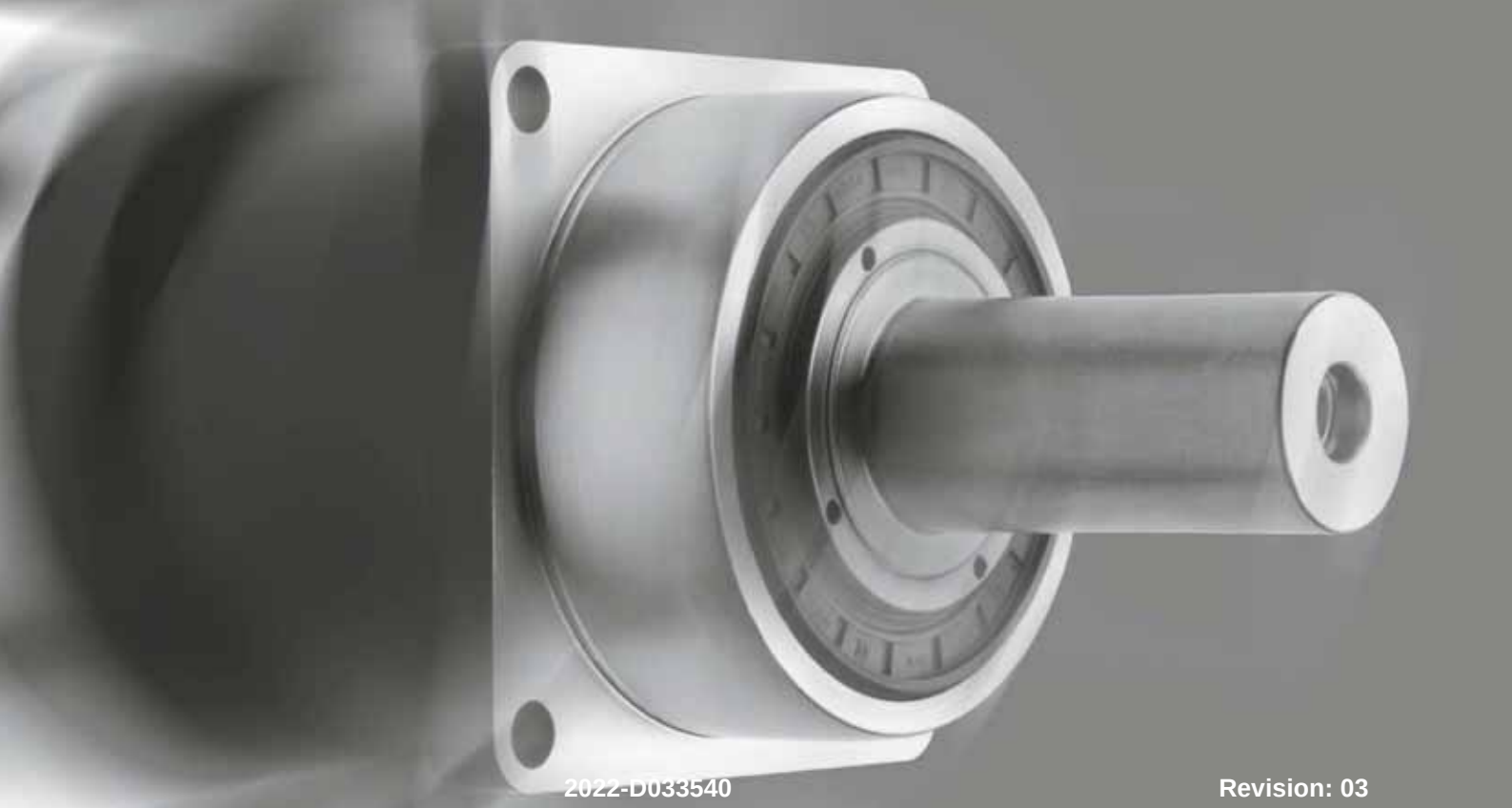
WITTENSTEIN alpha

SP+

Operating Manual



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Revision: 03

Revision history

Revision	Date	Comment	Chapter
01	07.05.09	New version	All
02	01.08.09	Machinery Directive	1, 2, 3, 4, 6
03	13.07.10	Technical Data	5.4.1

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Contents

1 Regarding this manual

These instructions contains necessary information for the safe operation of the planetary gearhead SP+, referred to as gearhead in the following.

The operator must make sure that this operating manual is read through by all persons assigned to install, operate, or maintain the gearhead, and that they understand them.

Store these instructions within reach near the gearhead.

These **safety instructions** should be shared with colleagues working in the vicinity of the device to ensure individual safety.

The original instructions were prepared in German; all other language versions are translations of these instructions.

1.1 Signal words

The following signal words are used to bring your attention to dangers, prohibitions, and important information:

	⚠ DANGER **This signal word points to an imminent danger that can cause serious injuries and even death.**
	⚠ WARNING **This signal word points to a possible danger that can cause serious injuries and even death.**
	⚠ CAUTION **This signal word points to a possible danger that can cause slight to serious injuries.**
	NOTICE **This signal word points to a possible danger that can cause material damage.**
	A note without signal word draws your attention to application tips or especially important information when handling the gearhead.

1.2 Safety symbols

The following safety symbols are used to bring your attention to dangers, prohibitions, and important information:


General danger


Hot surface


Suspended loads

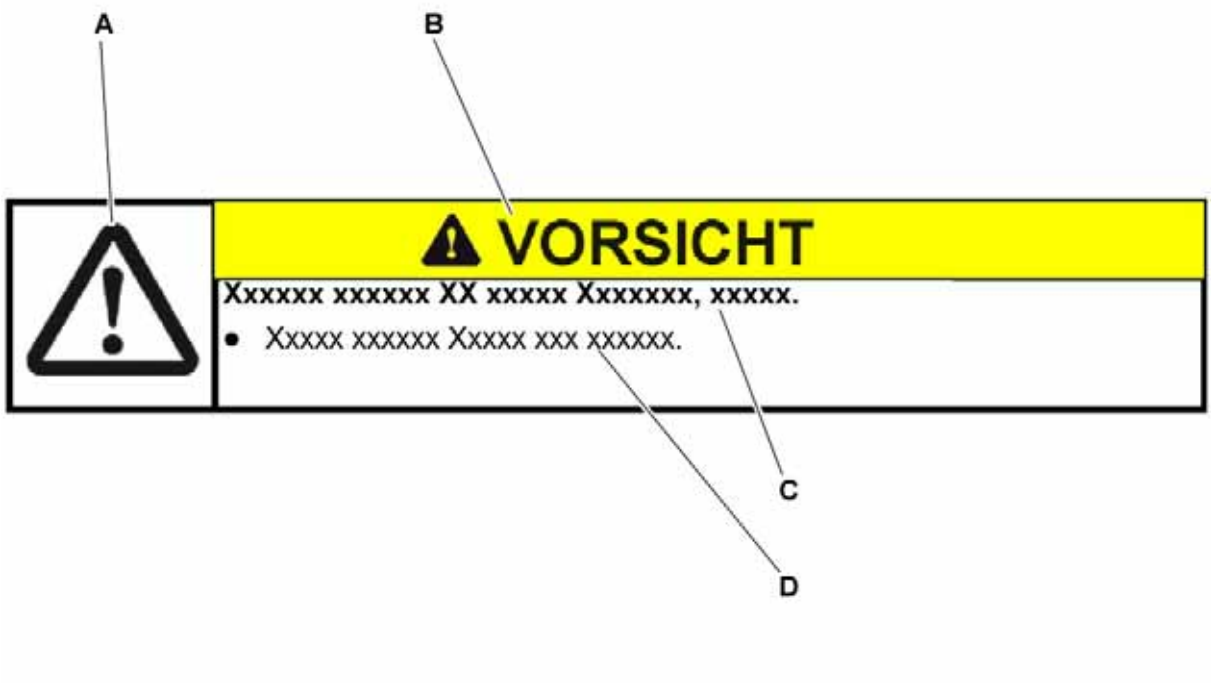

Danger of being pulled in


Environment protection


Information

1.3 Design of the safety instructions

The safety instructions of this operating manual are designed according to the following pattern:



A = Safety symbol (see Chapter 1.2 "Safety symbols")
B = Signal word (see Chapter 1.1 "Signal words")
C = Type and consequence of the danger
D = Prevention of the danger

1.4 Information symbols

The following information symbols are used:

- requires you to carry out an action
  ➲ indicates the results of an action

ⓘ provides additional information on handling

2 Safety

These instructions, especially the safety instructions and the rules and regulations valid for the operating site, must be observed by all persons working with the gearhead.

In addition to the safety specifications mentioned in this operating manual, the general and also the local regulations on the prevention of accidents (for instance, personal safety equipment) and on environmental protection should be observed.

2.1 EC – Machinery directive

The gearhead is considered a "machine component" and is therefore not subject to the EC Machinery Directive 2006/42/EC.

Operation is prohibited within the area of validity of the EC directive until it has been determined that the machine in which this gearhead is installed corresponds to the regulations within this directive.

2.2 Dangers

The gearhead has been constructed according to current technological standards and accepted safety regulations.

To avoid danger to the operator or damage to the machine, the gearhead may be put to use only for its intended usage (see chapter 2.4 "Intended use") and in a technically flawless and safe state.

- Be informed of the general safety instructions before beginning work. (see Chapter 2.7 "General safety instructions").

2.3 Personnel

Only persons who have read and understood these instructions may carry out work on the gearhead.

2.4 Intended use

The gearhead serves to convert torques and speeds. It is built for industrial applications that do not fall under article 2 of the directive 2002/95/EU (usage restriction of certain dangerous materials on electro and electronic equipment).

The gearhead is specified for installment on motors that:

- correspond to the design B5 (for any divergences, please consult our Customer Service Department [technical customer service])
- show a radial and axial runout tolerance of at least “N” according to DIN 42955 and
- have a smooth shaft

2.5 Reasonably predictable misuse

Any usage that exceeds the maximum permitted speeds, torques and temperature is considered a misuse and is therefore prohibited.

2.6 Guarantee and liability

Guarantee and liability claims are excluded for personal injury and material damage in case of

- Ignoring the information on transport and storage
- Improper use (misuse)
- Improper or neglected maintenance and repair
- Improper assembly / disassembly or improper operation
- Operation of the gearhead when safety devices and equipment are defective
- Operation of the gearhead without lubricant
- Operation of a heavily soiled gearhead
- Modifications or reconstructions that have been carried out without the approval of **WITTENSTEIN alpha GmbH**

2.7 General safety instructions

⚠ WARNING

Objects flung out by rotating components can cause serious injuries.

- Remove objects and tools from the gearhead before putting it into operation.

⚠ WARNING

Rotating components on the gearhead can pull in parts of the body and cause serious injuries and even death.

- Keep a sufficient distance to rotating machinery while the gearhead is running.
- Secure the machine against restarting and unintentional movements during assembly maintenance work.

⚠ CAUTION

Hot gearhead housing can cause serious burns.

- Touch the gearhead housing only when wearing protective gloves or after the gearhead has been at standstill for some time.

NOTICE

Loose or overloaded screw connections can damage the gearhead.

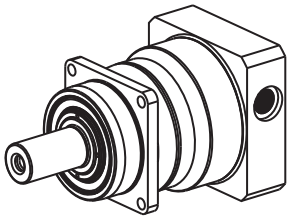
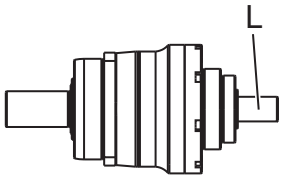
- Use a calibrated torque wrench to tighten and check all screw connections for which a tightening torque has been specified.

Solvents and lubricants can pollute soil and water.

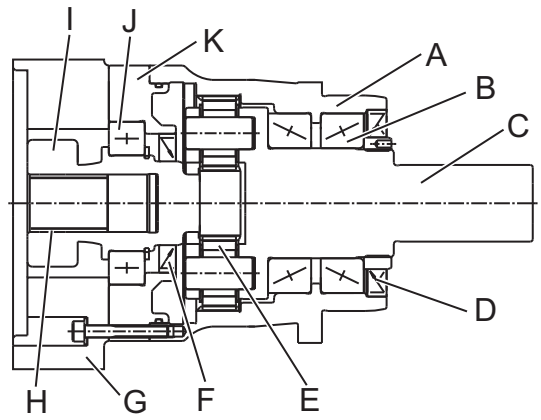
- Use and dispose of cleaning solvents as well as lubricants appropriately.

3 Description of the gearhead

The gearhead is a single- or multistage, low-backlash planetary gearhead, which is manufactured as standard in the following versions:

	**"M" (motor-mounted gearhead)** Motor centering of the motor-mounted gearhead is performed: - up to gearhead size SP+ 100 and a motor shaft diameter of 28 mm of by the clamping hub (plug receptacle or coupling) - from gearhead size SP+ 140 and a motor shaft diameter of >28 mm by the centering collar of the motor A radial distortion of the motor is avoided. Adaptation to various motors is done by an adapter plate and a bushing. The output shaft bearing is designed to withstand high tilting moments and axial forces. The gearhead can be optionally constructed with a coupling to compensate for thermal linear expansion.
	**"S" (self-contained gearhead)** The self-contained gearhead is based on the motor-mounted gearhead and additional mounting parts, such as drive housing and drive shaft (L). It is possible to drive the gearhead directly at the drive shaft, for instance, using a belt pulley. The drive and output shaft bearing is designed to withstand high tilting moments and axial forces.

3.1 Overview of the gearhead components

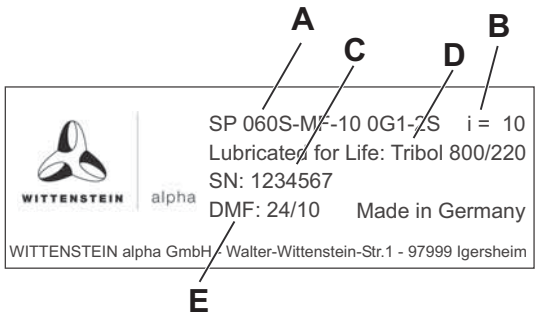


	Gearhead components
A	Gearhead housing
B	Output bearing
C	Output shaft
D	Radial shaft sealing ring
E	Planetary gear stage
F	Radial shaft sealing ring
G	Adapter plate
H	Bushing
I	Clamping hub (plug receptacle / coupling)
J	Drive bearing arrangement
K	Drive housing

Tbl-1: Overview of the gearhead components

3.2 Type plate

The type plate is attached to the gearhead housing as well input flange.

		Designation
	A	Ordering code (see Chapter 3.3 "Ordering code")
	B	Ratio
	C	Serial number
	D	Lubricant
	E	Production date

Tbl-2: Type plate (sample values)

3.3 Ordering code

SP140 S-M F 1-10-0 K 1-2 K

Gearhead type
SP+ 060/075/100/140/180/
210/240

Type code
A = Mass inertia optimized version
F = Food lubrication
G = Grease
L = Friction optimized version
(only with MC version)
S = Standard
X = Special gear

Gearhead variations
M = Motor attachment gearhead
S = Self-Contained version

Gearhead model
C = Continuous duty S1 (HIGH SPEED)
F = Cyclic duty S5

Number of stages
1 = 1-stage
2 = 2-stage

Ratios i

Output shaft shape
0 = Smooth shaft
1 = Shaft with key DIN 6885
Form A
2 = Involute DIN5480
3 = System output
4 = Other
5 = Shaft mounted

Clamping hub bore hole diameter
See catalogue

Backlash
0 = Reduced
1 = Standard

Generation

Motor-mounted
K = Coupling
S = Plug receptacle

3.4 Performance statistics

Please refer to our catalogue or our Internet page for the maximum permitted speeds and torques:http://www.wittenstein-alpha.de

Please consult our Customer Service department if your gearhead is older than a year. You will then receive the valid performance data.

3.5 Weight

The table "Tbl-3" specifies the gearhead dimensions with medium-sized adapter plate. If another adapter plate is mounted, the actual dimensions can deviate by up to 10%.

Gearhead size SP+		060	075	100	140	180	210	240
Design	**Stages**							
M	**1**	1.9	3.9	7.7	17.2	34.0	56.0	77.0
	2	2.0	3.6	7.9	17.0	36.4	53.0	76.0
S		on request						

Tbl-3: Weight [kg]

3.6 Noise emission

Depending on the gearhead type and product size, the continuous sound pressure level is up to 66 dB(A).

Contact our Customer Service department if you need information about your particular product.

4 Transport and storage

4.1 Scope of delivery

- Check the completeness of the delivery against the delivery note.

  ⓘ Missing parts or damage must be notified immediately in writing to the carrier, the insurance, or **WITTENSTEIN alpha GmbH**.

4.2 Packaging

The gearhead is delivered packed in foil and cardboard boxes.

- Dispose of the packaging materials at recycling sites intended for that. Observe the locally valid regulations for disposals.

4.3 Transport

NOTICE

Hard knocks, for instance because of falling or hard dropping, can damage the gearhead.

- Only use hoisting equipment and transports with sufficient capacity.
- The maximum permitted lift capacity of a hoist may not be exceeded.
- Lower the gearhead slowly.

⚠ WARNING

Suspended loads can fall and can cause serious injuries and even death.

- Do not stand under suspended loads.

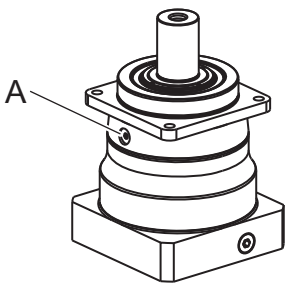
Specifications on the weights, refer to Chapter 3.5 "Weight".

4.3.1 Transport of gearheads up to and including size SP+ 140

No special transport mode is prescribed for transporting the gearhead.

4.3.2 Transport of gearheads as of size SP+ 180

For gearheads as of size SP+ 180, a support bore (A) is provided for a ring screw (e.g. acc. to DIN 580). The ring screw is used for attaching the gearhead securely to the hoisting equipment.

	Gearhead size SP+	Support bore (A) [Ø]
	180	M8
	210	M10
	240	M12

Tbl-4: Support bore on the gearhead

4.4 Storage

Store the gearhead in horizontal position and dry surroundings at a temperature of 0 °C to +40 °C in the original packaging. Store the gearhead for a maximum of 2 years.

For storage logistics, we recommend the "first in – first out" method.

5 Assembly

- Be informed of the general safety instructions before beginning work. (see Chapter 2.7 "General safety instructions").

5.1 Preparations

NOTICE

Pressurized air can damage the gearhead seals.

- Do not use pressurized air to clean the gearhead.

NOTICE

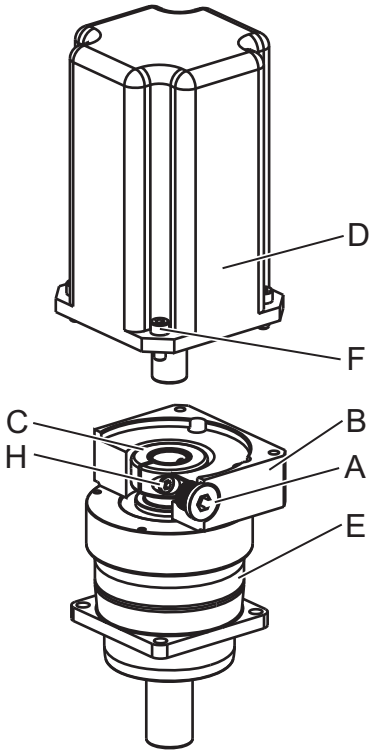
Directly sprayed cleaning agents can alter the frictional values of the clamping hub.

- Only spray cleaning agents onto a cloth, with which you can then clean the clamping hub.

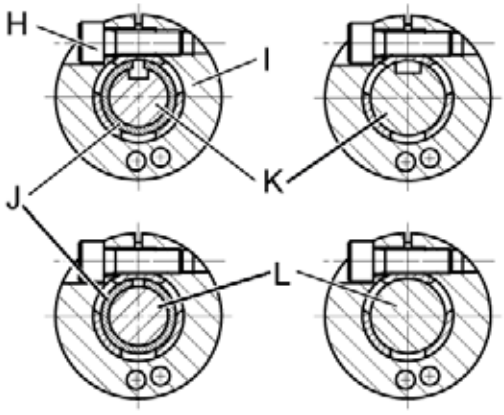
- Clean / De-grease the following components with a clean and lint-free cloth and grease-dissolving, non-aggressive detergent:
  - All fitting surfaces to neighboring components
  - Centering
  - The motor shaft
  - The inside diameter of the clamping hub
  - The bushing inside and out
- Dry all fitting surfaces to neighboring components in order to achieve the proper friction values of the screw connections.
- Check the fitting surfaces additionally for damage and impurities.

5.2 Mounting the motor onto the gearhead

- Observe the general information and safety instructions of the motor manufacturer.
- Observe the safety and processing instructions of the screw-bonding agents to be used.



- Ensure that the motor is mounted if possible in a vertical direction.
- If the motor shaft has a shaft key, remove the shaft key.
  - ⓘ If recommended by the motor manufacturer, insert a half wedge.
- Remove the plug (A) from the mounting bore in the adaptor plate (B).
- Turn the clamping hub (C) until the clamping bolt (H) can be reached by the mounting bore.
- Loosen the clamping bolt (H) of the clamping hub (C) by one revolution.
- Push the motor shaft into the clamping hub of the gearhead (E).
  - ⓘ The motor shaft should slip in easily. If this is not the case, the clamping bolt must be loosened more.
  - ⓘ A slotted bushing has to be installed extra for certain motor shaft diameters and applications.
  - ⓘ The slot of the bushing (if provided) and clamping hub have to be flush with the groove (if provided) of the motor shaft, see table "Tbl-5".
  - ⓘ No gap is permitted between motor (D) and the adaptor plate (B).

		Designation
	H	Clamping bolt
	I	Steel/aluminum clamping ring [part of the clamping hub (C)]
	J	Bushing
	K	Keyed motor shaft
	L	Smooth motor shaft

Tbl-5: Arrangement of motor shaft, clamping hub, and bushing

- Smear screw-bonding agent (for example Loctite 243) onto the four bolts (F).
- Fasten the motor (D) onto the adaptor plate (B) with the four screws (F).
- Select the tightening torque for the clamping bolt (H) according to the material of the clamping ring (I).
  - Clamping bolt for **steel** clamping ring: Property class 12.9
  - Clamping bolt for **aluminum** clamping ring: Property class 8.8
  - ⓘ For bolt sizes and specified torques refer to chapter 9.1 "Specifications on mounting onto a motor", tables "Tbl-14".

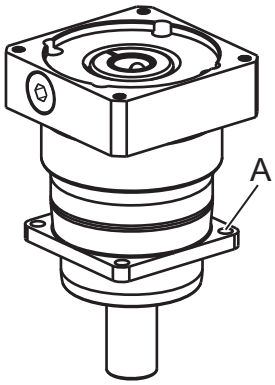
- Tighten the clamping bolt (H) of the clamping hub (D).
- Screw in plug (A) of the adaptor plate (B).
  ⓘ For screw sizes and specified torques refer to table "Tbl-6".

Width across flats [mm]	5	8	10	12
Tightening torque [Nm]	10	35	50	70

Tbl-6: Torques for the plugs

5.3 Mounting the gearhead to a machine

	● Observe the safety and processing instructions of the screw-bonding agents to be used.



- Center the gearhead in the machine bed.
- Smear a screw-bonding agent (for example Loctite 243) onto the fastening screws.
- Fasten the gearhead on the machine with the fastening screws through the through-holes (A).
  ⓘ Mount the gearhead in such a way that the type plate remains legible.
  ⓘ Do not use washers (e.g. plain washers, tooth lock washers).
  ⓘ For prescribed screw sizes and torques refer to Chapter 9.3 "Specifications on mounting onto a machine", table "Tbl-16".

5.4 Mounted components on the gear output side

The output shaft is manufactured as standard in the following versions:

- Smooth output shaft
- Grooved output shaft
- Involute gearing
- Slip-on shaft

- Please observe for mounting to the slip-on shaft the further instructions in Chapter 5.4.1 "Mounting on the slip-on shaft with shrink disk".

NOTICE

Distortions during mounting operations can damage the gearhead.

- Mount gearwheels and toothed belt pulleys onto the output shaft without forcing.
- Do not on any account attempt an assembly by force or hammering!
- Only use suitable tools and equipment for assembly.
- If you pull on or shrink-fit a gearwheel onto the output shaft, you must make sure that the maximum permitted static axial forces of the output bearing (see table "Tbl-7") are not exceeded.

Size SP+	060	075	100	140	180	210	240
Fa max[N]	9250	10750	18500	31250	49750	83250	97750

Tbl-7: Maximum permitted static axial forces at static bearing statistic (s0) = 1.8 and radial force (Fr) = 0

5.4.1 Mounting on the slip-on shaft with shrink disk

The slip-on shaft has a smooth design (without keyway). For the load shaft, we recommend the tolerance h6 (DIN ISO 286). The material must have a minimum yield stress of 385 N/mm^2. The slip-on shaft is axially secured to the load shaft by means of a shrink disk connection. If you have ordered a shrink disk, it has already been installed on the slip-on shaft.

- In case you use another shrink disk, observe the instructions of the manufacturer.

NOTICE

Dirt can inhibit transmission of the torque.

- Do not disassemble the shrink disk prior to installation.
- De-grease the load shaft and the slip-on shaft bore in the area of the shrink disk seat, leaving no residual traces.

ⓘ Only the exterior surface of the slip-on shaft may be greased in the area of the shrink disk seat.

NOTICE

The forces of the shrink disk can deform the slip-on shaft.

- Always install the load shaft first before tightening the clamping screws of the shrink disk.

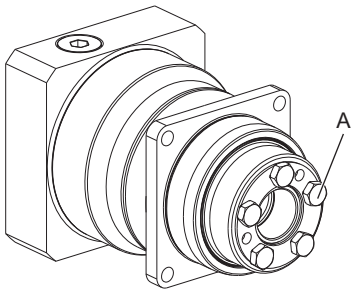
- Slide the slip-on shaft onto the load shaft by hand, taking into account the minimum clamping length and the maximum permissible depth.

  ⓘ For the minimum clamping length and the maximum permitted depth of the slip-on shaft see Chapter 9.2 "Specifications on mounting on the gear output side", table "Tbl-15".

NOTICE

A jamming of the shafts can lead to damage.

- Make sure that the slip-on shaft is aligned with the machine shaft.
- Mount the slip-on shaft onto the machine shaft without using force.
- Do not on any account attempt an assembly by hammering or applying pressure.



- Tighten the clamping screws (A) of the shrink disk evenly distributed in multiple circular passes.
- Tighten the individual clamping screws only up to the maximum permitted tightening torque.

  ⓘ For bolt sizes and specified torques see table "Tbl-8".

Gearhead size SP+	Clamping screw thread	Tightening torque [Nm]	
		Property class 10.9	Property class Ax-80)[1]
060, 075	M6	12	9
100 to 180	M8	29	21
)[1] Ax-80 = stainless steel (optional)			

Tbl-8: Tightening torques for clamping screws of the supplied shrink disk

- Check that the front surfaces of the outer and inner rings are aligned. Only then is the correct braced condition obtained. If this flush alignment is not obtained during bracing, the tolerance of the machine shaft must be checked.
- Check twice in a row that the clamping screws (A) have the maximum tightening torque.

ⓘ If you want to install a shrink disk that was supplied separately, read the information at Chapter 5.4.2 "Installing the shrink disk".

5.4.2 Installing the shrink disk

ⓘ The removed shrink disk does not need to be disassembled and regreased prior to bracing again. It is only necessary to disassemble and clean the shrink disk when it is dirty.

NOTICE

Cleaned shrink disks can have other coefficients of friction. This can lead to damage during mounting.

- Lubricate the inner smooth surfaces of the shrink disk using a solid lubricant with a coefficient of friction of μ = 0.04.

ⓘ The following lubricants are permissible for relubricating the shrink disk:

Lubricant	Commercial form	Manufacturer
Molykote 321 R (lubricating varnish)	spray	DOW Corning
Molykote Spray (powder spray)	spray	DOW Corning
Molykote G Rapid	spray or paste	DOW Corning
Aemasol MO 19 P	spray or paste	A. C. Matthes
Molykombin UMFT 1	spray	Klüber Lubrication
Unimoly P 5	powder	Klüber Lubrication

Tbl-9: Lubricants for relubricating the shrink disk

- Push the shrink disk onto the slip-on shaft.

ⓘ Only the exterior surface of the slip-on shaft may be greased in the area of the shrink disk seat.

- Please observe the instructions in Chapter 5.4.1 "Mounting on the slip-on shaft with shrink disk".

6 Startup and operation

- Be informed of the general safety instructions before beginning work. (see Chapter 2.7 "General safety instructions").

	Improper use can cause damage to the gearhead. ● Make sure that - the **ambient temperature** does not drop below –15 °C or exceed +40 °C and - the **operating temperature** does not exceed +90 °C. ● Avoid icing, which can damage the seals. ● For other conditions of use, please consult our Customer Service Department. ● Only use the gearhead only up to its maximum limit values, see Chapter 3.4 "Performance statistics". ● Only use the gearhead only in a clean, dust-free and dry environment.

7 Maintenance and disposal

- Be informed of the general safety instructions before beginning work. (see Chapter 2.7 "General safety instructions").

7.1 Maintenance work

7.1.1 Visual inspection

- Check the entire gearhead for exterior damage.
- The radial shaft seals are subject to wear. Therefore also check the gearhead for leakage during each visual inspection.
  - ⓘ You can find more general information on radial shaft seals on our partner's Internet site at http://www.simrit.de.
  - ⓘ Check the mounting position, so that no foreign medium (e.g. oil) has collected on the output shaft.

7.1.2 Checking the tightening torques

- Check the tightening torque of the fastening bolts on the gearhead housing.
  - ⓘ You can find the prescribed tightening torques in Chapter 9.3 "Specifications on mounting onto a machine", table "Tbl-16".
- Check the tightening torque of the clamping bolt on the motor mounting.
  - ⓘ You can find the prescribed tightening torques in Chapter 9.1 "Specifications on mounting onto a motor", table "Tbl-14".

7.2 Startup after maintenance work

- Clean the outside of the gearhead.
- Attach all safety devices.
- Do a trial run before releasing the gearhead again for operation.

7.3 Maintenance schedule

Maintenance work	At startup	First time after 500 operating hours or 3 months	Every 3 months	Yearly
Visual inspection	X	X	X	
Checking the tightening torques	X	X		X

Tbl-10: Maintenance schedule

7.4 Notes on the lubricant used

All gearheads are permanently lubricated by the manufacturer with synthetic gear oil (polyglycols) of viscosity class ISO VG100, ISO VG220 or with a high-performance lubricant (see type plate). All bearings are permanently lubricated by the company.

You can receive further information on the lubricants directly from the manufacturer:

Standard lubricants	Lubricants for the food industry (NSF-H1 registered)
Castrol Industrie GmbH, Mönchengladbach Tel.: + 49 2161 909-30 www.castrol.com	Klüber Lubrication München KG, Munich Tel.: + 49 89 7876–0 www.klueber.com

Tbl-11: Lubricant manufacturers

7.5 Disposal

Consult our Customer Service Department for supplementary information on exchanging the adapter plate, on disassembly, and on disposal of the gearhead.

- Dispose of the gearhead at the recycling sites intended for this purpose.
  ⓘ Observe the locally valid regulations for disposals.

8 Malfunctions

NOTICE

Changed operational behavior can be an indication of existing damage to the gearhead or cause damage to the gearhead.

- Do not put the gearhead back into operation until the cause of the malfunction has been rectified.

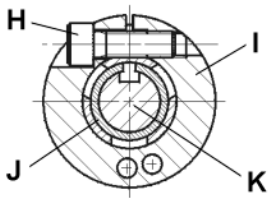
Rectifying of malfunctions may be done by only by especially trained technicians.

Fault	Possible cause	Solution
Increased operating temperature	The gearhead is not suited for the task.	Check the technical specifications.
	Motor is heating the gearhead.	Check the wiring of the motor.
		Ensure adequate cooling.
		Change the motor.
	Ambient temperature too high.	Ensure adequate cooling.
Increased noises during operation	Distortion in motor mounting	Please consult our Customer Service Department.
	Damaged bearings	
	Damaged gear teeth	
Loss of lubricant	Lubricant quantity too high	Wipe off discharged lubricant and continue to watch the gearhead. Lubricant discharge must stop after a short time.
	Seals not tight	Please consult our Customer Service Department.

Tbl-12: Malfunctions

9 Appendix

9.1 Specifications on mounting onto a motor

		Designation
	H	Clamping bolt
	I	Clamping ring (part of the clamping hub)
	J	Bushing
	K	motorshaft

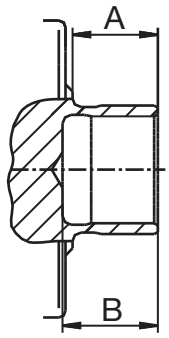
Tbl-13: Arrangement of motor shaft, clamping hub, and bushing

Gearhead size SP+		Clamping hub interior Ø "x" [mm]	Clamping screw (H) / DIN ISO 4762	Width across flats [mm]	Tightening torque [Nm] property class 12.9 (8.8)	max. axial force clamping hub [N]	
						Plug receptacle	Coupling
060	1-stage	x≤11 11< x ≤14 14< x ≤19	M4 M5 M6	3 4 5	4.1 (2.8) 9.5 (5.6) 14 (9.5)	100	10
	2-stage	x≤11 11< x ≤14	M4 M5	3 4	4.1 (2.8) 9.5 (5.6)	80	5
075	1-stage	x≤14 14< x ≤19 19< x ≤24	M5 M6 M8	4 5 6	9.5 (5.6) 14 (9.5) 35 (23)	120	20
	2-stage	x≤11 11< x ≤14 14< x ≤19	M4 M5 M6	3 4 5	4.1 (2.8) 9.5 (5.6) 14 (9.5)	100	10
100	1-stage	x≤19 19< x ≤24 24< x ≤28 28< x ≤38	M6 M8 M6 M10	5 6 5 8	14 (9.5) 35 (23) 14 (9.5) 79 (45)	150	30
	2-stage	x≤14 14< x ≤19 19< x ≤24	M5 M6 M8	4 5 6	9.5 (5.6) 14 (9.5) 35 (23)	120	20
140	1-stage	x≤24 24< x ≤38 38< x ≤48	M8 M10 M12	6 8 10	35 (23) 79 (45) 135 (78)	200	50
	2-stage	x≤19 19< x ≤24 24< x ≤38	M6 M8 M10	5 6 8	14 (9.5) 35 (23) 79 (45)	150	30
180	1-stage	x≤38 38< x ≤48	M10 M12	8 10	79 (45) 135 (78)	250	200
	2-stage	x≤24 24< x ≤38	M8 M10	6 8	35 (23) 79 (45)	200	50

Gearhead size SP+		Clamping hub interior Ø "x" [mm]	Clamping screw (H) / DIN ISO 4762	Width across flats [mm]	Tightening torque [Nm] property class 12.9 (8.8)	max. axial force clamping hub [N]	
						Plug receptacle	Coupling
210	1-stage	48< x ≤55	M12	10	135 (78)	300	—
	2-stage	38< x ≤48	M12	10	135 (78)	250	200
240	1-stage	48< x ≤60	M16	14	330 (195)	300	—
	2-stage	38< x ≤48	M12	10	135 (78)	250	200

Tbl-14: Specifications on mounting onto a motor

9.2 Specifications on mounting on the gear output side

Requirement for the slip-on shaft			
	Gearhead size SP+	Minimum clamping length (A) [mm]	max. permissible depth (B) [mm]
	**060**	14	19
	075	16	21
	100	20	25
	140	25	30
	180	25	125

Tbl-15: Specifications on mounting on the gear output side

9.3 Specifications on mounting onto a machine

Gearhead size SP+	Hole circle Ø [mm]	Bore Ø [mm]	Screw size / property class	Tightening torque [Nm]
060	68	5.5	M5 / 12.9	9.0
075	85	6.6	M6 / 12.9	15.4
100	120	9.0	M8 / 12.9	37.3
140	165	11.0	M10 / 12.9	73.4
180	215	13.0	M12 / 12.9	126
210	250	17.0	M16 / 12.9	310
240	290	17.0	M16 / 12.9	310

Tbl-16: Specifications on mounting onto a machine

9.4 Tightening torques for common thread sizes in general mechanics

The specified tightening torques for headless screws and nuts are calculated values and are based on the following conditions:

- Calculation acc. VDI 2230 (Issue February 2003)
- Friction value for thread and contact surfaces μ=0.10
- Exploitation of the yield stress 90 %

	Tightening torque [Nm] for threads												
Property class Bolt / nut	**M3**	**M4**	**M5**	**M6**	**M8**	**M10**	**M12**	**M14**	**M16**	**M18**	**M20**	**M22**	**M24**
8.8 / 8	1.15	2.64	5.24	8.99	21.7	42.7	73.5	118	180	258	363	493	625
10.9 / 10	1.68	3.88	7.69	13.2	31.9	62.7	108	173	265	368	516	702	890
12.9 / 12	1.97	4.55	9.00	15.4	37.3	73.4	126	203	310	431	604	821	1042

Tbl-17: Tightening torques for headless screws and nuts

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