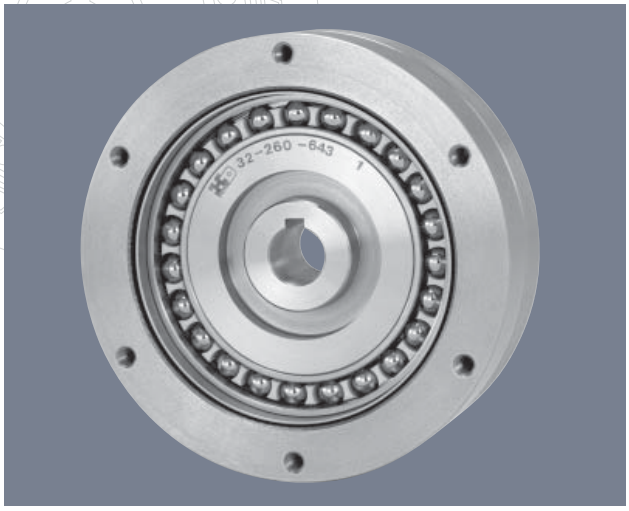
Features



HDUR/FR series component type

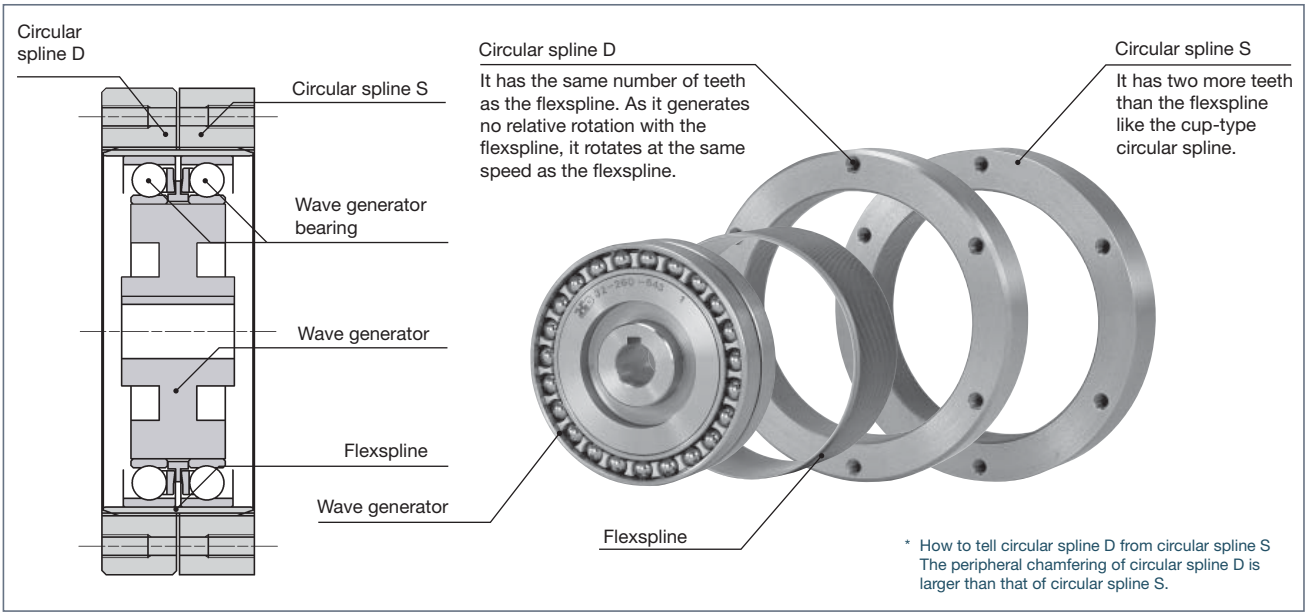
The HDUR/FR series component type is a flat, thin type for high torque. It consists of four parts like the HDUF/FB series and operates using the same principle as the cup type.
It is basically structured in the same way as the HDUF/FB series and supports high torque capacity by arranging the wave generator bearings in two lines and widening the tooth width of the circular spline and the flexspline.

Features of HDUR/FR series

- Flat and thin shape
- High torque capacity
- Compact and simple design
- High positioning and rotational accuracies
- Coaxial input and output

Structure of the HDUR/FR series component type

Fig. 1-1



Model and symbol

HDUR - 20 - 80 - 2 - GR

Table 2-1

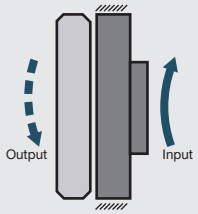
Model name	Model No.	Reduction ratio Note 1																		Model	
HDUR** FR	14	50	—	88	—	100	110	—	—	—	—	—	—	—	—	—	—	—	—	2= Component type	GR= New type * There is no G for Model 14
	20	50	—	80	—	100	—	—	128	—	—	—	160	—	—	—	—	—	—		
	25	50	—	80	—	100	—	120	—	—	—	—	160	—	200	—	—	—	—		
	32	50	78	—	—	100	—	—	—	131	157	—	—	—	200	—	—	—	260		
	40	50	—	80	—	100	—	—	128	—	—	—	160	—	200	—	—	258	—		
	50	—	—	80	—	100	—	120	—	—	—	—	160	—	200	—	242	—	—		
	65	—	78	—	—	—	104	—	—	—	132	158	—	—	—	208	—	—	260		
	80	—	—	80	96	—	—	—	128	—	—	—	160	194	—	—	—	258	—		
	100	—	—	80	—	100	—	120	—	—	—	—	160	—	200	—	242	—	—		

* The reduction ratio indicates the value for the following condition.
Input: wave generator, fixed: circular spline, output: flexspline
** Model names: HDUR for European markets, FR for Asia and North America

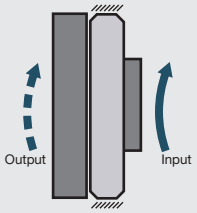
Rotational direction and reduction ratio

Fig. 2-2

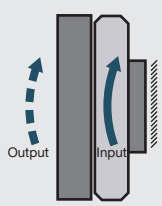
(Note) Contact us if you use the product as Accelerator (5) and (6).

① 

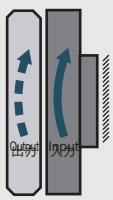
(1) Reducer
Input: Wave Generator
Output: Circular Spline D
Fixed: Circular Spline S
$i=\frac{-1}{R}$

② 

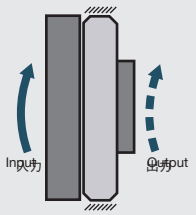
(2) Reducer
Input: Wave Generator
Output: Circular Spline S
Fixed: Circular Spline D
$i=\frac{1}{R+1}$

③ 

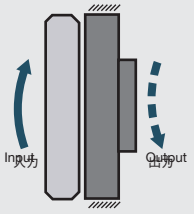
(3) Reducer
Input: Circular Spline D
Output: Circular Spline S
Fixed: Wave Generator
$i=\frac{R}{R+1}$

④ 

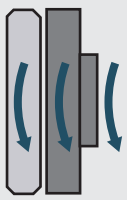
(4) Overdrive
Input: Circular Spline S
Output: Circular Spline D
Fixed: Wave Generator
$i=\frac{R+1}{R}$

⑤ 

(5) Overdrive
Input: Circular Spline S
Output: Wave Generator
Fixed: Circular Spline D
$i=R+1$

⑥ 

(6) Overdrive
Input: Circular Spline D
Output: Wave Generator
Fixed: Circular Spline S
$i=-R$

⑦ 

(7) Differential
When all of the Wave Generator, the Circular Spline S and the Circular Spline D rotate, Combinations (1) through (6) are available.

Technical Data

Rating table

Table 3-1

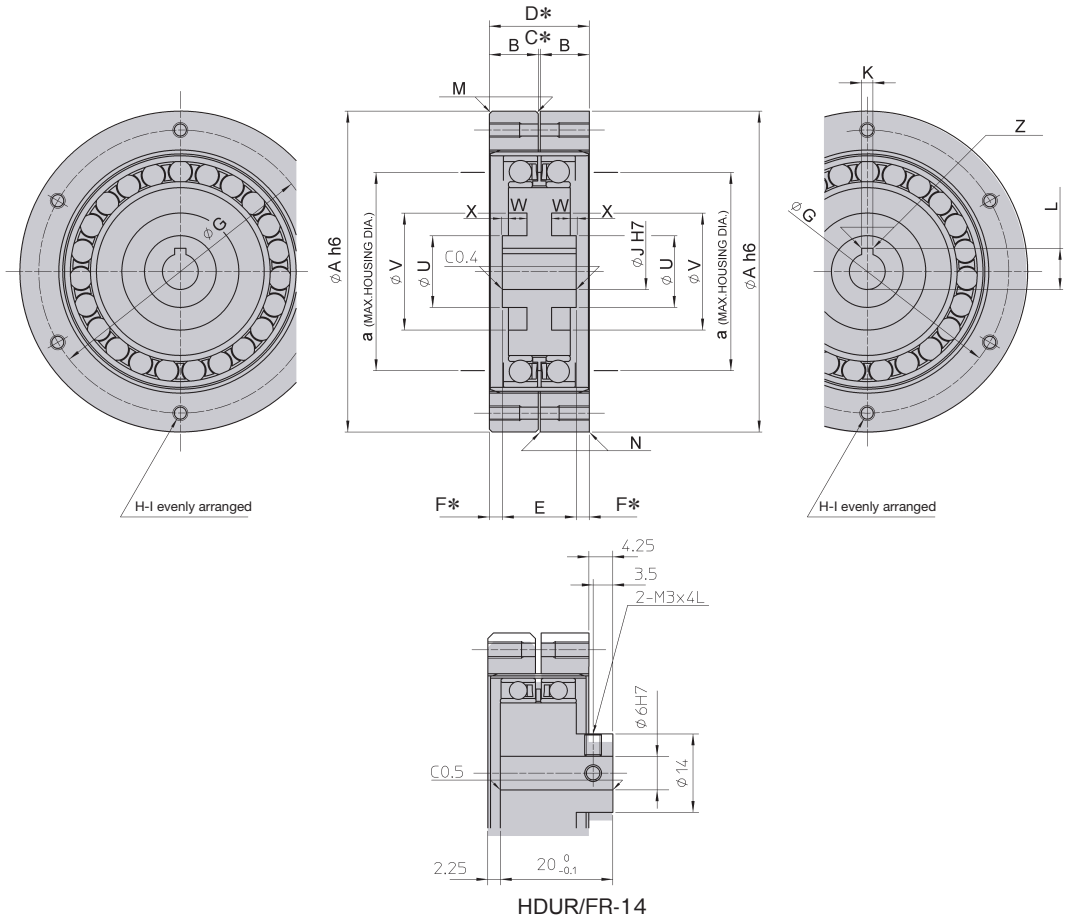
Model	Reduction ratio	Rated torque at input 2000rpm		Permissible peak torque at start/stop		Permissible max. value of ave. load torque		Instantaneous permissible max. torque		Rated input rotational speed	Permissible max. input rotational speed (rpm)		Permissible ave. input rotational speed (rpm)		Inertia moment	
		Nm	kgfm	Nm	kgfm	Nm	kgfm	Nm	kgfm	rpm	Oil lubricant	Grease lubricant	Oil lubricant	Grease lubricant	I ×10^{-4}kgm^2	J ×10^{-5}kgfms^2
14	50	4.4	0.45	5.4	0.55	5.4	0.55	13.7	1.4	2000	6000	3600	4000	2500	0.060	0.061
	88	5.9	0.6	9.8	1.0	9.8	1.0	19.6	2.0*							
	100	7.8	0.8	13.7	1.4	9.8	1.0	19.6	2.0*							
	110	7.8	0.8	13.7	1.4	9.8	1.0	19.6	2.0*							
20	50	25	2.5	34	3.5	34	3.5	69	7.0	2000	6000	3600	3600	2500	0.32	0.33
	80	34	3.5	41	4.2	41	4.2	72	7.3							
	100	40	4.1	53	5.4	49	5.0	94	9.6							
	128	40	4.1	67	6.8	49	5.0	102	10.4*							
	160	40	4.1	77	7.9	49	5.0	86	8.8							
25	50	39	4.0	55	5.6	55	5.6	108	11.0	2000	5000	3600	3000	2500	0.7	0.71
	80	56	5.7	69	7.0	69	7.0	122	12.4							
	100	67	6.8	91	9.3	91	9.3	160	16.3							
	120	67	6.8	108	11.0	108	11.0	190	19.4							
	160	67	6.8	135	13.8	108	11.0	172	17.6*							
	200	67	6.8	147	15.0	108	11.0	172	17.6*							
32	50	76	7.8	108	11	108	11	216	22	2000	4500	3600	2500	2300	2.6	2.61
	78	108	11	137	14	137	14	245	25							
	100	137	14	176	18	176	18	323	33							
	131	137	14	255	26	216	22	451	46							
	157	137	14	294	30	216	22	500	51*							
	200	137	14	314	32	216	22	372	38*							
	260	137	14	314	32	216	22	372	38*							
40	50	137	14	196	20	196	20	353	36	2000	4000	3300	2000	2000	6.8	6.9
	80	196	20	245	25	245	25	431	44							
	100	255	26	314	32	314	32	549	56							
	128	294	30	392	40	392	40	686	70							
	160	294	30	461	47	451	46	813	83							
	200	294	30	529	54	451	46	745	76*							
	258	294	30	627	64	451	46	745	76*							
50	80	363	37	441	45	441	45	784	80	1700	3500	3000	1700	1700	21	21
	100	470	48	578	59	578	59	1019	104							
	120	559	57	696	71	696	71	1225	125							
	160	559	57	833	85	833	85	1470	150							
	200	559	57	960	98	843	86	1411	144*							
	242	559	57	1176	120	843	86	1411	144*							
65	78	745	76	921	94	921	94	1617	165	1400	3000	2200	1400	1400	76	78
	104	1070	109	1340	137	1340	137	2360	241							
	132	1070	109	1650	168	1570	160	2890	295							
	158	1070	109	1970	201	1570	160	3450	352*							
	208	1070	109	2180	222	1570	160	2590	264*							
	260	1070	109	2200	224	1570	160	2590	264*							
80	80	1320	135	1640	167	1640	167	2870	293	1200	2500	2000	1200	1200	213	217
	96	1660	169	2050	209	2050	209	3590	366							
	128	2300	235	2820	288	2830	289	4960	506							
	160	2350	240	3380	345	3130	319	5940	606							
	194	2350	240	4300	439	3130	319	6900	704*							
	258	2350	240	4350	444	3130	319	5170	528*							
	320	2350	240	4350	444	3130	319	5170	528*							
100	80	2330	238	2870	293	2870	293	5040	514	1000	2000	1700	1000	1000	635	648
	100	3200	327	3940	402	3940	402	6920	706							
	120	3890	397	4780	488	4780	488	8400	857							
	160	4470	456	6230	636	5720	584	10950	1117							
	200	4470	456	7090	723	5720	584	12440	1269							
	242	4470	456	7960	812	5720	584	9410	960*							
	320	4470	456	7960	812	5720	584	9410	960*							

(Note) The value of asterisk is limited by ratcheting torque.

1. Inertia moment: $I=\frac{1}{4}GD^2$

Outline drawing

Fig. 4-1



HDUR/FR-14

* The allowance varies depending on the part manufacturing method (cast or machined products).
Contact us if the allowance is not described in the dimensions and is required.

Measurement table

Table 4-2
Unit: mm

Symbol \ Model		14	20	25	32	40	50	65	80	100
ϕA (h6)		50	70	85	110	135	170	215	265	330
B		8.5	12	14	18	21	26	35	41	50
C*		1	1	1	1	1	1	1	1	1
D*		18	25	29	37	43	53	71	83	101
$E^{0}_{-0.1}$		—	17.3	20	25.9	31.5	39	50.5	62	77.2
F*		—	3.85	4.5	5.55	5.75	6.95	10.25	10.5	11.9
ϕG		44	60	75	100	120	150	195	240	290
H		6	6	6	6	6	6	6	8	8
I		M3×6	M3×6	M4×8	M5×10	M6×12	M8×16	M10×20	M10×20	M12×24
ϕJ (H7)	Standard	6	9	11	14	14	19	24	28	28
	Max. size	8	11	11	17	20	26	26	32	33
K (J_{s9})		—	3	4	5	5	6	8	8	8
$L^{+0.1}_{0}$		—	10.4	12.8	16.3	16.3	21.8	27.3	31.3	31.3
M		c1	c1	c1.5	c1.5	c1.5	c1.5	c1.5	c2	c2
N		c0.2	c0.2	c0.2	c0.2	c0.4	c0.4	c0.4	c0.4	c0.4
a		29	42	53	69	84	105	138	169	211
ϕU		—	—	22	28	32	38	44	52	58
ϕV		—	—	32	42	52	62	86	100	128
W		—	—	4.8	6.1	7.6	9.8	12.6	16	19.7
X		—	42	1.6	1.9	2.5	3.2	4.4	5.1	6.3
Z		—	R0.08~0.16	R0.08~0.16	R0.08~0.25	R0.08~0.25	R0.08~0.25	R0.08~0.25	R0.08~0.25	R0.08~0.25
Mass	kgf	0.2	0.5	0.8	1.7	3.0	6.0	12.0	22.3	42.6

(Note) For Circular spline D, the outer circumference is Size M.

- The C, D and F sizes indicated by an asterisk are the mounting positions in the shaft direction and allowance of the three parts (wave generator, flexspline, circular spline) comprising HarmonicDrive®. Strictly observe these sizes as they affect the performance and intensity.
- Four parts (wave generator, flexspline, circular spline D, circular spline S) are not assembled when the product is delivered.

Efficiency characteristics

The efficiency varies depending on the following conditions.

- Reduction ratio
- Input rotational speed
- Load torque
- Temperature
- Lubrication condition (Type of lubricant and the quantity)

Measuring condition

Table 5-1

Assembly	Assembled to the recommended precision		
Load torque	The rated torque shown in the ratings (see the page 3)		
Lubricating condition	Grease lubrication	Name	Harmonic grease SK-1A
			Harmonic grease SK-2
	Oil lubrication		Gear oil as recommended
	Application quantity		Appropriate application quantity. *

* Contact us for oil lubrication.

■ Efficiency correction coefficient

If the load torque is smaller than the rated torque, the efficiency value lowers. Obtain correction coefficient Ke from the efficiency correction coefficient graph of Graph 5-2 to obtain the efficiency using the following example of calculation.

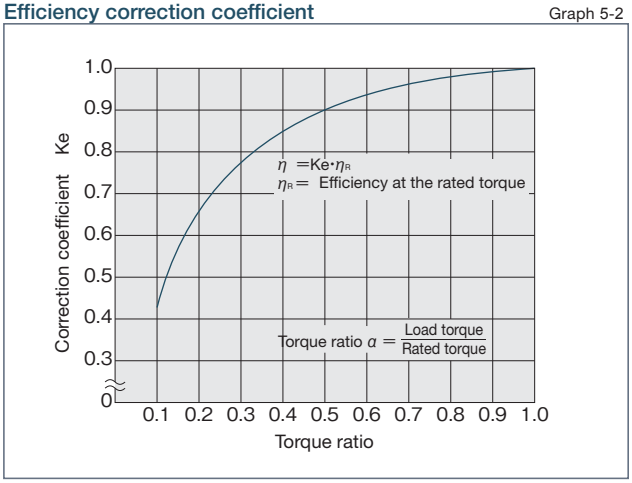
Example of calculation

Efficiency η (%) under the following condition is obtained from the example of HDUR-20-80-2GR.
Input rotational speed: 1000 rpm
Load torque: 19.6 Nm
Lubrication method: Grease lubrication (Harmonic grease SK-1A)
Lubricant temperature: 20°C
Since the rated torque of model number 20 with a reduction ratio of 80 is 34 Nm (Ratings: Page 3), the torque ratio α is 0.58.
(α=19.6/34=0.58)

- The efficiency correction coefficient is Ke=0.86 from Graph 5-2.
- Efficiency η at load torque 19.6 Nm: η=Ke・ηR=0.86 x 65=56%

Efficiency correction coefficient

Graph 5-2

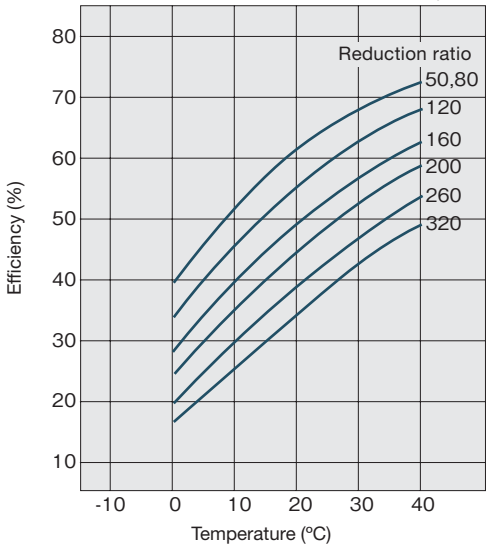


* Efficiency correction coefficient Ke=1 holds when the load torque is greater than the rated torque.

■ Efficiency at rated torque (oil lubrication)

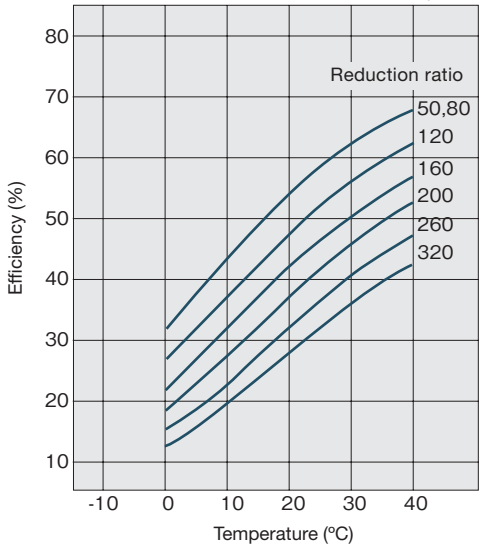
Input rotational speed: 500rpm

Graph 6-1



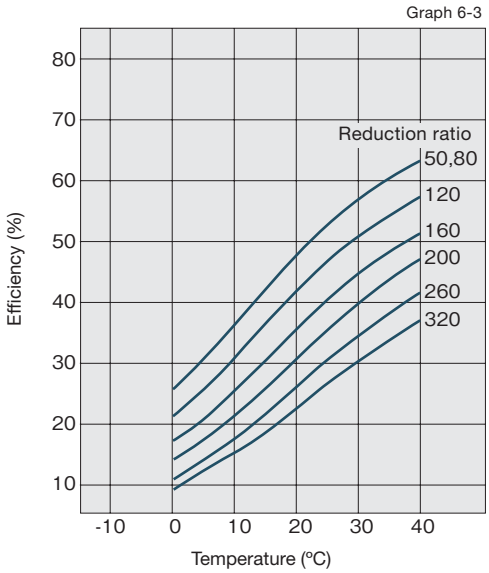
Input rotational speed: 1000rpm

Graph 6-2



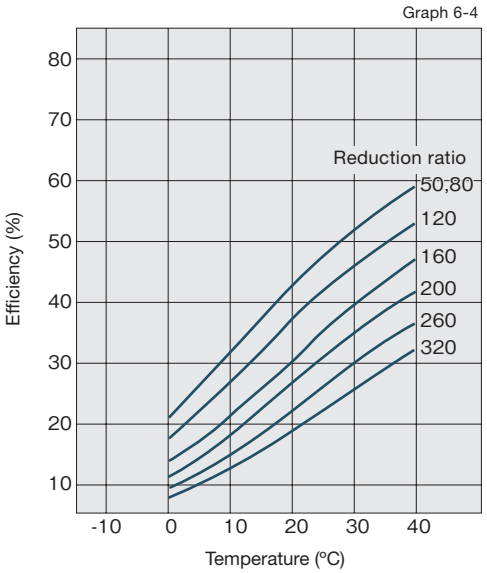
Input rotational speed: 2000rpm

Graph 6-3



Input rotational speed: 3500rpm

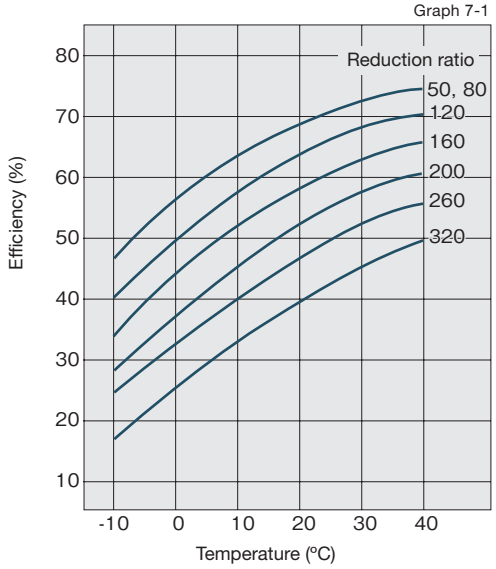
Graph 6-4



■ Efficiency at rated torque (grease lubrication)

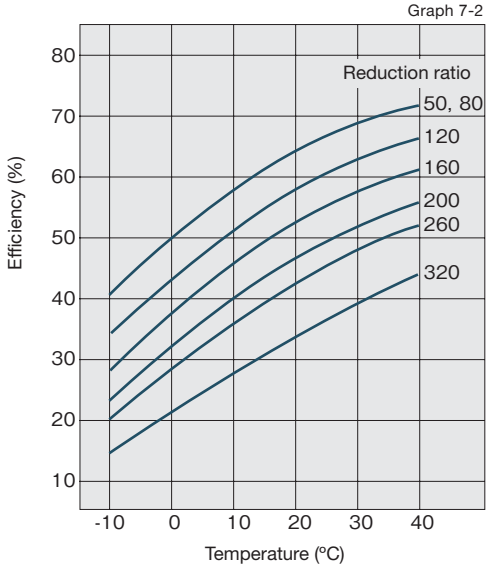
Input rotational speed: 500rpm

Graph 7-1



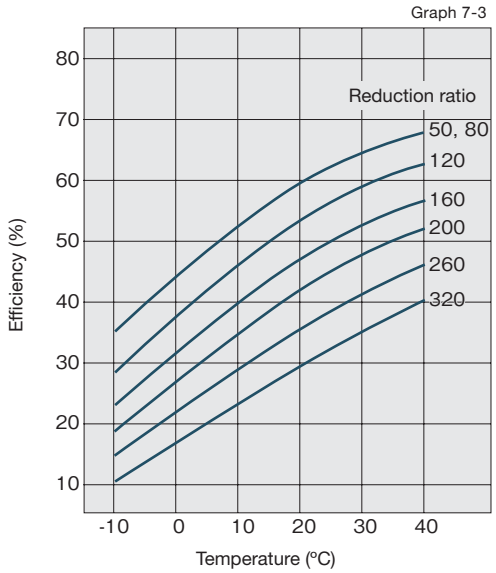
Input rotational speed: 1000rpm

Graph 7-2



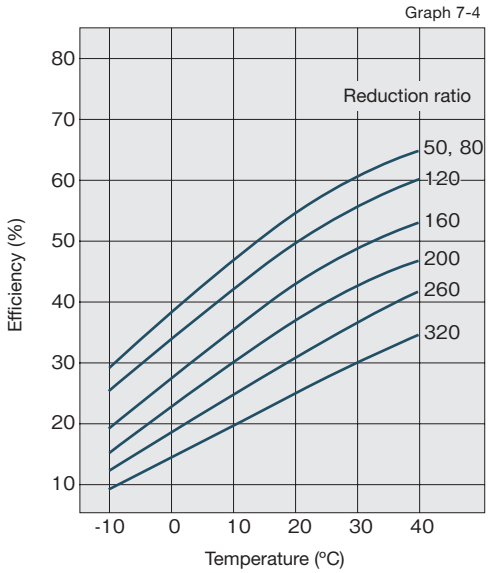
Input rotational speed: 2000rpm

Graph 7-3



Input rotational speed: 3500rpm

Graph 7-4



No-load running torque, starting torque, backdriving starting torque

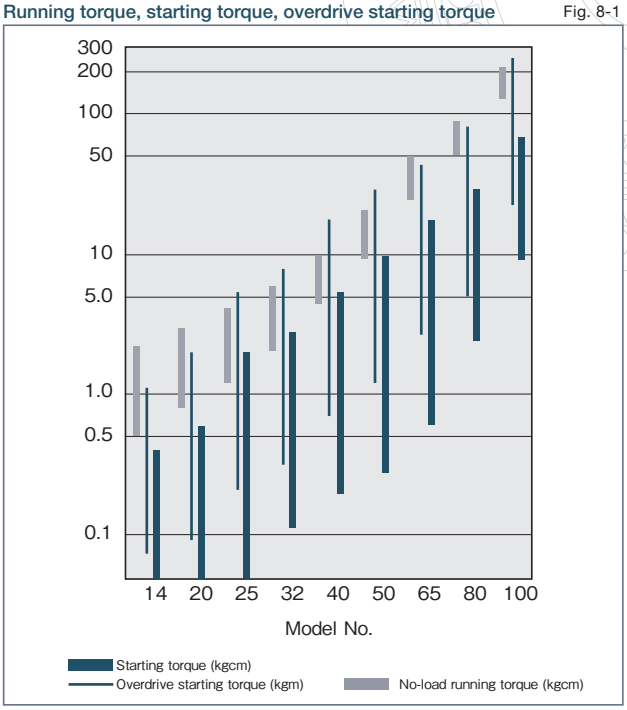
Figure 8-1 shows the result of measurement when the component has been built in as the double shaft-type reducer. The values include frictional resistance due to the oil seal of the input and output shaft, and oil bath-type lubrication.

(1) No-load running torque..... This is the torque on the high-speed shaft required for rotation in a no-load condition. The value in the graph indicates the condition when the input rotational speed is 1500 rpm and the oil temperature is about 40ºC.

(2) Starting torque ..... This is the static torque required to start the high-speed shaft in a no-load condition.

(3) Backdriving starting torque.. This is the static torque required to start the low-speed shaft in a no-load condition.

Running torque, starting torque, overdrive starting torque Fig. 8-1



Lost motion and the spring constant

Lost motion and the spring constant of the pancake type is the value when of the wave generator and either of the circular splines is fixed and when a torque is applied to the other circular spline.

Table 9-1

Model No.	Lost motion (arc min)		Spring constant (kgm/min)	
	± Load (kgm)	Standard product	Load (kgm)	Spring constant
14	0.04	max. 3.0	1.26	0.3
20	0.12	3.0	3.69	0.9
25	0.23	3.0	7.20	2.1
32	0.46	3.0	15.78	4.4
40	0.92	3.0	29.50	7.8
50	1.73	3.0	57.60	16
65	3.9	3.0	126.7	27
80	7.4	3.0	236.2	52
100	14.4	3.0	460.8	100

■ Description on lost motion and spring constant

As for the backlash specified in normal, HarmonicDrive® has unique teeth engagement theory. The teeth engagement ratio is high, approx. 10% of the total number of teeth and the value is extremely smaller in the standard specification due to the averaged pitch difference.
The lost motion value is used for the backlash of the pancake type HarmonicDrive®.

(1) Lost motion (LM)

The lost motion is the total value of rotational angle of low-speed shaft when the high-speed shaft is fixed in rotational direction with the HarmonicDrive® installed and when slight load torque (see Table 9-1) is applied to the low-speed shaft the other way round.

(2) Spring constant

By increasing the load torque gradually in the same manner as the lost motion and applying the load the other way round, "load torque - torsional angle" diagram emerges as shown in Fig. 9-3. The average spring constant obtained by this diagram is shown in Table 9-1. (This value is only for the HarmonicDrive® components.)

Fig. 9-2

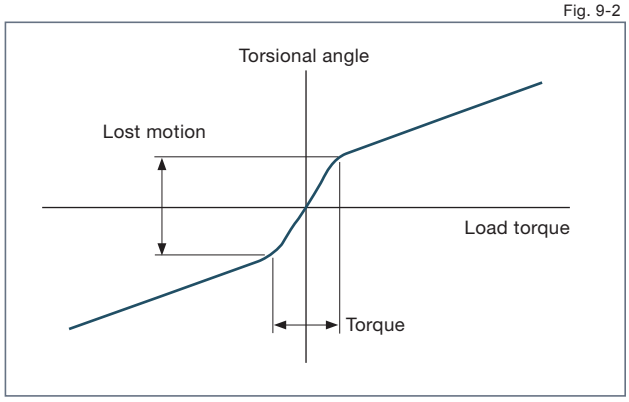
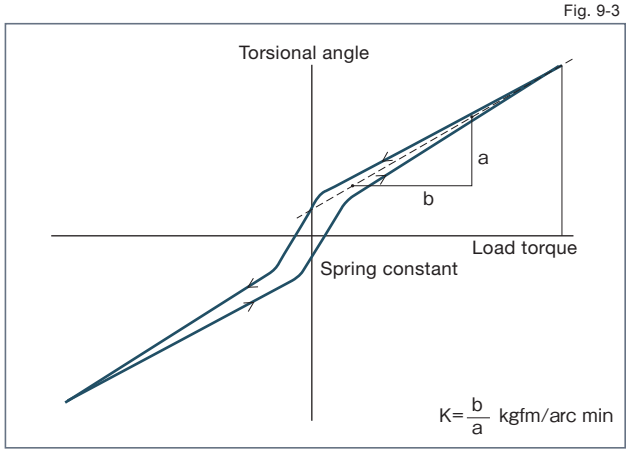


Fig. 9-3



■ Example of calculation

Use the HarmonicDrive® model number HDUR-40-160-2A-GR to fix the input shaft in rotational direction, and apply the load (30kgfm) rated in the catalog to the output shaft, and then obtain the torsional angle.

$$\text{Torsional angle } \theta = \frac{L \cdot M}{2} + \frac{1}{K}(T\text{-}T_{LM})$$

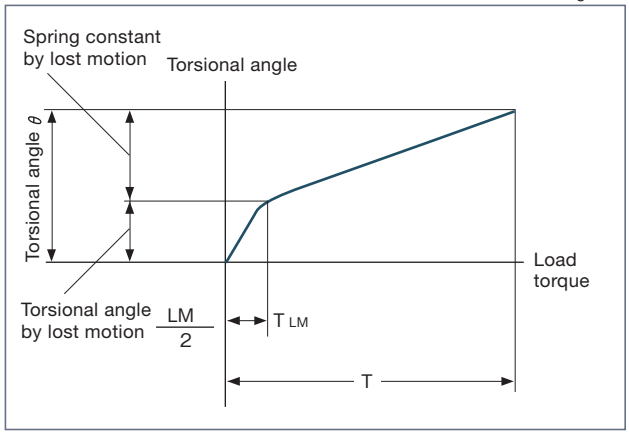
$$= 1.5 + \frac{1}{7.8}(30\text{-}0.92)$$

$$= 5.23 \text{arc min}$$

Maximum value "θmax" when rotated the other way round is

$$\theta max = 2 \cdot \theta = 10.46 \text{arc min}$$

Fig. 9-4



Design guide

Installation precision

Maintain the recommended precision shown in Figure 10-1 and Table 10-2 to fully bring out the excellent performance of HarmonicDrive® for built-in design.

Recommended precision for the assembly

Fig. 10-1

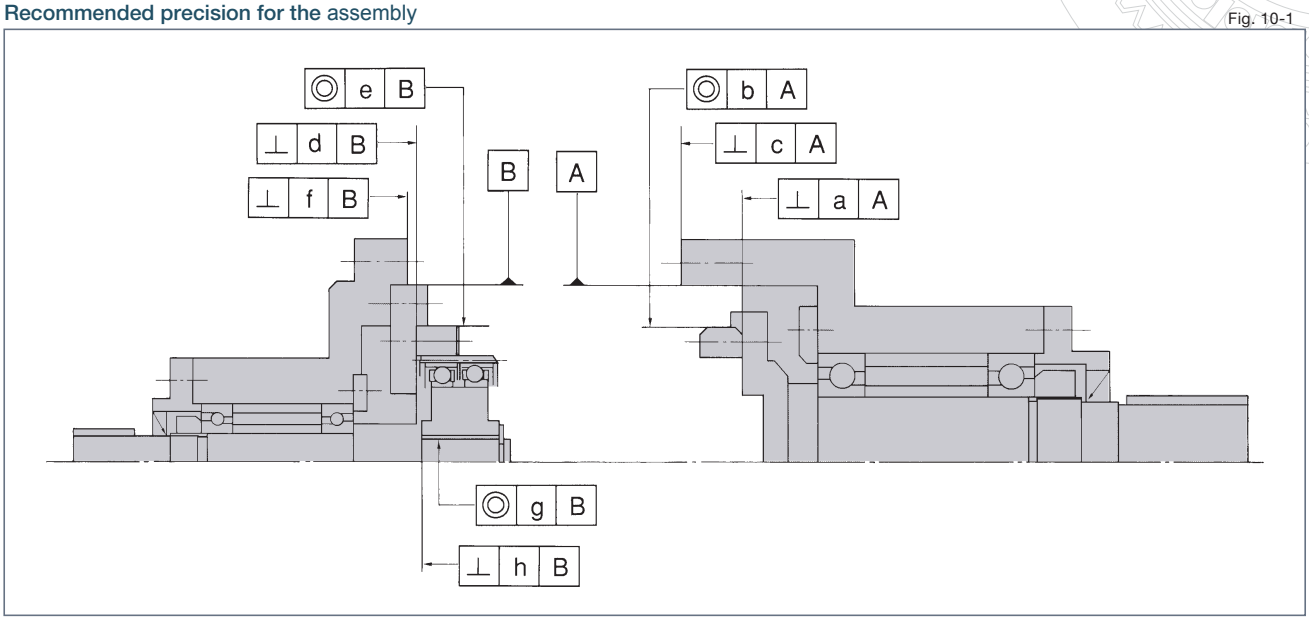


Table 10-2

Recommended precision for the assembly

Unit: mm

Symbol \ Model	14	20	25	32	40	50	65	80	100
a	0.013	0.017	0.024	0.026	0.026	0.028	0.034	0.043	0.057
b	0.015	0.016	0.016	0.017	0.019	0.024	0.027	0.033	0.038
c	0.016	0.020	0.029	0.031	0.031	0.034	0.041	0.052	0.068
d	0.013	0.017	0.024	0.026	0.026	0.028	0.034	0.043	0.057
e	0.015	0.016	0.016	0.017	0.019	0.024	0.027	0.033	0.038
f	0.016	0.020	0.029	0.031	0.031	0.034	0.041	0.052	0.068
g	0.011	0.013	0.016	0.016	0.017	0.021	0.025	0.030	0.035
h	0.007	0.010	0.012	0.012	0.012	0.015	0.015	0.015	0.015

Installation of the circular spline

Conduct design and part control corresponding to the load condition for installation of the circular spline. Transmission torques by the recommended bolts and tightening torques are shown in the following table.

Installation with bolts

Table 10-3

Item \ Model		14	20	25	32	40	50	65	80	100
Number of bolts		6	6	6	6	6	6	6	8	8
Bolt size		M3	M3	M4	M5	M6	M8	M10	M10	M12
Installation of bolts: P.C.D.	mm	44	60	75	100	120	150	195	240	290
Bolt tightening torque	Nm	2.0	2.0	4.5	9.0	15.3	37	74	74	128
	kgfm	0.20	0.20	0.46	0.92	1.56	3.8	7.5	7.5	13.1
Bolt transmission torque	Nm	54	74	159	338	573	1300	2680	4410	7750
	kgfm	5.5	7.5	16	34	58	132	273	450	790

1. It is assumed that the material of the threads can endure the bolt tightening torque.
2. Recommended bolt grade 12.9 or more

Please contact us if you require details concerning the connections.

Precautions on assembly

HarmonicDrive® may generate vibration and abnormal sound due to problems during assembly. Perform assembly based on the HDUF/FB series precautions (page 10, fig. 10-1 and table 10-2).

Lubrication

There are two types of lubrication; oil lubrication and grease lubrication. Although oil lubrication is common, grease lubrication is applicable to intermittent operation.

■ Oil lubrication

1. Type of lubricant

Mineral oil CLP 68 (ISO VG 68) according to DIN 51517 T3.

2. Oil quantity

The oil level shall be the position shown in table 11-2.

Fig. 11-1

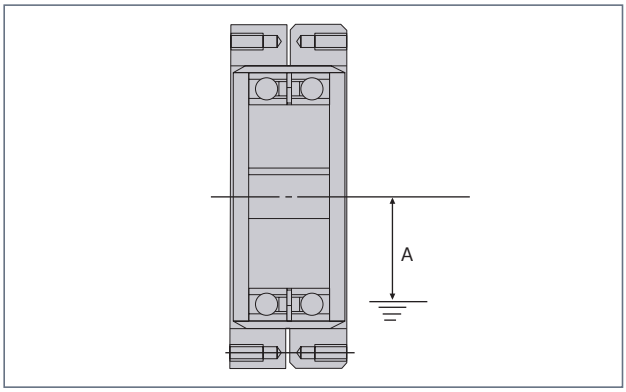


Table 11-2
Oil level position
Unit: mm

Model	14	20	25	32	40	50	65	80	100
A	7	12	15	31	38	44	62	75	94

■ Grease lubrication

Different from oil lubrication, as a cooling effect is not expected from grease lubrication, it is only available for short operation.

- Operating condition: ED%‥ 10% or less, continuous operation for 10 minutes or less, the maximum permissible input rotational speed in Table 3-1 or less
- Recommended grease:····· Harmonic grease SK-1A for model numbers 20 to 100
  Harmonic grease SK-2 for model number 14

(Note) If you use the product over ED% or the maximum permissible rotational speed, the grease will deteriorate, will not work as a lubricating mechanism and will result in damaging the reducer earlier. Extreme care should be taken.