	8	6
	P2	M3	M3	M3×6	M3×6	M3×6	M4×8	M4×8	M4×8	M4×8	M5×10
	φP3	—	—	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
	Q1	8	12	12	12	12	12	18	12	16	16
	φQ2	3.5	3.5	3.5	4.5	5.5	6.6	6.6	9	9	11
	φQ3	0.25	0.25	0.25	0.25	0.25	0.3	0.3	0.5	0.5	0.5
	φR	64	74	84	102	132	158	180	200	226	258
	φS	—	—	25.5	33.5	40.5	52	58	67	77	88
	T1	2	4	4	4	4	6	6	6	8	8
	T2	M3×6	M3×6	M3×8	M3×8	M4×8	M4×10	M4×10	M5×12	M5×12	M6×16
	T3 (angle)	22.5°	15°	15°	15°	15°	15°	10°	15°	11.25°	11.25°
	φU	44	54	62	77	100	122	140	154	178	195
	V1	12 E.A. 8	20 E. A. 16	16	16	16	16	12	16	12	16
	V2	M3×5	M3×6	M3×6	M4×7	M5×8	M6×10	M8×10	M8×11	M10×15	M10×15
	V3	φ3.5×6	φ3.5×6.5	φ3.5×7.5	φ4.5×10	φ5.5×14	φ6.6×17	φ9×19	φ9×22	φ11×25	φ11×29
	V4	0.25	0.25	0.25	0.25	0.25	0.3	0.5	0.5	0.5	0.5
	W1	4	4	4	4	4	4	4	8	6	8
	W2	M3×6	M3×6	M3×8	M3×10	M4×16	M5×20	M5×20	M5×25	M6×25	M6×30
Minimum housing clearance	φa	38	45	53	66	86	106	119	133	154	172
	b	1	1	1.5	1.5	1.5	2	2	2	2.5	2.5
	φc	31	38	45	56	73	90	101	113	131	150
	d	1.7	2.1	2	2	2	2	2.3	2.5	2.9	3.5
	e	D49585	D59685	D69785	D84945	D1101226	D1321467	D1521707	D1681868	D1932129	D21623811
	f	—	—	—	—	—	—	d1 121.5 d2 2.0	S135	d1 157.0 d2 2.0	S175

- As the flexspline is subject to elastic deformation, the housing clearance should be φa, b, c or more and it should not exceed.
- *The D1 and D3 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 tolerances.
- The circular spline of sizes 14 to 40 does not have an O-ring groove (symbol: f) for sealing. Account for sealing during design and installation.

Mass (2SH)

Table 259-1
Unit: kg

Symbol \ Size	14	17	20	25	32	40	45	50	58	65
Mass	0.45	0.63	0.89	1.44	3.1	5.4	6.9	10.2	14.1	20.9

Lubrication

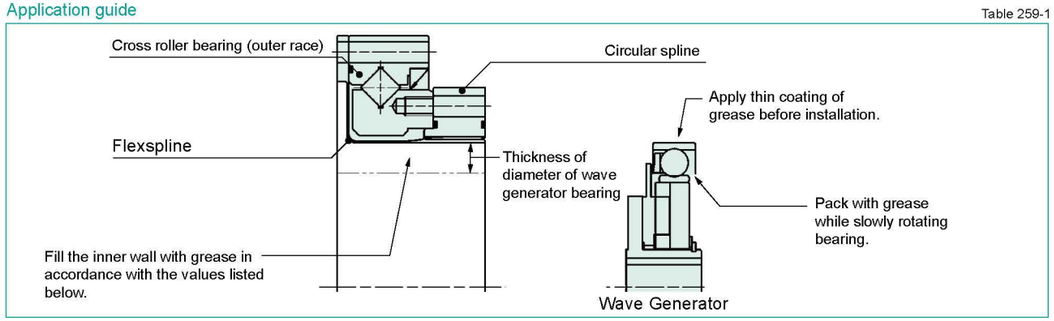
Standard lubrication for SHG/SHF series is grease.
See "Engineering data" on Page 016 for details of the lubricant.

Application guide

As the gear unit is shipped with the outer race of the cross roller bearing and the flexspline temporarily bolted together, grease is not applied other than the gear teeth. Refer to the following application guide for grease application instructions

Application guide

Table 259-1



Application quantity

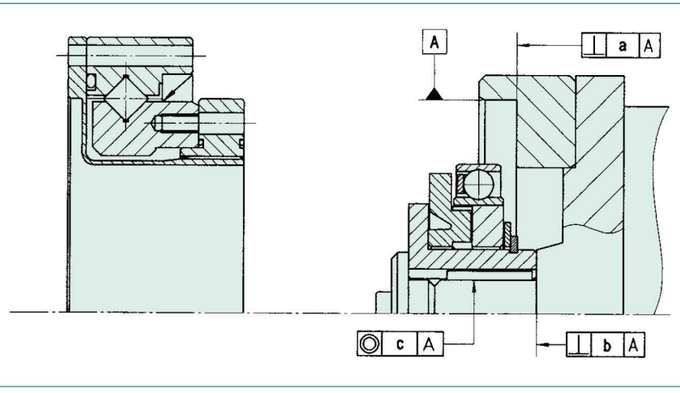
Table 259-2
Unit: g

Application \ Size		14	17	20	25	32	40	45	50	58	65
Horizontal use		5.8	11	18	32	64	120	185	235	385	495
Vertical use	Output shaft facing up	7.5	13	19	37	74	130	200	255	400	530
	Output shaft facing down	8.9	15	22	42	84	150	230	290	480	630

Installation accuracy

Maintain the recommended tolerances shown in Figure 260-1 and Table 260-1 for peak performance.

Fig. 260-1



Unit: mm

Size	14	17	20	25	32	40	45	50	58
a	0.011	0.015	0.017	0.024	0.026	0.026	0.027	0.028	0.031
b	0.017 (0.008)	0.020 (0.010)	0.020 (0.010)	0.024 (0.012)	0.024 (0.012)	0.024 (0.012)	0.032 (0.012)	0.032 (0.015)	0.032 (0.015)
c	0.030 (0.016)	0.034 (0.018)	0.044 (0.019)	0.047 (0.022)	0.047 (0.022)	0.050 (0.022)	0.063 (0.024)	0.066 (0.030)	0.068 (0.033)

Table 260-1

* The value in the parentheses indicates that Wave Generator does not have an Oldham coupling.

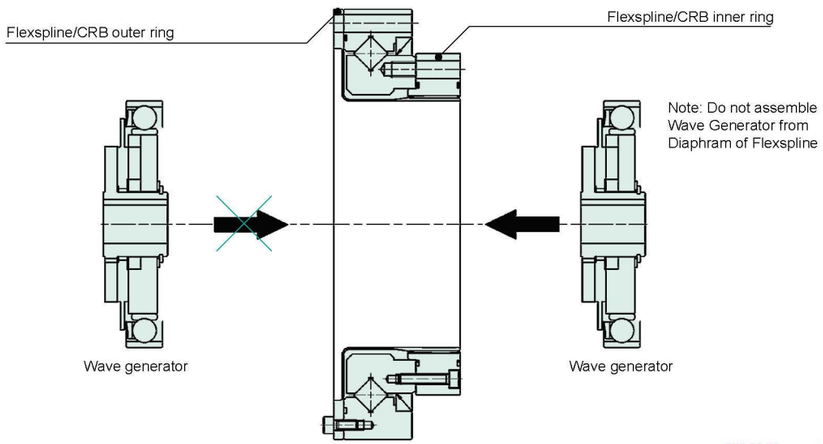
Installation Recommendations

■ Installation sequence

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. 260-2



▪ 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 253).
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.