HARMONIC REDUCERS

PRODUCT INFORMATION

INFRANOR
MOTION EXCELLENCE

PRODUCT COMPOSITION

The harmonic gear drive consists of three basic components: Wave generator, FS and CS.

WAVE GENERATOR

As the input end of the harmonic reducer, the wave generator is generally composed of a cam and a flexible bearing. The inner ring of the flexible bearing is fixed to the cam. The outer ring is elastically deformed by the rolling elements to have an elliptical shape.

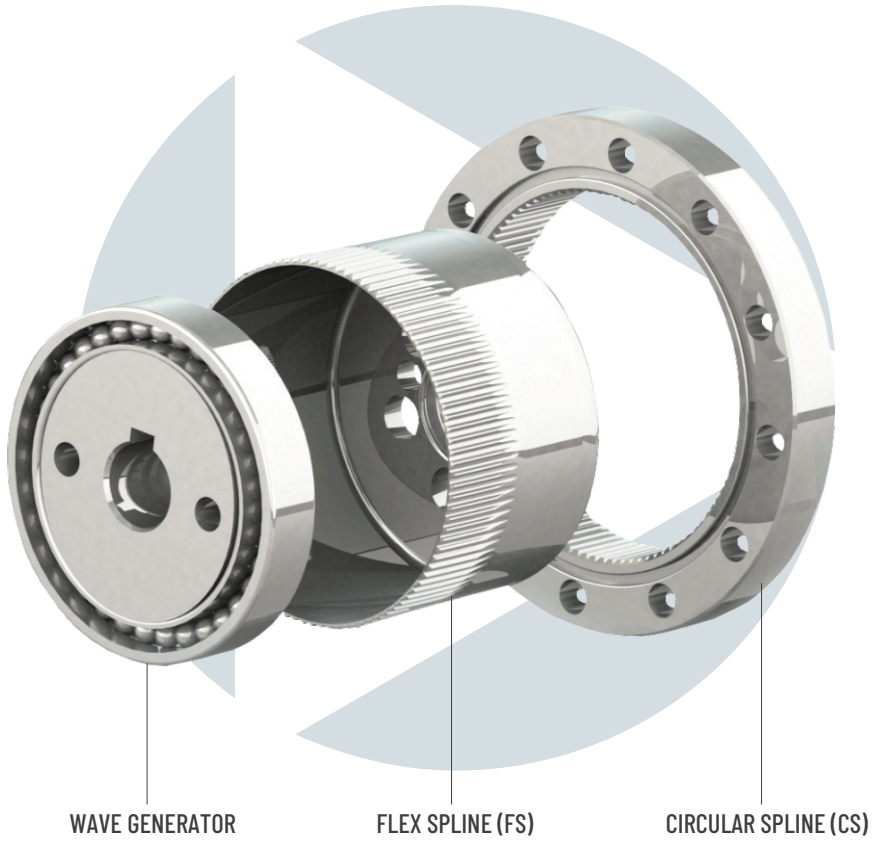
FLEX SPLINE (FS)

Generally installed at the output end of the reducer, FS has an outer ring gear with flexible thin-walled parts, and its inner ring is matched with the outer ring of the flexible bearing.

CIRCULAR SPLINE (CS)

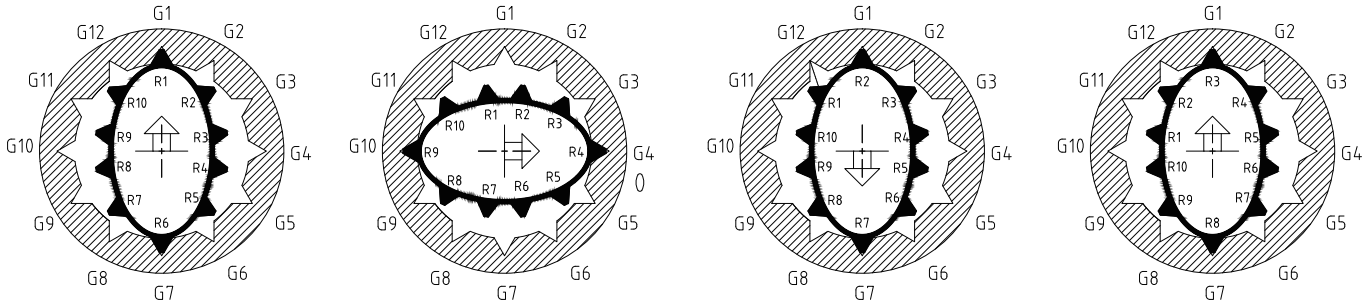
The CS is fixed to the body of the reducer. It has an inner ring gear with rigid annular parts, which has generally two teeth more than the FS.

COMPOSITION OF AHARMONIC REDUCER



Harmonic gear drives are often used as reducers. During the working process, as the FS is forced to elastically deform into an elliptical shape, and the fully engaged state occurs in which the teeth of the FS at the long axis are inserted into the tooth grooves of the CS; While the two-wheel teeth at the short axis are completely out of contact and are in a disengaged state. The teeth are engaging-in or engaging-out during the process of meshing to disengagement. When the wave generator rotates continuously, the FS is forced to generate elastic deformation continuously, so that the two-wheel teeth change their working states continuously during the process of engaging-in, meshing, engaging-out and disengaged, and the staggered teeth movement is generated. Thereby, the motion transmission between the active wave generator and the FS is realized.

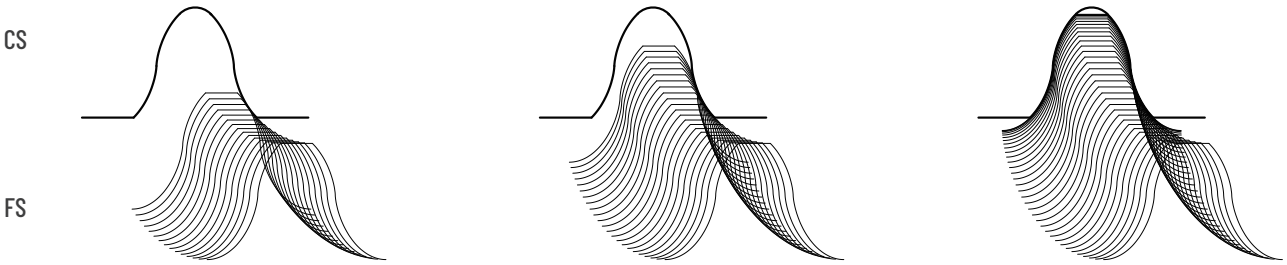
STAGGERED TEETH PROCESS OF HARMONIC REDUCERS



1. Large transmission ratio with a wide range.
2. Large number of teeth pairings participate in the meshing at the same time.
3. Limited and uniform wear to the tooth surface and a high transmission efficiency.
4. High transmission accuracy and long life.
5. Stable transmission with no impact and low noise emission.

ABOUT THE TOOTH PROFILE

Our tooth profile is designed based on the curve mapping theory, the IH tooth shape and the Harmonic Gear Transmission Theory and Design. we have applied for a patent application. The number of teeth that the toothed harmonic gear meshes at the same time during operation can reach 30% of the total number of teeth. In contrast, the traditional involute toothed harmonic gear does not exceed 15% of the teeth engaged when it is stressed. At the same time, by the increase of the number of meshing teeth, the performance of the harmonic gear in stiffness, transmission accuracy, output torquecan increases up to more then 30%.



SCHEMATIC DIAGRAM OF THE FLEX SPLINE AND CIRCULAR SPLINE MOVEMENT

TERMS AND DEFINITIONS

RATED TORQUE
Rated torque indicates allowable continuous load torque at rated input speed.

LIMIT FOR AVERAGE TORQUE
In cases where load torque and input speed vary, it is necessary to calculate an average value of load torque. The table indicates the limit for average torque. The average torque calculated must not exceed this limit.

MAXIMUM AVERAGE INPUT
SPEED MAXIMUM INPUT SPEED
Do not exceed the allowable rating.

LIMIT FOR REPEATED PEAK TORQUE
During acceleration and deceleration the Harmonic Reducer gear experiences a peak torque as a result of the moment of inertia of the output load. The table indicates the limit for repeated peak torque.

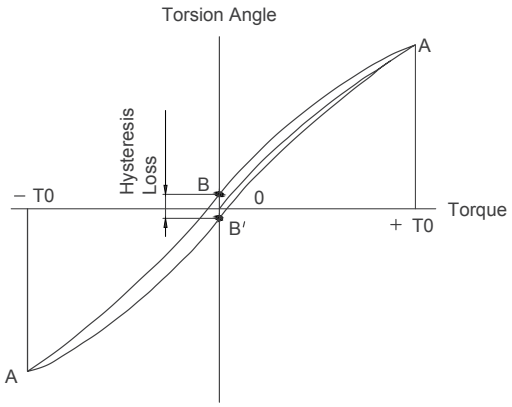
LIMIT FOR MOMENTARY PEAK TORQUE
The gear may be subjected to momentary peak torques in the event of a collision or emergency stop . The magnitude and frequency of occurrence of such peak torques must be kept to a minimum and they should, under no circumstance, occur during normal operating cycle. In addition, a limit of frequency of such torque action shall be set.

POSITIONAL ACCURACY
Positional Accuracy values represent the difference between the theoretical angle and the actual angle of output for any given input.The values shown in the table are maximum values.

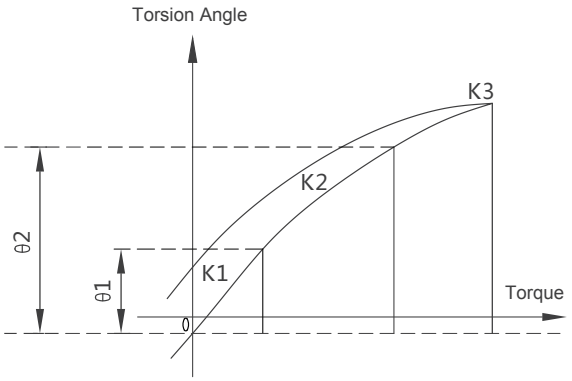
STIFFNESS

Fixing the input side (wave generator) and applying torque to the output side (flexspline) generates torsion almost proportional to the torque on the output side.

The following figure is drawn based on the changes in the torsion angle on the output side when the torque applied to the output shaft increases or decreases to +T0/-T0 on the positive and negative sides starting from 0. It is referred to as a "torque-torsion angle diagram" and is generally depicted as a loop of 0-A-B-A'-B '-A. Torsional stiffness K1, K2, K3 is given in the respective reducer data sheet.



TORQUE-TORSION ANGLE DIAGRAM



SPRING CONSTANT

LIFE

The life of a gear is determined by the life of the wave generator bearing. The life may be calculated by using the input speed and the output load torque.

Life		
Series	RCU/RCH	RSUT/RSHT
L_{10} (10% damage accuracy)	7000	10000
L_{50} (Average life)	35000	50000

Remark: Life is based on the input speed and output load torque from the rating table.

CALCULATION FORMULA FOR RATED LIFETIME

Ln——Life of L10 or L50
Tr——Rated torque
Nr——Rated input speed
Tav——Average load torque on the output side
Nav——Average input speed

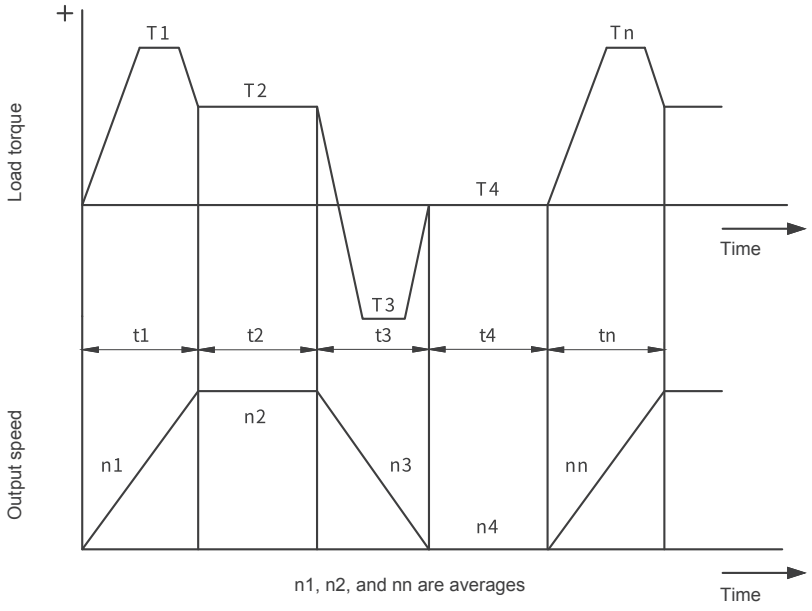
$$L_h = L_n * \left(\frac{T_r}{T_{av}}\right) * \frac{N_r}{N_{av}}$$

PRODUCT SIZING & SELECTION

In general, a servo system rarely operates at a continuous load and speed. The input rotational speed and load torque change and also during start/stop large torque effects can occur. Unexpected impact torque may be applied. These fluctuating load torques should be converted to the average load torque when selecting a model.

CHECKING THE APPLICATION MOTION PROFILE

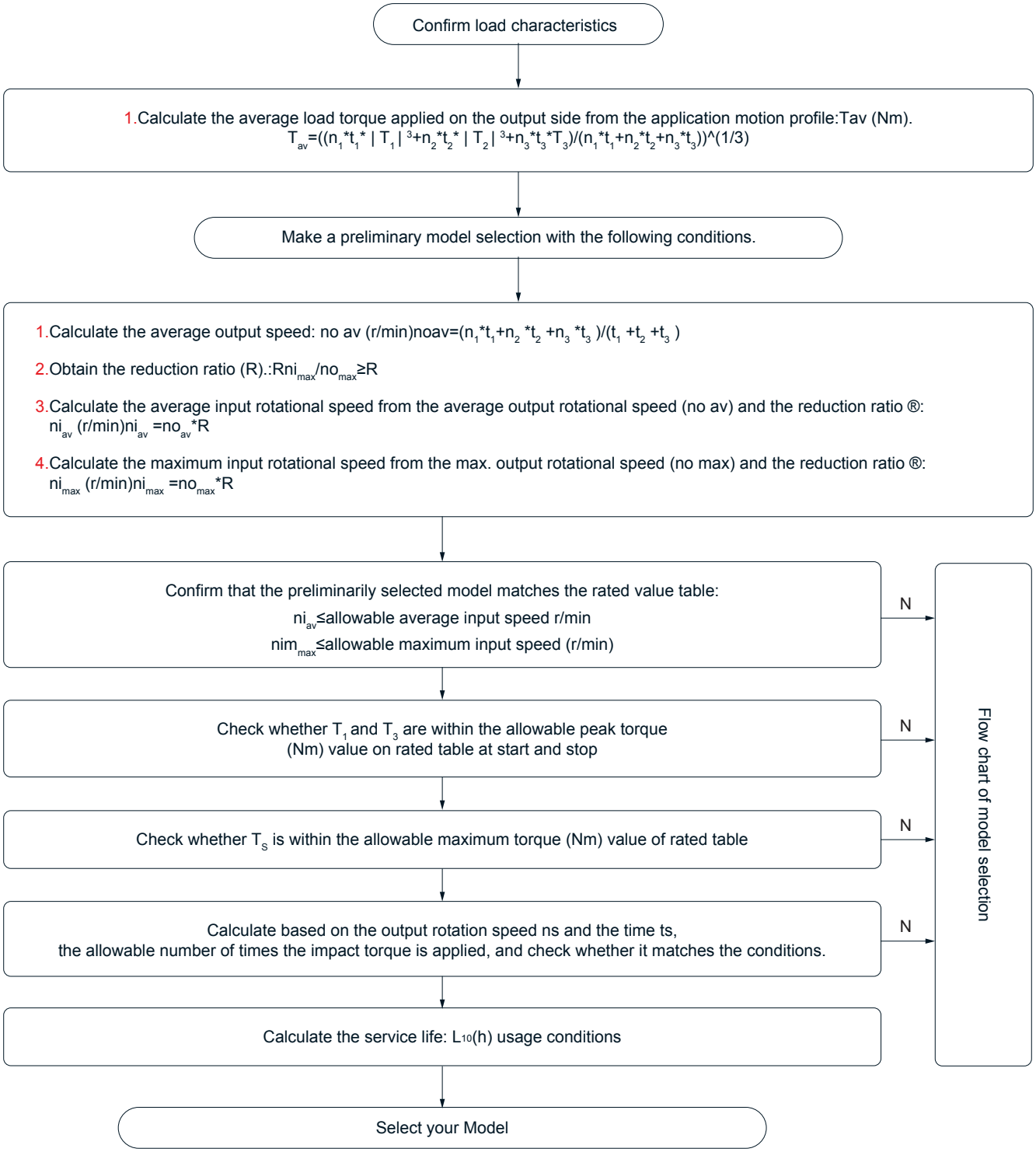
Be sure to use the recommended values for the housing shown below, to achieve the best performance of the assembly. Check the application motion profile.



LOAD CYCLE DIAGRAM

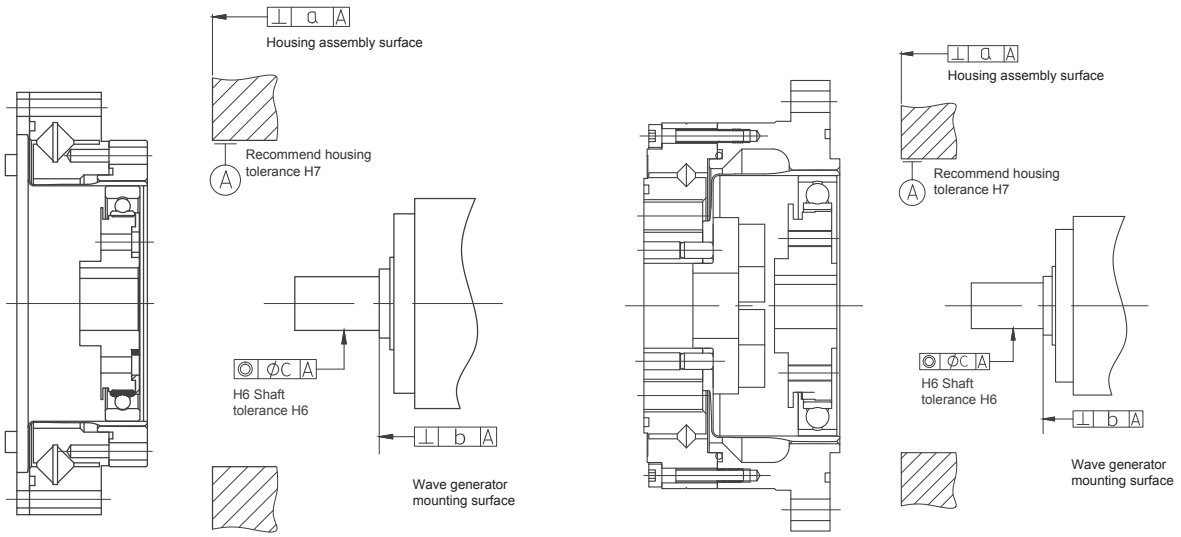
FLOWCHART FOR SELECTING A SIZE

Use the flowchart shown below for selecting a size. Operating conditions must not exceed the performance ratings.



ASSEMBLY PRECISION

Be sure to use the recommended values for the housing shown below to achieve the best performance of the assembly.

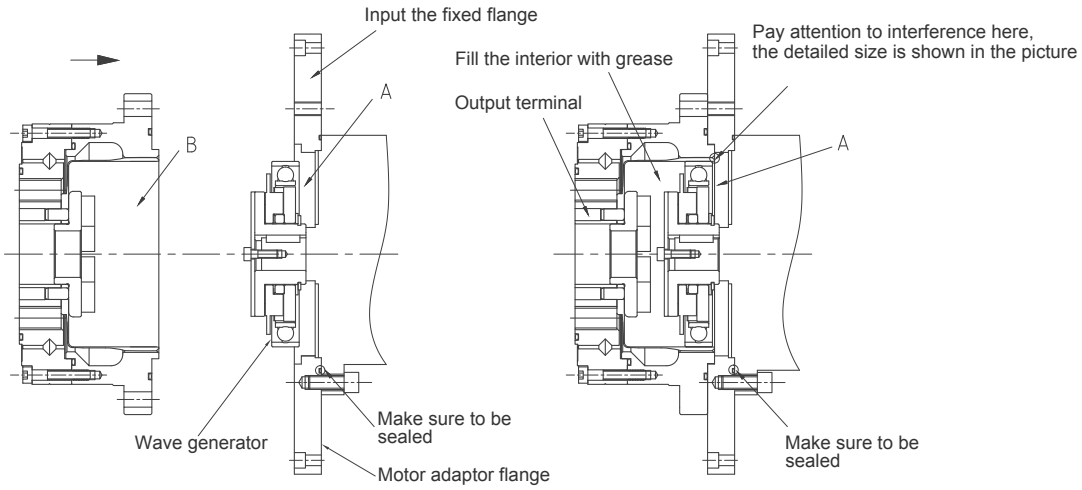


Unit:mm

Size / Symbol	14	17	20	25	32	40	45
a	0.011	0.015	0.017	0.024	0.02 6	0.026	0.027
b	0.008	0.010	0.010	0.012	0.012	0.012	0.013
c	0.016	0.018	0.019	0.022	0.022	0.024	0.027

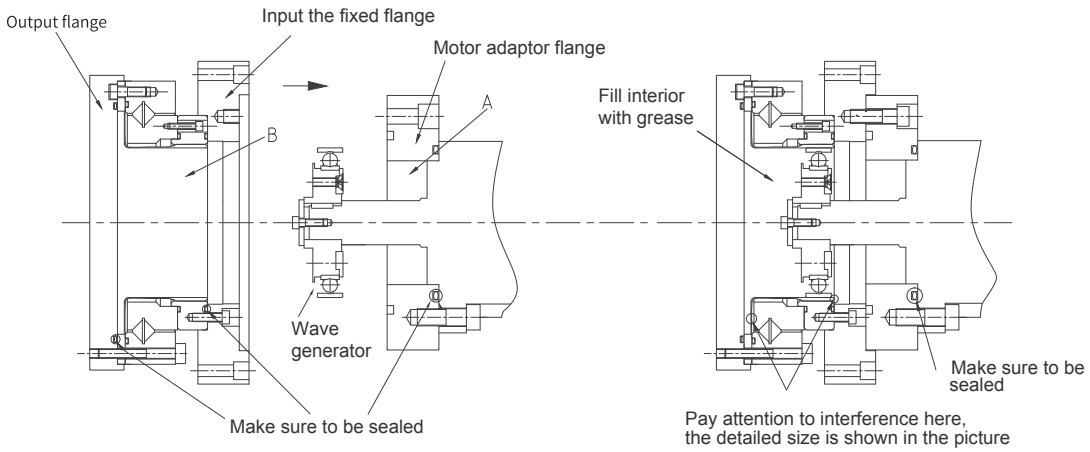
DCS(G) SERIES INSTALLATION EXAMPLE

CS FOR FIXATION, FS FOR OUTPUT



DHS(G) SERIES INSTALLATION EXAMPLE

CS FOR FIXATION, FS FOR OUTPUT

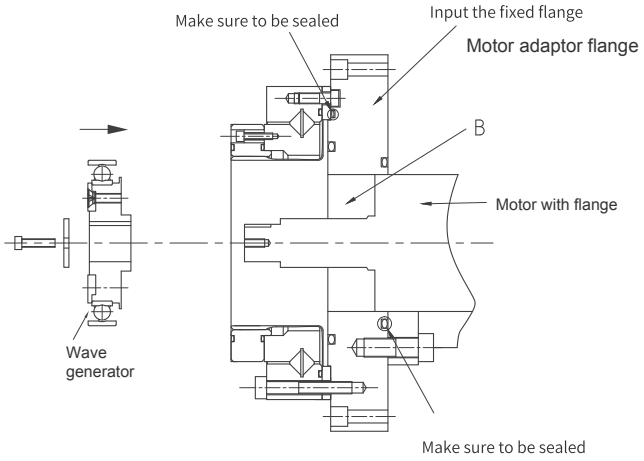


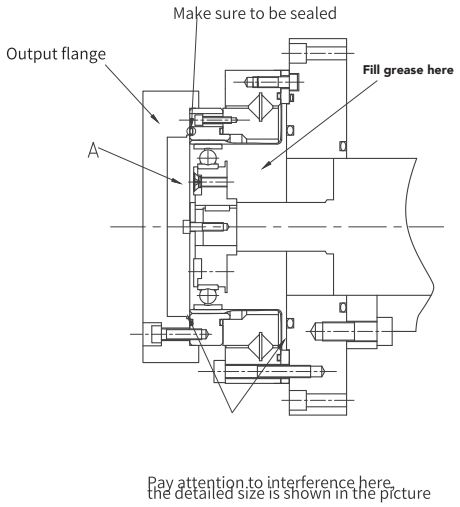
1. The motor is fixed to the flange, and the wave generator is fixed to the motor shaft;
2. Install the combination of the FS, the CS and the crossed roller bearing onto the flange.

Notes: a. Do not use excessive force while assembling. The wave Generator can be installed by spinning it counter to the Flex Spline.
b. Do not tilt during installation.

DHS(G) SERIES INSTALLATION EXAMPLE 2

When the Flex Spline (FS) is fixed and the Circular Spline (CS) is the output, the reduction ratio is the indicated reduction ratio +1.

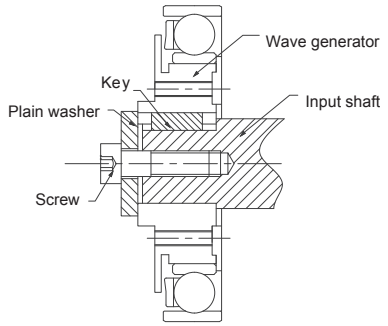




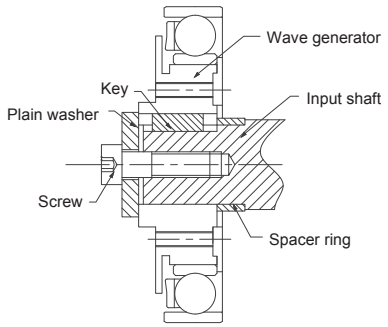
1. Fix the motor to the flange and fix the combination of the FS, CS and the crossed roller bearing to the flange.
2. Install the wave generator on the motor shaft.

Notes: a. Do not use excessive force while assembling. The wave Generator can be installed by spinning it counter to the Flex Spline.
b. Do not tilt during installation.

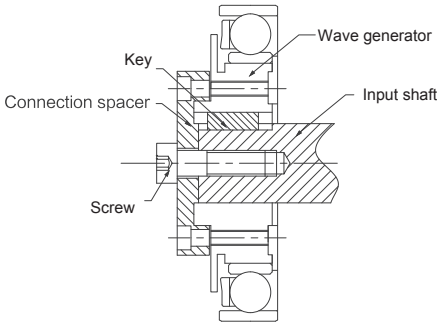
COMMON CONNECTION METHODS OF WAVE GENERATORS



1. The input shaft has a shoulder that can be directly attached to the wave generator.

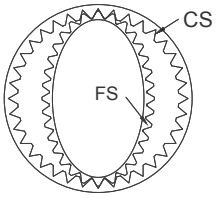


2. The input shaft is connected to the wave generator after adding the spacer ring. The input shaft has a shoulder with a length too long, and a spacer (the parallelism of the two sides of the spacer ring shall be within 0.01mm) can be applied to the shaft and then the shaft can be fixed to the wave generator.

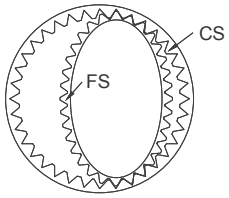


3. Attach the input shaft to the wave generator using a screw and a connection spacer.

PRECAUTIONS FOR INSTALLATION



Correct installation



Wrong installation

1. The harmonic reducer shall be installed in a clean environment, and no foreign matter is allowed to enter the inside of the reducer during installation to avoid damage to the reducer during use.
2. Make sure that the gear face and flexible bearing parts of the reducer are always lubricated adequately. It is not recommended to always use the gears with the teeth facing up, as this impairs the lubricating effect.
3. Do not change the product part combination. As the complete set guarantees their performance, do not replace the combined parts.
4. Please take care to avoid product falling. Even if there are no scratches on the surface, internal stress changes may reduce the fatigue strength, when the wave generator and the FS falls. Do not use dropped products.
5. Please avoid excessive force on the wave generator and the FS during assembly. A smooth insertion occurs by rotating the wave generator.
6. After installing the wave generator, make sure that the FS and the CS mesh 180 degrees symmetrical. If it is biased to one side, it causes vibration and the FS shall be damaged quickly. The following two methods are used to determine whether the assembly is meshed properly:
   a. Turn the input shaft by hand when the output end is not loaded, if the force required during the rotation is extremely uneven, there is a possibility of installation error.
   b. Make the motor rotate when the output end does not have a load, if the average current value of the motor is 2-3 times under normai conditions, there may be an installation error.
7. Please run at low speed (100 rpm) after installation. If there is abnormal vibration or noise, please stop using it immediately and contact us to avoid damage to the reducer due to improper installation.

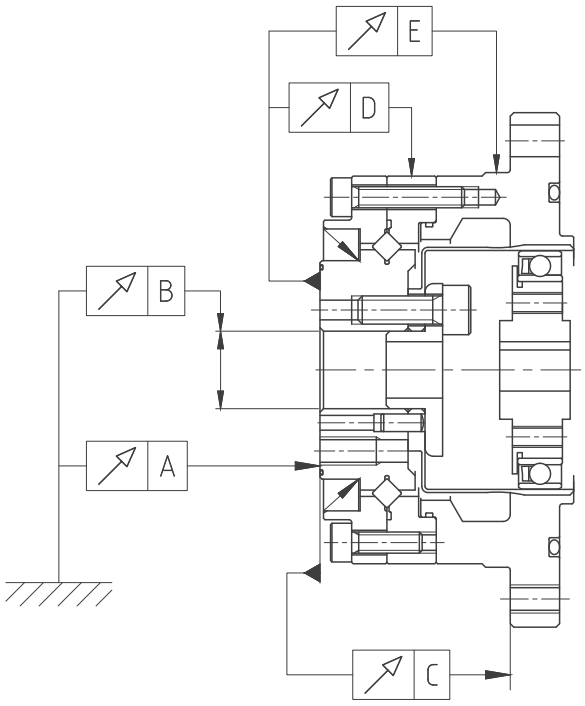
GREASES

Our products have been sealed with grease inside before delivery. However, grease must be injected and applied when the wave generator is assembled.
Precautions for grease use:

1. The input and output of the harmonic reducer has to be appropriatly sealed.
2. Our specific grease shall be used. Avoid mixing with other greases.
3. The grease must be used in accordance with the requirements of our installation instructions. Pay attention that greases are injected and applied in different amounts according to the model.
4. If the wave generator is always facing up during the harmonic reducer is in use, it may cause poor lubrication. In this case, increase the amount of grease injected or consult with us.
5. The performance of the grease changes as the temperature changes, and the higher the temperature, the faster the degradation. In order to ensure that the grease is always in good condition, the heat balance temperature at the high temperature end of the harmonic reducer should be lower than 60°C, and the temperature rise should be less than 40°C.
6. The wear of the moving parts of the harmonic reducer is mainly affected by the performance of the grease. The grease should be replaced every 3,000 hours of operation.

All products are subject to strict factory inspection. In order to ensure the accuracy of the whole machine, the following requirements are made to the mechanical precision of the harmonic reducer.

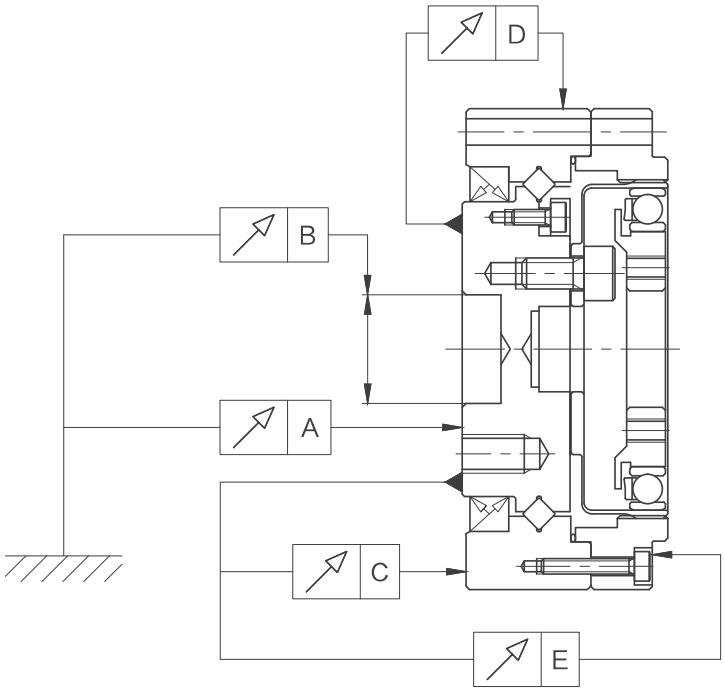
DCS(G) SERIES



Unit:mm

Size / Symbol	14	17	20	25	32	40	45
A	0.010	0.010	0.010	0.015	0.0 15	0.015	0.018
B	0.010	0.012	0.012	0.013	0.013	0.015	0.015
C	0.024	0.026	0.038	0.045	0.056	0.060	0.068
D	0.010	0.010	0.010	0.010	0.010	0.015	0.015
E	0.038	0.038	0.047	0.049	0.054	0.060	0.065

DCD SERIES

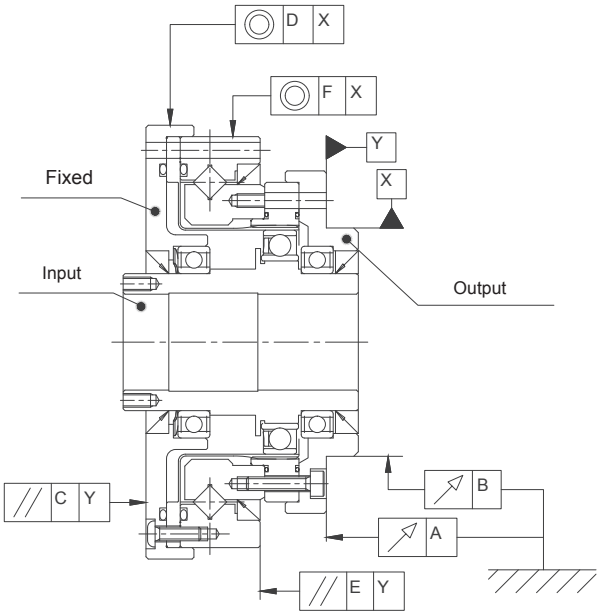


Unit:mm

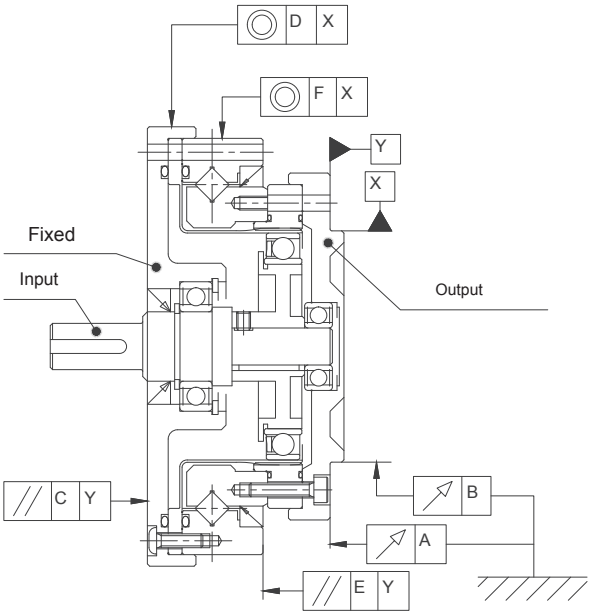
Symbol \ Size	14	17	20	25	32
A	0.010	0.010	0.010	0.015	0.015
B	0.010	0.012	0.012	0.013	0.013
C	0.007	0.007	0.007	0.007	0.007
D	0.010	0.010	0.010	0.010	0.010
E	0.025	0.025	0.025	0.035	0.037

DHSG -H/S SERIES

FS FOR FIXATION, CS FOR OUTPUT



DHSG-H



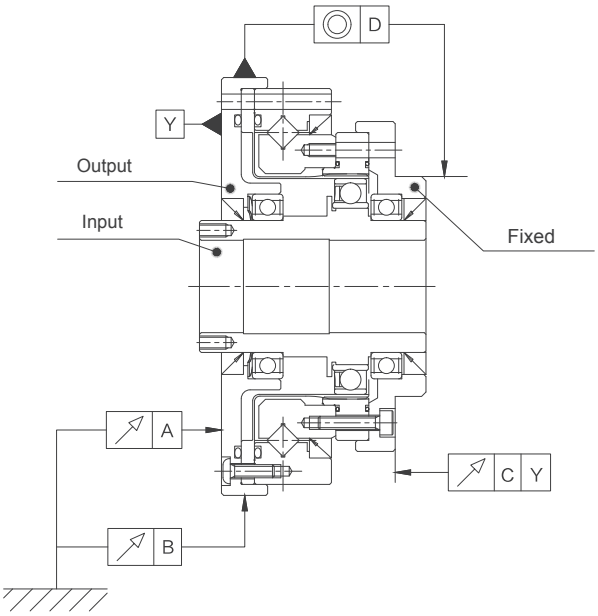
DHSG-S

Unit:mm

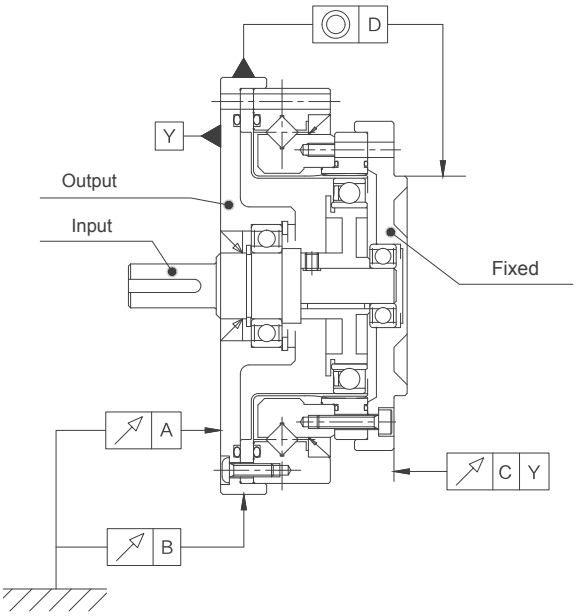
Size / Symbol	14	17	20	25	32	40	45
A	0.033	0.038	0.040	0.046	0.05 4	0.057	0.057
B	0.035	0.035	0.039	0.041	0.047	0.050	0.053
C	0.064	0.071	0.079	0.085	0.104	0.111	0.118
D	0.053	0.050	0.059	0.061	0.072	0.075	0.078
E	0.040	0.045	0.051	0.057	0.065	0.071	0.072
F	0.038	0.038	0.047	0.049	0.054	0.060	0.065

DHSG - H/S SERIES

CS FOR FIXATION, FS FOR OUTPUT



DHSG-H

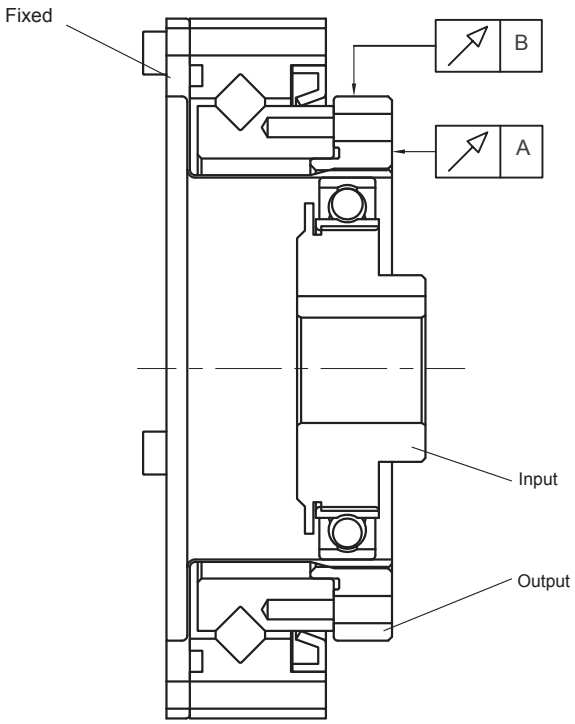


DHSG-S

Unit:mm

Size / Symbol	14	17	20	25	32	40	45
A	0.037	0.039	0.046	0.047	0.059	0.060	0.070
B	0.031	0.031	0.038	0.038	0.045	0.048	0.050
C	0.064	0.071	0.079	0.085	0.104	0.111	0.118
D	0.053	0.053	0.059	0.061	0.072	0.075	0.078

DHSG-R AND DHD-R SERIES

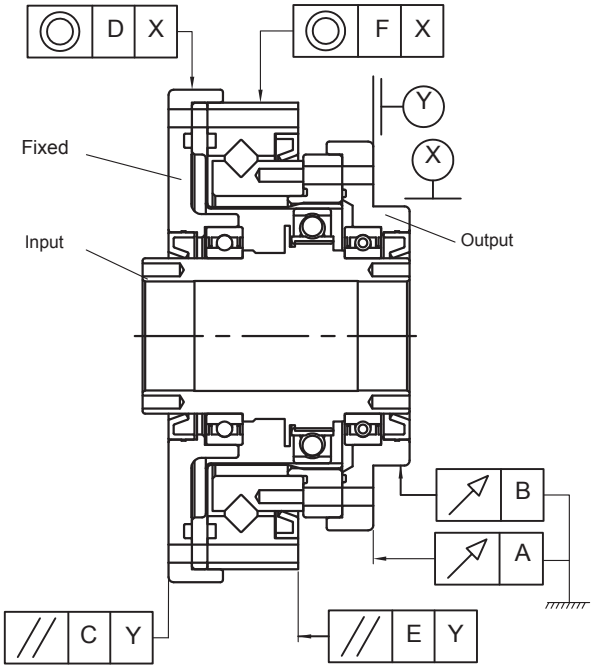


Unit:mm

Symbol \ Size	14	17	20	25	32
A	0.033	0.038	0.040	0.046	0.054
B	0.035	0.035	0.039	0.041	0.047

DHD-H/R SERIES

CS FOR FIXATION, FS FOR OUTPUT

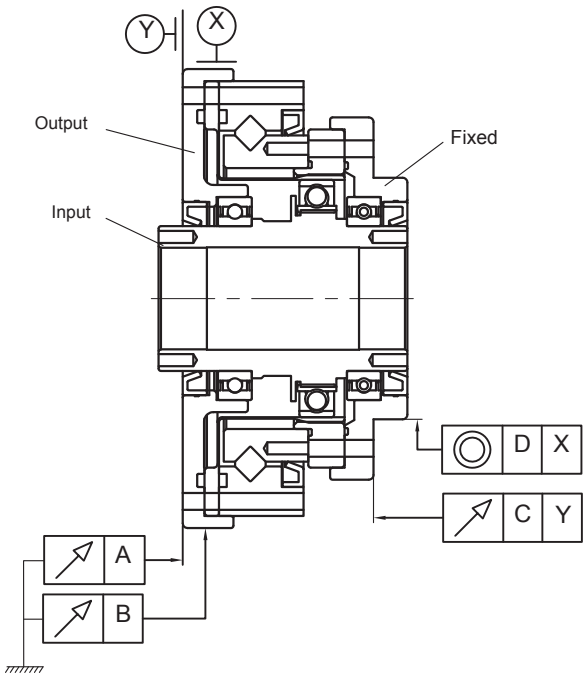


Unit:mm

Symbol \ Size	14	17	20	25	32
A	0.033	0.038	0.040	0.046	0.054
B	0.035	0.035	0.039	0.041	0.047
C	0.064	0.071	0.079	0.085	0.104
D	0.053	0.050	0.059	0.061	0.072
E	0.040	0.045	0.051	0.057	0.065
F	0.038	0.038	0.047	0.049	0.054

DHD-H/R SERIES

CS FOR FIXATION, FS FOR OUTPUT



Unit:mm

Size / Symbol	14	17	20	25	32
A	0.037	0.039	0.046	0.047	0.059
B	0.031	0.031	0.038	0.038	0.045
C	0.064	0.071	0.079	0.085	0.104
D	0.053	0.053	0.059	0.061	0.072