

## 5. Installation and Operation

### 5.1 Transport and Storage

Gears should be transported in the original packaging. If the gear is not put into service immediately on receipt, it should be stored in a dry area in the original packaging. The permissible storage temperature range is -20° C to +60° C.

### 5.2 Gear Condition at Delivery

The gears are generally delivered according to the dimensions indicated in the confirmation drawing.

#### **Gears with Grease Lubrication**

Units are supplied with grease lubricant as standard.

#### **Gears with Oil Lubrication**

Harmonic Drive® Units with oil lubrication are generally customer-specific solutions. Please follow the notes given on the confirmation drawing. The oil temperature during operation must not exceed 90° C. Oil must be filled into the unit by the customer as the standard delivery does not include any oil lubricant.

#### **Oil Quantity**

The values specified in the confirmation drawing include the valid oil quantities to fill in. The oil quantity defined on the confirmation drawing must be obeyed in any case. Too much oil results in excessive heat production and early wear due to the thermal destruction of the oil. If the oil level is too low, this may lead to early wear as a result of lubricant deficiency.

### 5.3 Assembly Information

#### ADVICE

**Screws which have been tightened by the gear manufacturer must not be loosened.**

## 5.4 Recommended Tolerances for Assembly CSF-1U-CC, CSF-2XH-J

In order for the new features of Harmonic Drive® Units to be exploited fully, it is essential that the tolerances according to table 51.2 are observed for the input assembly.

Illustration 51.1

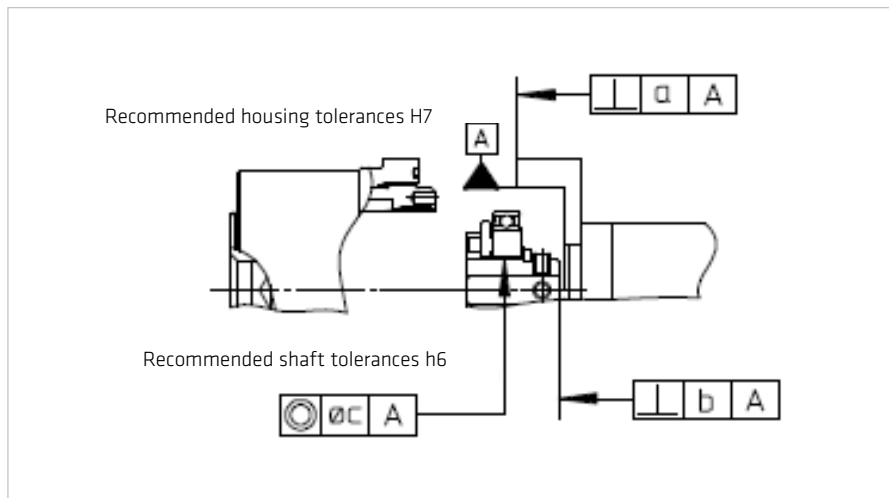


Table 51.2

[mm]

Size	38	5	8	11	14
a	0.006	0.008	0.010	0.011	0.011
b	0.004	0.005	0.012 (0.006)	0.012 (0.007)	0.017 (0.008)
c	0.004	0.005	0.015 (0.006)	0.015 (0.007)	0.030 (0.016)

The values in brackets are the recommended tolerances for component sets featuring a Wave Generator without Oldham coupling. The Oldham coupling serves to compensate for eccentricity of the input shaft and is available in the standard version. For the direct mounting of a Wave Generator without Oldham coupling (optional) on a motor shaft, the shaft tolerances should fulfill the DIN 42955 R standard.

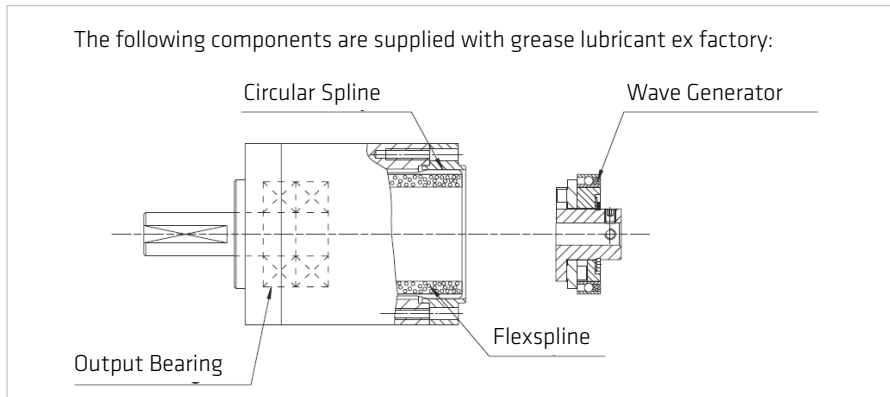
## 5.5 Lubrication

Harmonic Drive® Gearboxes are delivered ready for immediate installation. They are supplied with lifetime lubricant which is a high performance grease that meets the specific requirements of the Harmonic Drive® gears. It guarantees constant accuracy of the gears for their whole life. A re-lubrication of the Units is not necessary.

### 5.5.1 Grease Lubrication CSF-1U-CC, CSF-2XH-J

Gearboxes are supplied with standard grease lubricant. Illustration 52.1 shows the sections where lubrication is required and which are filled with grease lubrication at the time of delivery. If no special arrangements are made the specially developed high performance grease 4BNo.2 is used. If any other grease is used this will be indicated on the customer drawing.

Illustration 52.1



## 5.6 Preparation for Assembly

### Assembly preparation

The gear assembly must be carried out very carefully and within a clean environment. Please make sure that during the assembly procedure no foreign particles enter the gear.

### General information

Clean, degrease and dry all mating surfaces to ensure an adequate coefficient of friction. The values given in table 8 are valid for 12.9 quality screws which must be tightened by means of a torque wrench. Locking devices such as spring washers or toothed washers should not be used.

### Auxiliary materials for assembly

For the assembly, we recommend the application of the following auxiliary materials or the use of those with similar characteristics. Please pay attention to the application guidelines given by the manufacturer. Auxiliary materials must not enter the gear.

### Surface sealing

- Loctite 5203
- Loxeal 28-10

Recommended for all mating surfaces, if the use of o-ring seals is not intended. Flanges provided with O-ring grooves must be sealed with sealing compound when a proper seal cannot be achieved using the O-ring alone.

### Screw fixing

- Loctite 243

This adhesive ensures that the screw is fixed and also provides a good sealing effect. Loctite 243 is recommended for all screw connections.

### Assembly paste

- Klüber Q NB 50

Recommended for o-rings which may come out of the groove during the assembly procedure. Before starting with the assembly you should spread some grease (which you can take from the gear) on all other o-rings.

### Adhesives

- Loctite 638

Apply Loctite 638 to the connections between motor shaft and Wave Generator. You should make use of it only if this is specified in the confirmation drawing.

## 5.7 Assembly

### 5.7.1 Motor Assembly CSF-1U-CC, CSF-2XH-J

The Gearboxes have been designed for simple motor assembly. This means that the Wave Generator is mounted directly on the motor shaft. When ordering please indicate which motor type is to be used, so that the Wave Generator can be manufactured to match. If required, units can be provided including the motor adaptor flange or with a ready assembled motor. In addition to the correct dimensioning of the motor, particular attention must be paid to the geometric tolerances of the motor output flange and motor shaft. The shaft and flange tolerances of the motor should fulfill the requirements of the DIN 42955 standard. To fully exploit the excellent performance characteristics of the units we recommend the use of motors fulfilling DIN 42955 R tolerances.

#### Adaptor Flange

The transmission accuracy of the gearbox is dependent on the manufacturing accuracy of the motor adaptor flange. Table 51.2 shows the recommended tolerances for the motor with assembled adaptor flange.

#### ADVICE

For the manufacturing of the adaptor flange we recommend the dimensions and tolerances given in table 51.2. To achieve the given value for concentricity and run out we recommend that the motor- and gear side flange surfaces are manufactured at a single clamping.

## 5.7.2 Mounting the Wave Generator (WG) to the Motor Shaft

Illustration 54.1 shows some possibilities how to assemble the gearboxes to the motor. If the designs of the components differ from those shown in illustration 54.1, please follow the instructions as appropriate.

### Removal of the Protection Cap

If a protection cap is mounted, please remove it.

### Assembly of the Adaptor Flange

Connect the adaptor flange(s) (1) according to illustration 54.1.

### Grease Quantity Check

Please refer to section 5.5. for more information

- The axial position of the Wave Generator in the gearbox is critical for the correct operation of the unit. Please check the correct position of the Wave Generator against the confirmation drawing.
- Push the greased Wave Generator (2) onto the motor shaft according to the assembly dimension given in the confirmation drawing. If there is no assembly value given, the Wave Generator must be moved until it reaches the shaft collar.
- Fix the Wave Generator (2) with the set screw (3). Set screw tightening torques are listed in table 55.1.
- Eventually seal the flange (1) with the set screw (4). Please consider section 5.6. If a glued shaft-hub connection is used, please pay attention to the information given in section 5.6.

Illustration 54.1

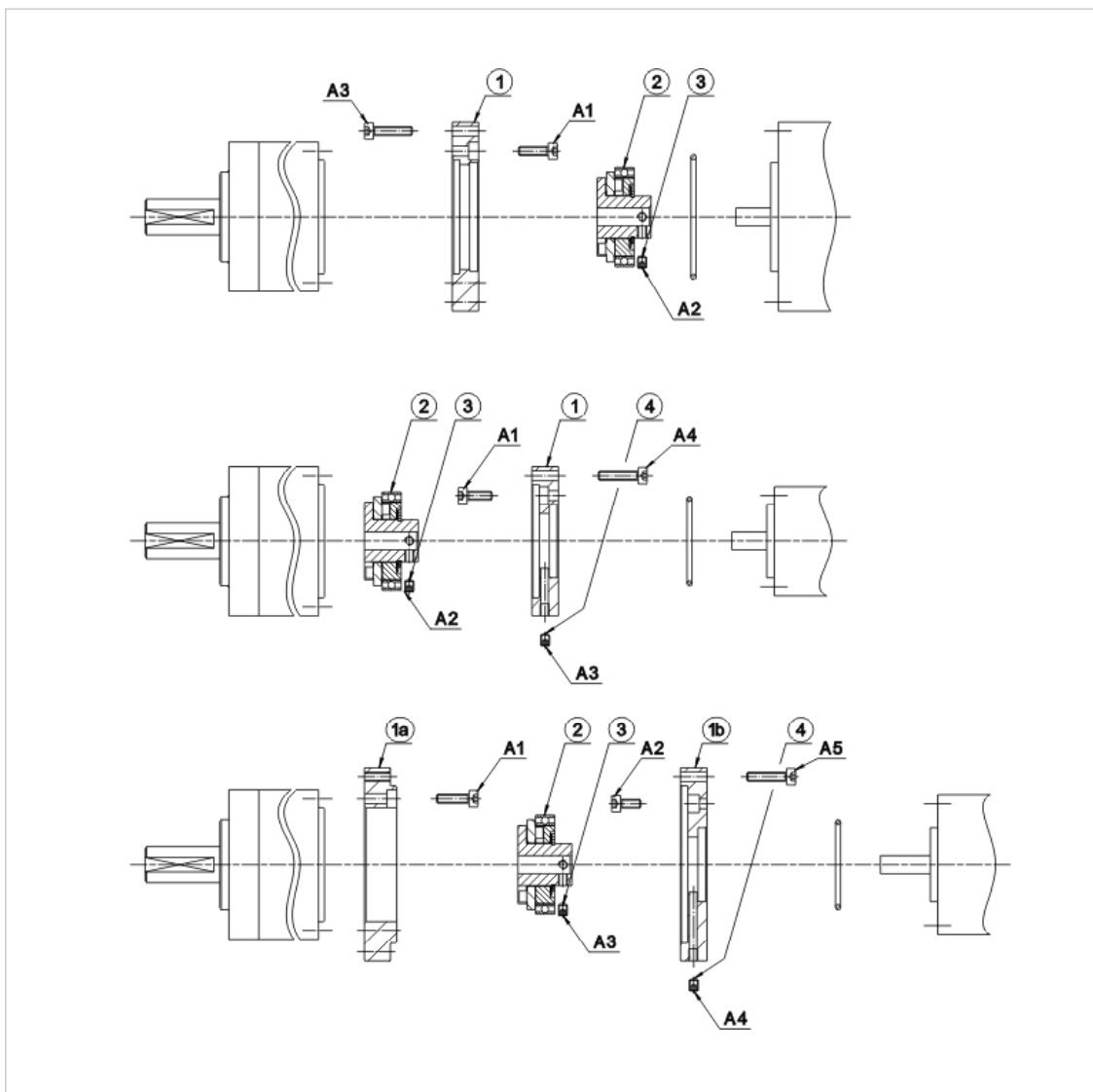


Table 55.1

Size	3B	5	8	11	14
Number of Bolts	1	2	2	2	2
Bolt Size	M 1.6	M 2	M 2	M 3	M 3
Tightening Torque	0.09	0.19	0.19	0.69	0.69

### 5.7.3 Check before Assembly of the Wave Generator (WG)

- Final check of position of the Wave Generator. For some clamping elements an axial movement may occur during tightening. Please take account of this effect when positioning the Wave Generator on the shaft.
- Check whether the WG is lubricated in accordance with illustration 52.1. When the gear is oil lubricated, fill with the prescribed oil quantity.

### 5.7.4 Assembly of the Wave Generator (WG) into the Flexspline (FS)

When the Wave Generator is assembled into the Flexspline please consider that the parts must not be tilt during assembly. By parallel assembly it is ensured that the teeth of Flexspline and Circular Spline mesh symmetrically.

Alternatively the assembly can be executed during slowly rotation of the input shaft ( $n < 10$  rpm). This method eases the assembly.

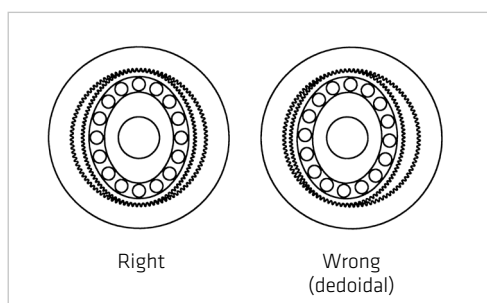
### 5.7.5 Assembly Control

Very rarely, an eccentric tooth mesh, called dedoidal, may occur. The correct assembly can be checked as follow:

- Check the running behaviour by rotating the input shaft (in case of types with input shaft). Alternatively you may rotate the output flange. If you notice torque variations these may be caused by eccentric tooth mesh.
- Check the running behaviour and the motor current while the motor is rotating. Strong fluctuations in the motor current and/or an excessive no-load current may be the result of an eccentric tooth mesh.

In case of a dedoidal assembly you can avoid permanent damage to the gear if the wrong installation is recognized by means of the above mentioned inspection. The problem can be solved by disassembling the gear followed by a new assembly.

Illustration 55.1



## 5.7.6 Assembly of the Output Flange

Table 56.1

Size	5	8	11	14
Designation (Ill. 56.3)	B			
Number of Bolts	3	4	6	6
Bolt Size	M2	M3	M3	M4
Bolt pitch diameter [mm]	9.8	15.5	20.5	25.5
Tightening Torque / Bolt [Nm]	0.54	2	2	4.6
Torque transmitting capacity <sup>1)</sup> [Nm]	2	13	26	55

## 5.7.7 Assembly of the Housing

Table 56.2

Size	3B	5	8	11	14	5	8	11	14
Version	1U, 1U-CC, 1U-F, 1U-CC-F					2XH-F, 2XH-J			
Designation (Ill. 56.3)	A								
Number of Bolts	4	4	4	4	4	2	2	2	2
Bolt Size	M1.6	M2	M3	M4	M5	M2	M3	M3	M4
Bolt pitch diameter [mm]	15	23	35	46	58	9.8	15.5	20.5	25.5
Tightening Torque / Bolt [Nm]	0.26	0.25	0.85	2.0	4.0	0.54	2.0	2.0	4.6
Torque transmitting capacity <sup>1)</sup> [Nm]	3.0	3.5	12	29	57	2	13	26	55

<sup>1)</sup> The tables are valid for completely degreased surfaces (friction coefficient  $\mu_k = 0.15$ ) and metric socket head cap screws according to EN ISO 4762 12.9 quality, untreated, oiled, with  $\mu_{ges} = 0.12$ .

Illustration 56.3

