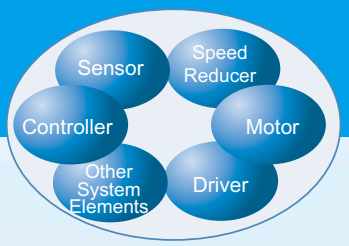


HarmonicDrive®

The CSF-mini series now includes Ultra Flat models with High-Moment Stiffness

Harmonic Drive® gear units are housed, zero-backlash gears with a precision output bearing. The newest series, CSF-2UP has been added to our CSF Mini product line. The new models are lightweight and extremely flat. Thanks to a cross roller bearing used at the output flange, the CSF-2UP gearheads offer high-moment stiffness.

The CSF-2UP mini gearheads are ideally suited for small robots or equipment that require an ultra-compact solution.

Features

- The ultra flat structure enables compact designs.
- High-moment stiffness cross roller bearing enables direct mounting of the external load.
- Motor mounting flange can be provided for your motor.

■ Example of motor installation

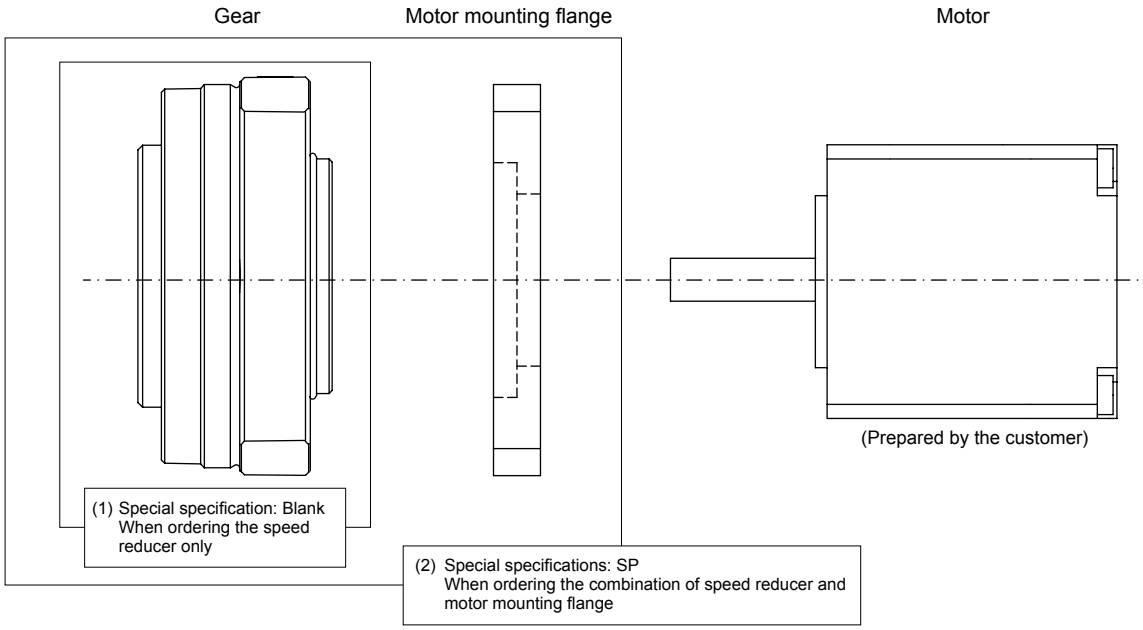
■ Model No. and Ordering Code

CSF - 14 - 100 - 2UP - Specification

Table 2-1

Model name	Size	Reduction ratio			Type	Special specifications
						–
CSF series	8	30	50	100	2UP (High-moment stiffness)	Blank = standard product SP = Specification for special shape and performance (Including the motor mounting flange option)
	11	30	50	100		
	14	30	50	100		

■ Specifications



* The motor mounting flange is designed and sold as an option. Please let us know the required dimension shown in Figure 11-1 on page 11 if you need the flange designed.
* Installation of the motor mounting flange and motor must be performed by the customer. For proper installation, refer to pages 8 through 10.
* The special specification: SP may include other special specifications.

■ Rating Table

Table 2-2

Size	Reduction ratio	Rated torque at input speed 2000 rpm	Limit for repeated peak torque	Limit for average torque	Limit for momentary peak torque	Maximum Input Speed	Limit for average input speed	Moment of inertia ($1/4GD^2$)
		Nm	Nm	Nm	Nm	rpm	rpm	$kgcm^2$
8	30	0.9	1.8	1.4	3.3	8500	3500	4.0×10^{-3}
	50	1.8	3.3	2.3	6.6			
	100	2.4	4.8	3.3	9.0			
11	30	2.2	4.5	3.4	8.5	8500	3500	1.5×10^{-2}
	50	3.5	8.3	5.5	17			
	100	5.0	11	8.9	25			
14	30	4.0	9.0	6.8	17	8500	3500	4.0×10^{-2}
	50	5.4	18	6.9	35			
	100	7.8	28	11	54			

(Note) For details about terms, refer to the technical manual in the CSF Catalog.

■ Cross Roller Bearing Specifications

A precise cross roller bearing is built in the CSF-mini series 2UP for the purpose of directly supporting external load (on the output side).
In order to fully achieve the performance of the unit, check the maximum load moment load, cross roller bearing life, and static safety coefficient.
For details about the equations for the respective values, refer to the technical manual.

■ Checking procedure

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

Determine the maximum load moment load (M max). → Maximum load moment load (M max) ≤ permissible moment (Mc)

(2) Checking the life

Determine the average radial load (Fr*av*) and the average axial load (Fa*av*). → Determine the radial load coefficient (X) and an axial load coefficient (Y). → Calculate the life and check it

(3) Checking the static safety coefficient

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

■ Main roller bearing specifications

Table 3-1

Size	Pitch circle	Offset	Basic rated load		Permissible moment load Mc	Moment stiffness Km
	dp	R	Basic dynamic rated load C	Basic static rated load Co		
	mm	mm	× 10^2 N	× 10^2 N	Nm	Nm/rad
8	35	12.9	58	80	15	2.0 × 10^4
11	42.5	14	65	99	40	4.0 × 10^4
14	54	14	74	128	75	8.0 × 10^4

* The basic dynamic load rating is referred to as a constant static radial load so that the basic dynamic load rating of the bearing is to be a million rotations.
* The basic static load rating is referred to as a static load that provides a constant level contact stress (4kN/mm^2) at the center of the contact side between the rolling element that bears the maximum load and the orbit.
* The permissible moment load is referred to as the maximum moment load that can be applied to the output bearing while the basic performance can be retained within the range of the maximum moment load that can be operable.
* The values of the moment stiffness are the reference values. The lower limit value is approximately 80% of the display value.
* The permissible radial load and the permissible axial load are the values that satisfy the life of the speed reducer when either of the pure radial load or pure axial load is applied to the output shaft. (In the case when radial load: Lr+R = 0 mm and the axial load: La = 0 mm.)

■ Lubrication

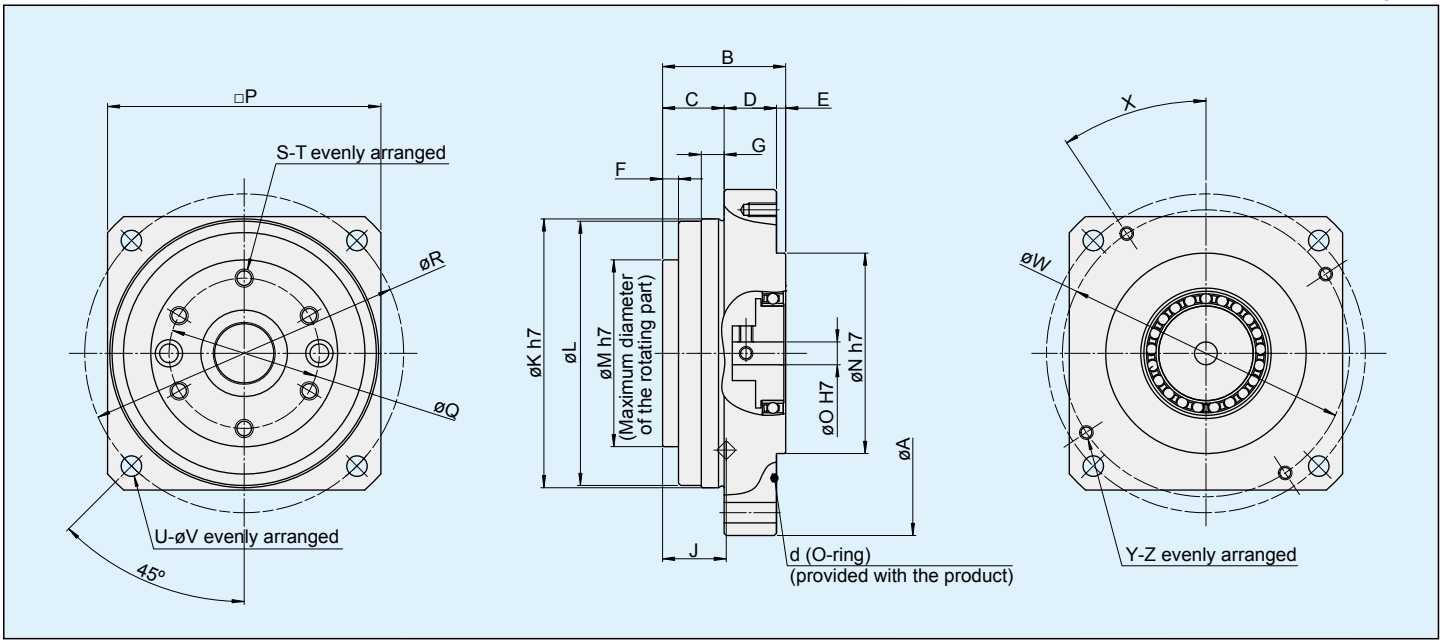
Grease is the standard lubrication for CSF-2UP mini series. There is no need to add or apply grease upon installation since the products are shipped with the grease applied.

Table 3-2

Lubricated area	Gear	Cross roller bearing
Lubrication	Harmonic Grease® SK-2	
Manufacturer	Harmonic Drive Systems Inc.	
Base oil	Refined oil	
Puffing agent	Lithium soap base	
Mixing consistency (25°C)	265 to 295	
Dropping point	198°C	
Appearance	Green color	

External Dimensions

Figure 4-1



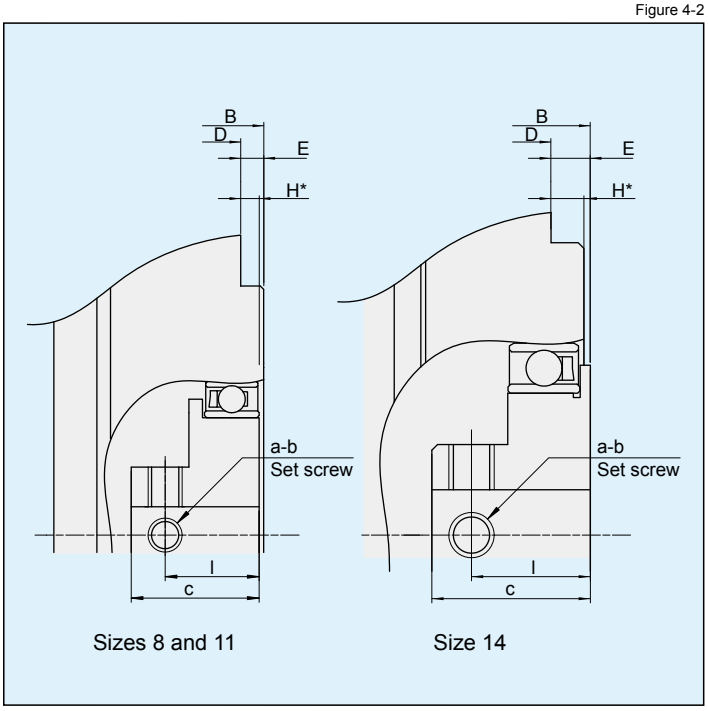
Dimension table

Table 4-1
Unit: mm

Symbol \ Size	8	11	14
øA	66	80	100
B	24.8	27	33.5
C	13	13.5	18.5
D	9	11.5	12
E	2.8	2	3
F	3	3.5	3.5
G	5	5	8
H*	$1.1^{0}_{-0.3}$	$1.6^{0}_{-0.7}$	$3.5^{0}_{-0.8}$
I	7.2	8.3	10.5
J	12.9	14	14
øK	49	59	74
øL	48	58	73
øM	33.5	41	52.5
øN	30	44	52
øO	5	5	8
□P	50±1	60±1	75±1
øQ	25.5	33	44
øR	58	70	88
S	6	6	6
T	M3 × 5	M4 × 5	M5 × 7
U	4	4	4
øV	3.5	4.5	5.5
øW	52	63	70.71
X	35°	33.5°	55°
Y	4	4	4
Z	M3 × 5	M3 × 6	M4 × 8
Mass (g)	200	330	620

Wave generator mounting dimension enlarged view diagram

Figure 4-2



* Dimension H is the mounting position in the shaft direction and tolerance of the three parts (wave generator, flexspline, circular spline). Strictly observe these dimensions as they affect the performance and strength.

Table 4-2

Symbol \ Size	8	11	14
a	2	2	2
b	M3×4	M3×4	M4×4
c	10.2	11.3	14
d	ø29.8×0.8	ø54.0×1.2	ø58.4×1.3

Wave Generator Hole Diameter Dimension

The hole diameter dimension (as shown in Table 4-1 on page 4, øO) can be changed in accordance with the shaft diameter of the mounting motor within the range shown in the table below:

Table 5-1
Unit: mm

Symbol \ Size	8	11	14
øO H7	2 to 8	3 to 8	4 to 10

* The special specification is applied to the entire unit when a hole diameter is changed. For information on the dimensions, please contact our sales representatives.
* The wave generator of a standard product is a rigid type (integral type). The Oldham type (self-aligning mechanism) is included in the special specification.

Mechanical Accuracy

By using a high-accuracy and high-stiffness cross roller bearings, the CSF-mini series 2UP, achieves high accuracy. The mechanical accuracy on the output side is shown below.

Figure 5-1

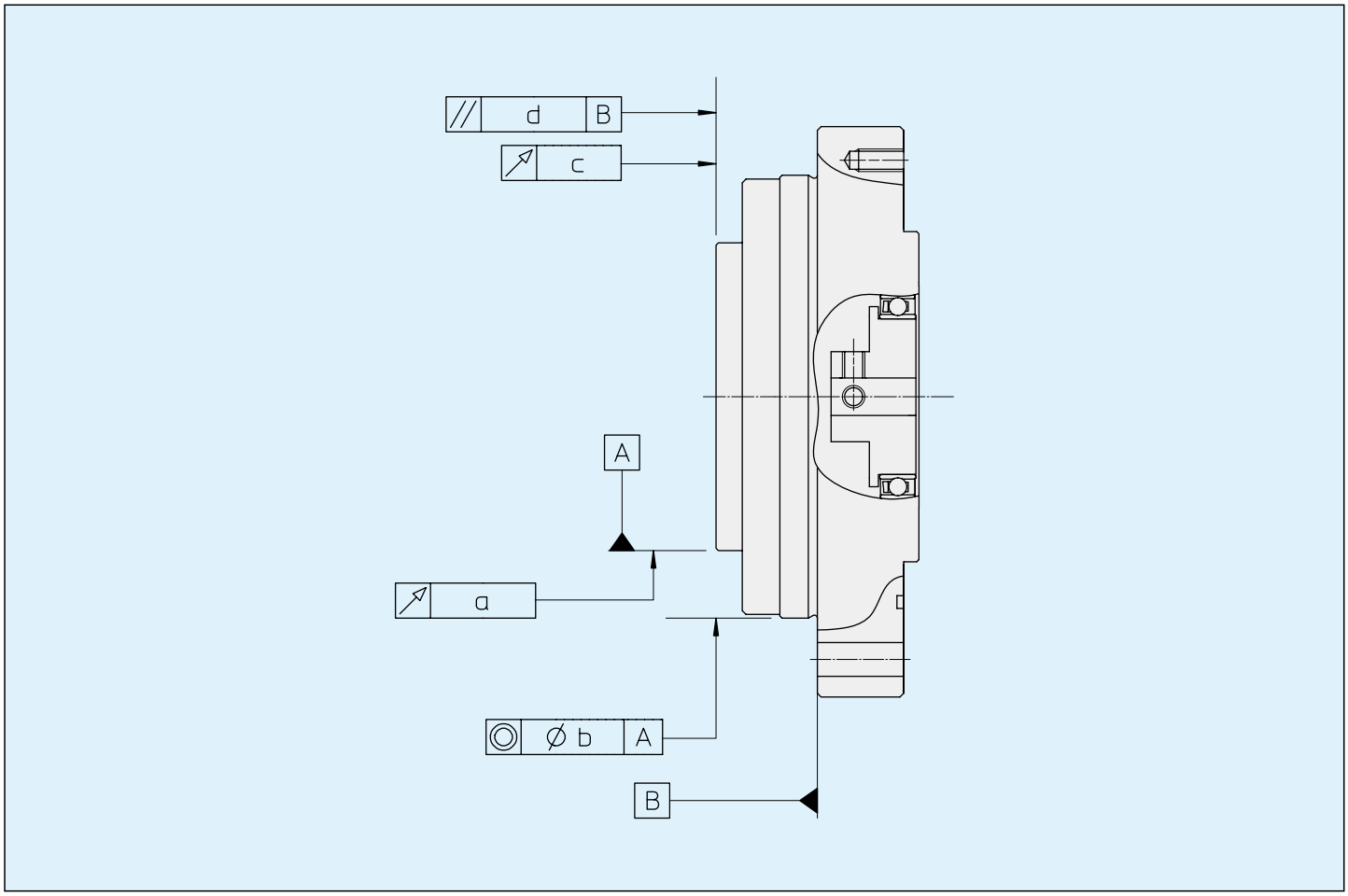


Table 5-2
Unit: mm

Symbol	Feature	Size		
		8	11	14
a	Output shaft axial runout	0.010		
b	Concentricity of the mounting pilot	0.040		
c	Output flange surface runout	0.010		
d	Parallelism between the mounting face and the output flange face	0.040		

(Note) Values are based on the Total Indicator Reading (T.I.R.).

■ Efficiency

The efficiency varies depending on the following conditions.
- Reduction ratio
- Input rotating speed
- Load torque
- Temperature
- Lubrication condition (Lubricant type and amount)

■ Efficiency compensation coefficient

The value of efficiency drops when load torque is smaller than rated torque. Calculate the compensation coefficient Ke from graph 6-1 and calculate the value of efficiency with the reference to the efficiency compensation calculation formula.

Example: Calculate efficiency η (%) for the CSF-8-100-2UP under the following conditions:
Input rotational speed 1000 rpm
Load torque: 2.0 Nm
Lubrication method: Grease lubricant
Lubricant temperature: 20°C

Torque ratio α is 0.83 since the rated torque for size 8 and reduction ratio 100 is 2.4 Nm. (α = 2.0 / 2.4 ≒ 0.83)

The efficiency compensation coefficient is calculated according to graph 6-1: Ke = 0.99

Efficiency η when load torque is 2.0 Nm is calculated: $\eta = Ke \cdot \eta_R = 0.99 \times 77\% = 76\%$

* When load torque is larger than rated torque, efficiency compensation coefficient Ke = 1.

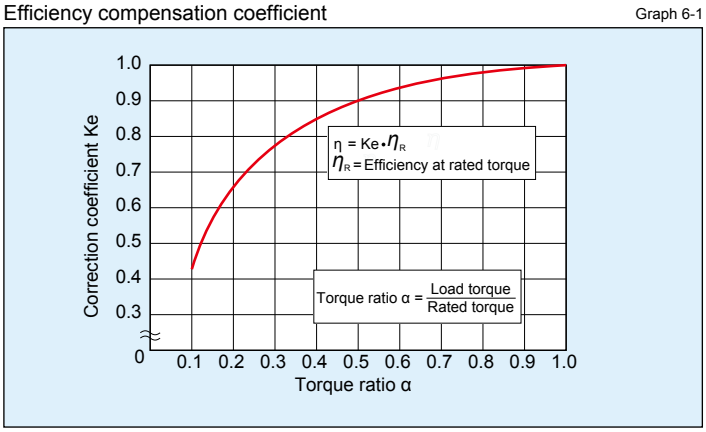
Measuring condition

Table 6-1

Load torque	Rated torque indicated in the rating table		
Lubrication condition	Grease lubrication	Name	Harmonic Grease® SK-2
		Applied amount	Appropriate applied amount

Efficiency compensation coefficient

Graph 6-1

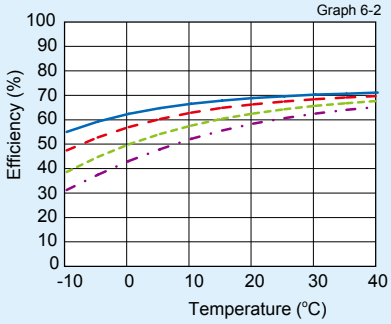


■ Efficiency at rated torque

Size: 8

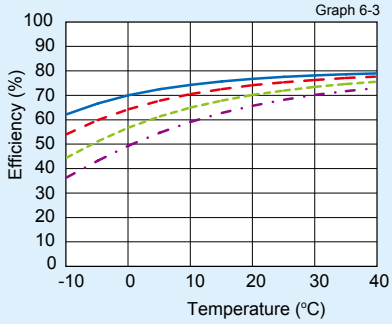
Reduction ratio 30

Graph 6-2



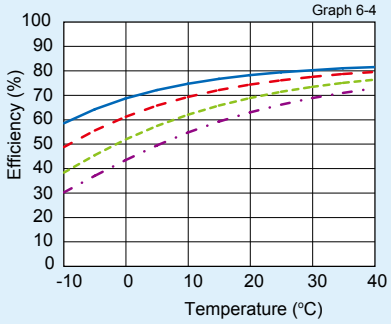
Reduction ratio 50

Graph 6-3



Reduction ratio 100

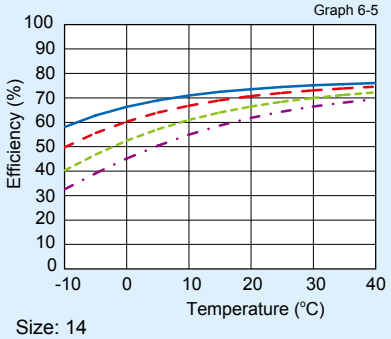
Graph 6-4



Size: 11

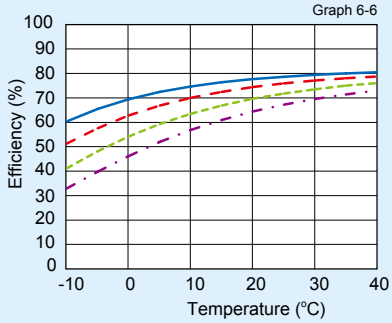
Reduction ratio 30

Graph 6-5



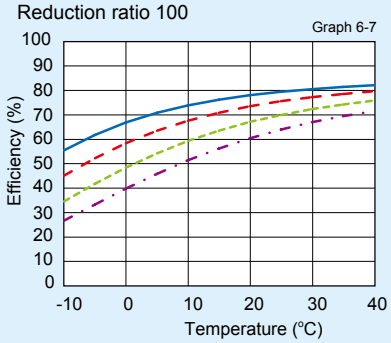
Reduction ratio 50

Graph 6-6



Reduction ratio 100

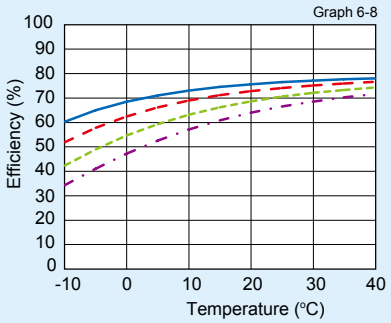
Graph 6-7



Size: 14

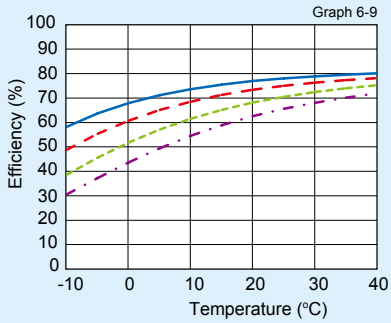
Reduction ratio 30

Graph 6-8



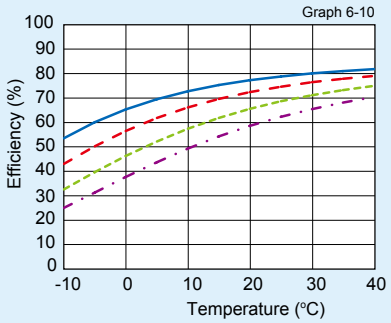
Reduction ratio 50

Graph 6-9



Reduction ratio 100

Graph 6-10



Input rotational speed — 500r/min — 1000r/min — 2000r/min — 3500r/min

■ No Load Running Torque

No load running torque is the input torque (high-speed shaft side) that is required to rotate the HarmonicDrive® gear with no load applied to the output.

* For details about the values, please contact our sales representatives.

■ Compensation Value in Each Ratio

The no load running torque of the gear varies with ratio. Graphs 7-1 through 7-4 show the value of reduction ratio 100. Other reduction ratios must be calculated by adding the compensation value indicated in Table 7-2.

Measuring condition

Table 7-1

Reduction ratio 100			
Lubrication condition	Grease lubricant	Name	Harmonic Grease® SK-2
The torque value is measured after two or more hours run-in at 2000 rpm input.			

No load running torque compensation value

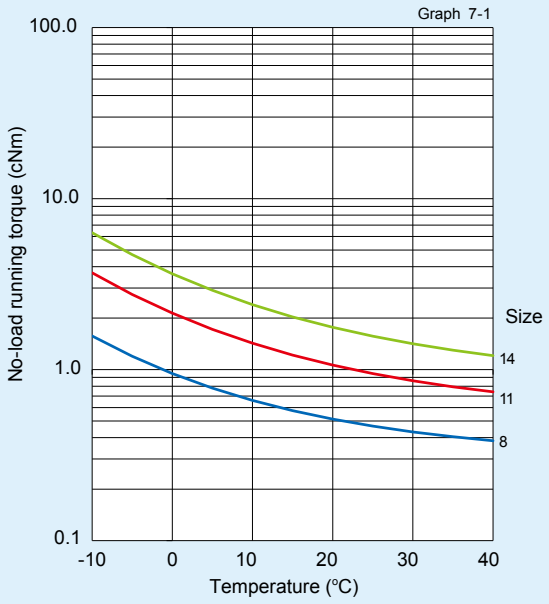
Table 7-2
Unit: cNm

Size \ Reduction ratio	30	50
8	0.49	0.22
11	0.81	0.36
14	1.25	0.55

■ No load running torque for reduction ratio 100

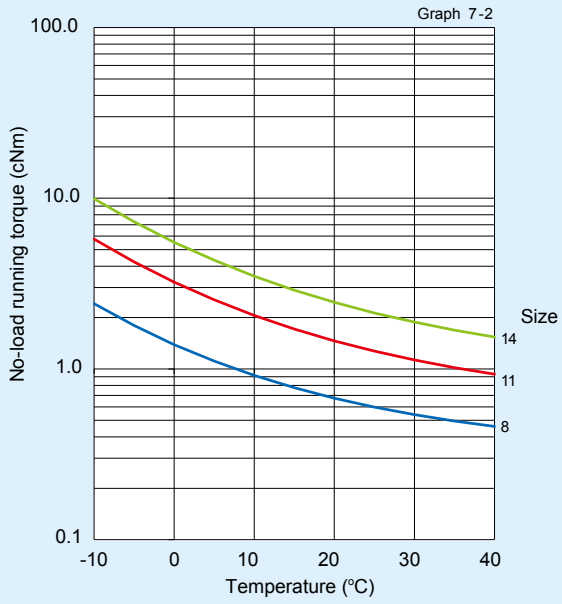
Input rotational speed 500r/min

Graph 7-1



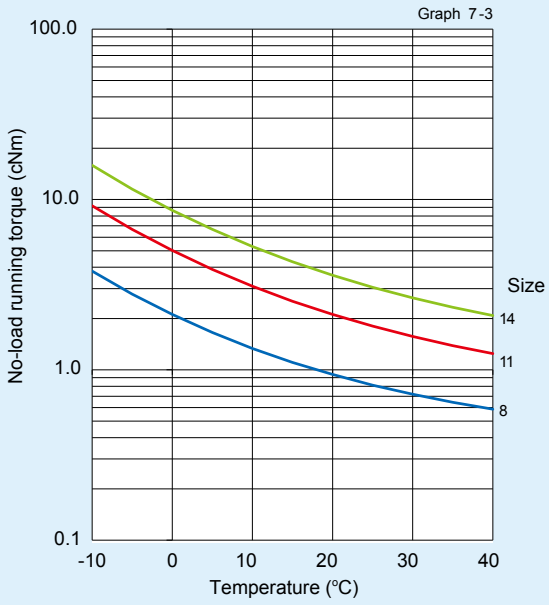
Input rotational speed 1000r/min

Graph 7-2



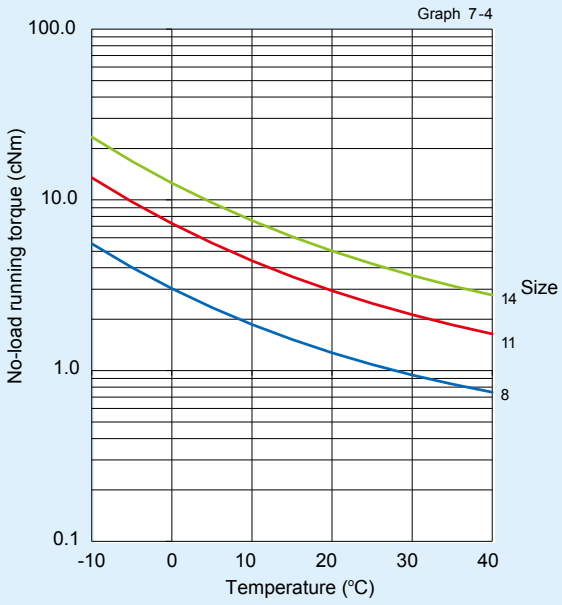
Input rotational speed 2000r/min

Graph 7-3



Input rotational speed 3500r/min

Graph 7-4

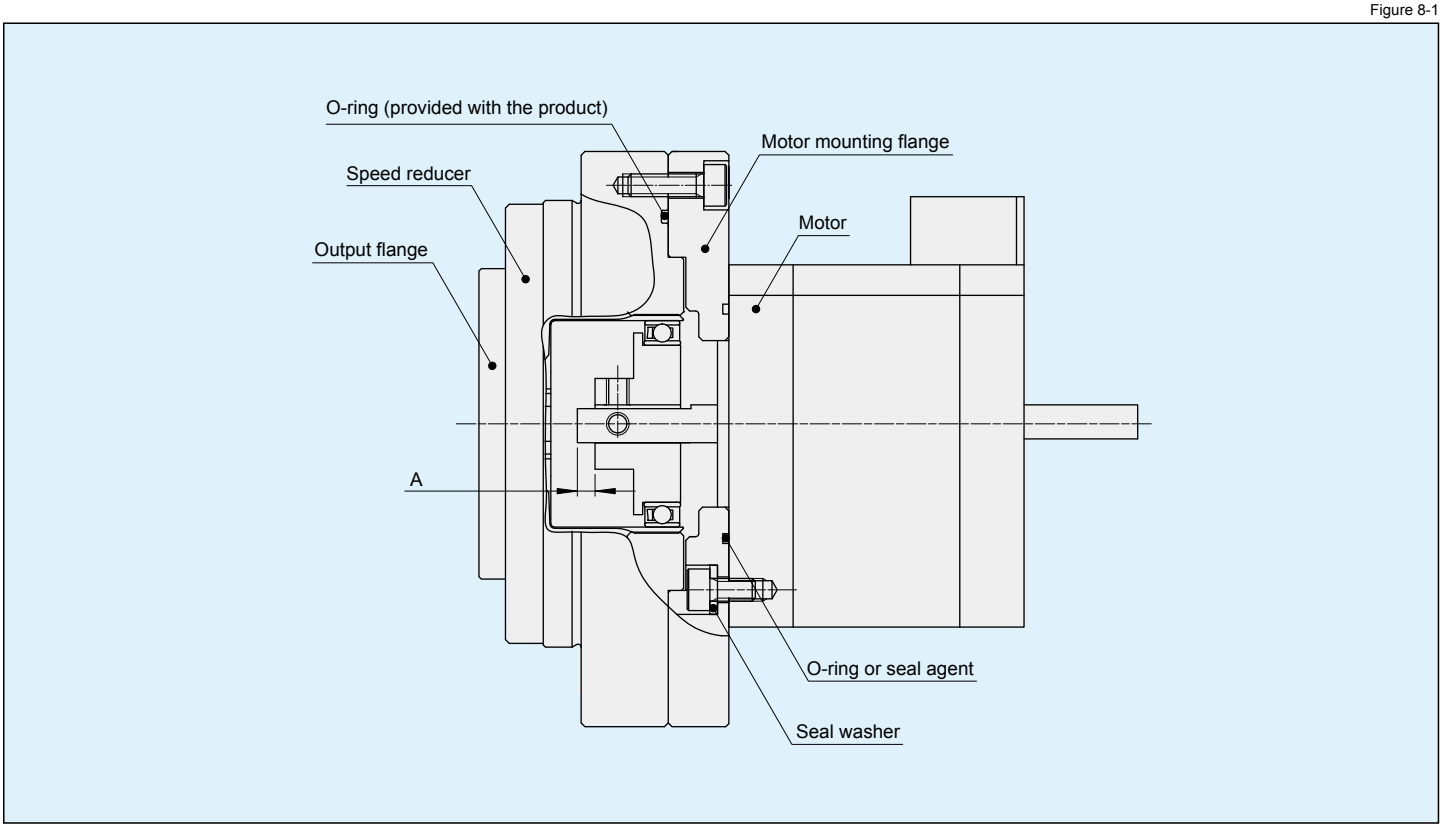


*Average value is $\bar{X}$ in this graph.

■ Example of Mounting

Example of a mounting on the motor is shown below:

Figure 8-1



■ Sealing

The sealing structure as shown below is required for mounting the motor for the purpose of grease leakage prevention and of maintaining the high durability of the HarmonicDrive® gear.

Table 8-1

Area requiring sealing		Recommended sealing method
Motor mounting flange	On the gear side (On the reducer side)	Using O-ring (provided with our product)
	On the motor side	O-ring, seal agent, seal washer, and others (Take care regarding the distortion on the plane and how the O-ring is engaged.)
Motor output shaft		Please select a motor output shaft with oil seal attached. If the oil seal is not provided, employ a design where the oil seal is attached to the motor mounting flange.
Screw hole area		Use the screw lock agent with sealing effect (Loctite 242 is recommended), or use the sealing tape.

* There is no need to apply a seal agent on the output flange because it includes a seal.

■ Precautions when installing the motor

Be sure that the motor shaft does not protrude from the wave generator more that permitted in Table 8-2 below. (Refer also to Figure 8-1)

Table 8-2
Unit: mm

Dimension \ Size	8	11	14
A	2.5	4.5	6

Installation Accuracy

In order to fully achieve the excellent performance of the CSF-mini series 2UP, maintain the recommended mounting accuracy shown below:

Figure 9-1

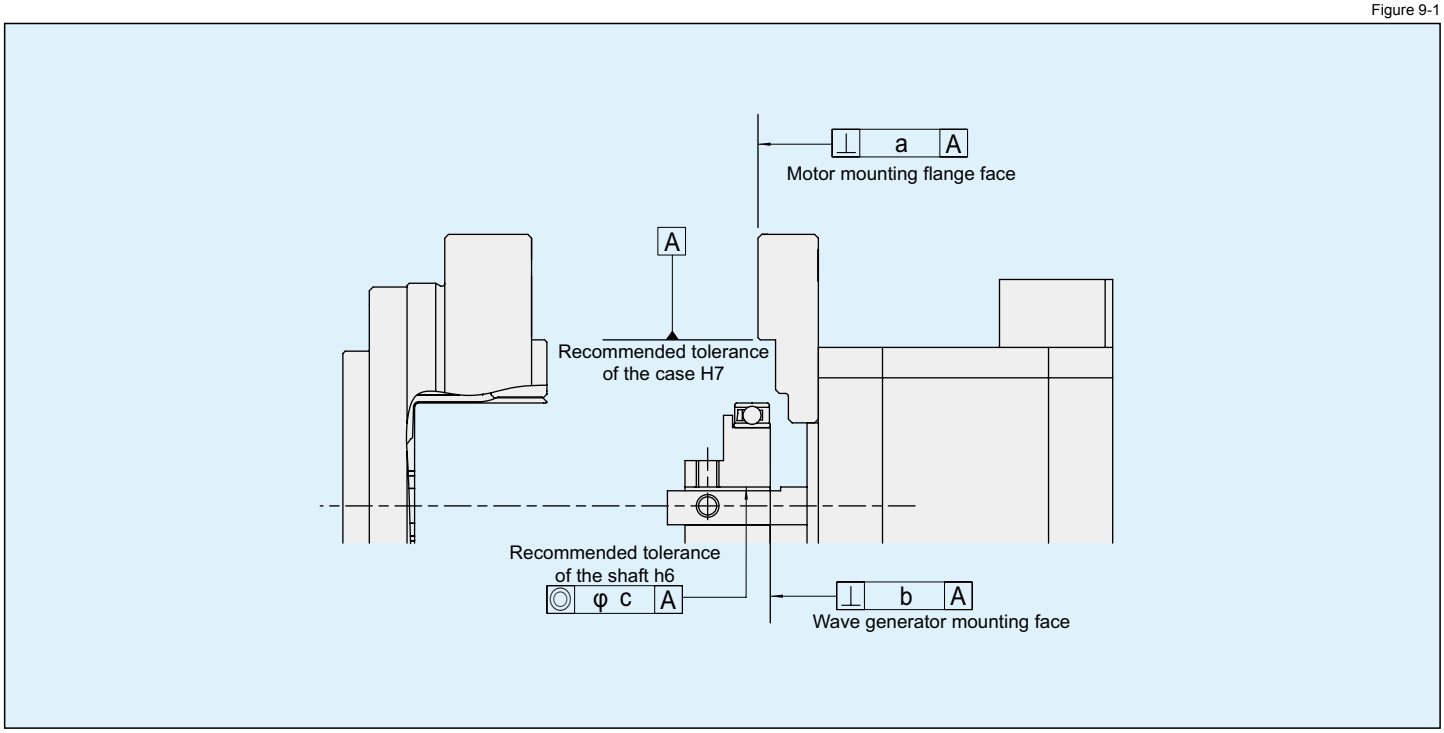
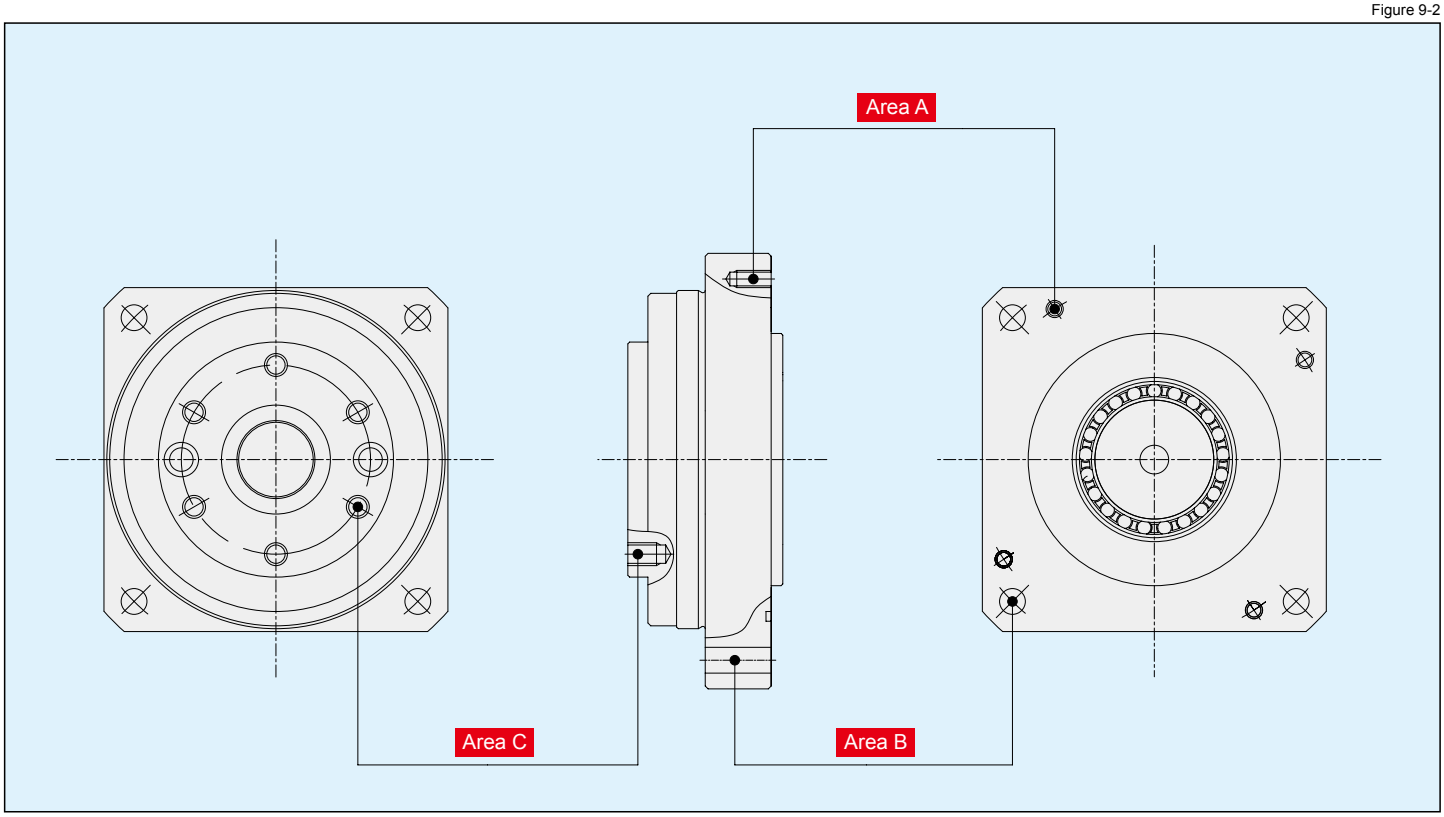


Table 9-1
Unit: mm

Tolerance \ Size		8	11	14
a	Adapter surface	0.010	0.011	0.011
b	Wave generator installation surface	0.006	0.007	0.008
c	Concentricity of the input shaft	0.006	0.007	0.016

Installation and Transmission Torque

Figure 9-2



■ Mounting on the flange A

When the CSF-mini series 2UP is installed on the motor, check the flatness of the mounting face and assure that holes are free from burrs, then fasten the reducer to the mounting flange using bolts.

Table 10-1

Item \ Size		8	11	14
Number of bolts		4	4	4
Bolt size		M3	M3	M4
Mounting P.C.D	mm	52	63	70.7
Tightening torque*	Nm	0.85	0.85	2.0
	kgfm	0.09	0.09	0.20
Minimum length of the screw mating	mm	3.6	3.6	4.8
Transmission torque*	Nm	18	22	44
	kgfm	1.9	2.3	4.5

* Recommended bolt name: JIS B 1176 hexagon socket head bolt, tensile strength rank: JIS B 1051 12.9 or higher

■ Installation into the equipment B

When the CSF-mini series 2UP type is installed into the equipment, check the flatness of the mounting face and assure that holes are free from burrs, then fasten the reducer to the equipment using bolts.

Table 10-2

Item \ Size		8	11	14
Number of bolts		4	4	4
Bolt size		M3	M4	M5
Mounting P.C.D	mm	58	70	88
Tightening torque*	Nm	1.2	2.7	5.4
	kgfm	0.12	0.28	0.55
Minimum length of the screw mating	mm	3.6	4.8	6.0
Transmission torque*	Nm	29.0	59.1	119
	kgfm	3.0	6.0	1.2

* When the part of the mounting destination is made of steel
* Recommended bolt name: JIS B 1176 hexagon socket head bolt, tensile strength rank: JIS B 1051 12.9 or higher

■ Mounting load into the output C

Mount the load to the output side of the CSF-mini series 2UP by taking into consideration the cross roller bearing specifications.

Table 10-3

Item \ Size		8	11	14
Number of bolts		6	6	6
Bolt size		M3	M4	M5
Mounting P.C.D	mm	25.5	33.0	44.0
Tightening torque	Nm	2.0	4.5	9.0
	kgfm	0.20	0.46	0.92
Minimum length of the screw mating	mm	3.6	4.8	6.0
Transmission torque	Nm	31.9	69.6	184
	kgfm	3.3	7.1	15

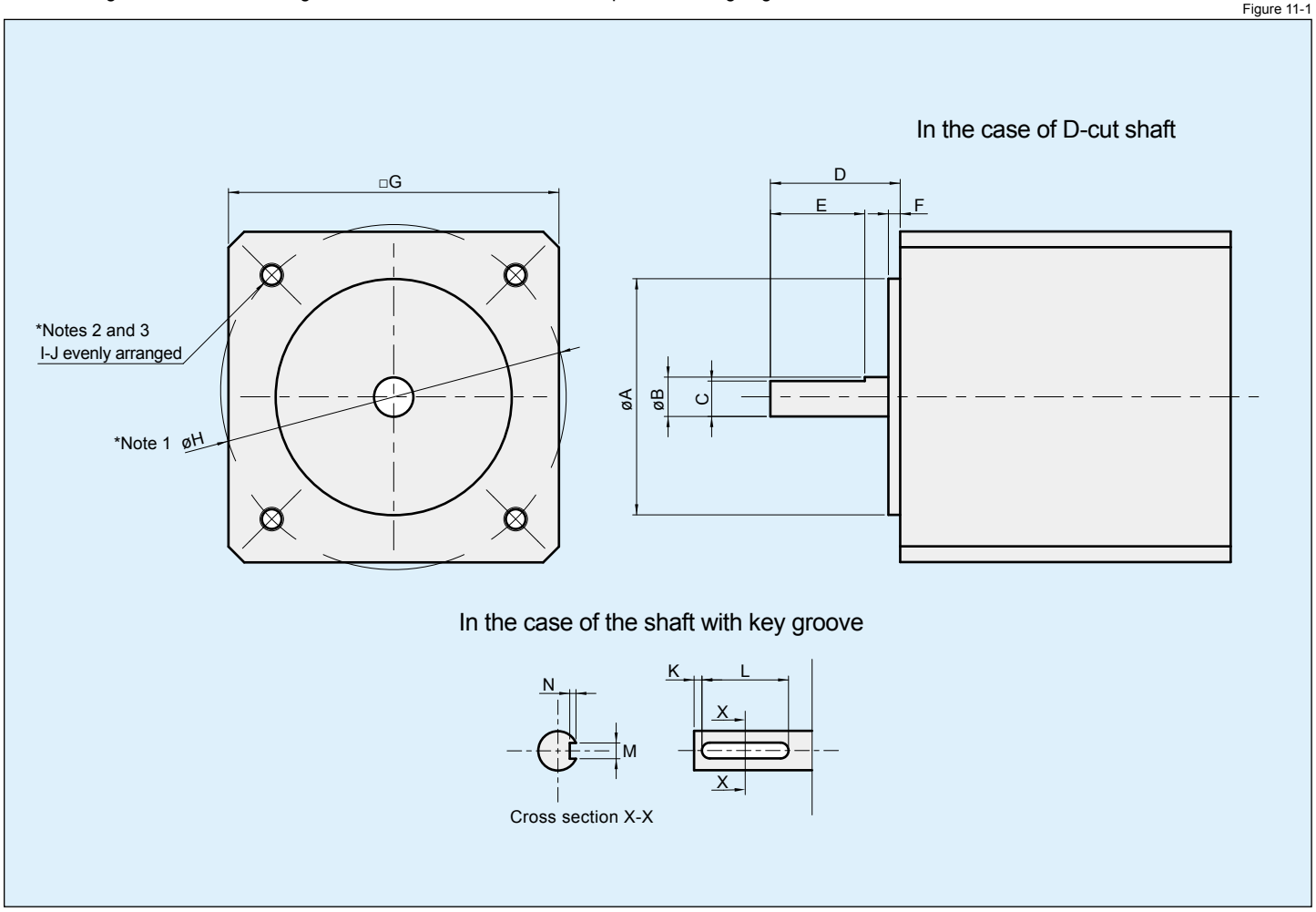
There is no need to apply a sealing compound to the output flange because it includes a seal.

* Recommended bolt name: JIS B 1176 hexagon socket head bolt, tensile strength rank: JIS B 1051 12.9 or higher

Motor Mounting Flange

The motor mounting flange is provided by our company.
Please let us know dimensions A through J (when the key groove is attached: A through N) described in Figure 11-1 when ordering because the motor dimension is required for designing.

Figure 11-1



* Note 1. H: Mounting hole pitch diameter or pitch angular dimension
* Note 2. I: Total number of mounting holes
* Note 3. J: Tap hole nominal diameter and hole depth or through hole diameter
* Note 4. Please let us know the O-ring dimension when it is used on the motor and the motor mounting flange connecting part.

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