Life of the output bearing

Calculate life of the output bearing by Formula 032-1.
You can calculate the dynamic equivalent radial load (Pc) by Formula 032-2.

Formula 032-1

(Cross roller bearing)

$$L_{10} = \frac{10^6}{60 \times Nav} \times \left(\frac{C}{fw \cdot Pc}\right)^{10/3}$$

(4-point contact ball bearing)

$$L_{10} = \frac{10^6}{60 \times Nav} \times \left(\frac{C}{fw \cdot Pc}\right)^{3}$$

Symbols for Formula 032-1

Table 032-1

L_{10}	Life	hour	——
Nav	Average output rated load speed	rpm	See "How to calculate the average load."
C	Basic dynamic rated load	N(kgf)	See "Specification of the output bearing" of each series.
Pc	Dynamic equivalent	N(kgf)	See Formula 032-2.
fw	Load coefficient	——	See Table 032-3.

Load coefficient

Table 032-3

Load status	fw
Steady operation without impact and vibration	1 to 1.2
Normal operation	1.2 to 1.5
Operation with impact and vibration	1.5 to 3

Formula 032-2

$$Pc = X \cdot \left(Frav + \frac{2(Frav(Lr+R) + Fav \cdot La)}{dp}\right) + Y \cdot Faav$$

Symbols for Formula 032-2

Table 032-2

Frav	Average radial load	N(kgf)	See "How to calculate the average load." See Formula 031-1.
Faav	Average axial load	N(kgf)	See "How to calculate the average load." See Formula 031-2.
dp	Pitch circle diameter	m	See Fig. 030-1 and "Specification of the output bearing" of each series.
X	Radial load coefficient	——	See Formula 031-4.
Y	Axial load coefficient	——	See Formula 031-4.
Lr, La	——	m	See Figure 030-1.
R	Offset	m	See Fig. 030-1 and "Specification of the output bearing" of each series.
M ave	Average moment load	Nm	

How to calculate life during oscillating motion

Calculate the life of the cross roller bearing during oscillating motion by Formula 033-1.

Formula 033-1

(Cross roller bearing)

$$Loc = \frac{10^6}{60 \times n1} \times \frac{90}{\theta} \times \left(\frac{C}{fw \cdot Pc}\right)^{10/3}$$

(4-point contact ball bearing)

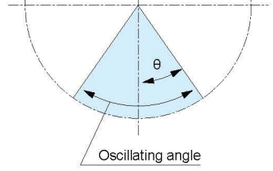
$$Loc = \frac{10^6}{60 \times n1} \times \frac{90}{\theta} \times \left(\frac{C}{fw \cdot Pc}\right)^{3}$$

Symbols for Formula 033-1

Table 033-1

Loc	Rated life for oscillating motion	hour	——
n1	Round trip oscillation each minute	cpm	——
C	Basic dynamic rated load	N(kgf)	——
Pc	Dynamic equivalent radial load	N(kgf)	See Formula 032-2.
fw	Load coefficient	——	See Table 032-3.
θ	Oscillating angle /2	Degree	See Fig. 033-1.

Fig. 033-1



(Note) A small angle of oscillation (less than 5 degrees) may cause fretting corrosion to occur since lubrication may not circulate properly. Contact us if this happens.

How to calculate the static safety coefficient

Basic static rated load is an allowable limit for static load, but its limit is determined by usage. In this case, static safety coefficient of the cross roller bearing can be calculated by Formula 034-2.

Formula 034-1

$$fs = \frac{Co}{Po}$$

Formula 034-2

$$Po = Frmax + \frac{2M\ max}{dp} + 0.44Fa\ max$$

Symbols for Formula 034-1

Table 034-1

Co	Basic static rated load	N(kgf)	See "Specification of the output bearing" of each series.
Po	Static equivalent radial load	N(kgf)	See Formula 034-2.

Symbols for Formula 034-2

Table 034-2

Frmax	Max. radial load	N(kgf)	See "How to calculate the maximum moment load" on Page 030.
Famax	Max. axial load	N(kgf)	
Mmax	Max. moment load	Nm(kgfm)	
dp	Pitch circle diameter of a roller	m	See Fig. 030-1 and "Specification of the output bearing" of each series.

Static Safety Coefficient

Table 034-3

Operating condition of the roller bearing	fs
When high rotation precision is required	≧3
When shock and vibration are expected	≧2
Under normal operating condition	≧1.5

Features

CSG/CSF Gear Unit

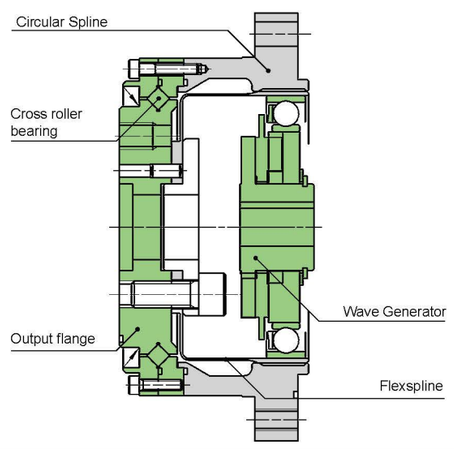
CSF/CSG are housed component gear sets combined with a precision cross roller output bearing & flange. A highly rigid cross roller bearing is built in to directly support (output bearing) the external load. They are a very compact, robust and easy to use gearhead solution. CSF and CSG are also available in lightweight versions.

Features

- Zero backlash
- Compact design
- High-torque capacity
- High stiffness
- High-positional and rotational accuracies

Structure of CSG/CSF series gear unit

Fig. 124-1



CSF v. CSG

CSG high torque
• 30% Higher torque than CSF series.
• The life has been improved by 43% (10,000 hours) compared to CSF.

CSF: standard torque
• Reduction ratio of 30:1 included for high-speed

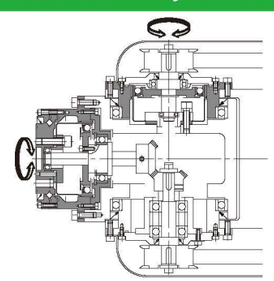
CSF/CSG-LW series: Lightweight (sizes 14 to 45)
• 30% average lower weight than Standard Series.
• Same performance as CSF/CSG series.

Main markets

Industrial robot

Various mechanical equipment

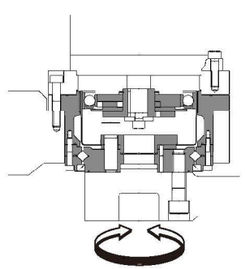
Vertical multi-joint robot



垂直多关节机器人手腕的弯曲、扭转驱动

※按照本组装示例使用时，必须使用防止润滑剂泄漏的密封机构。

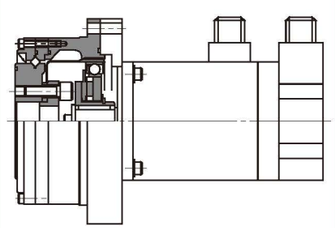
Horizontal multi-joint robot



水平多关节机器人的机械臂驱动

※按照本组装示例使用时，必须使用防止润滑剂泄漏的密封机构。

Example of direct-connected servo motor



Ordering Code

CSG - 25 - 100 - 2UH - SP

Table 125-1

Series	Size	Ratio *1					Model	Special specification
CSG	14	50	80	100	—	—	2A= Component type 2UH= Unit type 2UJ = Unit type with input shaft *2	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
*2 Contact us for details.

Rating table

■ CSG Series

Table 126-1

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)		Moment of Inertia	
		Nm	kgfm	Nm	kgfm	Nm	kgfm	Nm	kgfm	Oil lubricant	Grease lubricant	Oil lubricant	Grease lubricant	I ×10⁻⁴ kgm²	J ×10⁻³ kgfms²
14	50	7.0	0.7	23	2.3	9	0.9	46	4.7	14000	8500	6500	3500	0.033	0.034
	80	10	1.0	30	3.1	14	1.4	58 *3	5.9 *3						
	100	10	1.0	36	3.7	14	1.4	58 *3	5.9 *3						
17	50	21	2.1	44	4.5	34	3.4	91	9	10000	7300	6500	3500	0.079	0.081
	80	29	2.9	56	5.7	35	3.6	109 *3	11 *3						
	100	31	3.2	70	7.2	51	5.2	109 *3	11 *3						
	120	31	3.2	70	7.2	51	5.2	109 *3	11 *3						
20	50	33	3.3	73	7.4	44	4.5	127	13	10000	6500	6500	3500	0.193	0.197
	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	0.413	0.421
	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	*4	*4						
	160	87	8.9	229	23	140	14	*4	*4						
32	50	99	10	281	29	140	14	497	51	7000	4800	4600	3500	1.69	1.72
	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	4.50	4.59
	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	1510 *4	154 *4						
	160	382	39	841	86	586	60	1510 *4	154 *4						
45	50	229	23	650	66	345	35	1235	126	5000	3800	3300	3000	8.68	8.86
	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	12.5	12.8
	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	27.3	27.9
	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	46.8	47.8
	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 "Engineering data" on Page 12 for details of the terms.
3. The value of allowable max momentary torque is limited by the transmission torque of the unit. (See table 138-1, 2 on p.138.)
4. When using LW series, see the transmission torque of the unit (Table 138-3, 4 on p.138) for the allowable maximum momentary torque.

Ordering Code

CSF - 25 - 100 - 2UH - SP

Table 125-2

Series	Size	Ratio *1							Model	Special specification
CSF	14	30	50	80	100	—	—		2A= Component type 2UH= Unit type 2UJ = Unit type with input shaft *2	LW= Lightweight (sizes 14 to 45) SP= Special specification code Blank= Standard product
	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			
	65	—	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 Contact us for details.

Rating table

■ CSF Series

Table 127-1

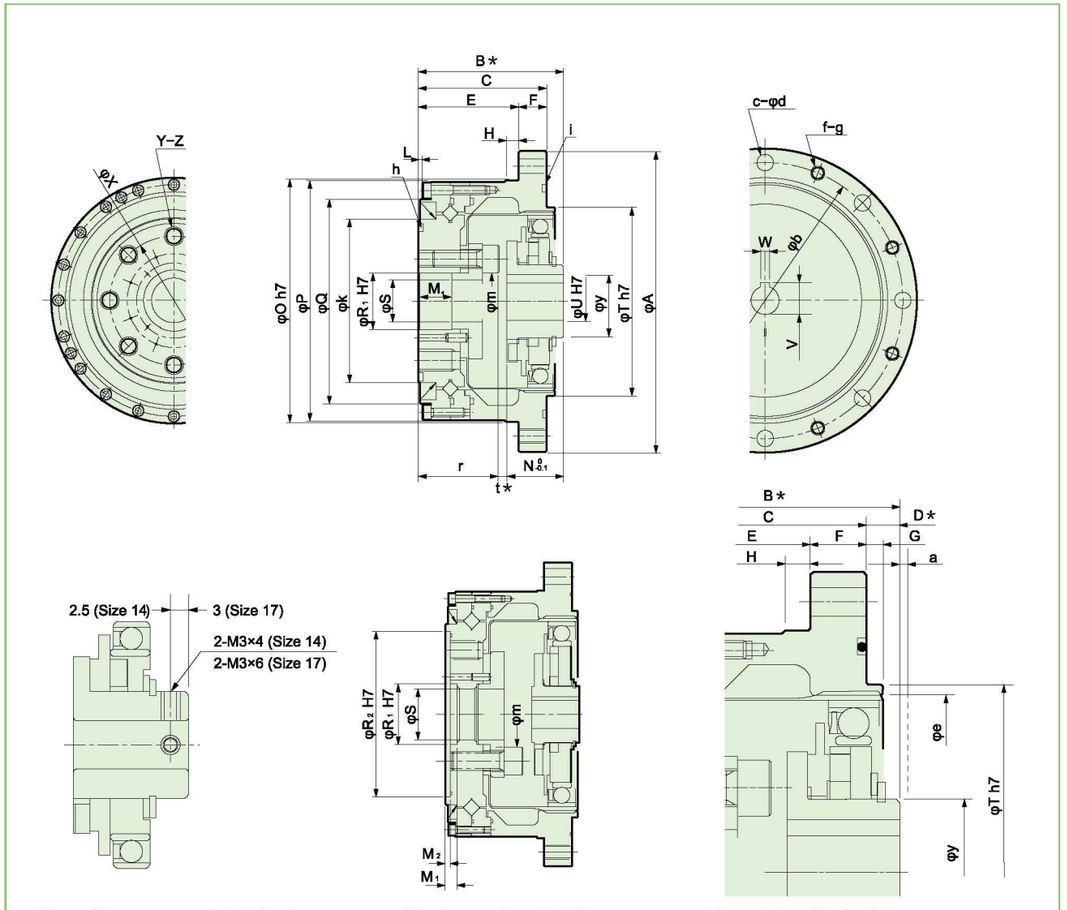
Size	Ratio	Rated Torque at 2000rpm		Limit for Repeated Peak Torque		Limit for Average Torque		Limit for Momentary Peak Torque		Maximum Input Speed (rpm)		Limit for Average Input Speed (rpm)		Moment of Inertia	
		Nm	kgfm	Nm	kgfm	Nm	kgfm	Nm	kgfm	Oil lubricant	Grease lubricant	Oil lubricant	Grease lubricant	I ×10⁻⁴ kgm²	J ×10⁻³ kgfms²
14	30	4.0	0.41	9.0	0.92	6.8	0.69	17	1.7	14000	8500	6500	3500	0.033	0.034
	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	0.079	0.081
	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	108	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	0.193	0.197
	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	0.413	0.421
	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	1.69	1.72
	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	4.50	4.59
	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	8.68	8.86
	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	245	25	715	73	350	36	1430	146	4500	3500	3000	2500	12.5	12.8
	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	18	27	1960	200	4000	3000	2700	2200	27.3	27.9
	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						
65	50	245	25	1420	145	360	27	2830	289	3500	2800	2400	1900	46.8	47.8
	80	745	76	2110	215	1040	106	3720	380						
	100	951	97	2300	235	1520	155	4750	485						
	120	951	97	2510	256	1570	160	4750	485						
	160	951	97	2630	268	1570	160	4750	485						

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

Outline Dimensions

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

Fig. 128-1



Shape of the wave generator hub for size 14 and 17 (no keyhole)

The shape on the output side of size 65

Enlarged view of the input side

(Note) Note that the length of the path of contact of the bolt will be within the depth of the female screw. If the length exceeds the size indicated by the symbol, Z, it will damage the flexspline.

* The shape of the output flange may vary depending on the size. Contact us for details. * Check the confirmation drawing for de tails of the sizes.
* See Fig. 040-3 on Page 40 for the shapes of the wave generator. The dimension tolerances that are not specified vary depending on the manufacturing method. Please check the confirmation drawing or contact us for dime nsion tolerances not shown on the drawing.

Dimensions

Table 129-1
Unit: mm

Symbol \ Size		14	17	20	25	32	40	45	50	58	65
φA		73	79	93	107	138	160	180	190	226	260
B*		41 $^{0}_{-0.9}$	45 $^{0}_{-0.9}$	45.5 $^{0}_{-1.0}$	52 $^{0}_{-1.0}$	62 $^{0}_{-1.1}$	72.5 $^{0}_{-1.1}$	79.5 $^{0}_{-1.2}$	90 $^{0}_{-1.3}$	104.5 $^{0}_{-1.3}$	115 $^{0}_{-1.3}$
C		34	37	38	46	57	66.5	74	85	97	108.5
D*	CSG Series	7 $^{0}_{-0.4}$	8 $^{0}_{-0.4}$	7.5 $^{0}_{-0.4}$	6 $^{0}_{-0.5}$	5 $^{0}_{-0.6}$	6 $^{0}_{-0.6}$	5.5 $^{0}_{-0.8}$	5 $^{0}_{-0.6}$	7.5 $^{0}_{-0.6}$	6.5 $^{0}_{-0.6}$
	CSG-LW Series										
	CSF Series	7 $^{0}_{-0.8}$	8 $^{0}_{-0.9}$	7.5 $^{0}_{-1.0}$	6 $^{0}_{-1.0}$	5 $^{0}_{-1.1}$	6 $^{0}_{-1.1}$	5.5 $^{0}_{-1.2}$	5 $^{0}_{-1.3}$	7.5 $^{0}_{-1.3}$	6.5 $^{0}_{-1.3}$
	CSF-LW Series										
E		27	29	28	36	45	50.5	58	69	77	84.5
F		7	8	10	10	12	16	16	16	20	24
G		2	2	3	3	3	4	4	4	5	5
H	CSG Series	3.5	4	5	5	5	5	6	6	6	6
	CSG-LW Series	4	4	5	5	4.5	4.5	6	6	6	6
	CSF Series	3.5	4	5	5	5	5	6	6	6	6
	CSF-LW Series	4	4	5	5	4.5	4.5	6	6	6	6
L	CSG Series	0.5	0.5	0.5	0.5	1	1.5	1	1	1.5	1.5
	CSG-LW Series	1.1	1.1	1.1	1.1	1.2	1.6	1.6	1	1.5	1.5
	CSF Series	0.5	1.1	1.1	1.1	1.2	1.6	1.6	1	1.5	1.5
	CSF-LW Series	1.1	1.1	1.1	1.1	1.2	1.6	1.6	1	1.5	1.5
M1		9.4	9.5	9	2	15	5	6	8	10	10
M2		-	-	-	-	-	-	-	-	-	4
N $^{0}_{-0.1}$	CSG Series	18.5	20.7	21.5	21.6	23.6	29.7	30.5	34.8	38.3	44.6
	CSG-LW Series										
	CSF Series	17.6	19.5	20.1	20.2	22	27.5	27.9	32	34.9	40.9
	CSF-LW Series										
φO h7		56	63	72	86	113	127	148	158	186	212
φP	CSG Series	56	62	70	85	112	123	147	157	185	210
	CSG-LW Series	54.6	61.6	69.6	85	110	124.5	143	155	183.4	208.4
	CSF Series	55	62	70	85	112	123	147	157	185	210
	CSF-LW Series	54.6	61.6	69.6	85	110	124.5	143	155	183.4	208.4
φQ	CSG Series	42.5	49.5	58	73	96	109	127	137	161	186
	CSG-LW Series	40.5	47.5	55.5	71	91.1	103	123	130	155	180
	CSF Series	42.5	49.5	58	73	96	109	127	137	161	186
	CSF-LW Series	40.5	47.5	55.5	71	91.1	103	123	130	155	180
φR1 H7		11	10	14	20	26	32	32	40	46	52
φR2 H7		-	-	-	-	-	-	-	-	-	142
φS		8	7	10	15	20	24	25	32	38	44
φT h7		38	48	56	67(68)	90	110	124	135	156	177
φU H7		6	8	12	14	14	14	19	19	22	24
V		-	-	13.8 $^{+0.1}_{0}$	16.3 $^{+0.1}_{0}$	16.3 $^{+0.1}_{0}$	16.3 $^{+0.1}_{0}$	21.8 $^{+0.1}_{0}$	21.8 $^{+0.1}_{0}$	24.8 $^{+0.1}_{0}$	27.3 $^{+0.2}_{0}$
W Js9		-	-	4	5	5	5	6	6	6	8
φX		23	27	32	42	55	68	82	84	100	110
Y		6	6	8	8	8	8	8	8	8	8
Z		M4×8	M5×10	M6×9	M8×12	M10×15	M10×15	M12×18	M14×21	M16×24	M16×24
a		1	1	1.5	1.5	1.5	2	2	2	2.5	2.5
φb		65	71	82	96	125	144	164	174	206	236
c	CSG Series	8	8	8	10	12	10	12	14	12	8
	CSG-LW Series	6	8	8	10	12	10	16	18	16	12
	CSF Series	6	6	6	8	12	8	12	12	12	8
	CSF-LW Series	6	8	8	10	12	10	16	18	16	12
φd		4.5	4.5	5.5	5.5	6.6	9	9	9	11	14
φe		38	45	53	66	86	106	119	133	154	172
f	CSG Series	8	8	8	10	12	10	12	14	12	8
	CSG-LW Series	6	8	8	10	12	10	16	18	16	12
	CSF Series	6	6	6	8	12	8	12	12	12	8
	CSF-LW Series	6	8	8	10	12	10	16	18	16	12
g		M4	M4	M5	M5	M6	M8	M8	M8	M10	M12
h		29.0×0.50	34.5×0.80	40.64×1.14	53.28×0.99	S71	AS568-042	S100	S105	S125	S135
i		S50	S56	S67	S80	S105	S125	S145	S155	S180	S205
φk		31	38	45	58	78	90	107	112	135	155
φm		10	10.5	15.5	20	27	34	36	39	46	56
r		21.4	23.5	23	29	37	39.5	45.5	53	62.8	66.5
t*	CSG Series	1.1	0.8	1	1.4	1.4	3.3	3.5	2.2	3.4	3.9
	CSG-LW Series										
	CSF Series	2	2	2.4	2.8	3	5.5	6.1	5	6.8	7.6
	CSF-LW Series										
φy		14	18	21	26	26	32	32	32	40	48
Mass (kg)	CSG Series	0.52	0.68	0.98	1.5	3.2	5.0	7.0	8.9	14.6	20.9
	CSG-LW Series	0.32	0.46	0.64	1.1	2.2	3.5	5.1	7	11.3	16.2
	CSF Series	0.52	0.68	0.98	1.5	3.2	5.0	7.0	8.9	14.6	20.9
	CSF-LW Series	0.32	0.46	0.64	1.1	2.2	3.5	5.1	7	11.3	16.2

(note1) the dimension in parenthesis is for reduction ratio 30.

- *The B, D, and t values indicate relative position of individual gearing components (wave generator, flexspline, circular spline). Please strictly adhere to these values when designing your housing and mating parts.
- Wave generator is removed when the product is delivered.
- CSF & CSG-LW available in sizes 14 to 45.

Positioning accuracy

See "Engineering data" for a description of terms.

Table 150-1
Unt: X10^{-4}rad (arc·min)

Ratio	Specification \ Size	14	17	20	25	32	40 to 65
30	Standard product	5.8	4.4	4.4	4.4	4.4	—
		(2)	(1.5)	(1.5)	(1.5)	(1.5)	—
	Special product	—	—	2.9	2.9	2.9	—
		—	—	(1)	(1)	(1)	—
50 or more	Standard product	4.4	4.4	2.9	2.9	2.9	2.9
		(1.5)	(1.5)	(1)	(1)	(1)	(1)
	Special product	2.9	2.9	1.5	1.5	1.5	1.5
		(1)	(1)	(0.5)	(0.5)	(0.5)	(0.5)

Hysteresis loss

See "Engineering data" for a description of terms.

Table 150-2

Ratio	Size	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
	arc min	2.0	2.0	2.0	2.0	2.0	2.0
80 or more	×10^{-4}rad	2.9	2.9	2.9	2.9	2.9	2.9
	arc min	1.0	1.0	1.0	1.0	1.0	1.0

Max. backlash quantity

See "Engineering data" for a description of terms.

Table 150-3

Ratio	Size	14	17	20	25	32	40	45	50	58	65
30	×10^{-4}rad	29.1	16.0	13.6	13.6	11.2	—	—	—	—	—
	arc sec	60	33	28	28	23	—	—	—	—	—
50	×10^{-4}rad	17.5	9.7	8.2	8.2	6.8	6.8	5.8	5.8	4.8	4.8
	arc sec	36	20	17	17	14	14	12	12	10	10
80	×10^{-4}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^{-4}rad	8.7	4.8	4.4	4.4	3.4	3.4	2.9	2.9	2.4	2.4
	arc sec	18	10	9	9	7	7	6	6	5	5
120	×10^{-4}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^{-4}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

Torsional Stiffness

See "Engineering data" for a description of terms.

Table 150-4

Symbol	Size	14	17	20	25	32	40	45	50	58	65
T_1	Nm	2.0	3.9	7.0	14	29	54	76	108	168	235
	kgfm	0.20	0.40	0.70	1.4	3.0	5.5	7.8	11	17	24
T_2	Nm	6.9	12	25	48	108	196	275	382	598	843
	kgfm	0.7	1.2	2.5	4.9	11	20	28	39	61	86
Reduction ratio 30											
K_1	×10^{4}Nm/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^{4}Nm/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^{4}Nm/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	×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	×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^{4}Nm/rad	0.34	0.81	1.3	2.5	5.4	10	15	20	31	44
	kgfm/arc min	0.1	0.24	0.38	0.74	1.6	3.0	4.3	5.9	9.3	13
K_2	×10^{4}Nm/rad	0.47	1.1	1.8	3.4	7.8	14	20	28	44	61
	kgfm/arc min	0.14	0.32	0.52	1.0	2.3	4.2	6.0	8.2	13	18
K_3	×10^{4}Nm/rad	0.57	1.3	2.3	4.4	9.8	18	26	34	54	78
	kgfm/arc min	0.17	0.4	0.67	1.3	2.9	5.3	7.6	10	16	23
θ	×10^{-4}rad	5.8	4.9	5.2	5.5	5.5	5.2	5.2	5.5	5.2	5.2
	arc min	2.0	1.7	1.8	1.9	1.9	1.8	1.8	1.9	1.8	1.8
θ	×10^{-4}rad	16	12	15.4	15.7	15.7	15.4	15.1	15.4	15.1	15.1
	arc min	5.6	4.2	5.3	5.4	5.4	5.3	5.2	5.3	5.2	5.2

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

Table 151-1

Symbol	Size	14	17	20	25	32	40	45	50	58	65
T_1	Nm	2.0	3.9	7.0	14	29	54	76	108	168	235
	kgfm	0.20	0.40	0.70	1.4	3.0	5.5	7.8	11	17	24
T_2	Nm	6.9	12	25	48	108	196	275	382	598	843
	kgfm	0.7	1.2	2.5	4.9	11	20	28	39	61	86
Reduction ratio 80 or more											
K_1	×10^{4}Nm/rad	0.47	1	1.6	3.1	6.7	13	18	25	40	54
	kgfm/arc min	0.14	0.3	0.47	0.92	2.0	3.8	5.4	7.4	12	16
K_2	×10^{4}Nm/rad	0.61	1.4	2.5	5.0	11	20	29	40	61	88
	kgfm/arc min	0.18	0.4	0.75	1.5	3.2	6.0	8.5	12	18	26
K_3	×10^{4}Nm/rad	0.71	1.6	2.9	5.7	12	23	33	44	71	98
	kgfm/arc min	0.21	0.46	0.85	1.7	3.7	6.8	9.7	13	21	29
θ	×10^{-4}rad	4.1	3.9	4.4	4.4	4.4	4.1	4.1	4.4	4.1	4.4
	arc min	1.4	1.3	1.5	1.5	1.5	1.4	1.4	1.5	1.4	1.5
θ	×10^{-4}rad	12	9.7	11.3	11.1	11.6	11.1	11.1	11.1	11.1	11.3
	arc min	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.

Starting torque

See "Engineering data" for a description of terms. As the values in the table below vary depending on the use conditions, use them as reference values.

■ CSG Series

Table 151-2
Unit: Ncm

Ratio \ Size	14	17	20	25	32	40	45	50	58	65
50	4.5	6.7	8.6	17	34	61	85	—	—	—
80	3.1	4.4	5.4	10	21	39	54	73	108	154
100	2.8	3.7	4.7	8.8	20	34	47	64	97	132
120	—	3.4	4.2	8.0	17	31	43	57	88	121
160	—	—	3.6	6.9	15	26	36	50	75	102

■ CSF Series

Table 151-3
Unit: Ncm

Ratio \ Size	14	17	20	25	32	40	45	50	58	65
30	6.4	9.3	15	25	54	—	—	—	—	—
50	4.1	6.1	7.8	15	31	55	77	110	160	220
80	2.8	4	4.9	9.2	19	35	49	66	98	140
100	2.5	3.4	4.3	8	18	31	43	58	88	120
120	—	3.1	3.8	7.3	15	28	39	52	80	110
160	—	—	3.3	6.3	14	24	33	45	68	93

Backdriving torque

See "Engineering data" for a description of terms. As the values in the table below vary depending on the use conditions, use them as reference values.

■ CSG Series

Table 151-4
Unit: Nm

Ratio \ Size	14	17	20	25	32	40	45	50	58	65
50	1.8	3.3	5.2	9.9	20	36	52	—	—	—
80	1.8	3.3	5.3	10	21	36	53	69	106	154
100	2	3.6	5.6	11	22	40	56	75	121	165
120	—	3.9	6.1	12	24	43	61	80	121	176
160	—	—	7	14	29	51	70	94	143	198

■ CSF Series

Table 151-5
Unit: Nm

Ratio \ Size	14	17	20	25	32	40	45	50	58	65
30	2.4	3.8	6.2	11	23	—	—	—	—	—
50	1.6	3	4.7	9	18	33	47	62	95	130
80	1.6	3	4.8	9.1	19	33	48	63	96	140
100	1.8	3.3	5.1	9.8	20	36	51	68	110	150
120	—	3.5	5.5	11	22	39	55	73	110	160
160	—	—	6.4	13	26	46	64	85	130	180

Ratcheting torque

See "Engineering data" for a description of terms.

■ CSG Series

Table 132-1
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

■ CSF Series

Table 132-2
Unit: Nm

Ratio \ Size	14	17	20	25	32	40	45	50	58	65
30	59	100	170	340	720	—	—	—	—	—
50	88	150	220	450	980	1800	2700	3700	5800	7800
80	110	200	350	680	1400	2800	3900	5400	8200	11000
100	84	160	260	500	1000	2100	3100	4100	6400	9400
120	—	120	240	470	980	1900	2800	3800	5800	8300
160	—	—	220	450	980	1800	2600	3600	5600	8000

Buckling torque

See "Engineering data" for a description of terms.

■ CSG Series

Table 132-3
Unit: Nm

Size	14	17	20	25	32	40	45	50	58	65
Total reduction ratio	260	500	800	1700	3500	6700	8900	12200	19000	26600

■ CSF Series

Table 132-4
Unit: Nm

Size	14	17	20	25	32	40	45	50	58	65
Total reduction ratio	190	330	560	1000	2200	4300	5800	8000	12000	17000

No-load running torque

No load running torque indicates the torque which is needed to rotate input of the gear, "Wave Generator", with no load on the output side (low speed side).

Measurement condition

Table 132-5

Ratio			
Lubricant	Grease lubrication	Name	Harmonic Grease SK-1A
			Harmonic Grease SK-2
		Quantity	Recommended quantity
Torque value is measured after 2 hours at 2000rpm input.			

* Contact us for oil lubrication.

■ Compensation Value in Each Ratio

No-load running torque of the gear varies with ratio.
The graphs indicate a value for ratio 100.
For other gear ratios, add the compensation values from table on the right.

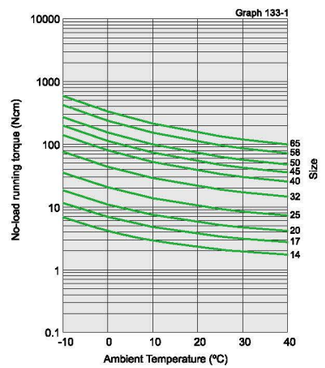
Compensation value for no-load running torque

Table 132-6
Unit: Ncm

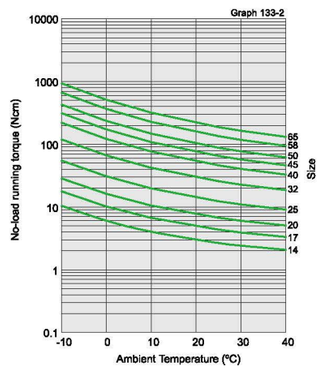
Size \ Ratio	30	50	80	120	160
14	2.5	1.1	0.2	—	—
17	3.8	1.6	0.3	-0.2	—
20	5.4	2.3	0.5	-0.3	-0.8
25	8.8	3.8	0.7	-0.5	-1.2
32	16	7.1	1.3	-0.9	-2.2
40	—	12	2.1	-1.5	-3.5
45	—	16	2.9	-2.1	-4.9
50	—	21	3.7	-2.6	-6.2
58	—	30	5.3	-3.8	-8.9
65	—	41	7.2	-5.1	-12

■ No-load running torque for a reduction ratio of 100:1

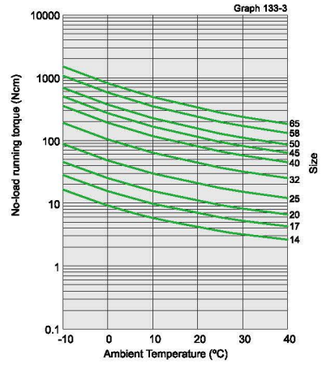
Input speed: 500rpm



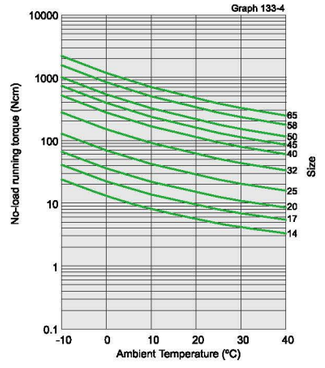
Input speed: 1000rpm



Input speed: 2000rpm



Input speed: 3500rpm



*The values in this graph are average values(X). σ≈20%

Efficiency

The efficiency varies depending on the following conditions.

- Reduction ratio
- Input rotational speed
- Load torque
- Temperature
- Lubrication (Type and quantity)

■ Efficiency compensation coefficient

If the load torque is lower than the rated torque, the efficiency will be lower. Calculate the compensation coefficient Ke from Graph 134-1 to calculate the efficiency using the following example.

Calculation Example

Efficiency η (%) under the following condition is calculateed from the example of CSF-20-80-2A-GR.
Input rotational speed: 1000 rpm
Load torque: 19.6 Nm
Lubrication: Grease lubrication (Harmonic Grease SK-1A)
Lubricant temperature: 20°C
Since the rated torque of size 20 with a reduction ratio of 80 is 34 Nm (Ratings: Page 127), the torque ratio α is 0.58.
(α =19.6/34=0.58)

- The efficiency compensation coefficient is Ke=0.93 from Graph 134-1.
- Efficiency η at load torque 19.6 Nm: η=Ke · ηR=0.93 x 78=73%

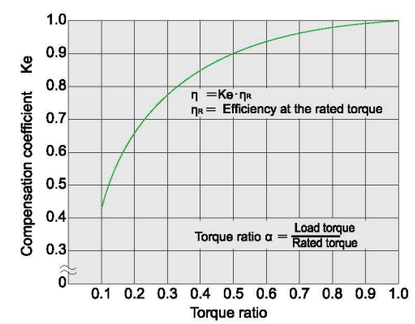
Measurement condition

Table 134-1

Installation	Based on recommended tolerance.		
Load torque	The rated torque shown in the rating table (see page 126 and 127)		
Lubricant	Grease lubrication	Name	Harmonic Grease SK-1A
			Harmonic Grease SK-2
		Quantity	Recommended quantity

Efficiency compensation coefficient

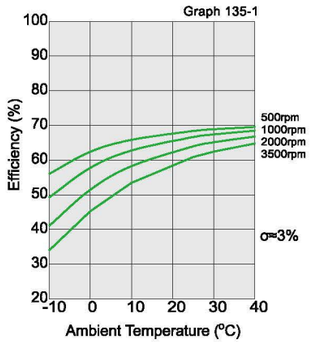
Graph 134-1



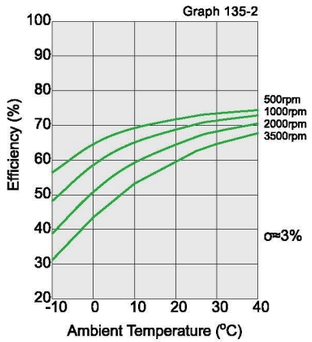
* Efficiency compensation coefficient Ke=1 holds when the load torque is greater than the rated torque.

■ Efficiency at rated torque (Size 14)

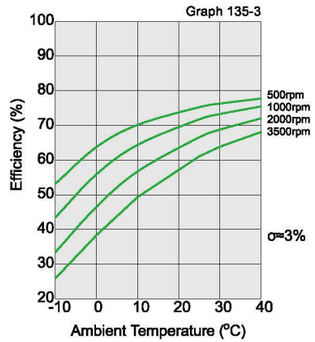
Ratio 30



Ratio 50, 80

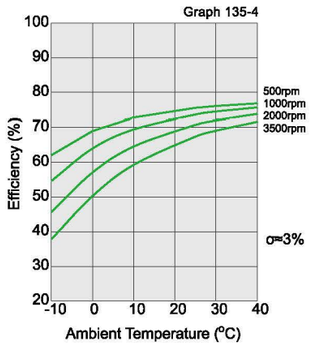


Ratio 100

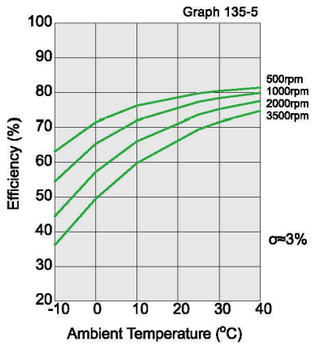


■ Efficiency at rated torque (Sizes 17 to 65)

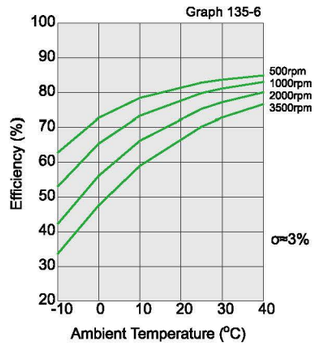
Ratio 30



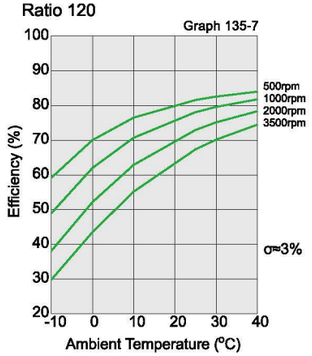
Ratio 50



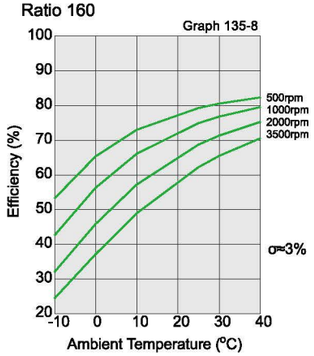
Ratio 80, 100



Ratio 120



Ratio 160



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 bearing and static safety coefficient to fully bring out the performance of the uni t type.
See Pages 30 to 34 of "Engineering data" for each calculation formula.

■ Checking procedure

(1) Checking the maximum moment load (Mmax)

Calculate maximum moment load (M max). → Maximum moment load (M max) ≤ allowable moment (Mc)

(2) Checking the life

Calculate the radial load (Frav) and the average axial load (Fæv). → 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 136-1.

Specifications CSG Series/CSF Series

Table 136-1

Size	Pitch circle dia. of a roller dp	Offset R	Basic rated load				Allowable moment load Mc		Moment stiffness	
			Basic dynamic rated load C		Basic static rated load Co					
	m	m	×10 ³N	kgf	×10 ³N	kgf	Nm	kgfm	×10 ⁴ Nm/rad	kgfm/ arc min
14	0.035	0.0095	47	480	60.7	620	41	4.2	4.38	1.3
17	0.0425	0.0095	52.9	540	75.5	770	64	6.5	7.75	2.3
20	0.050	0.0095	57.8	590	90.0	920	91	9.3	12.8	3.8
25	0.062	0.0115	96.0	980	151	1540	156	16	24.2	7.2
32	0.080	0.013	150	1530	250	2550	313	32	53.9	16
40	0.096	0.0145	213	2170	365	3720	450	46	91.0	27
45	0.111	0.0155	230	2350	426	4340	686	70	141	42
50	0.119	0.018	348	3550	602	6140	759	77	171	51
58	0.141	0.0205	518	5290	904	9230	1180	120	283	84
65	0.160	0.0225	556	5670	1030	10500	1860	190	404	120

* Basic dynamic rated load is a constant radial load where the basic dynamic rated life of CRB is 1 x 106 rotations.
* Basic static rated load is a static load where the value of moment rigidity is the average value.
* The value of the moment stiffness is the average value.

Recommended Tolerances for Assembly

Recommended tolerances for assembly

Fig. 137-1

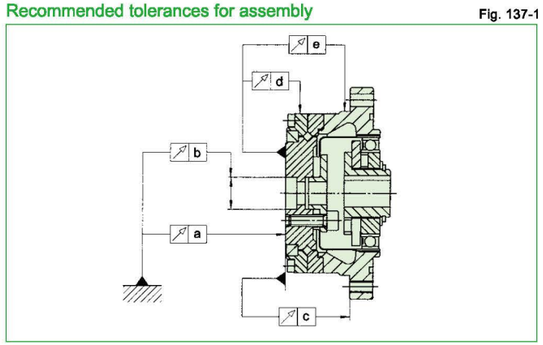


Table 137-1
Unit: mm

Symbol \ Size	14	17	20	25	32	40	45	50	58	65
a	0.010	0.010	0.010	0.015	0.015	0.015	0.018	0.018	0.018	0.018
b	0.010	0.012	0.012	0.013	0.013	0.015	0.015	0.015	0.017	0.017
c	0.024	0.026	0.038	0.045	0.056	0.060	0.068	0.069	0.076	0.085
d	0.010	0.010	0.010	0.010	0.010	0.015	0.015	0.015	0.015	0.015
e	0.038	0.038	0.047	0.049	0.054	0.060	0.065	0.067	0.070	0.075

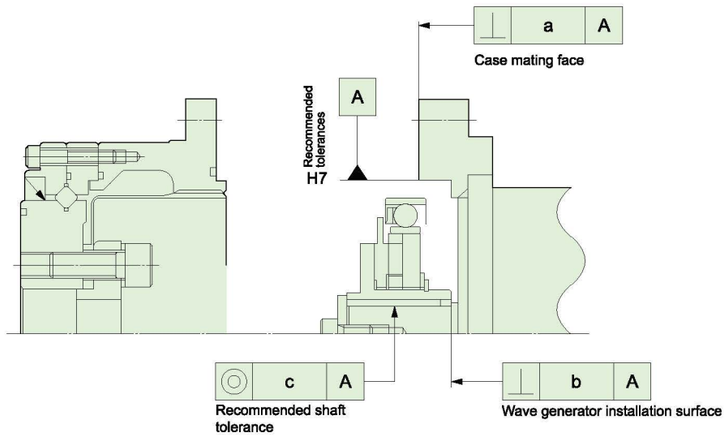
Design Guide

Installation accuracy

For peak performance of your gear, maintain the recommended tolerances shown in Figure 137-1 and Table 137-1.

Recommended tolerances for installation

Fig. 137-2



Recommended Tolerances for Assembly

Table 137-2

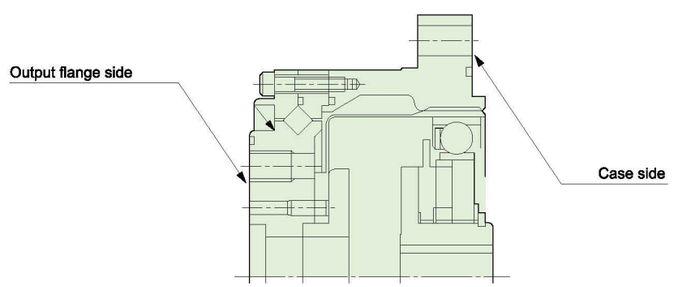
Unit: mm

Symbol \ Size	14	17	20	25	32	40	45	50	58	65
a	0.011	0.015	0.017	0.024	0.026	0.026	0.027	0.028	0.031	0.034
b	0.017	0.020	0.020	0.024	0.024	0.032	0.032	0.032	0.032	0.032
	(0.008)	(0.010)	(0.010)	(0.012)	(0.012)	(0.012)	(0.013)	(0.015)	(0.015)	(0.015)
c	0.030	0.034	0.044	0.047	0.050	0.063	0.065	0.066	0.068	0.070
	(0.016)	(0.018)	(0.019)	(0.022)	(0.022)	(0.024)	(0.027)	(0.030)	(0.033)	(0.035)

* The value in the parentheses indicates that input (wave generator) is a solid wave generator.

Installation and transmission torque

Fig. 138-1



CSG series: Installation of output flange side and transmission torque

Table 138-1

Item \ Size		14	17	20	25	32	40	45	50	58	65
Number of bolts		6	6	8	8	8	8	8	8	8	8
Bolt size		M4	M5	M6	M8	M10	M10	M12	M14	M16	M16
Pitch circle	mm	23	27	32	42	55	68	82	84	100	110
Clamp torque	Nm	5.4	10.8	18.4	45	89	89	154	246	383	383
Torque transmission capacity (bolt only)	Nm	58	109	245	580	1220	1510	2624	3690	5981	6579

CSG series: Installation of case side and transmission torque

Table 138-2

Item \ Size		14	17	20	25	32	40	45	50	58	65
Number of bolts		8	8	8	10	12	10	12	14	12	8
Bolt size		M4	M4	M5	M5	M6	M8	M8	M8	M10	M12
Pitch circle	mm	65	71	82	96	125	144	164	174	206	236
Clamp torque	Nm	4.5	4.5	9.0	9.0	15.3	37	37	37	74	128
Torque transmission capacity (bolt only)	Nm	182	196	365	538	1200	2100	2844	3251	5717	6293

(Table 138-1, 138-2/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 over 12.9.
3. Torque coefficient: K=0.2
4. Clamp coefficient: A=1.4
5. Tightening friction coefficient μ=0.15

CSF series: Bolt connection to output flange and resulting transmission torque

Table 139-1

Item \ Size		14	17	20	25	32	40	45	50	58	65
Number of bolts		6	6	8	8	8	8	8	8	8	8
Bolt size		M4	M5	M6	M8	M10	M10	M12	M14	M16	M16
Pitch circle	mm	23	27	32	42	55	68	82	84	100	110
Clamp torque	Nm	4.5	9	15.3	37	74	74	128	205	319	319
Torque transmission capacity (bolt only)	Nm	49	91	204	486	1108	1258	2200	3070	4980	5480

CSF series: Bolt connection to output flange and resulting transmission torque

Table 139-2

Item \ Size		14	17	20	25	32	40	45	50	58	65
Number of bolts		6	6	6	8	12	8	12	12	12	8
Bolt size		M4	M4	M5	M5	M6	M8	M8	M8	M10	M12
Pitch circle	mm	65	71	82	96	125	144	164	174	206	236
Clamp torque	Nm	4.5	4.5	9.0	9.0	15.3	37	37	37	74	128
Torque transmission capacity (bolt only)	Nm	137	147	274	431	1200	1680	2860	3040	5670	6310

(Table 139-1, 139-2/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 over 12.9.
3. Torque coefficient: K=0.2
4. Clamp coefficient: A=1.4
5. Tightening friction coefficient μ=0.15

■ Precautions on installing the load to the output flange (Sizes 14 to 25)

As the distance (see the size symbol “L” in Figure 128-1 on Page 128) between the oil seal on the output flange periphery and the edge of the output flange (rotor) is short for the gear units sizes 14, 17, 20 and 25, the load may interfere with the oil seal. Produce a design so that the load cannot be applied to the oil seal.

Installation of a motor

■ Motor mounting flange

A motor mounting flange is required for installing a motor. The recommended size and precision of the basic part of the motor mounting flange is shown in Table 140-1.

Fig. 140-1

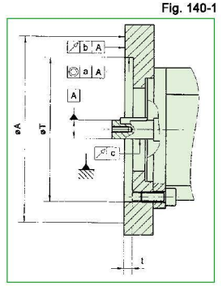


Table 140-1
Unit: mm

Symbol \ Size	14	17	20	25	32	40	45	50	58	65
a	0.03	0.04	0.04	0.04	0.04	0.05	0.05	0.05	0.05	0.05
b	0.03	0.04	0.04	0.04	0.04	0.05	0.05	0.05	0.05	0.05
c	0.015	0.015	0.018	0.018	0.018	0.018	0.021	0.021	0.021	0.021
φA	73	79	93	107	138	160	180	190	226	260
t	3	3	4.5	4.5	4.5	6	6	6	7.5	7.5
φT	38H7	48H7	56H7	67H7	90H7	110H7	124H7	135H7	156H7	177H7

■ Installation procedure

As shown in Figures 141-1 and 141-2, there are two basic procedures to install a motor. Select the installation procedure by the diameter of the pilot hole on the motor mounting surface. Table 141-1 shows the selection standard by the diameter of the pilot hole on the motor mounting surface.

Table 141-1
Unit: mm

Size	14	17	20	25	32	40	45	50	58	65	Reference drawing for installation
The dia. of the pilot hole on the motor mounting surface	＜35.5	＜43.5	＜50.0	＜62.5	＜81.5	＜100.0	＜113.5	＜124.5	＜147	＜167	Installation procedure-1 (Fig. 141-1)
	≧35.5	≧43.5	≧50.0	≧62.5	≧81.5	≧100.0	≧113.5	≧124.5	≧147	≧167	Installation procedure-2 (Fig. 141-2)

Fig. 141-1

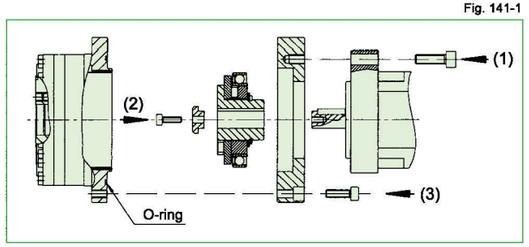
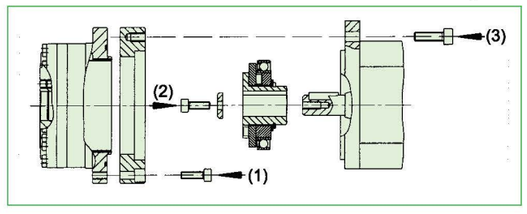


Fig. 141-2



Installation procedure-1

(1) Install the mounting flange on the motor mounting surface.
(2) Install a wave generator on the motor output shaft.
(3) Install the main unit.

Installation procedure-2

(1) Install the mounting flange on the main unit.
(2) Install a wave generator on the motor output shaft.
(3) Install the mounting flange (main unit) on the motor mounting surface.

■ Precautions on assembly

It is extremely important to assemble the gear accurately, in proper sequence. Perform assembly based on the following precautions.

Precautions regarding the 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. If the wave generator does not have an Oldham coupling, extra care must be given to ensure that concentricity and inclination are within the specified limits (see "Installation accuracy" of each series on Page 137).

Other precautions

1. Is the flatness of the mounting surface poor or distorted?
2. Is any embossment of the screw hole area, burr or trapped foreign matter found?
3. Have chamfering and relief working of the corner been performed to prevent interference with the area of installation of the unit?

Rust-prevention

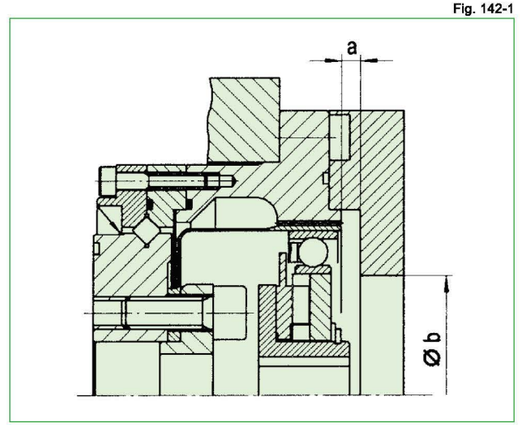
Although Harmonic Drive gears come with some corrosion protection, the gear can rust if exposed to the environment. The gear external surfaces typically have only a temporary corrosion inhibitor and some oil applied. If an anti-rust product is needed, please contact us to review the options.

Lubrication

Grease lubrication is standard for the CSF/CSG gear units. Harmonic Grease SK-2 is for sizes 14 and 17, and Harmonic Grease SK-1A is for sizes 20 to 65 (Harmonic Grease 4B No.2 for the cross roller bearing). Harmonic Grease 4B No.2 is also available for long-life and for use in a wide temperature range. (see "Engineering data" for the specifications of the grease).

See table below for recommended housing dimensions. These dimensions must be maintained to prevent damage to the gear and to maintain a proper grease cavity.

Fig. 142-1



Recommended housing dimensions

Table 142-1
Unit: mm

Symbol \ Size	14	17	20	25	32	40	45	50	58	65
a*	1	1	1.5	1.5	1.5	2	2	2	2.5	2.5
a**	3	3	4.5	4.5	4.5	6	6	6	7.5	7.5
φb	16	26	30	37	37	45	45	45	56	62

* Horizontal and vertical: when the wave generator is below
** Vertical: when the wave generator is above

■ Other precautions

Fill the gap between the wave generator and the input cover (motor flange) with grease to use the wave generator facing upward or downward (see Figure 048-3 on Page 48).

Sealing

Sealing is needed to maintain the high durability of the gear and prevent grease leakage

- Rotating Parts ..... Oil seal (with a spring). Surface should be smooth (no scratches)
- Mating flange ..... O-ring and seal adhesive. Take care regarding distortion on the plane and how the O-ring is engaged.
- Screw hole area ..... Screws should have a thread lock (LOCKTITE 242 is recommended) or seal adhesive.

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

Sealing area and the recommended sealing method for the unit type

Table 142-2

Area requiring sealing		Recommended sealing method
Output side	Pass-through hole in the center of the output flange and the output flange mating face	Use O-ring (supplied with product)
	Spanner screw area	Screw lock agent with sealing effect (LOCTITE® 242 is recommended)
Input side	Flange mating face	Use O-ring (supplied with product)
	Motor output shaft	Please select a motor which has an oil seal on the output shaft.

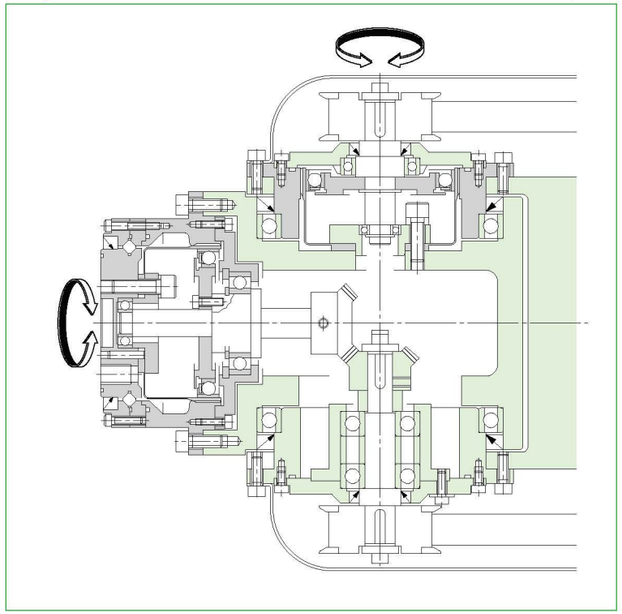
Rust prevention

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.

Application

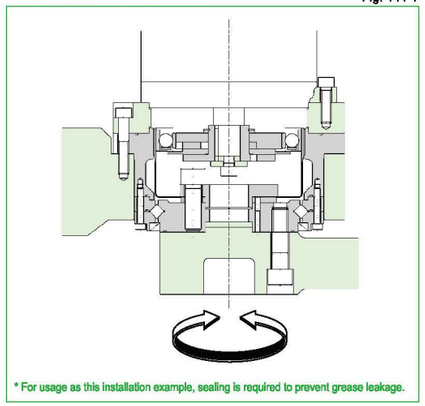
Multi-joint Robot

Fig. 143-1



Horizontal Multi Arm Robot

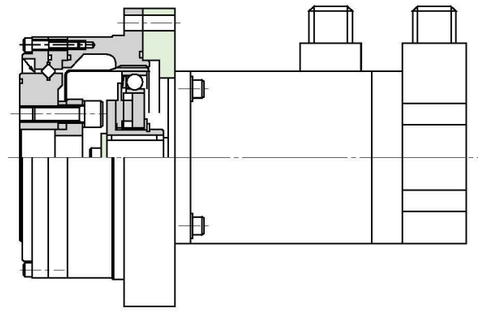
Fig. 144-1



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

Direct Connection to a Servomotor

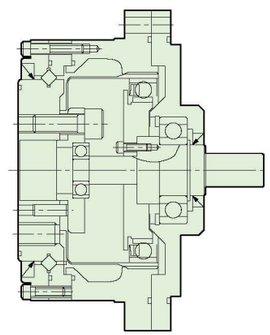
Fig. 144-2



Optional Input Shaft

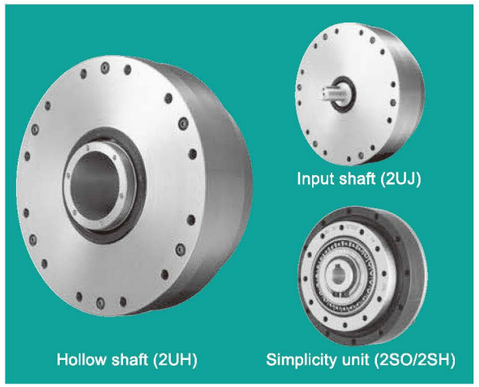
Fig. 144-3

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