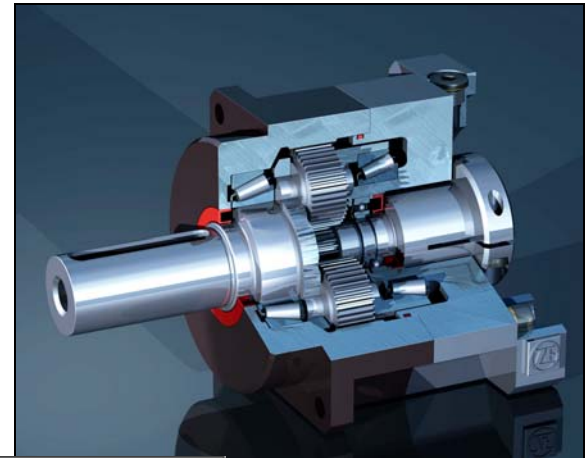


OPERATING INSTRUCTIONS

Planetary Gear Units for Servomotors

ZF-SERVOPLAN®



For Further Information Contact

Heason Technologies Group Ltd

Tel: +44(0)1403 755800

Fax: +44(0)1403 755810

Email: sales@heason.com

Freephone 0800 374903 www.heason.com

Heason
Technologies Group

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Subject to modifications

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Please read these operating instructions and the safety notes carefully before starting up the gear unit and follow the procedures described.

No warranty claims can be accepted unless the information and procedures described in these operating instructions have been followed exactly.

These operating instructions are supplied with the product. Comply with the instructions issued by the motor manufacturer and the applicable directives of national employer's liability insurance associations for the relevant countries when starting up this product.

The following safety instructions are used in these operating instructions:

NOTE

Indicates special procedures, methods, information, etc.

CAUTION

This is used when incorrect operation or operation other than as instructed could lead to damage to the product.



DANGER!

This is used when lack of caution could lead to injury to people and damage to property.

General instructions

The operating instructions are intended to help you to start up the gear units in accordance with the applicable regulations and to operate them correctly in accordance with their designated use.

Refer to the technical data sheets of the gear units for the load limit values applicable to operation.

These operating instructions also contain important maintenance instructions. The gear units do not require a CE mark or EC declaration of conformity because gear units are not machines in the sense of the EC Machinery Directive.

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1 Field of application

These operating instructions apply to the ZF Servoplan series of gear units, type PG (planetary gear unit), available as single stage units PG25/1, PG100/1, PG200/1, PG500/1, PG1200/1 and PG3000/1 as well as two-stage units PG25/2, PG100/2, PG200/2, PG500/2, PG1200/2 and PG3000/2.

2 Delivery condition

The gear units are always delivered in recyclable cardboard boxes with molded cardboard fillers. The gear units are also packed in specially coated plastic bags to afford the best possible protection against corrosion during their transport. Larger sizes are also dispatched on a pallet.

The gear units are filled with lubricant at the factory and are therefore ready to use. The input and output ends have anti-corrosion agent applied to them. All traces of this anti-corrosion agent must be removed from all versions before mounting the gear unit.

CAUTION

Do not clean the units with compressed air. This could give rise to positive pressure inside the gear unit and have a negative effect on the function and service life of the gear unit.

3 Storage

We recommend storing the gear units in their original packaging until they are actually put into service. The gear units can be stored in the dry for up to 2 years at 0 °C to +30 °C. We recommend using a first-in first-out strategy for your warehouse logistics procedure.

4 Technical operating data

The planetary gear units have been designed for the permitted power values specified in the catalog. For reasons of operational safety, the gear units are only allowed to be utilized within these limits and with consideration for all service factors (see the technical data sheet, if appropriate). Using the gear unit above its maximum load shall be classified as not in accordance with its designated use. Independent modifications to the gear units shall invalidate the manufacturer's liability for resultant damage.

CAUTION

The gear units are supplied ex-works with the appropriate adapter parts for mounting on the motor. Subsequent disassembly or variation of the adapter parts shall invalidate all warranty rights.

Refer to the dimension drawings in the Servoplan® catalog or the specific installation drawings for the dimensions.

5 Motor mounting

Adapter parts make it possible for the gear unit to be mounted on any servomotor (mounting position B5 and, as a rule, special mounting position B14 with special flange as well). The motor shaft is connected to the gear unit output shaft using the clamping hub.

The motor is centered on the centering diameter of the motor and the appropriate centering diameter of the gear unit input flange. The diameters of the clamping hubs are adapted to the corresponding motor shaft diameters.

Slotted distance bushings are used with small motor shafts in order to compensate for the difference in diameter compared to the gear unit clamping hub. These distance bushings are fitted in the factory so the slot in the distance bushing lines up with the slot in the clamping hub (see also *Fig. 2*). This should be checked and any necessary connection made before the motor is mounted.

Motor mounting

We always recommend using motors with a smooth input shaft.

In the case of motors with a key, we recommend inserting a half key in the keyway of the motor to avoid any imbalance in the drive unit as a whole (depending on the balancing type of the servomotor).

5.1 Concentricity accuracy of the motor

The output shafts of servomotors which are to be mounted should have a face runout and concentricity accuracy in class "N" to DIN 42955 (*Table 1*). If necessary, check this before mounting the gear unit (*Fig. 1*).

Motor shaft diameter [mm]	Concentricity tolerance [mm]
Up to 10	0.03
Above 10 to 18	0.035
Above 18 to 30	0.04
Above 30 to 50	0.05
Above 50 to 80	0.06

Table 1: Permitted concentricity tolerance of the motor

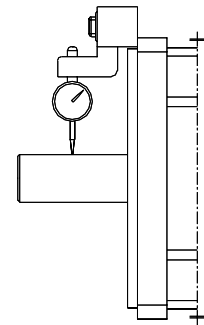


Fig. 1: Measuring the concentricity of the motor shaft

Carefully check all parts for damage before mounting the servomotor onto the gear unit. All connections have been manufactured so that the parts can slide into one another easily and without needing to be forced. Avoid damaging the motor shaft or the gear unit hub, since such damage can prevent this.

Damage to the flat surface of the motor plate or the gear unit flange, or if the plate or flange are dirty, can result in an angular misalignment between the motor shaft and the gear unit. This can place stress on the connection and have a negative effect on the service life of the motor and/or gear unit.

5.2 Index of protection

The sturdy oil seals used on the input and output shafts of the gear units, combined with the sealed sealing screws for the motor mounting mean that the gear units have a high index of protection (IP65 to EN 60529) against external influences.

The following measures must be taken in order to achieve this index of protection, if required, even after the motor has been mounted to make a motor/gear unit combination:

- Use servomotors with the required protection class.
- Make sure the seal in the joint between the motor and the gear unit is reliable. We recommend commercially available gasket compounds such as Loctite 5480 for this purpose.

Motor mounting

5.3 Motor connection

The gear units are equipped with the appropriate connection parts for the specified motor type as stated in the order. If the motor specified in the order corresponds to that which is used, then the connection parts will be suitable for the motor. We recommend checking the suitability of the motor to be on the safe side or if the motor type is unknown (see also *Fig. 6: Possible problems with obstructive contours on the motor*).

It is advantageous to use motors with a smooth shaft. If the motor has a key, it must be removed during mounting. The keyway must then be lined up with a gap in the clamping hub. Insert a half-height key in order to avoid or reduce any imbalance caused by removing the key.

Take account of the balancing type of the servomotor when doing this.

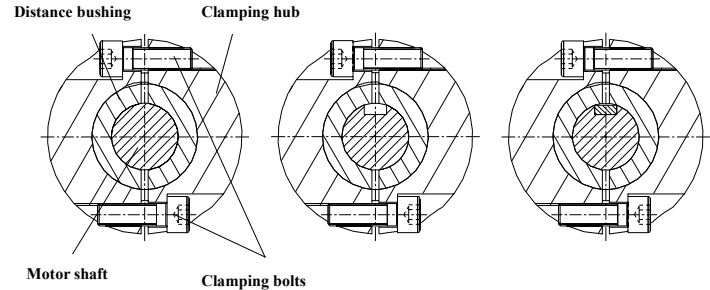


Fig. 2: Motor mounting: Clamping hub positions

5.4 Mounting procedure

Once you have checked that the gear unit and motor are suitable for mounting, we recommend you follow the procedure below when mounting the gear unit on the motor:

Step 1: Clean and check the parts

Check for damage to the motor shaft, clamping hub bore and any distance bushing, as well as the flat contact surfaces of the motor and gear unit; give these parts a thorough clean. Do not clean the units with compressed air. Avoid using aggressive cleaning agents which could damage the seals.

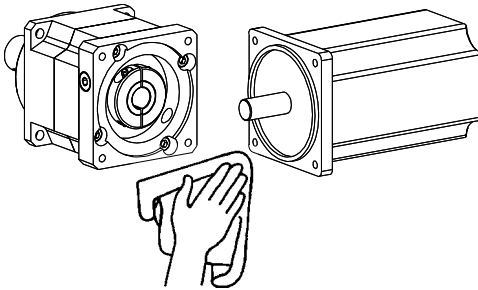


Fig. 3: Cleaning and checking the parts for mounting

Step 2: Remove sealing screws

Remove the sealing screws in the gear unit connection flange which cover the access to the two bolts in the clamping hub.

Turn the clamping hub so the heads of the clamping bolts line up with the tapped holes in the gear unit connection flange which have now been opened.

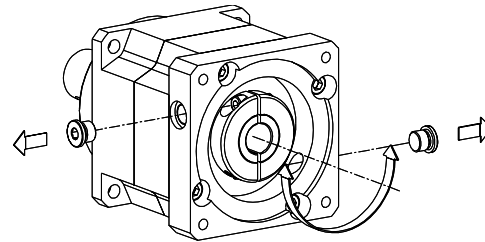


Fig. 4: Removing the sealing screws

Motor mounting

Step 3: Join the motor onto the gear unit

Push the motor into the gear unit until the gear unit connection flange and the motor mounting surface are fully in contact without any gap. It must be possible to push the motor on easily when doing this.

CAUTION

We recommend performing this joining procedure with the motor and gear unit held vertically, so as to avoid exerting stress on the components due to the weight of the motor and/or gear unit.

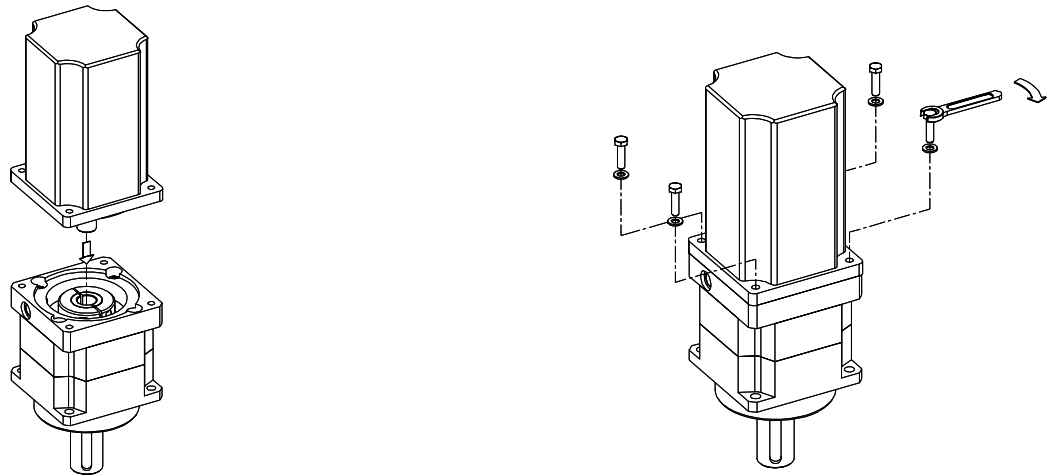


Fig. 5: Joining and bolting together the motor and gear unit

The gear unit is equipped with integrated thermal length compensation. This compensates for the lengthening of the motor shaft as it heats up.

When joining the units together, the axial force exerted onto the clamping hub must not exceed the value specified in *Table 2*. If this force value is exceeded all the same, then the length compensation function is no longer assured in the event of thermal expansion of the motor shaft. This can lead to damage to the motor and/or gear unit.

Gear unit type	Clamping bolt EN ISO 4762	Wrench size	Tightening torque	Max. axial force on clamping hub
		[mm]	[Nm]	[N]
PG25	M5 - 8.8	4	5.5	60
PG100	M5 – 12.9	4	9.5	85
PG200	M6 – 12.9	5	16	115
PG500	M8 – 12.9	6	40	130
PG1200	M10 – 12.9	8	79	170
PG3000	M16 – 12.9	14	330	220

Table 2: Axial forces

Motor mounting

In individual cases, special designs of servomotor may lead to unwanted installation problems. The following possible problems can arise:

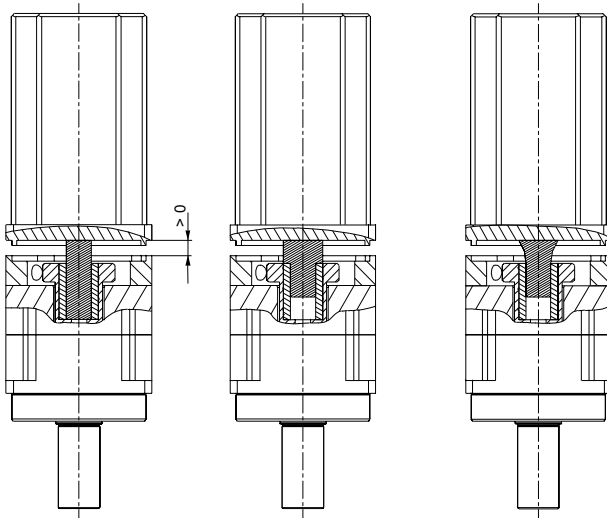


Fig. 6.1.

Fig. 6.2.

Fig. 6.3.

Fig. 6: Possible problems with obstructive contours on the motor

Fig. 6.1:

The motor shaft is too long and makes contact with the base of the clamping hub. The motor plate does not contact the gear unit flange.

Fig. 6.2:

The motor shaft has a long projecting shoulder which is blocked by the end of the clamping hub.

Fig. 6.3:

The motor shaft has a pronounced shoulder radius which reduces the effective length of the motor shaft. This means the motor shaft is blocked by the clamping hub and exerts an expansion force on it.

Screwing the motor and gear unit together under such circumstances may lead to (possibly permanent) damage to the motor and/or gear unit due to the excessive stresses.

In such cases, please check the obstructive contours by measuring them or check the measurements stated in our catalog and the information provided by the motor manufacturer.

Step 4: Connect the motor to the gear unit

Tighten the motor mounting bolts to the correct torque, working diagonally across, to avoid placing excessive stress on the motor/gear unit connection (Fig. 5).

Step 5: Tighten the clamping bolts step-by-step

Tighten the clamping bolts step-by-step, working from one bolt to the next, until reaching the maximum tightening torque. This is in order to avoid placing excessive stress on the slotted clamping hub.

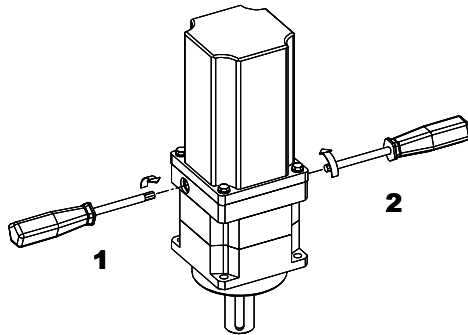


Fig. 7.1

Gear unit type	1st stage	2nd stage	3rd stage
	Fig. 7.1	Fig. 7.2	
PG 25	Tighten the bolts by hand	2.5 Nm	5.5 Nm
PG100		5 Nm	9.5 Nm
PG 200		8 Nm	16 Nm
PG 500		20 Nm	40 Nm
PG1200		40 Nm	79 Nm
PG3000		165 Nm	330 Nm

Table 3: Tightening torques

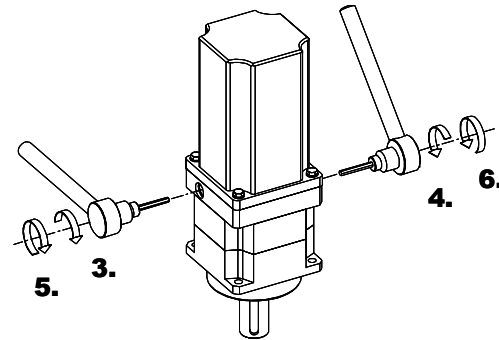


Fig. 7.2

Fig. 7: Tightening the clamping bolts step-by-step and working from one to the next

Motor mounting

Step 6: Insert the sealing screws

In order to ensure that the drive system achieves the level of seal integrity required by the index of protection, the sealing screws removed in step 2 must be fitted with sealing washers and screwed back in. Tighten them to the specified torque (*Table 4*).

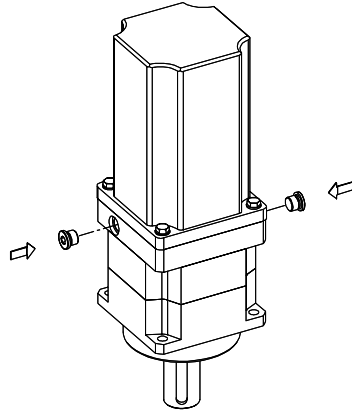


Fig. 8: Closing the mounting openings with the sealing screws

Sealing screw DIN 908	Tightening torque [Nm]
M12x1.5	20
M16x1.5	30

Table 4: Sealing screw tightening torques

6 Mounting position

The gear unit can be operated irrespective of its mounting position.

7 Gear unit mounting

The gear unit must be mounted on the customer's structure (machine, robot, etc.) using the centering diameter on the gear unit output (D1 in *Table 5*) and the four through-holes in the gear unit housing provided for this purpose.

We recommend using ISO bolts of quality 12.9 and tightening them to the specified tightening torques (*Table 5*). Furthermore, we recommend securing the bolts using an adhesive compound.

Gear unit type	Centering diameter D1 (g6)	Bolt size	Tightening torque
	[mm]		[Nm]
PG 25	60	M5 – 12.9	9.5
PG 100	70	M6 – 12.9	16
PG 200	90	M8 – 12.9	40
PG 500	130	M10 – 12.9	79
PG 1200	160	M12 – 12.9	135
PG 3000	200	M16 – 12.9	330

Table 5: Flange-mounting data for installing the gear unit in the machine

Gear unit mounting

Remove the shaft guard cap and thoroughly clean the centering fixture, the shaft and the contact surfaces (see **5.4 step 1**).

Make sure no stress is applied to the components when installing the gear unit. Parts mounted on the output shaft such as gears or belt sheaves must be fitted without applying force. Never drive them on or fit them by striking them. Only use suitable tools or fixtures.

The maximum mounting forces stated in *Table 6* are permitted for this. Applying greater mounting force levels may result in permanent damage to the output bearings.

CAUTION

Ensure there is an unhindered air flow during operation to prevent a heat build up leading to overheating of the drive system (gear unit and motor).

Gear unit type	Maximum static axial force
	[N]
PG 25	9000
PG 100	11000
PG 200	19000
PG 500	32000
PG 1200	50000
PG 3000	90000

Table 6: Maximum static axial force on the output shaft

8 Maintenance

Servoplan® servo gear units are maintenance-free. The gear units are provided with fill-for-life lubrication and do not require any maintenance provided they are operated in accordance with their designated use.

9 Disposal

Comply with the relevant legal provisions when disposing of the units.

10 Servicing

You can contact the ZF Industrial Drives Service Department in the event of a problem with your gear unit.

The latest information about contacts is available on:

<http://industrial-drives.zf.com>