FLENDER GEAR UNITS

Helical bevel-planetary gear unit

Assembly and operating instructions 9228en
Edition 09/2021

P.DB

345...775



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Assembly and operating instructions

P.DB
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Warning notice system

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

⚠ **DANGER**
indicates that death or severe personal injury **will** result if proper precautions are not taken.

⚠ **WARNING**
indicates that death or severe personal injury **may** result if proper precautions are not taken.

⚠ **CAUTION**
indicates that minor personal injury can result if proper precautions are not taken.

NOTICE
indicates that property damage can result if proper precautions are not taken.

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

Qualified Personnel

The product/system described in this documentation may be operated only by **personnel qualified** for the specific task in accordance with the relevant documentation, in particular its warning notices and safety instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products/systems.

Proper use of Flender products

Note the following:

⚠ **WARNING**
Flender products may only be used for the applications described in the catalog and in the relevant technical documentation. If products and components from other manufacturers are used, these must be recommended or approved by Flender. Proper transport, storage, installation, assembly, commissioning, operation and maintenance are required to ensure that the products operate safely and without any problems. The permissible ambient conditions must be complied with. The information in the relevant documentation must be observed.

Trademarks

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Disclaimer of Liability

We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

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Introduction 1

1.1 General information

Purpose of the operating instructions

These operating instructions describe the gear unit and provide information about handling it - from assembly to maintenance.

Please keep these operating instructions for later use. Please read these operating instructions prior to handling the gear unit and follow the information in them.

Note

Disclaimer

Please make sure that every person who is commissioned to work on the gear unit has read and understood these operating instructions prior to handling the gear unit and adheres to all of the points. Failure to observe these operating instructions can cause product or property damage or personal injury.

Flender does not accept any liability for damage or operating failures which are due to non-adherence to these operating instructions.

The gear unit described in these instructions reflects the state of technical development at the time these operating instructions went to print.

In the interest of technical advancements, Flender reserves the right to make changes to the individual components and accessories which are considered necessary for improving their performance and safety, while maintaining their essential features.

ATEX Directive

The term "ATEX Directive" used in these instructions stands for the harmonisation legislation of the European Union in compliance with the declaration of conformance for equipment and protective systems for correct use in hazardous zones.

Basic knowledge required

In order to understand these operating instructions, you will need the following general knowledge about gear units. You will also need a basic understanding of the following topics:

- Application planning
- Assembly
- Commissioning
- Maintenance

Documentation landscape

These operating instructions form part of the delivery of your gear unit.

These operating instructions form part of the complete documentation supplied with the gear unit. The complete documentation encompasses other documents, including:

- Data sheet
- List of equipment
- Dimension drawing
- Operating instructions for gear unit lubrication and preservation BA 7300
- Operating instructions for mounted components
- Operating instructions for devices and equipment from third-party suppliers

Copyright

The copyright for these operating instructions is held by Flender.

Without the authorisation of Flender, these operating instructions may not be used wholly or in parts for competitors' purposes or be given to third parties.

If you have any technical queries, please contact one of our Customer Services addresses (Page 87).

1.2 Lubricants

The quality of the oil used must meet the requirements of the operating instructions BA 7300, which is provided as a separate item, otherwise the warranty provided by Flender will be void. Flender urgently recommends using one of the oils listed in BA 7300, all of which have been appropriately tested and meet the requirements.

To avoid misunderstandings, Flender points out that, by making this recommendation, Siemens is not approving the product in the sense of expressing a warranty for the quality of the lubricants supplied by your supplier. Each lubricant manufacturer must provide a warranty for the quality of its own product.

You will find the oil grade, oil viscosity and the required quantity of oil on the rating plate of the gear unit and in the documentation provided with it.

The quantity of oil specified on the rating plate is an approximate quantity. The decisive factors for the quantity of oil to be filled are the marking of the oil dipstick or oil sight glass.

The operating instructions for the current lubricant recommendations of Flender can also be viewed in the Internet (https://www.flender.com/lubricants).

The oils listed there are constantly tested. For this reason, oils recommended there may be removed later or replaced with further developed oils.

Flender recommends regular inspection to ascertain whether the selected lubricating oil is still approved by Flender. If it is not, a different make should be used instead.

Safety instructions 2

2.1 Security notes

Flender offers products and solutions with industrial security functions, which support the safe and secure operation of plants, systems, machines and networks.

In order to safeguard plants, systems, machines and networks against cyber threats it is necessary to implement (and continually maintain) a holistic industrial security concept that corresponds to the current state of the art. Flender products and solutions undergo continuous development in this respect.

Customers are responsible for preventing unauthorised access to their plants, systems, machines and networks. These systems, machines and components shall be connected to the company network or the Internet only when and to the extent that this is absolutely necessary and appropriate protective measures (e.g. firewalls and/or network segmentation) shall be taken.

You can find further information about possible protection measures as part of Industrial Security in the following international series of standards, for example: IEC 62443 "Network and system security".

Flender products and solutions undergo continuous development in order to make them even safer. Flender strongly recommends that you regularly implement product updates as soon as they become available and that you only use the current product versions. Use of older or no longer supported versions can increase the risk of cyber threats.

2.2 The five safety rules

For your personal safety and to avoid damage to property, observe the safety relevant information and the following five safety rules defined in EN 50110-1 "Dead working" when working on the electrical components of the installation.

Before commencing work on the machine, apply the following safety rules:

1. Disconnect completely
   Also disconnect the auxiliary circuits, such as the anti-condensation heater
2. Secure against reconnection
3. Verify that the installation is dead
4. Earth and short circuit
5. Cover or cordon off adjacent live parts

After completion of the work, remove these precautions in the reverse order.

2.3 General information

Introduction

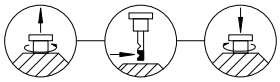
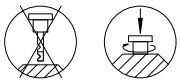
All work on the gear unit should be performed with care and only by qualified personnel.

Symbols on the gear unit

The following symbols apply to the gear unit; some of which are found as coloured markings on the gear unit:

Table 2-1 Symbols and markings

Points labelled on the gear unit	Symbol	Coloured markings
Earth connection point		
Air relief point		yellow
Oil filling point		yellow
Oil draining point		white
Oil level indicator		red
Oil level measurement		red
Oil overflow		
Connection point for vibration monitoring		
Lubrication point		red
Apply grease		
Lifting eye		
Eye bolt		

Points labelled on the gear unit	Symbol	Coloured markings
Do not unscrew		
Alignment surface, horizontal		
Alignment surface, vertical		
These symbols indicate the oil level checking procedure using the oil dipstick.		
These symbols indicate that the oil dipstick must be firmly screwed in.		

2.4 General warnings and symbols

The following table contains general warnings and their associated symbols.

Table 2-2 General warnings

ISO	ANSI	Warning
		Warning - hazardous electrical voltage
		Warning - explosive substances
	---	Warning - entanglement hazard
	---	Warning - hot surfaces
	---	Warning - substances that are harmful to health or are irritants
	---	Warning - corrosive substances
	---	Warning - suspended load
	---	Warning - hand injuries
		ATEX certification

2.5 Special types of danger and personal protective equipment

Requirements

Fulfil the following requirements before commencing work on the gear unit:

- Ensure that the oil pressure lines are depressurised.
- Only perform work on the gear unit when it is not in operation.
- Disconnect electrical systems from the power supply.



⚠ DANGER

Electric shock

Energised parts can cause an electric shock.

Ensure that the entire plant is de-energised before starting electrical installation work.

Protective equipment

Wear the following personal protective equipment when handling the gear unit:

- Safety shoes
- Overalls
- Helmet
- Safety gloves
- Safety goggles

⚠ WARNING

Risk of eye injury

Small foreign particles such as sand or dust can enter the cover plates of the rotating parts and be hurled back by them.

Wear safety goggles.

Dangers during operation

Damage to the gear unit is possible.

Switch the gear unit to standstill immediately if inexplicable changes are noticed during operation. Such changes may include unusual gear unit noise or a significant increase in operating temperature.

⚠ WARNING

Risk of falling

There is an increased risk of falling when standing or walking on the gear unit during operation.

Only walk or stand on the gear unit or its mounted components for maintenance and repair work when the gear unit is at a standstill. Do not walk or stand on shaft ends, protection covers, mounted components or pipes.



⚠ WARNING

Danger to life due to rotating or moving parts

There is danger that rotating or moving parts may catch hold of you or pull you in.

Rotating or moving parts must be fitted with suitable safeguards to prevent contact.

Surface temperature

The surface temperatures of the gear unit can become very extreme depending on the operating conditions.



⚠ WARNING

Risk of burns

Possible risk of serious burn injury from hot surfaces (> 55 °C).

Wear suitable protective gloves and protective clothing.

⚠ WARNING

Risk of scalding

Risk of serious injury possible through escaping hot operating media when these are being changed.

Wear suitable protective gloves, safety goggles and protective clothing.

⚠ WARNING

Danger due to low temperatures

Possible risk of serious injuries due to frost (pain, numbness, frostbite) on cold surfaces (< 0 °C).

Wear suitable protective gloves and protective clothing.

Chemical substances

Injuries can be sustained when using chemical substances.



⚠ WARNING

Risk of chemical burns from chemical substances

There is a risk of chemical burns when handling aggressive cleaning agents.

Please observe the manufacturer's guidelines on how to handle cleaning agents and solvents. Wear suitable personal protective equipment (gloves, safety goggles). Please use binding agents to immediately clear up any spilt solvent.



⚠ CAUTION

Risk of injury due to chemically aggressive operating materials

There is a risk of injury to eyes and hands when handling chemically corrosive consumables.

Please observe the safety instructions in the data sheets of the oil used. Wear suitable personal protective equipment (gloves, safety goggles). Use an oil-binding agent to immediately clean up spilt oil.

2.6 Correct use in hazardous zones (explosive atmospheres)

Only use the gear unit according to the conditions specified in the service and delivery contract and the technical data (Page 99) in the Annex. Deviating operating conditions are considered improper use. The user or owner of the machine or plant is solely liable for any resulting damage.

When using the gear unit please specifically observe the following:

- Do not make any modifications to the gear unit that go beyond the permissible handling described in these operating instructions. This also applies to safety features designed to prevent accidental contact.
- Only ever use original spare parts.
  Other spare parts are not tested and approved by Flender. Non-approved spare parts may possibly change the design characteristics of the gear unit and thus impair its active or passive safety.
  Flender will accept no liability or warranty whatsoever for damage occurring as a result of the use of non-approved spare parts. The same applies to any accessories which were not supplied by Flender.
- All mounted components must strictly comply with the requirements laid down in the ATEX directive.

If you have any queries, please contact Customer Service (Page 87).



⚠ WARNING

An explosive atmosphere can be ignited

An explosive atmosphere can be ignited if mounted components are used that do not comply with the ATEX directive.

All mounted components must strictly comply with the requirements laid down in the ATEX directive.

Connect basic electrical equipment (e.g. monitoring devices, switches, Pt 100 measuring resistors) that have no marking according to the ATEX directive using suitable isolating amplifiers so that intrinsic safety is guaranteed.

⚠ WARNING

Risk of falling

Risk of possible serious injury through falling.

Only walk or stand on the gear unit for maintenance and repair work when it is at a standstill. Do not walk or stand on shaft ends, protection covers, mounted components or pipes.

Gear unit use

When using the gear unit, please observe the following basic rules:

- Ensure that the gear unit is operationally safe.
- The gear unit must only be operated, maintained or repaired by authorised, trained, instructed and qualified personnel.
- The relevant work safety and environmental protection regulations must be complied with at all times during transport, assembly, dismantling, operation, maintenance and servicing.
- The outside of the gear unit must not be cleaned using high-pressure cleaning equipment.
- No welding work must be performed on the gear unit or on parts connected to it. The gear unit and any parts connected to it must not be used as an earthing point for electric-welding operations. Toothed parts and rolling-contact bearings may be irreparably damaged by welding.
- Establish the appropriate potential equalisation connections.



⚠ WARNING

An explosive atmosphere can be ignited

An explosive atmosphere can be ignited if sparking occurs as a result of a gear unit that has not been earthed.

Perform potential equalisation in accordance with the applicable regulations and guidelines.

Threaded holes are provided on the gear unit for an earth connection. This work must always be done by specialist electricians.

- In the case of gear units that are operated in combination with electrical machines that generate current or through which current flows (e.g. motors and generators), take measures to ensure that no current can flow through the gear unit.
  Current flowing through the gear unit can result in irreparable damage to rolling-contact bearings and gearing. Short circuits, voltage flashovers and deposits of conductive dust, for example, can all allow current to flow.
  Use insulators and earth the gear unit properly.
- When removing any protective devices, retain their fixings safely.
- Removed protective devices must be re-fitted prior to starting up.
- Observe the notices mounted on the gear unit, e.g. rating plate, direction arrow symbol etc. The notices must be kept free from paint or dirt. Replace missing plates.
- Bolts that have been damaged during assembly or disassembly work must be replaced with new bolts of the same strength class and type.

⚠ DANGER

Danger to life due to live system

Death or serious injury will occur.

Always shut down the gear unit and any oil supply system (whether separate or mounted on the gear unit) before you perform any work. Secure the drive unit against being operated accidentally as follows:

- Turn off the key-operated switch.
- Remove the fuses in the power supply.
- Attach a notice to the start switch, clearly stating that work is being carried out on the gear unit.

Makes sure that the entire system is not under a load to avoid danger during disassembly work.



⚠ WARNING

An explosive atmosphere can be ignited

An explosive atmosphere can be ignited if electrostatic discharge occurs due to the coating becoming charged.

Carefully ensure that highly efficient charge generating mechanisms, which can cause layers and coatings to be electrostatically charged, are reliably avoided.

The mechanisms that can very easily generate electrostatic charges include:

- Fast streaming past of air with a high dust content
- Sudden outflow of pressurized gases containing particles
- Other severe friction (not manual cleaning or rubbing with cleaning cloths)

If explosion protection is necessary according to the ATEX Directive for areas of explosion group IIC or with the minimum ignition energy ≤ 3 mJ, the coating must be conductive enough to remove electrostatic charges.

Reactivating the gear unit

When the machine or system manufacturers install the gear unit in machines or systems, they must ensure that the instructions, notes and descriptions contained in these operating instructions are incorporated in their own operating instructions.

Storing the gear unit

It is only permissible to store the product on the substructure supplied and in the transport position. Use wedges or bars to prevent the gear unit from rolling away.

⚠ **WARNING**
Danger to life through falling or uncontrolled rolling gear unit
Persons are at risk of being crushed or struck by a gear unit that collapses or rolls away.
Only store the gear unit on the subassembly provided in the transport position. Use wedges or bars to prevent the gear unit from rolling away.
Do not stack gear units on top of one another.

NOTICE
Damage to the gear unit
Damage to the gear unit due to use of unsuitable storage possible.
Only store the gear unit on the subassembly provided in the transport position. Use wedges or bars to prevent the gear unit from rolling away.
Do not stack gear units on top of one another.

Also observe the notes on corrosion protection provided in BA 7300 in the complete documentation for the gear unit.

Description

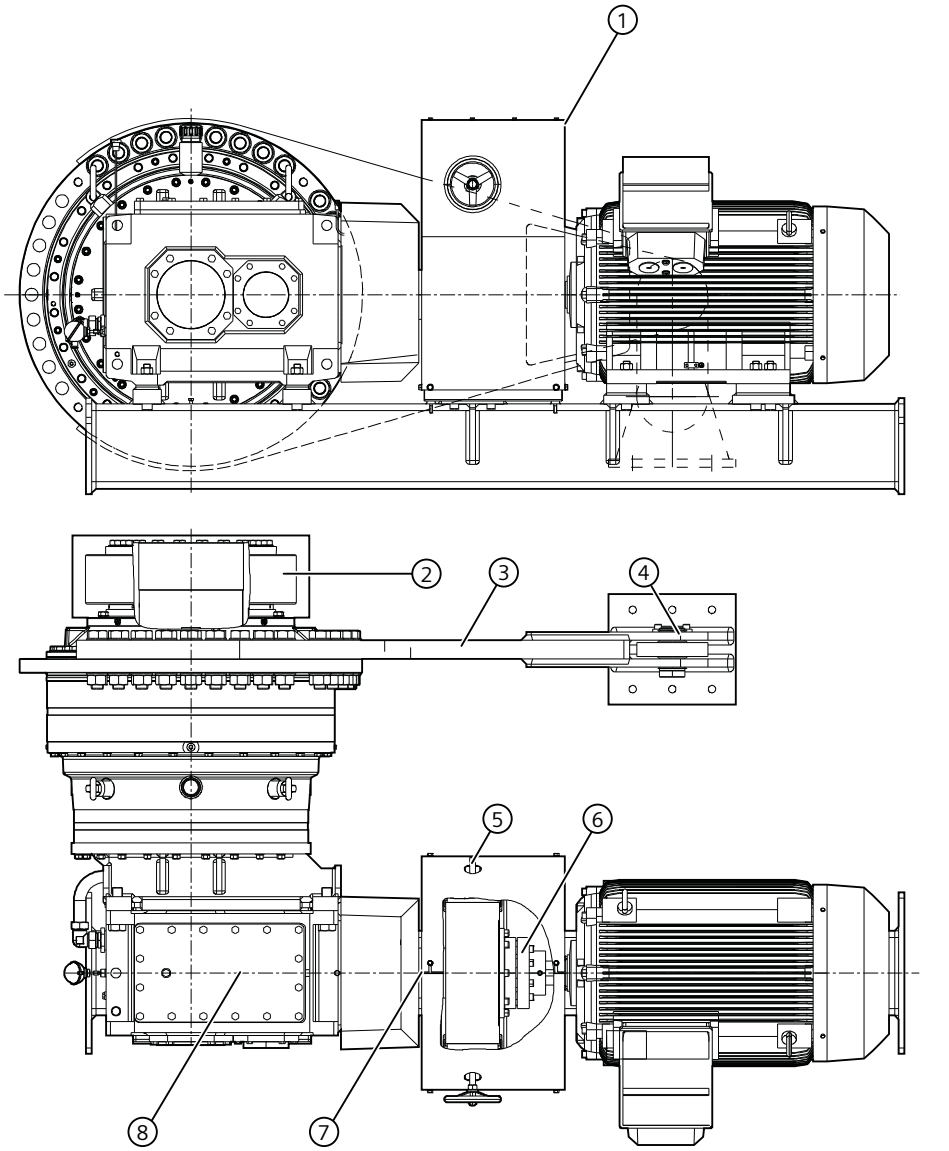
3

3.1 General description

The FLENDER® helical bevel-planetary gear unit (subsequently called "gear unit") described in these operating instructions has been developed for use in bucket wheel excavators.

The bucket wheel gear drive comprises various components which, when completely assembled, form a single drive unit.

The following diagram shows the equipment of the helical bevel-planetary gear unit:



① Protective cover
② Shrink disk
③ Torque arm
④ Ball-and-socket joint (optional)
⑤ Brake
⑥ Coupling
⑦ Fan
⑧ Helical bevel-planetary gear unit

Figure 3-1 Gear unit equipment

3.2 Housing

Introduction

The housing is usually made of cast iron but can be made of spheroidal cast iron or steel, if required.

The gear unit housing has the following features:

- Attachment points for moving the gear unit
- Inspection cover for inspection
- Dipstick for checking the oil level
- Oil drain plug or oil drain valve for changing the oil
- Air filter for ventilation and bleeding

More information

You can find more information and a detailed illustrated description of the gear unit in the dimension drawing.

3.3 Design and principle of operation of bevel helical planetary gear units

The helical bevel-planetary gear unit essentially comprises 2 to 6 planetary stages, two helical gear stages, one bevel gear stage and one output shaft, which is a hollow shaft with shrink disk.

If contractually agreed, the gear unit can be mounted with the following inclinations:

- Longitudinal inclination: ≤ ± 15°
- Transverse inclination: ≤ ± 10°

The current mounting orientation and the maximum inclination are shown in the dimension drawing.

3.4 Oil supply to the gear unit

The following oil supply versions are possible:

- Splash lubrication
- Pressure lubrication
- Circulating-oil lubrication

The gear teeth and rolling-contact bearings are supplied with sufficient oil in the gear units.

For safety reasons, the gear unit is shipped without an oil filling.

3.5 Bearing arrangement of the shafts

All shafts are mounted in rolling-contact bearings.

3.6 Shaft seals

Depending on requirements, shaft seals prevent oil from escaping from the gear unit or dirt from entering the gear unit.

3.6.1 Rotary shaft sealing rings

Rotary shaft sealing rings are the standard seal used. Wherever possible, rotary shaft sealing rings are equipped with an additional dust lip which protects the actual sealing lip against external contaminants.

NOTICE
Irreparable damage to the rotary shaft sealing ring caused by high concentration of dust
A damaged rotary shaft sealing ring might not be able to effectively seal the gear unit.
In very dusty atmospheres, do not use rotary shaft sealing rings unless they have additional protection.

The diagram below shows a rotary shaft sealing ring:

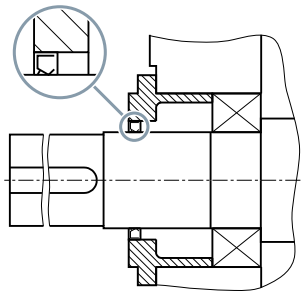


Figure 3-2 Rotary shaft sealing ring

For specific mounting positions, the rotary shaft sealing ring is used together with a grease packing in conjunction with a ring.

For high dust concentrations, in compliance with the ATEX Directive, use is only permitted in conjunction with a taconite seal (Page 25).

3.6.2 Labyrinth seal

The individual components of the housing are sealed statically against leakage with Loctite 640.

The gear unit is also provided with a regreasable labyrinth seal to prevent the ingress of dust.

The following diagram shows the labyrinth seal:

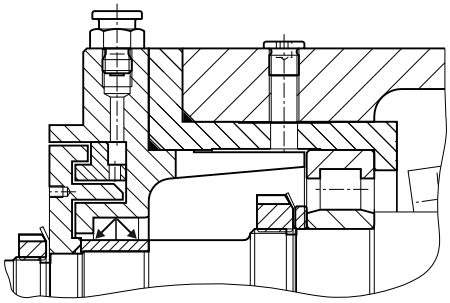


Figure 3-3 Labyrinth seal

3.6.3 Taconite seal

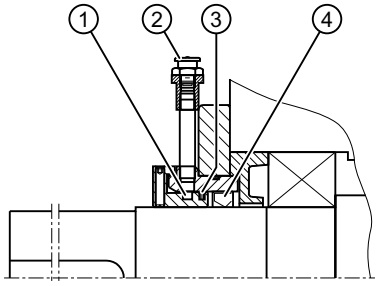
The taconite seal is a combination of two sealing elements:

- Rotary shaft sealing ring to prevent the escape of lubricating oil
- Grease-filled dust seal (comprising a labyrinth and a lamellar seal) to allow operation of the gear unit in extremely dusty environments

The taconite seal is ideal for use in dusty environments.

NOTICE
Gear unit leaks caused by poor sealing Ensure that the labyrinths are regreased at the defined regreasing intervals. The regreasing intervals are specified in the maintenance schedule (Page 76).

A taconite seal is illustrated in the diagram below:



① Labyrinth, filled with grease, can be regreased
② Grease nipple
③ Lamellar seal
④ Rotary shaft sealing ring

Figure 3-4 Taconite seal



⚠ DANGER

An explosive atmosphere can be ignited

An explosive atmosphere can be ignited by sparking or impermissible temperature rise with an insufficient gap dimension.

In the case of a shaft seal with taconite seals, ensure that the set gap dimension of $1^{+0.5}$ mm on the grease labyrinth is not changed when the input and output elements (e.g. coupling parts) are mounted. Rotating and stationary parts must not touch.

3.7 Cooling

The gear unit is cooled by radiation of heat from the housing.

3.7.1 Fan

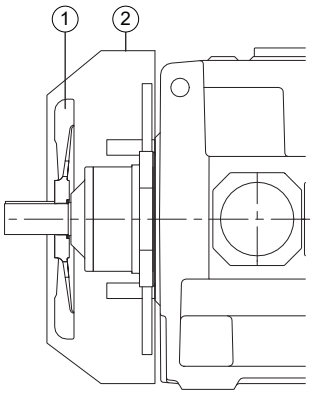
Principle of operation

Generally, the fan is mounted on the high-speed shaft of the gear unit and is protected from accidental contact using an air guide cover. The fan draws in air through the protective grille of the air guide cover and blows it along the lateral air ducts on the gear unit housing. The fan dissipates a certain amount of heat from the housing.

Improper use can damage the gear unit. Follow the instructions given below in order to protect the gear unit against overheating:

- When you install the protective device for the coupling or similar on gear units that are equipped with a fan, make sure that you leave sufficient clearance for cooling air to be drawn into the fan.
  The required clearance is specified in the dimension drawing in the complete documentation for the gear unit.
- Make sure that the air guide cover is correctly fastened.
- Protect the air guide cover against damage by external components.
- Make sure that there is no contact between the fan and the air guide cover.
- Note that the cooling effect can be significantly impaired if the fan is dirty or if the surface of the housing is covered with dust or contaminants that act as an insulating layer.
  Clean the fan and the gear unit. Observe the cleaning information in chapter Cleaning the fan and gear unit (Page 80).

A fan mounted on a gear unit is illustrated in the diagram below:



① Fan ② Air guide cover

Figure 3-5 Fan

Further information

Further information and a detailed illustration of the gear unit and the position of the mounted components can be found in the dimension drawings in the complete documentation for the gear unit.

3.8 Couplings

Elastic couplings are provided for the gear unit input and/or output.

If rigid couplings are to be used or other input and/or output elements that exert additional radial or axial forces (e.g. gear wheels, belt pulleys, flywheels, or hydraulic couplings), this must be contractually agreed in advance.

Couplings with circumferential velocities on the outer diameter of up to 30 m/s must be statically balanced. Couplings with circumferential velocities above 30 m/s require dynamic balancing.

When the drives are installed, the individual components must be precisely aligned with each other to minimise restoring forces due to angular and axial misalignments and to prevent premature wear of elastic coupling elements.

Further information

You can find additional information on the coupling in the operating instructions for the coupling.

3.9 Brake

Further information

You can find additional information on the brake in the operating instructions for the brake, which are part of the complete documentation of the gear unit.

3.10 Shrink disk

For the helical bevel-planetary gear unit, a shrink disk is provided as friction-locked clamping connection between the gear unit solid shaft and the bucket wheel.

Further information

You can find additional information about the shrink disk in the operating instructions for the shrink disk. These operating instructions are included in the complete documentation of the gear unit.

3.11 Oil level indicator

The following components can be mounted on the gear unit to visually check the oil level:

- Oil sight glass
- Oil level indicator
- Oil dipstick
- Oil overflow hole

Check the oil level when the gear unit is stationary and the oil has cooled down.

Further information

You can find additional information about the oil level indicator in the operating instructions BA 7300, which are part of the complete documentation of the gear unit.

You can find additional and a detailed illustration of the gear unit and the position of the mounted components in the dimension drawing, which is part of the complete documentation of the gear unit.

3.12 Oil temperature monitoring system

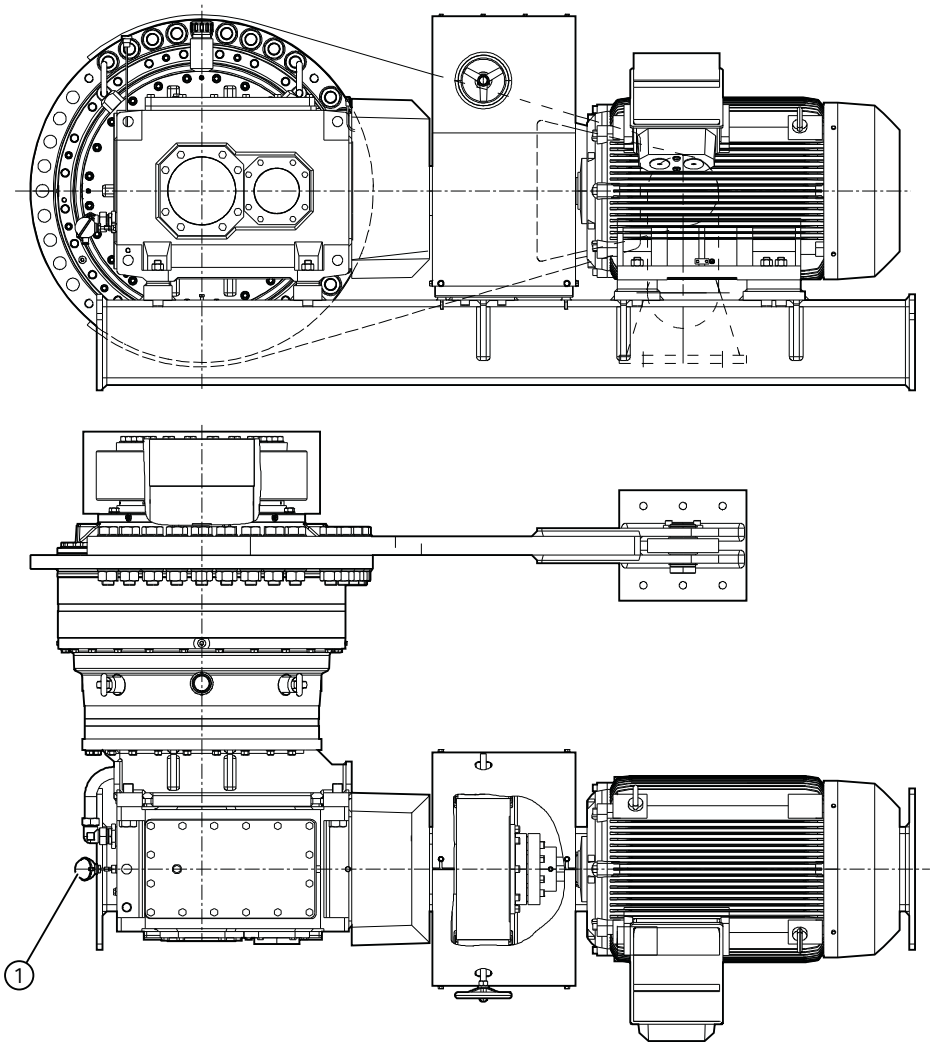
Depending on the order specification, the gear unit can be fitted with a Pt 100 resistance thermometer for measuring the oil temperature in the oil sump.

To measure temperatures or temperature differences, connect the Pt 100 resistance thermometer to an evaluation unit (to be supplied by the customer). The resistance thermometer has a connection head for the wiring. A two-wire circuit is provided by the manufacturer, but customers can also configure a three or four-wire circuit.

For gear units belonging to equipment Category 2, an oil temperature monitoring system **must** be mounted on the gear unit.

For gear units belonging to equipment Category 3, an oil temperature monitoring system **can** be mounted on the gear unit.

The following diagram shows an oil temperature monitor mounted on the gear unit:



① Pt 100 resistance thermometer

Figure 3-6 Oil temperature monitoring system

Further information

You can find additional and a detailed illustration of the gear unit and the position of the mounted components in the dimension drawing, which is part of the complete documentation of the gear unit.

You can find additional about the oil temperature monitoring system, such as control information and technical data, in the oil temperature monitoring system operating instructions and in the list of equipment, which are part of the complete documentation of the gear unit.

3.13 Bearing monitoring

3.13.1 Bearing monitoring using a Pt 100 resistance thermometer

Depending on the order specification, the gear unit can be equipped with Pt 100 resistance thermometers to monitor the bearings.

You must connect the Pt 100 resistance thermometer to an evaluation unit provided by the customer to be able to measure temperatures or temperature differences. The resistance thermometer has a connection head for the wiring. A two-wire circuit is provided by the manufacturer. However, customers can also configure a three or four-wire circuit.

Further information

You can find additional and a detailed illustration of the gear unit and the position of the mounted components in the dimension drawing, which is part of the complete documentation of the gear unit.

You can find additional information on bearing monitoring using a Pt 100 resistance thermometer, such as control information and technical data in the Pt 100 resistance thermometer operating instructions and in the list of equipment, which are part of the complete documentation of the gear unit.

3.13.2 Bearing monitoring by shock-pulse transducer

Depending on the order specification, the gear unit can be equipped with measuring nipples for monitoring the bearings.

These measuring nipples are used to attach shock-pulse transducers with quick-release coupling and are mounted on the housing close to the rolling-contact bearings to be monitored.

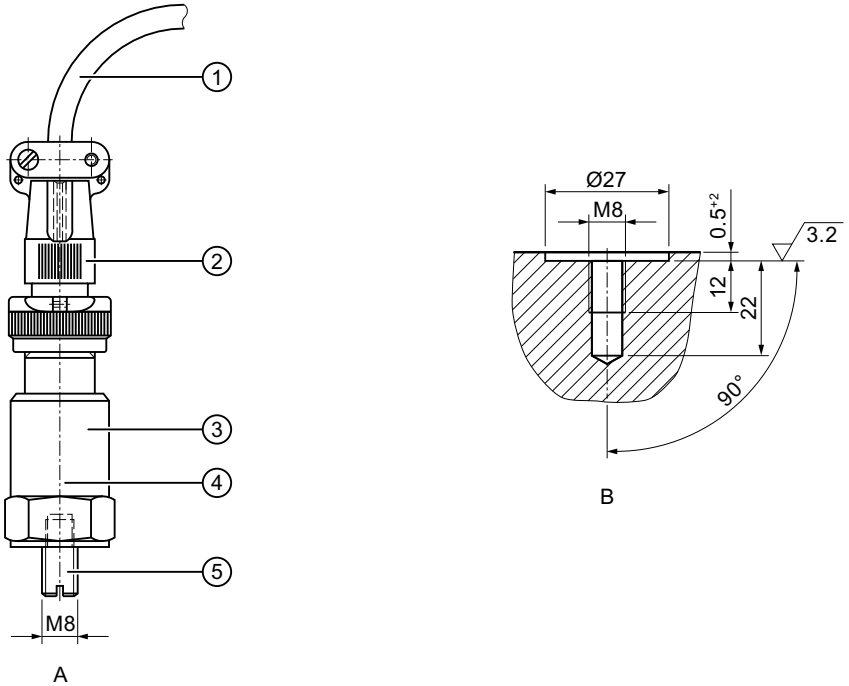
Further information

You can find additional and a detailed illustration of the gear unit and the position of the mounted components in the dimension drawing, which is part of the complete documentation of the gear unit.

3.13.3 Bearing monitoring using acceleration sensor

Depending on the contract, the gear unit can be equipped with threaded holes to attach acceleration sensors. These threaded holes can either have an M6, M8 or 1/4"-28UNF-2B thread depending on the particular version.

The following diagram shows the fully assembled acceleration sensor (A), and the threaded connector (B) for variants 1 to 4:



① Shielded cable (oil-proof)
② MIL-spec connector
③ Acceleration sensor
④ Sensitivity specification
⑤ Set screw

Figure 3-7 Fully assembled acceleration sensor (A), and threaded connector (B) for variants 1 to 4

The following diagram shows the fully assembled acceleration sensor (C), and the threaded connector (D) for variants 5A and 5B:

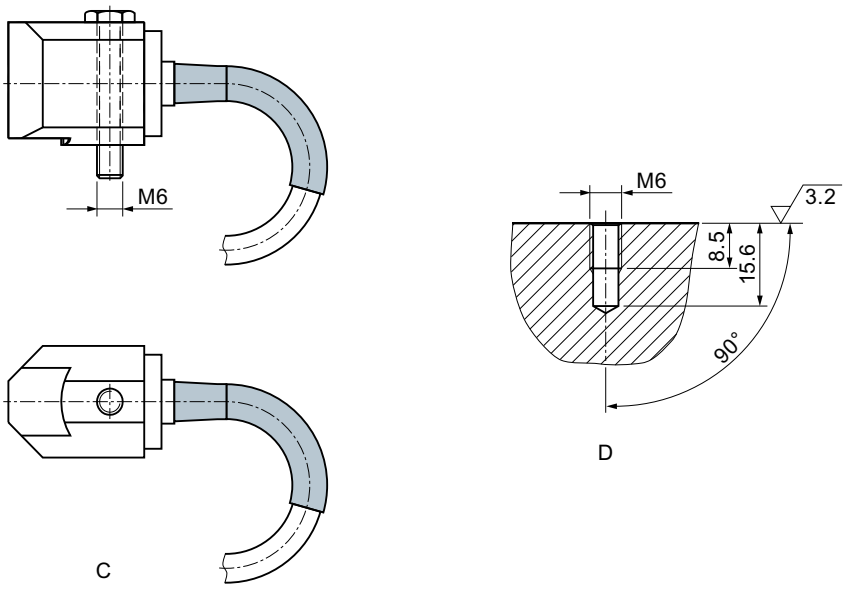


Figure 3-8 Complete acceleration sensor (C), and threaded connector (D) for versions 5A and 5B

The following diagram shows the threaded connector 1/4”-28UNF-2B:

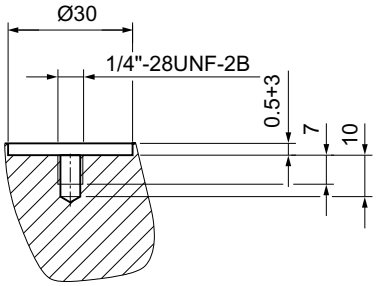


Figure 3-9 Threaded connector 1/4”-28UNF-2B

Further information

You can find additional information and a detailed illustration of the gear unit with attached sensors in the dimension drawing, which is part of the complete documentation of the gear unit.

You can find additional about the sensors in the sensor operating instructions in the complete documentation for the gear unit.

3.14 Bucket wheel operating modes

3.14.1 Settling of the bucket wheel

Note the following steps for allowing the bucket wheel to settle:

- Follow the operating and safety instructions for the brake on the input shaft of the main gear unit.
- Open the brake.

NOTICE
Damage to the gear unit and the brake
The brake on the input shaft of the gear unit is designed as a blocking brake and must on no account be used to brake from motion.
Failure to observe this can irreparably damage the gear unit and the brake.

3.14.2 Starting after the bucket wheel has stopped

Requirement

The bucket wheel must have settled.

Procedure

To start the gear unit again when the bucket wheel is at standstill, proceed as follows:

1. Open the brake.
2. Switch on the pump.
3. Switch on the main motor after 10 minutes.

3.14.3 Protection "off" (emergency stop)

Procedure

To put the gear unit into protection mode "off", proceed as follows:

1. Switch off the main motor.
2. Close the brake.

3.15 Motor-driven oil pump

The gear unit can be equipped with a motor-driven oil pump that establishes oil pressure in the lubrication system.

More information

You can find more information on the mounted components in the operating instructions for the mounted components, which are part of the complete documentation of the gear unit.

You can find more technical data of the mounted components in the separate data sheet and in the list of equipment, which are part of the complete documentation of the gear unit.

Application planning

4

4.1 Scope of delivery

The scope of delivery is listed in the shipping documents. Immediately upon receiving the gearbox, check that everything has been delivered. Report any damaged and/or missing parts to Customer Services (Page 87) immediately.

⚠ WARNING
Serious injury through defective product
Serious injury may occur.
If the gearbox exhibits any visible damage, you should not put it into operation.

4.2 Transport

General information

The gear unit is delivered fully assembled. Additional items such as shrink disks, couplings, oil coolers, pipework and valves may be delivered separately packaged, as necessary.

When transporting the gear unit, observe the following instructions to avoid damaging the gear unit:

- Transport the gear unit only by suitable means of transport.
- Transport the gear unit without an oil filling and leave the gear unit on the transport packaging.
- Do not use incorrect attachment points.
  The threads in the front shaft ends must not be used for attaching lifting equipment.
- Do not use the pipes for moving the gear unit.
- Ensure that the lifting equipment is able to bear the weight of the gear unit plus a safety margin.



⚠ WARNING

Risk of crushing

There is a risk of being crushed by the transported component if the lifting equipment and load suspension devices used are not suitable and the component becomes detached.

When attaching the load, observe the load distribution information on the packaging.

Transport the product slowly and carefully in the lifted condition to avoid personal injury and damage to the gear unit.

Attaching the load

For transport, only attach the the gear unit at the identified attachment points intended for this purpose.

Ensure the following measures are taken when attaching, lifting, lowering and moving the load:

- Keep within the load limits
- If you are using a load suspension device with several load hooks, make sure that the load is evenly distributed between them
- Be aware that the centre of gravity is not in the centre
- Ensure that load suspension devices are correctly secured
- Move the equipment slowly
- Load sway and attachment of the load to objects or parts of buildings is not permissible
- Load hooks must not be loaded at their tip
- Only set down products on a flat, non-slip and strong base
- Use wedges or bars to prevent the gear unit from rolling away



⚠ DANGER

Falling load

A danger to life is posed by a falling load due to incorrect attachment.

Do not stand under suspended loads. Keep within the load limits.

Packaging

The gear unit is delivered fully assembled. Additional equipment is also delivered separately packaged, as necessary.

The gear unit may be packed in various forms, depending on the size of the unit and method of transport.

Please pay attention to the symbols applied on the packaging.

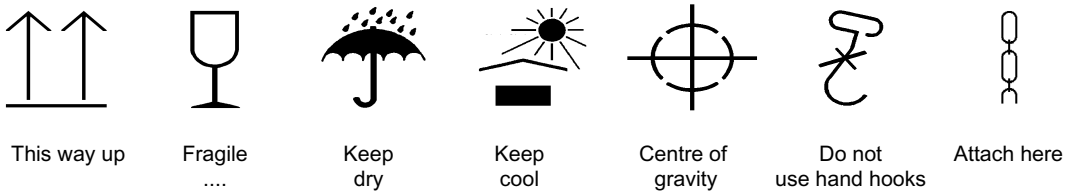


Figure 4-1 Transport symbols

4.3 Attachment points

Lifting eyes

Lifting eyes are provided on the gear unit to be used for transport during installation.

The angle of the vertical load on the lifting eyes of the gear unit must not exceed 45°.

Sling swivels

Gear units have threaded holes to specifically attach lifting eyes so that they can be transported during assembly.

When the load is attached at sling swivels, the diagonal pull must not be at a greater angle than 45°.

Note

Damage to the gear unit during transport

If incorrect attachment points are used, gear units can be damaged when they are transported.

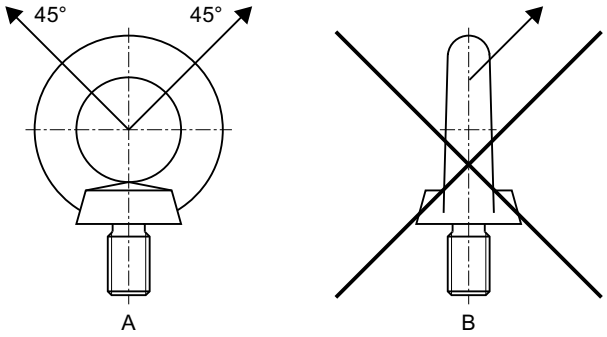
Eye bolts

The use of sling swivels instead of eye bolts is generally recommended.

When using eye bolts, please note that their load-bearing capacity may be reduced if they are alternately attached to different components that require moving.

Load eye bolts must not be loaded by pulling laterally away from the plane of the bolt eye.

The following figure shows the permissible oblique and lateral pulling when using eye bolts:



A Permitted oblique pulling in direction of eye plane (maximum angle of 45°)

B Non-permitted lateral pulling away from the plane of the bolt eye

Figure 4-2 Oblique and lateral pulling when using eye bolts

Position of the attachment points

The following diagram shows the position of the attachment points on the helical bevel-planetary gear unit:

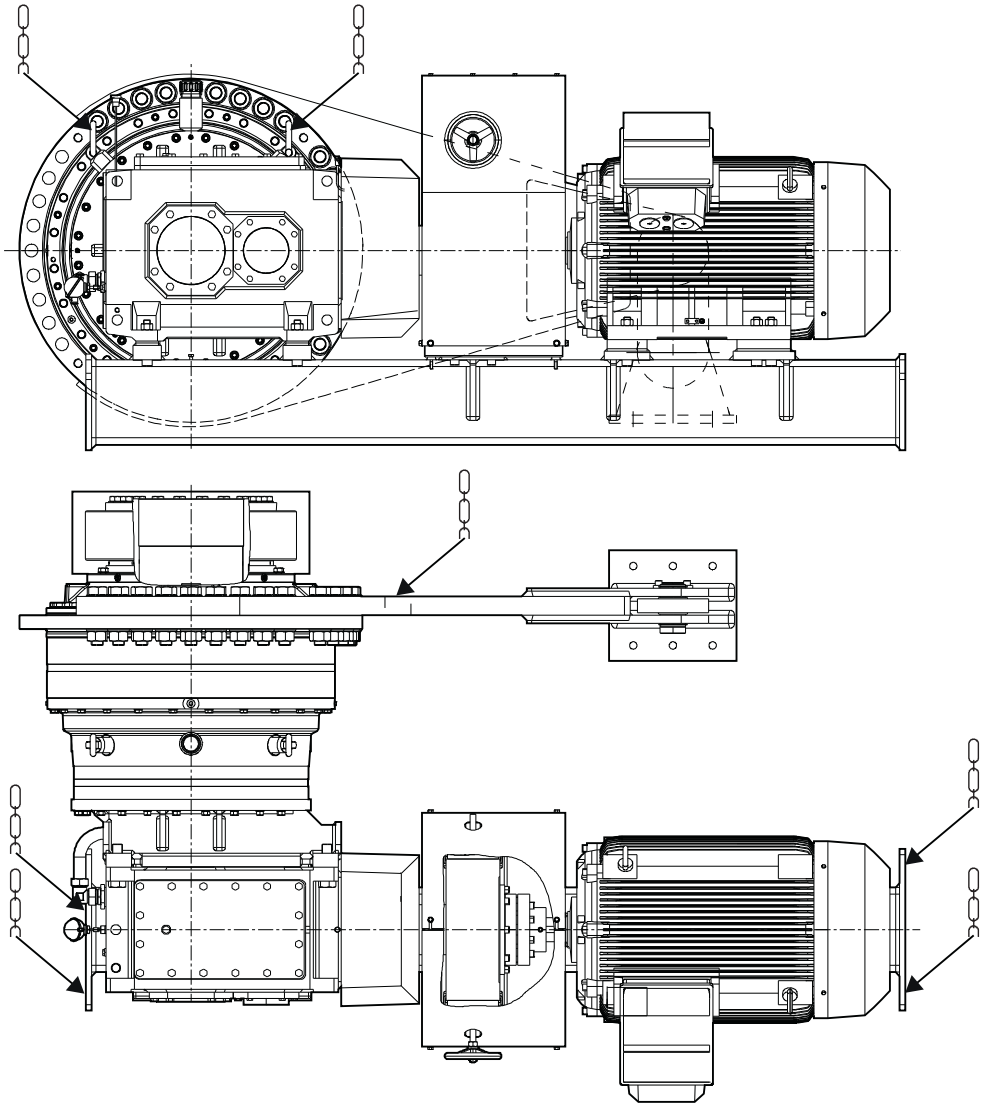


Figure 4-3 Attachment points

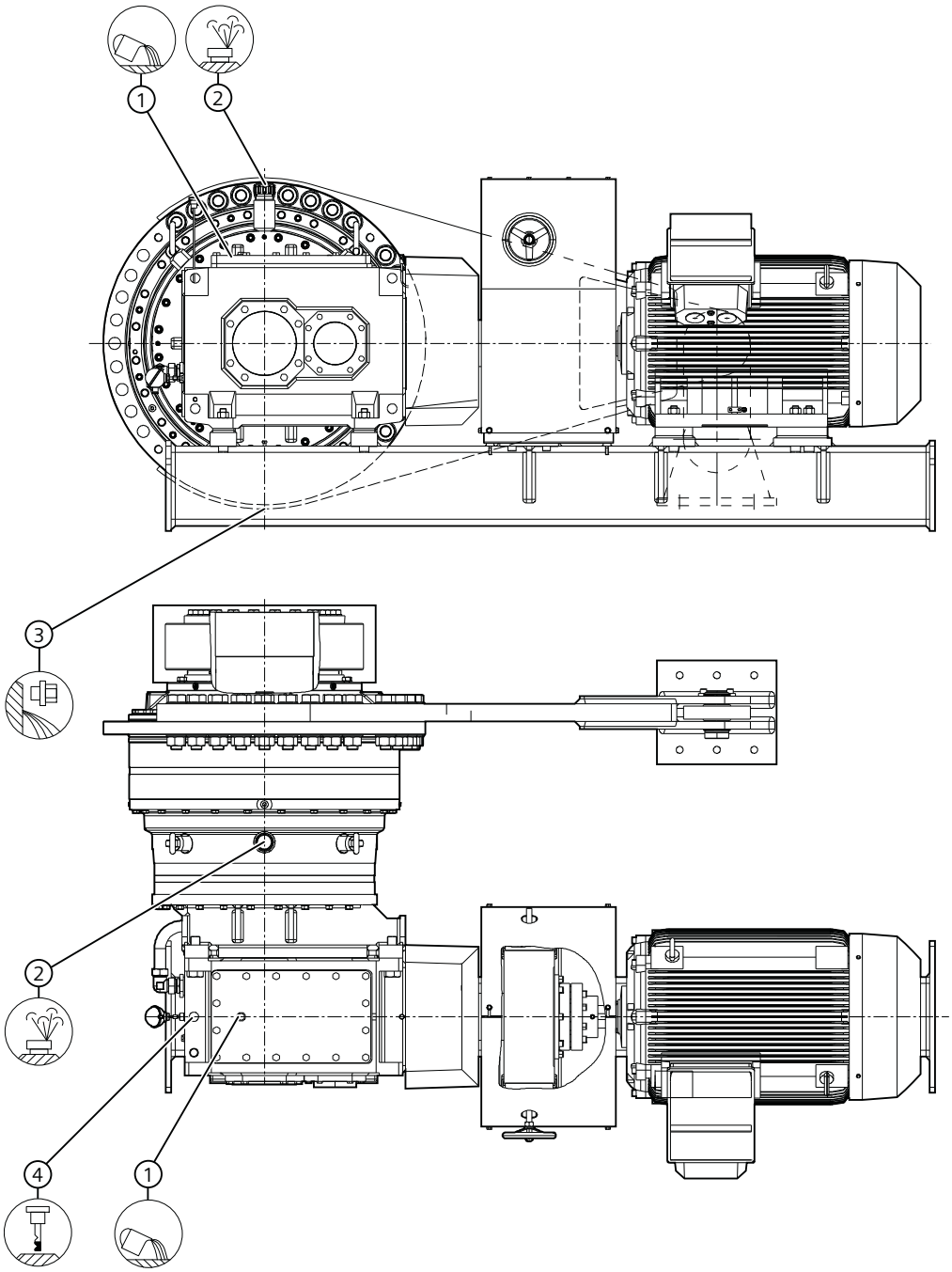
Further information

You will find further information and a detailed illustration of the gear unit, the position of the attachment points, the centre of gravity and data on the weight in the drawings, which are part of the complete documentation of the gear unit.

4.4 Special aspects relating to lubrication

4.4.1 Oil filling and oil drain

The following diagram shows the oil filling locations and oil drain locations for the helical bevel-planetary gear unit:



① Inspection cover / oil filling
② Housing ventilation and bleeding
③ Oil drain
④ Oil level indicator / dipstick

Figure 4-4 Oil filling locations and oil drain locations for the helical bevel-planetary gear unit

Assembly

5

5.1 General assembly instructions

The mounting work must be performed very carefully by authorised, trained and suitably instructed personnel. Liability will be disclaimed for damage caused by the incorrect performance of this work.

Requirements

Improper use can damage the gear unit. Take the following precautions:

- Protect the gear unit against falling objects and from becoming covered over.
- Do not perform any welding work anywhere on the drive.
- Do not use the gear unit as an earthing point for electric-welding operations.
- On gear units that are operated in conjunction with electrical machines, ensure that no current can flow through the gear unit.
- Use all the fastening points provided in the particular unit design.
- Replace any bolts that can no longer be used with bolts of the same strength class and type.
- Make sure that sufficient lifting equipment is available.

Mounting position and attachment points

Already during the planning phase, ensure that sufficient clearance is left around the gear unit to enable mounting and subsequent care and maintenance work.

The positions of the attachment points are shown in the dimension drawing. To ensure the unit is properly lubricated during operation, please observe the mounting position specified in the dimension drawings.

Further information

You can find additional information on dimensions, space requirement and arrangement of the supply connections in the dimension drawings, which are part of the complete documentation of the gear unit.



⚠ DANGER

Danger of explosion

Danger to life due to ignition of a potentially explosive atmosphere possible during assembly work on the gear unit.

Assembly of the gear unit must not take place in an explosive environment.



⚠ DANGER

Danger of explosion due to gear unit heating caused by environmental effects.

Danger to life due to ignition of a potentially explosive atmosphere possible if gear unit becomes overheated due to environmental effects.

The gear unit must not be heated by external heat sources (exposure to direct sunlight, for example) while it is in operation and suitable measures must be taken to protect it.

You can take the following measures to protect the gear unit against this hazard:

- A canopy to protect against the sun
- An additional cooling device
- A temperature monitoring device with trip function in the oil sump

Hotspots can develop if you use a canopy to provide protection against the sun.

If you use a temperature monitoring device, it must be capable of outputting an alarm when the maximum permissible oil sump temperature is reached. It must also be capable of tripping the drive when the maximum permissible oil sump temperature is exceeded. The operator's process might be interrupted when the drive is shut down.



⚠ DANGER

Risk of explosion due to ignition of vapours emitted from solvents

There is danger to life due to ignition of vapours emitted from solvents or another explosive atmosphere during cleaning work.

There must not be an explosive atmosphere during cleaning work on the gear unit.

Please note the following:

- Ensure sufficient ventilation.
- Do not smoke.

5.2 Unpacking the gear unit

Introduction

The scope of delivery is listed in the shipping documents.

⚠ WARNING
Severe injury caused when the content of the packaging slides
There is a risk of being crushed when opening the packaging in which the part is transported.
While being transported, the content of the packing can slide.
Carefully open the packing.
Wear suitable personal protective equipment (gloves, safety goggles).

⚠ WARNING
Risk of serious injury due to defective product
A defective gear unit can result in serious injury.
Do not start the gear unit if it is noticeably damaged.
Contact Customer Service (Page 87).

Requirements

Check that everything has been delivered immediately upon receipt.

NOTICE
Damage to the gear unit due to corrosion
Exposing the gear unit to moisture can result in damage from corrosion.
Do not damage or open the packaging too early if the packaging is used to preserve the unit.

Procedure

To unpack and use the gear unit, please proceed as follows:

1. Remove packaging and transport devices in accordance with regulations.
2. Visually inspect for damage and dirt.
3. Report any damaged or missing parts to Customer Service (Page 87) immediately.
4. Dispose of packaging material and transport devices in accordance with regulations.

5.3 Gear unit assembly

5.3.1 Foundation

Introduction

The gear unit is mounted on a steel structure that functions as the foundation.

Characteristics of the foundation

The foundation must have the following characteristics:

- Stable
- Horizontal
- Flat
- The design of the foundation must provide torsional rigidity
- Reaction forces from the gear unit must be braced

Requirements of the foundation

The foundation must meet the following requirements:

- Construct the foundation in such a way that it does not produce any resonance vibrations and that it is isolated against the transmission of vibrations from adjacent foundations.
- Design the foundation according to the relevant weight and torque, taking into account the forces acting on the gear unit.
- Align the foundation carefully with the equipment installed on the input and output sides of the gear unit.
- Take into account any elastic deformation that may be caused by operating forces.
- Install lateral stops to prevent displacement if external forces are acting on the gear unit.

NOTICE
Lack of stable foundation for the gear unit Damage to the gear unit is possible if it is not mounted on a stable foundation. Always use bolts with a minimum strength class (property class) of 8.8. For further information and tightening torque specifications, see Chapter Tightening procedure (Page 61). Tighten fastening bolts and nuts with the specified tightening torque. Ensure that the gear unit is not deformed or distorted when tightening the fastening bolts.

5.3.2 Measures prior to mounting

Measures prior to mounting



⚠ CAUTION

Risk of chemical burns from chemical substances

There is a risk of chemical burns when handling aggressive cleaning agents.

Please observe the manufacturer's guidelines on how to handle cleaning agents and solvents. Wear suitable personal protective equipment (gloves, safety goggles). Please use binding agents to immediately clear up any spilt solvent.

Improper use can damage the gear unit. Take the following precautions:

- Use a suitable cleaning agent (e.g. white spirit) to remove the corrosion protection from the shafts and adjoining mounting surfaces.
- Ensure that the cleaning agent does not come into contact with the shaft sealing rings.
- Mount the input and output elements (e.g. coupling components) on the shafts and lock them securely. See chapter Couplings (Page 54).
- Use suitable lifting equipment to place the gear unit in position.

Further information

You can find additional information on removing the corrosion protection in the operating instructions BA 7300, which are part of the complete documentation of the gear unit.

You can find additional information on attaching gear units to lifting equipment in cases where the weight of the gear unit necessitates the use of lifting equipment in chapter Application planning (Page 35).

If the gear unit is to be transported with mounted parts and components, then it may be necessary to use additional attachment points. You will find the position of these attachment points in the order-specific dimension drawing, which is part of the complete documentation of the gear unit.

Gap dimension at grease labyrinth

The following figure shows the gap dimension at the grease labyrinth:

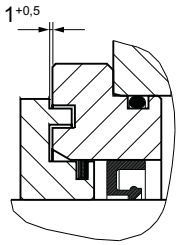


Figure 5-1 Gap dimension at grease labyrinth



⚠ DANGER

An explosive atmosphere can be ignited

Sparking or inadmissible temperature rise due to insufficient gap dimension might result in the ignition of an explosive atmosphere.

In the case of a shaft seal with taconite seals, ensure that the set gap dimension of $1^{+0.5}$ mm on the grease labyrinth is not changed when the input and output elements (e.g. coupling parts) are mounted. Rotating and stationary parts must not touch.

5.3.3 Mounting shaft-mounted gear units with shrink disk

Introduction

The end of the driven machine shaft (material C60+N or higher strength) should have a hole centred in its end face as defined by DIN 332, form DS (with thread). The connection dimensions for the driven machine shaft can be found in the dimension drawing in the complete documentation.

5.3.3.1 Mounting

Introduction

Measures to be taken prior to assembly



⚠ CAUTION

Risk of injury due to chemical substances

Observe the manufacturer's guidelines on how to handle lubricants and solvents.

Wear suitable protective clothing.

Improper use can damage the gear unit. Be sure to take the following precautions:

- Use a suitable cleaning agent to remove the corrosion protection from the hollow shaft and the machine shaft.
- Inspect the hollow shaft and machine shaft for damaged seats and edges.
- If necessary, rework the components with an appropriate tool and then clean them again.

NOTICE

Risk of damage to shaft sealing rings

Aggressive chemical cleaning agents may cause damage to shaft sealing rings.

Do not allow the cleaning agent to come into contact with the shaft-sealing rings.

Note

The bore of the hollow shaft and the machine shaft must be free of any grease

Make sure that the hollow shaft bore and the machine shaft are completely free of grease in the area around the shrink disk seat. The reliability with which torque is transmitted depends to a large extent on this.

Do not use any contaminated solvents or soiled cleaning cloths, nor any cleaning agents that contain oil (such as petroleum or turpentine) to degrease the surfaces.



⚠ DANGER

Danger of explosion

Danger to life through ignition of a potentially explosive atmosphere caused by sparks or hot surfaces.

If there is slip between the hollow shaft and stub shaft, or if the shrink disk slips on the hollow shaft, this can cause sparks and hot surfaces.

- Ensure that bore of the hollow shaft and the stub shaft in the area of the shrink disk seat are absolutely clean and free of any grease and oil.
- Ensure that the shrink disk is correctly mounted and tensioned before the system is switched on.

Pulling on with integrated DU bushing

Procedure

NOTICE

Damage to the gear unit

The gear unit can become damaged if it skews during assembly.

The hollow shaft must be flush with the machine shaft during assembly of the gear unit on the machine shaft. Do not allow the gear unit to skew.

NOTICE

Damage to the rolling-contact bearings

The rolling-contact bearings can become damaged if the gear unit skews during mounting.

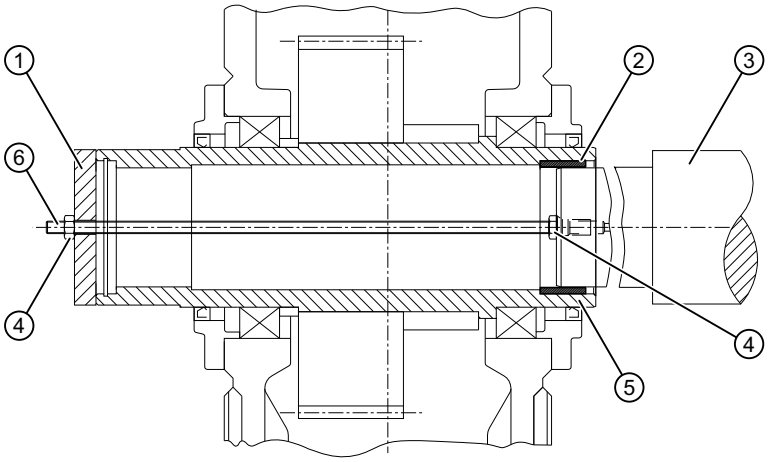
The hollow shaft may be mounted on a machine shaft shoulder only if the gear unit features one of the following:

- Torque arm
- Elastic pedestal
- Supported by gear unit swing base

Proceed as follows to mount the gear unit with hollow shaft and shrink disk onto the driven machine shaft with integrated DU bushing:

1. Use suitable hoisting gear to lift the gear unit.
2. Mount the gear unit using the nut and screw spindle.
   The gear unit is braced by the end plate in the hollow shaft.
3. Pull on the gear unit with hollow shaft up to the seat below the shrink disk on the machine shaft.
   The machine shaft centres itself in the seat below the shrink disk and in the DU bushing.
4. Mount the hollow shaft against the machine shaft collar:

The following diagram shows the preparation for gear units with hollow shaft and shrink disk:



① End plate
② DU bushing
③ Machine shaft
④ Nut
⑤ Hollow shaft
⑥ Screw spindle

Figure 5-2 Preparation for gear units with hollow shaft and shrink disk

Parts 4 and 6 are not included in the scope of delivery.

Mounting with DU bushing as a separate component

Procedure

NOTICE
Damage to the gear unit
The gear unit can become damaged if it skews during assembly.
The hollow shaft must be flush with the machine shaft during assembly of the gear unit on the machine shaft. Do not allow the gear unit to skew.

NOTICE
Damage to the rolling-contact bearings
The rolling-contact bearings can become damaged if the gear unit skews during mounting.
The hollow shaft may be mounted on a machine shaft shoulder only if the gear unit features one of the following: • Torque arm • Elastic pedestal • Supported by gear unit swing base

Proceed as follows to mount the gear unit with hollow shaft and shrink disk onto the driven machine shaft with a DU bushing as a separate component:

1. Use suitable hoisting gear to lift the gear unit.
2. Push the separately supplied DU bushing onto the machine shaft.
3. Use a ratchet tie to tighten the DU bushing until it makes secure contact with the shaft.
4. Move the DU bushing together with the machine shaft into the hollow shaft of the gear unit.

Hydraulic pulling equipment can be used instead of the nut and screw spindle shown in the diagram.

Axial locking

Tightening the shrink disk as per specification ensures that the gear unit is properly axially locked. It is not necessary to install any further axial locking elements.

Dismantling

Procedure

To remove the shaft-mounted gear unit with hollow shaft and shrink disk from the machine shaft, proceed as follows:

1. Secure the gear unit in position.
2. Dismantle the shrink disk.
3. Lift the gear unit off the machine shaft using jacking screws until the seats under the shrink disk and the DU bushing are exposed.
4. Use suitable hoisting gear to lift the gear unit off the machine shaft.

5.3.4 Mounting the torque arm

Introduction

For all shaft-mounted gear units, use a torque arm to absorb the reaction torque, which corresponds in magnitude to the torque of the machine and is exerted on the housing in the opposite direction.

If it has not already been mounted, mount the mounted component of the torque arm on to the gear unit as specified in the order.

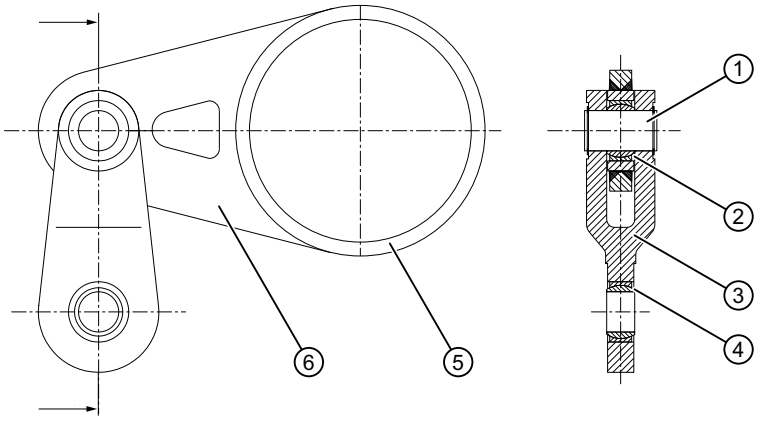
Degrease the contact surfaces before attachment and cover with Loctite 640 liquid adhesive. The liquid adhesive increases the friction coefficient of the torque transmitting surfaces, while simultaneously protecting against corrosion.

NOTICE
Damage to the gear unit due to incorrect attachment of the torque arm
Damage to the gear unit is possible due to incorrect attachment of the torque arm.
Torque arms must only be mounted in consultation with Flender. Mount the torque arm on the side of the machine without causing any distortion. Use the maximum possible number of bolts for mounting.

One-sided torque arm

If the gear unit is equipped with a one-sided torque arm, use a ball-and-socket joint or a flexible bushing.

The following diagram shows one-sided torque arm:



① Axle
② Ball-and-socket joint
③ Lever
④ Ball-and-socket joint
⑤ Connection at the gear unit
⑥ One-sided torque arm

Figure 5-3 One-sided torque arm

If the complete torque support system is included in the scope of delivery, you will find connection of the bracket to the machine frame in the dimension drawing.

If connection between the torque arm and the machine frame is performed by the customer, make sure that the gear unit is not subjected to strain. Use double-articulated or elastic elements.

Further information

You can find additional information and a detailed illustrated description in the dimension drawing, which is part of the complete documentation of the gear unit.

5.4 Couplings

Introduction

Improper use can damage the gear unit. Take the following precautions:

- If necessary, perform the following preparatory work in accordance with the operating instructions for the coupling:
  - Milling the finished bore
  - Mill the parallel keyway
  - Fit the axial locking element
  - Balance
- Align the individual components precisely with one another.
- Refer to the operating instructions for the coupling for instructions on how to install, maintain and operate the coupling.

⚠ **WARNING**
Danger of injury due to coupling rupture Flying fragments can cause fatal injury. Observe the operating instructions for the couplings.

NOTICE
Serious or irreparable damage to the gear unit and coupling caused by inaccurate or incorrect alignment Failure to accurately or correctly align the gear unit and coupling may result in serious or irreparable damage to both components. Align the individual components precisely with one another when installing the drives. Make sure that the maximum permissible misalignment values are not exceeded during operation.



⚠ **CAUTION**
Risk of crushing There is a risk of crushing when aligning and fastening the coupling. Wear suitable protective gloves and protective clothing.

More information

You can find more information on the coupling in the operating instructions for the coupling, which are part of the complete documentation of the gear unit.

5.4.1 Mounting the coupling

Introduction

The method used to mount the coupling varies according to type. The procedure described in these operating instructions is general rather than specific to one type of coupling.

Mount the coupling as described in the operating instructions for the specific coupling.

Improper use can damage the gear unit. Take the following precautions:

- Do not use force (hammer blows, etc.) to fit the coupling parts as this can cause internal damage to the gear unit.
- Take care not to damage the shaft sealing rings or shaft running surfaces when fitting the coupling parts.

Procedure

To fit the coupling, proceed as follows:

1. Carefully clean the shaft ends and the coupling parts.
2. Use a suitable fixture to mount the coupling parts on the shaft ends.
3. Lock the coupling parts to prevent axial displacement.
4. Move the machines to be coupled close to one another and then align them (Page 56).
5. Join the coupling parts together.

Heating coupling parts prior to mounting

Depending on the order specification, it may be necessary to heat the coupling parts before mounting them.



⚠ WARNING

Risk of burns

Possible risk of serious burn injury from hot surfaces (> 55 °C).

Wear suitable protective gloves and protective clothing.

Improper use can damage the gear unit. Take the following precautions:

- The required joining temperatures can be found in the dimension drawings in the operating instructions for the coupling
- Unless otherwise instructed, heat the coupling parts by an induction heater, with a torch or in an oven.
- Use heat shields designed to protect against radiant heat in order to safeguard the shaft sealing rings against damage or heating to above 100 °C.
- Quickly fit the coupling parts on the shafts. The mounting dimensions can be found in the dimension drawings in the operating instructions for the coupling.

Gear units with hollow output shaft or flanged output shaft

There is no need to install the output-side coupling for gear units with a hollow output shaft or flanged output shaft.

Mount gear units with hollow output shaft onto the shafts of the customer's driven machine. Use a mating flange to mount gear units with flanged output shaft onto the shaft of the customer's driven machine.

Further information

You can find additional information on the coupling in the operating instructions for the coupling, which are part of the complete documentation of the gear unit.

5.4.2 Aligning the coupling

Introduction

The coupling parts might become misaligned as a result of:

- Failure to accurately align the parts during mounting
- During operation of the system:
  - Due to thermal expansion
  - Due to shaft deflection
  - Due to machine frames that are too soft

Improper use can damage the gear unit or the coupling. Take the following precautions:

- Make sure that the maximum permissible misalignment values are not exceeded during operation.
  - If you are using couplings supplied by Flender, you will find the maximum permissible misalignment values in the operating instructions for the coupling.
  - If you are using couplings supplied by other manufacturers, contact them and ask them for the maximum permissible misalignment values, making sure that you specify the potential radial loads for your application. Keep the operating instructions for the coupling together with these operating instructions.
- Angular and radial misalignment might occur simultaneously.
  Make sure that the total value of both misalignments does not exceed the maximum permissible angular or radial misalignment value.

The diagram below illustrates the potential misalignments:

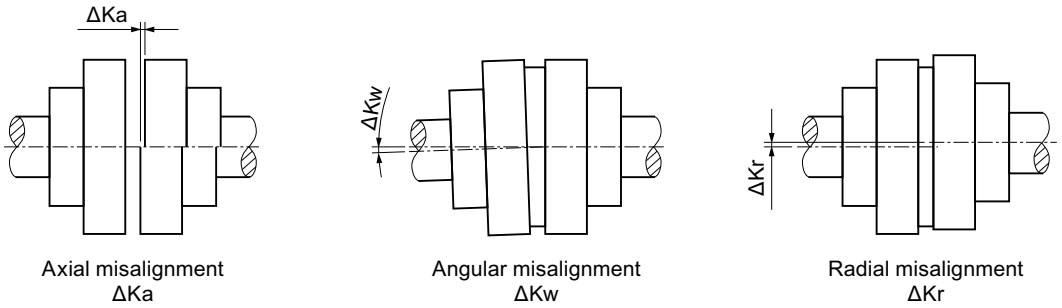


Figure 5-4 Possible misalignments

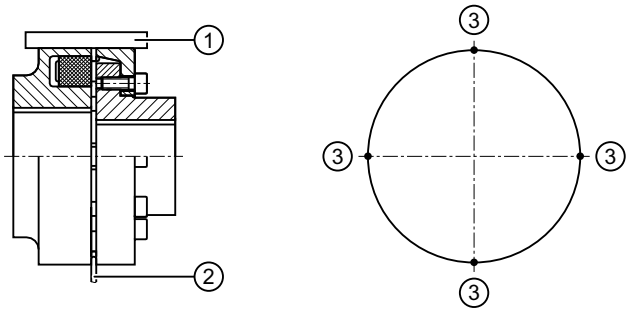
Alignment

Align the individual components in two mutually perpendicular axial planes. The following can be used as alignment tools:

- Ruler (radial misalignment)
- Feeler gauge (angular misalignment)
- Spirit level
- Dial gauge
- Laser alignment system

You will achieve a greater degree of alignment accuracy by using a dial gauge or laser alignment system.

The diagram below shows the alignment process based on the example of a flexible coupling:



① Ruler
② Feeler gauge
③ Measuring points

Figure 5-5 Alignment process based on the example of a flexible coupling

Note

It is advisable to insert shims or metal sheets under the mounting feet to align the drive components in the vertical direction. It is helpful to use support paws with adjusting screws on the foundation to adjust the drive components laterally.

Gear unit with motor bell housing

If the gear unit and the motor are connected through a motor bell housing, no alignment of the couplings is necessary.

Further information

You can find additional information on the permissible alignment errors in the operating instructions for the coupling, which are part of the complete documentation of the gear unit, or contact the manufacturer in question.

5.5 Installing the motor

⚠ DANGER

Risk of fatal injury from flying fragments

Failure to align the unit with the required degree of accuracy can cause the shaft to rupture. A ruptured shaft can result in serious or even fatal injuries.

Align the gear unit exactly so that it conforms to the specified alignment values.

Damage to the gear unit or its components or mounted parts is possible.

The accuracy of the alignment between the shaft axes largely determines the service life of the shafts, rolling-contact bearings and couplings. Please therefore always endeavour to achieve zero deviation in the alignment of the shaft axes (does not apply to ZAPEX couplings). In this context, please also refer to the relevant operating instructions for further information about, for example, the requirements of couplings.

Procedure

To install the motor, proceed as follows:

1. Follow the motor manufacturer's operating instructions.
2. Align the drive motor together with the coupling along the centre axis of the gear unit input shaft and secure the motor in position.
3. Record the alignment dimensions.
4. Keep the report in a safe place together with these operating instructions.

5.6 Connecting components

5.6.1 Gear units with mounted components

Depending on the order specification, the gear unit can be equipped with various components.

Connect the closed-loop control and open-loop control electrical devices corresponding to the specifications of the device supplier.

Further information

You can find additional information on operation and maintenance in the operating instructions supplied, which are part of the complete documentation of the gear unit.

You will find the technical data of the mounted components in the order-specific list of equipment, which is part of the complete documentation of the gear unit.

5.6.2 Connecting the Pt 100 resistance thermometer

Procedure

To connect the Pt 100 resistance thermometer to the gear unit, proceed as follows:

1. Check that the Pt 100 resistance thermometer connection is not damaged.
2. Install the electrical wiring between the Pt 100 resistance thermometer and the evaluation unit. The customer is responsible for providing the evaluation unit.

Further information

You can find additional information on the Pt 100 resistance thermometer in the Pt 100 resistance thermometer operating instructions, which are part of the complete documentation of the gear unit.

5.6.3 Connecting the bearing monitoring

Procedure

To connect the bearing monitoring system to the gear unit, proceed as follows:

1. Check that the connection of the bearing monitoring system is not damaged.
2. Install the electrical wiring for the bearing monitoring system.

Further information

You can find additional information on the bearing monitoring system in the operating instructions for the bearing monitoring system, which are part of the complete documentation of the gear unit.

5.6.4 Electrical connections

Requirements

Do not use any motor that exceeds the specified speed of the gear unit, otherwise the gear unit may become damaged. Speeds are displayed on the rating plate.

Improper use can damage the gear unit. Take the following precautions:

- Before connecting the motor, determine the phase sequence of the three-phase power system using a phase-sequence indicator.
- Connect the motor corresponding to the predefined direction of rotation.

Procedure



⚠ DANGER

Electric shock

Energised parts can cause an electric shock.

Ensure that the entire plant is de-energised before starting electrical installation work. Carefully observe the five safety rules (Page 11).

To connect the motors, monitoring devices and electrical components, proceed as follows:

1. Ensure that the connections of the motors, monitoring devices and electrical components are not damaged.
2. Wire the motors, monitoring devices and electrical components as shown in the terminal diagram.

Further information

You can find additional information about the electrical connections in the terminal diagrams and lists of equipment, which are part of the complete documentation of the gear unit.

You can find additional information on mounting the motor in the operating instructions of the motor.

5.6.5 Connecting the motor oil pump

Procedure

To connect the motor oil pump, proceed as follows:

1. Electrically connect the motor.
2. Electrically connect the double change-over filter.

3. Electrically connect the pressure monitor.
4. Electrically connect the volume flowmeter.

If a terminal box is delivered already mounted on the gear unit, the electrical cables to the devices are already wired in the terminal box.

Further information

You can find additional information on the mounted components in the operating instructions for the mounted components, which are part of the complete documentation of the gear unit.

You can find additional technical data of the mounted components in the separate data sheet and in the list of equipment, which are part of the complete documentation of the gear unit.

5.7 Tightening procedure

5.7.1 Introduction

Bolts

The bolts must have the following properties:

- Made of steel
- Black-annealed or phosphatised
- Lightly oiled (do not add additional oil)

Note
Replacing bolts

Replace any bolts that are no longer fit for use by bolts of the same type and strength class.

Mating threads

The mating threads must have the following properties:

- Made of steel or cast iron
- Dry, cut threads

Note
Using a lubricant

Lubricants must never be used because it can result in the bolted connection becoming overloaded.

5.7.2 Bolt connection classes

For screwing fastening bolts, note the information in the following table:

Table 5-1 Information on screwing fastening bolts

Bolt connection class	Range of the torque exerted by the tool	Tightening procedure
C	± 5 % to ± 10 %	• Hydraulic tightening with mechanical screwdriver • Torque-controlled tightening with a torque spanner or a signal-emitting torque spanner • Tightening with a precision mechanical screwdriver with dynamic torque measurement
D	± 10 % to ± 20 %	• Torque-controlled tightening with mechanical screwdriver
E	± 20 % to ± 50 %	• Tightening with an impact wrench or impact driver, without adjustment checking device • Tightening by hand, using a spanner without torque measuring device

Foundation bolts, hub bolts and bearing-cover bolts must always be tightened in accordance with bolt connection class "C".

Further information

You can find additional information on tightening torques for mounting the motor and brake in the operating instructions from the manufacturer in question.

5.7.3 Tightening torques and preload forces

The tightening torques specified in the following table apply only to these operating instructions for the gear unit.

Bolt the specified bolted connections with the tightening torques as stated in the following table.

The tightening torques apply to friction values of $\mu_{total} = 0.14$.

The following table lists the preload forces and tightening torques for bolt connections, strength classes 8.8; 10.9; 12.9:

Table 5-2 Preload forces and tightening torques

Nominal thread diameter	**Strength class of the bolt**	**Preload force for bolt connection classes from table in chapter Bolt connection classes (Page 62)**			**Tightening torque for bolt connection classes from table in chapter Bolt connection classes (Page 62)**		
d		**C**	**D**	**E**	**C**	**D**	**E**
mm		**$F_{M\ min.}$ N**			**M_A Nm**		
M10	8.8	18 000	11 500	7 200	44.6	38.4	34.3
	10.9	26 400	16 900	10 600	65.4	56.4	50.4
	12.9	30 900	19 800	12 400	76.5	66.0	58.9
M12	8.8	26 300	16 800	10 500	76.7	66.1	59.0
	10.9	38 600	24 700	15 400	113	97.1	86.6
	12.9	45 100	28 900	18 100	132	114	101
M16	8.8	49 300	31 600	19 800	186	160	143
	10.9	72 500	46 400	29 000	273	235	210
	12.9	85 000	54 400	34 000	320	276	246
M20	8.8	77 000	49 200	30 800	364	313	280
	10.9	110 000	70 400	44 000	520	450	400
	12.9	129 000	82 400	51 500	609	525	468
M24	8.8	109 000	69 600	43 500	614	530	470
	10.9	155 000	99 200	62 000	875	755	675
	12.9	181 000	116 000	72 500	1 020	880	790
M30	8.8	170 000	109 000	68 000	1 210	1 040	930
	10.9	243 000	155 000	97 000	1 720	1 480	1 330
	12.9	284 000	182 000	114 000	2 010	1 740	1 550
M36	8.8	246 000	157 000	98 300	2 080	1 790	1 600
	10.9	350 000	224 000	140 000	2 960	2 550	2 280
	12.9	409 000	262 000	164 000	3 460	2 980	2 670
M42	8.8	331 000	212 000	132 000	3 260	2 810	2 510
	10.9	471 000	301 000	188 000	4 640	4 000	3 750
	12.9	551 000	352 000	220 000	5 430	4 680	4 180
M48	8.8	421 000	269 000	168 000	4 750	4 090	3 650
	10.9	599 000	383 000	240 000	6 760	5 820	5 200
	12.9	700 000	448 000	280 000	7 900	6 810	6 080
M56	8.8	568 000	363 000	227 000	7 430	6 400	5 710
	10.9	806 000	516 000	323 000	10 500	9 090	8 120
	12.9	944 000	604 000	378 000	12 300	10 600	9 500
M64	8.8	744 000	476 000	298 000	11 000	9 480	8 460
	10.9	1 060 000	676 000	423 000	15 600	13 500	12 000
	12.9	1 240 000	792 000	495 000	18 300	15 800	14 100

Nominal thread diameter	Strength class of the bolt	Preload force for bolt connection classes from table in chapter Bolt connection classes (Page 62)			Tightening torque for bolt connection classes from table in chapter Bolt connection classes (Page 62)		
d		C	D	E	C	D	E
mm		$F_{M\ min.}$ N			M_A Nm		
M72x6	8.8	944 000	604 000	378 000	15 500	13 400	11 900
	10.9	1 340 000	856 000	535 000	22 000	18 900	16 900
	12.9	1 570 000	1 000 000	628 000	25 800	22 200	19 800
M80x6	8.8	1 190 000	760 000	475 000	21 500	18 500	16 500
	10.9	1 690 000	1 100 000	675 000	30 500	26 400	23 400
	12.9	1 980 000	1 360 000	790 000	35 700	31 400	27 400
M90x6	8.8	1 510 000	968 000	605 000	30 600	26 300	23 500
	10.9	2 150 000	1 380 000	860 000	43 500	37 500	33 400
	12.9	2 520 000	1 600 000	1 010 000	51 000	43 800	39 200
M100x6	8.8	1 880 000	1 200 000	750 000	42 100	36 200	32 300
	10.9	2 670 000	1 710 000	1 070 000	60 000	51 600	46 100
	12.9	3 130 000	2 000 000	1 250 000	70 000	60 400	53 900

5.8 Final work

Measures



⚠ DANGER

An explosive atmosphere can be ignited

An explosive atmosphere can be ignited if the gear unit overheats when the oil level is too low due to leakage.

Lock the oil drain valves against accidental opening. If an oil sight glass or an oil level indicator is used to check the oil level, protect them against damage.



⚠ DANGER

An explosive atmosphere can be ignited

An explosive atmosphere can be ignited by electrostatic discharge.

Perform potential equalisation in accordance with the applicable regulations and guidelines. Tapped holes are provided on the gear unit to establish an earth connection. This work must always be done by appropriately qualified electricians.

Once all the components have been assembled or connected, perform the following final work:

- Check whether all devices dismantled for transportation have been reassembled.
- Check all bolted connections for tightness after installation of the gear unit has been completed.
- Check the alignment after tightening the fastening elements. The alignment must not have changed in any way.
- Lock the oil drain valves against accidental opening.
- Protect the gear unit against falling objects.
- Check that the guards over rotating parts are securely fastened.
  Contact (accidental or deliberate) with rotating parts is not permitted.
- Check whether transport locks and protective covers of components have been removed.
- Protect the available oil sight glasses from damage.
- Protect the cable entries against penetrating moisture.
- Remove the sling swivels.

More information

You can find more information about the gear unit and all assembled elements in the operating instructions for assembled elements in the complete documentation for the gear unit.

You can find additional technical specifications in the separate data sheet, which is part of the complete documentation of the gear unit.

Commissioning

6

6.1 Measures prior to commissioning

Take the following measures before commissioning the gear unit:

- Read and observe the operating instructions.
- Replace the screw plug with the air filter or the venting screw. Read operating instructions BA 7300 for further information.
- Fill the gear unit with oil.
- Check the oil level.
- Check the gear unit for leaks.
- Ensure that all pipes and components are filled with oil.

Further information

You can find additional information on oil and changing the air filter in the operating instructions BA 7300, which are part of the complete documentation of the gear unit.

You can find additional information on individual components in the operating instructions for those components, which are part of the complete documentation of the gear unit.

Take the following measures before commissioning the gear unit:

- Read and observe the operating instructions.
- Replace the screw plug with the air filter or the venting screw. Read operating instructions BA 7300 for further information.
- Gear unit with motor-driven oil pump: Carefully observe the measures before commissioning the gear unit with motor-driven oil pump (Page 68). Note the valve positions of the shutoff valves and vent the gear unit beforehand.
- Fill the gear unit with oil.
- Check the oil level.
- Check the gear unit for leaks.
- Ensure that all pipes and components are filled with oil.
- Restart: Ensure that the drive cannot be restarted after safety equipment has responded unless the restarting lockout is cancelled.



⚠ DANGER

An explosive atmosphere can be ignited

An explosive atmosphere can be ignited if the gear unit overheats when the oil level is too low.

Check the oil level and top up with oil if necessary.

Check the gear unit for the ATEX marking.

Further information

Further information about oil and replacement of air filters can be found in the operating instructions BA 7300 in the complete documentation for the gear unit.

Further information about individual components can be found in the operating instructions for the components in the complete documentation for the gear unit.

6.1.1 Gear unit with motor-driven oil pump

Take the following measures before commissioning a gear unit equipped with motor-driven oil pump:

- Before connecting the motor, identify the phase sequence of the three-phase mains power supply.
- Connect the motor corresponding to the defined direction of rotation.
- Ensure that the pressure in the motor-driven oil pump components does not exceed the maximum permissible pressure.
- Ensure that the maximum permissible temperature of the motor-driven oil pump components is not exceeded.
- Using the motor-driven oil pump, lubricate the gear unit for 2 minutes using a pre-lubrication phase. During this time, the rolling bearings and gearing are supplied with sufficient oil for starting.



⚠ DANGER

Risk of explosion

Ignition of a potentially explosive atmosphere caused by overheating due to loss of lubrication could pose a danger to life.

Check that the connecting pipes are firmly seated and tight.

The minimum starting temperature of the motor-driven oil pump must not fall below 10 °C.

6.2 Measures during commissioning

Take the following measures when commissioning the gear unit and document them:

- Check the oil level.
- Check the tightness of the shaft seal on the gear unit (Page 24).
- Check that the rotating parts can rotate without contact.
- Check that the connecting pipes are firmly seated and tight.

Further information

You can find additional information on oil in the operating instructions BA 7300, which are part of the complete documentation of the gear unit.

Start gear units with a pole-changing or frequency-controlled motor at a minimum speed.

Version with motor-driven oil pump

The motor pump must be switched on at least 2 minutes before you start up the gear unit.



⚠ DANGER

An explosive atmosphere can be ignited

Ignition of an explosive atmosphere is possible.

The minimum starting temperature of the motor-driven oil pump must not fall below 10 °C.

More information

More information about deviating start temperatures can be found in the dimension drawing in the complete documentation for the gear unit.

6.2.1 Temperature measurement

Measure the oil sump temperature during the first commissioning and after maintenance work after run-in during use as intended (maximum driven machine power).

More information

You will find more information about the technical data of the gear unit in the separate data sheet and the list of equipment, which are part of the complete documentation of the gear unit.

6.2.2 Bearing monitoring (vibration measurement)

If provisions have been made for vibration measurement for bearing monitoring (Page 30), vibration measurements must be performed to obtain initial values and/or reference values for diagnosis during first commissioning. These measurements must be recorded and archived.

Note

Retaining the record

Keep the record together with these operating instructions.

Operation 7

7.1 Operating data

Introduction

To ensure correct, trouble-free operation of the system, observe the operating data of the gear unit. The operating data specified in the Appendix Technical data (Page 99) apply.



⚠ DANGER

An explosive atmosphere can be ignited

An explosive atmosphere can be ignited by electrostatic discharge.

Do not electrostatically charge the coating. Carefully ensure that highly efficient charge generating mechanisms, which can cause layers and coatings to be electrostatically charged, are reliably avoided.

The mechanisms that can very easily generate electrostatic charges include:

- Fast flows of highly dust-laden air
- Sudden outflow of pressurised gases containing particles
- Other severe friction (not manual cleaning or rubbing with cleaning cloths)

Further information

You will find further information about the technical data of the gear unit in the separate data sheet and the list of equipment, which are part of the complete documentation of the gear unit.

7.2 Control instructions

Introduction

In order to prevent damage to the gear unit and the motor-driven oil pump due to incorrect settings, ensure the following measures are taken:

- Observe the specifications of the list of equipment.
- Only the control instructions for the parts in the list of equipment apply to the supplied motor-driven oil pump.
  Refer to the specific switching points and values of the list of equipment.
- Do not change the factory settings of the pressure relief valve of the pump.
- Ensure that the pumps are not in operation during filling operations.

Pump

When operating the pump, the system pressure is limited by a pressure relief valve integrated in the pump.

Shutoff valves

Adjust the position of the valves according to the respective function.

Note the position symbol on the valves and the oil flow in the lubrication diagram.

More information

The positions of the shutoff valves are provided in the separate operating instructions for the motor-driven oil pump in the complete documentation for the gear unit.

More information about the oil pumps can be found in the separate data sheet and in the list of equipment in the complete documentation for the gear unit.

7.3 Anomalies

Introduction

Switch off the drive unit immediately if it exhibits anomalous behaviour during operation.

A few anomalies are listed below as examples:

- Oil temperature exceeds the maximum permissible value
- Alarm tripped by the pressure monitor in the oil cooling system
- Unusual operating noise

NOTICE
Faults can cause damage to the gear unit
The gear unit might sustain damage if it is not shut down when a fault occurs.
Switch off the drive unit immediately if any fault condition develops.

Rectifying anomalies

Proceed as follows to rectify any anomalies:

1. Switch off the drive unit if it exhibits anomalous behaviour during operation.
2. Refer to the fault information (Page 82) to find the cause of the fault.
3. If you still cannot determine the fault cause, contact Flender Customer Services (Page 87).



⚠ DANGER

An explosive atmosphere can be ignited

An explosive atmosphere can be ignited if the gear unit overheats as the oil level is too low.

Note the following measures:

- Regularly check the gear unit for leaks.
- Secure oil drainage valves against accidental opening.
- Protect any oil sight glasses against damage.
- After safety devices have responded and before recommissioning, make sure that any restart lockout has been cancelled.

7.4 Taking the unit out of service

If you take the unit out of service for a prolonged period, you must take the following measures depending on the length of time that the gear unit will remain out of service:

- Switch off the drive unit.
- For gear units equipped with motor-driven oil pump, perform the following steps before you preserve the gear unit:
  - Remove the connection between the motor-driven oil pump and the gear unit.
  - Close and seal the openings in the gear unit and motor driven oil pump so that they are air-tight.
- Take measures to preserve the gear unit if it is to be out of service for a prolonged period. Follow the procedure described in operating instructions BA 7300.

NOTICE

Decommissioning gear units with motor-driven oil pump

If the gear unit is to be temporarily decommissioned, e.g. due to production stoppage or plant malfunctions, then the motor-driven oil pump must rotate continuously. This will ensure optimum corrosion protection while the gear unit is at a standstill.

Switch the motor-driven pump off if the gear unit will be out of service long enough to require preservation.

Servicing 8

8.1 General maintenance information

The operator must ensure compliance with the stipulated intervals. This also applies if the maintenance activities are included in the operator's internal maintenance schedules.

The gear unit could be damaged if the stipulated intervals for maintenance and servicing work are not observed.

The time limits stipulated in the maintenance schedule are largely dependent on the conditions of use of the gear unit. For this reason, it is only possible to state average time limits here. These refer to the following conditions of use:

- Daily operating time 24 h
- Duty cycle "ED" 100%
- Gear unit input speed 1500 rpm
- Permissible average oil temperature (Page 71)



⚠ WARNING

Danger to life due to live system

Working on a gear unit while it is in operation is hazardous and can result in potentially fatal injuries.

Always shut down the gear unit and any oil supply system (whether separate or mounted on the gear unit) before you carry out any work. Take measures to prevent the accidental restarting of the drive assembly. Attach a notice stating clearly that work is being performed on the gear unit.

8.2 Maintenance schedule

Maintenance and servicing activities

The following table provides an overview of all maintenance and servicing activities which you are required to perform continuously or at regular intervals.

Table 8-1 Maintenance and servicing activities

Intervals and time limits	Measures
As required	Replace the wet-air filter Clean the air filter Clean the fan and gear unit
Plate on the gear unit, gear unit dimension drawing	Replace the backstop
According to the manufacturer's specifications	Check the ignition protection system
Daily	Check the oil temperature Check the oil pressure (if pressure lubrication is fitted) Check for changes in the gear unit noise
Monthly and prior to every start-up	Check for leaks Check the oil level
400 operating hours after commissioning	Check the water content of the oil Change the oil (or depending on results of the oil sample test) Check that the fastening bolts are tight
Every 3 months	Check the speed monitoring of the auxiliary drive Check the auxiliary drive Clean the oil filter Clean the air filter
Every 3 000 operating hours	Measure the vibration levels of the rolling-contact bearings
Every 3 000 operating hours, at least every 6 months	Regrease taconite seals
Every 12 months	Check the friction linings of the torque-limiting backstop Inspect the hose lines Inspect the shrink disk Check the water content of the oil
Every 10 000 operating hours, at least every 2 years	Change the oil if using API Groups I or II mineral oils, or saturated synthetic ester (or depending on the result of oil sample test) Check the condition of the air-oil cooler (the same time as you change the oil) Check the condition of the water-oil cooler (the same time as you change the oil)

Intervals and time limits	Measures
Every 2 years	Perform a general inspection on the gear unit Check that the fastening bolts are tight Clean the fan and gear unit
Every 20 000 operating hours, at least every 4 years	Change the oil if using semi-synthetic oil of API Group III, PAO or PG oil (or depending on the result of the oil sample test)
6 years after the stated date of manufacture	Change the hoses

Further information

You will find further information on additional maintenance and servicing activities in the separate data sheet and in the operating instructions BA 7300.

You will find further information on the installed components in the operating instructions for the components, which are part of the complete documentation of the gear unit.

8.3 Service and maintenance work

8.3.1 Clean the air filter

Cleaning interval

For dust deposits, you must clean the air filter before the minimum interval of 3 months expires.

⚠ CAUTION
Compressed air can cause injuries
There is a risk of eye injury when using compressed air.
Wear suitable safety goggles.

Procedure

To clean the air filter, proceed as follows:

1. Unscrew the air filter.
2. Do not allow foreign matter to enter the gear unit.
3. Wash the air filter with white spirit or a similar cleaning agent.
4. Dry the air filter and blast with compressed air.

8.3.2 Clean the venting screw

Cleaning interval

For dust deposits, you must clean the venting screw before the minimum interval of 3 months expires.

⚠ CAUTION
Compressed air can cause injuries
There is a risk of eye injury when using compressed air.
Wear suitable safety goggles.

Procedure

Proceed as follows to clean the venting screw:

1. Remove the venting screw.
2. Do not allow foreign matter to enter the gear unit.
3. Wash the venting screw with cleaning solvent or a similar cleaning agent.
4. Dry the venting screw and blow it out using compressed air.

8.3.3 Checking the oil temperature

Damage to the gear unit due to excessively high oil sump temperatures.

The gear unit can sustain damage due to inadequate lubrication if you allow it to operate at oil sump temperatures above the maximum permissible temperature.

Do not operate the gear unit above the maximum permissible oil sump temperature.

Procedure

Proceed as follows to check the oil temperature:

1. Allow the gear unit to become warm.
2. Operate the gear unit with the maximum driven machine power.
3. Measure the temperature of the oil in the oil sump.
4. Compare the measured value with the maximum permissible oil temperature (Page 71).
5. Immediately stop the gear unit if the maximum permissible oil temperature is exceeded. Contact Flender Customer Services.

8.3.4 Measuring the vibration levels of the rolling-contact bearings

Procedure

Proceed as follows to measure the vibration levels of the rolling-contact bearings:

1. Document the measurement results.
2. Compare the measured values with the comparison values that were recorded commissioning the gear unit was commissioned.
3. Replace defective rolling-contact bearings.
4. Archive the report together with these operating instructions.

Further information

You can find additional information on measuring the vibration levels on the rolling-contact bearings in the operating instructions of the measurement sensor, which are part of the complete documentation of the gear unit.

8.3.5 Measuring the temperature at the rolling-contact bearings

Procedure

Proceed as follows to measure the temperature at the rolling-contact bearings:

1. Measure the temperature at the rolling-contact bearings.
2. Document the measurement results.
3. Compare the measured values with the comparison values that were documented when commissioning the gear unit.
4. Archive the report together with these instructions.
5. Have Customer Services replace defective rolling-contact bearings.

Further information

Further information about measuring the temperature at the rolling-contact bearings can be found in the Pt 100 resistance thermometer operating instructions in the complete documentation for the gear unit.

8.3.6 Checking the ignition protection system

Procedure

Proceed as follows to check the ignition protection system:

1. Check the ignition protection system for temperature monitoring to ensure that it is functioning correctly.
2. Check the ignition protection system to monitor the temperature for measurement accuracy.

Further information

You will find further information on checking the ignition protection system in the operating instructions for the ignition protection system, which are part of the complete documentation of the gear unit.

8.3.7 Cleaning the fan and gear unit

Introduction

The gear unit can sustain damage due to inadequate cooling if you operate it with a damaged or soiled fan. Depending on the conditions at the site of installation, it may therefore be necessary to clean the fan and gear unit more frequently than stipulated in the maintenance schedule.

Procedure

Proceed as follows to clean the fan and gear unit:

1. Remove the air guide cover.
2. Remove dirt from the fan impeller, air guide cover, protective grille and housing using a hard brush. Never use a high-pressure cleaning device.
3. Remove any spots of corrosion.
4. Reinstall the air guide cover.
5. Ensure that the air guide cover is correctly fastened.
   Ensure that the fan does not come into contact with the air guide cover.



⚠ DANGER

An explosive atmosphere can be ignited

An explosive atmosphere can be ignited if the fan and air guide cover come into contact with one another as the cover has been incorrectly attached and sparks are generated.

Make sure that the air guide cover is correctly fastened. It is not permissible that the fan and air guide cover come into contact with one another.



⚠ DANGER

An explosive atmosphere can be ignited

An explosive atmosphere can be ignited if the gear unit overheats as a result of inadequate cooling.

Avoid dust from depositing on the gear unit. Adapt the cleaning intervals to the operational situation.

8.3.8 Inspecting the shrink disk

Introduction

The shrink disk inspection is limited to a visual assessment of its condition.

Inspection characteristics

Observe the following points when inspecting the shrink disk:

- Loose bolts
- Damage due to use of force
- Inner ring flush against the outer ring

Further information

You can find additional information about the shrink disk in the operating instructions for the shrink disk, which are part of the complete documentation of the gear unit.

8.3.9 General inspection

General inspection of the gear unit by Customer Services

Arrange for Flender Customer Services to perform a general inspection on the gear unit.

Based on their experience, Siemens technicians can best identify whether gear unit parts must be replaced.

8.3.10 Checking that the fastening bolts are tight

Procedure

To check that the fastening bolts are tight, proceed as follows:

1. Observe the information in chapter Tightening procedure (Page 61).
2. Replace any bolts that can no longer be used with new bolts of the same strength class and type.

8.4 Possible faults

The faults listed below are only intended as a troubleshooting guide.

If any faults occur while the unit is still under warranty, do not allow anyone except Flender Customer Services to attempt a repair.

Even after the warranty period has expired, you should still arrange for faults to be rectified by Flender Customer Services.

Note

Loss of warranty

You will invalidate the warranty for the gear unit if you modify it in any way without seeking the approval of Flender beforehand, or if you do not use original spare parts.

Only use original spare parts from Flender. Always arrange for Flender Customer Services to repair any faults that develop while the unit is still under warranty.

Possible faults and how to rectify them

The following table provides an overview of the possible faults and how to rectify them.

Table 8-2 Possible faults and how to rectify them

Possible faults	Causes	Possible remedies
Pressure monitor triggers an alarm (For gear units with pressure lubrication, air-oil cooler or water-oil cooler).	Oil pressure < 0.5 bar	• Check the oil level at room temperature • Top up with oil if necessary • Check the oil pump • If required, replace the oil pump • Check the oil filter, and replace if necessary
Grease escaping at the output shaft	Defective rotary shaft sealing rings	• Inspect the rotary shaft sealing rings and replace if necessary

Possible faults	Causes	Possible remedies
Noise	Damage to the gear teeth	• Contact Customer Service • Inspect the toothed components • If necessary, replace damaged components
	The bearing play is excessive.	• Contact Customer Service • Adjust bearing play
	Defective rolling-contact bearings	• Contact Customer Service • Replace defective rolling-contact bearings
	Gear unit fastening has worked loose	• Tighten bolts and nuts to the specified tightening torque • Replace damaged bolts and nuts
Outer surface of gear unit soiled with oil	Inadequate sealing of the housing cover or joints	• Seal housing cover or joints
	Mechanical face or labyrinth seals soiled with oil, incorrect position for transport	• Check oil filling • Clean labyrinth seals
	Static seal defective	• Check the seals
Main drive motor does not start	Motor direction of rotation incorrect	• Interchange the motor phases
	Brake blocked	• Release the brake • Check the connections
	Backstop cage with sprags incorrectly installed or defective	• Contact Customer Service • Install the backstop cage, rotated through 180° - or replace
	Overrunning clutch blocked	• Contact Customer Service • Replace the overrunning clutch
	Overrunning clutch cage with sprags incorrectly installed and/or defective	• Contact Customer Service • Install the overrunning clutch cage, rotated through 180° - or replace
Main drive motor can start while the auxiliary drive is operational	Defective electrical interlocking between the main and auxiliary motor	• Check the connections • If necessary, replace defective devices
	Defective speed monitoring	• Check the connections • If necessary, replace defective devices
Auxiliary drive motor does not start	Overload at the output	• Reduce the load at the output
	Defective auxiliary drive motor	• Repair or replace motor
	Motor brake not released	• Correct the electrical connection of the motor brake • If required, replace the motor brake
The auxiliary drive motor starts, the main gear unit output shaft does not turn	Motor direction of rotation incorrect	• Interchange the motor phases
	Overrunning clutch cage with sprags incorrectly installed	• Contact Customer Service • Install the overrunning clutch cage, rotated through 180° - or replace
	Defective overrunning clutch	• Contact Customer Service • Replace the overrunning clutch

Possible faults	Causes	Possible remedies
Leaks	Inadequate sealing of the housing cover or joints	• Seal housing cover or joints • Check the seals and if required, replace
	Labyrinth seals oiled up or transport position incorrect	• Check oil filling • Clean labyrinth seals
	Defective rotary shaft sealing rings	• Inspect the rotary shaft sealing rings and replace if necessary
Oil is foaming in the gear unit	Preservation agent not completely drained off	• Change the oil
	Oil supply system left in operation for too long at low temperatures	• Switch off the oil supply system • Degas the oil
	Gear unit too cold in operation	• Switch off the gear unit • Degas the oil • Start up without cooling water during cold restart
	Water in the oil	• Take test tube sample to examine oil condition for water penetration • Have the oil examined by a chemical lab • Change the oil if necessary
	Oil defoamer has run out	• Examine the oil • Change the oil if necessary
	Unsuitable mixture of oils	• Examine the oil • Change the oil if necessary
Oil escaping from the gear unit	Inadequate sealing of the housing cover or joints	• Check the seals and if required, replace • Seal housing cover or joints • Check the compression seals and retighten screws if necessary
	Leaking pipes	• Check the pipes, and replace or seal if necessary
Oil supply system malfunction	-	• Read the operating instructions for the oil supply system

Possible faults	Causes	Possible remedies
Elevated temperature during operation	Oil level in the gear unit housing too high	• Check the oil level • If required, correct the oil level
	Oil is too old	• Check when the last oil change was performed • Change the oil if necessary
	Oil is severely contaminated	• Change the oil
	Oil supply system defective	• Check the oil supply system • If necessary, replace defective components • Read the operating instructions for the oil supply system
	Gear unit with oil cooling system: Cooling liquid flow rate too low or too high	• Adjust the valves of the supply and return lines completely • Check that water and oil can freely flow through the water-oil cooler
	Gear unit with oil cooling system: The oil flow through the water-oil cooler is too low.	• Check the oil filter, and replace or clean if necessary
	On gear units with a fan: Air intake opening in air guide cover or gear unit housing is soiled	• Clean the air guide cover and gear unit housing
	Coolant temperature too high	• Check the temperature • Correct the temperature if necessary
	Defective oil pump	• Check the oil pump function • Repair or replace oil pump if required
Elevated temperature at bearing points	Oil level in the gear unit housing too low or too high	• Check the oil level at room temperature • Top up with oil if necessary
	Oil is too old	• Check when the last oil change was performed • Change the oil if necessary
	Oil supply system defective	• Check the oil supply system • If necessary, replace defective components • Read the operating instructions for the oil supply system
	Defective rolling-contact bearings	• Contact Customer Service • Inspect the rolling-contact bearings and replace if necessary
Increased backstop temperature with failure of the blocking function	Damaged backstop	• Contact Customer Service • Inspect the backstop and replace if necessary
Increased vibration amplitude at the bearing points	Defective rolling-contact bearings	• Contact Customer Service • Inspect the rolling-contact bearings and replace if necessary
	Gear wheels defective	• Contact Customer Service • Inspect the gear wheels and replace if necessary
Contamination indicator of the double change-over filter triggers an alarm	Double change-over filter clogged	• Changeover the double change-over filter corresponding to the separate operating instructions • Clean the filter element

Possible faults	Causes	Possible remedies
Water in the oil	Oil supply system defective	• Check the oil supply system • If necessary, replace defective components • Read the operating instructions for the oil supply system
	Machinery compartment fan is blowing cold air onto gear unit: Water condenses	• Install suitable thermal insulation to protect gear unit housing • Close the air outlet or change the direction of the air outlet using structural measures.
	Climatic conditions	• Contact Customer Service • Use wet-air filter if necessary
	Oil foams in the oil sump	• Take test tube sample to examine oil condition for water penetration • Have the oil examined by a chemical lab

Service & Support

9

Contact

When ordering spare parts, requesting a customer service technician or if you have any technical queries, contact our factory or one of our Customer Service addresses:

Flender GmbH

Am Industriepark 2

46562 Voerde

Germany

Tel.: +49 (0)2871 / 92-0

Fax: +49 (0)2871 / 92-1544

Further information

Further information about service and support can be found on the Internet.

Service & Support (https://www.flender.com/service)

Disposal

10

Disposal of the gear unit

When disposing of the gear unit after its useful life, please observe the following measures:

- Remove operating oil, preservation agents and coolant from the gear unit and dispose of it according to regulations.
- Dispose of the gear unit parts according to applicable national regulations or recycle them.

Environmental protection

Observe the following environmental protection measures for disposal:

- Dispose of or recycle packaging material according to applicable national regulations.
- When changing the oil, collect the used oil in suitable containers. Use oil-binding agents to clean up any oil spillages immediately.
- Store preservative agents separately from used oil.
- Dispose of used oil, preservative agents, oil binding agents and oil-soaked cloths according to the applicable environmental protection regulations.

Spare parts

11

By stocking the most important spare parts at the installation site you can ensure that the gear unit is ready for use at any time.

Note

Damage to the gear unit due to use of unsuitable spare parts

Only use original spare parts from Flender. Flender shall not accept any warranty claims for spare parts that are not supplied by Flender.

Other spare parts are not tested and approved by Flender. Non-approved spare parts may possibly change the design characteristics of the gear unit and thus impair its active or passive safety.

Flender will accept no liability or warranty whatsoever for damage occurring as a result of the use of non-approved spare parts. The same applies to any accessories which were not supplied by Flender.

The contact address of Flender Customer Services can be found under Service & Support (Page 87).

Information required when ordering spare parts

To order spare parts, refer to the spare-parts list. Only ever use original spare parts from Flender.

When ordering spare parts, please provide the following information:

- Order number with item
- Type and size
- Part number
- Quantity

11.1 Spare parts drawing

The following diagram shows the spare parts drawing for type P.DB:

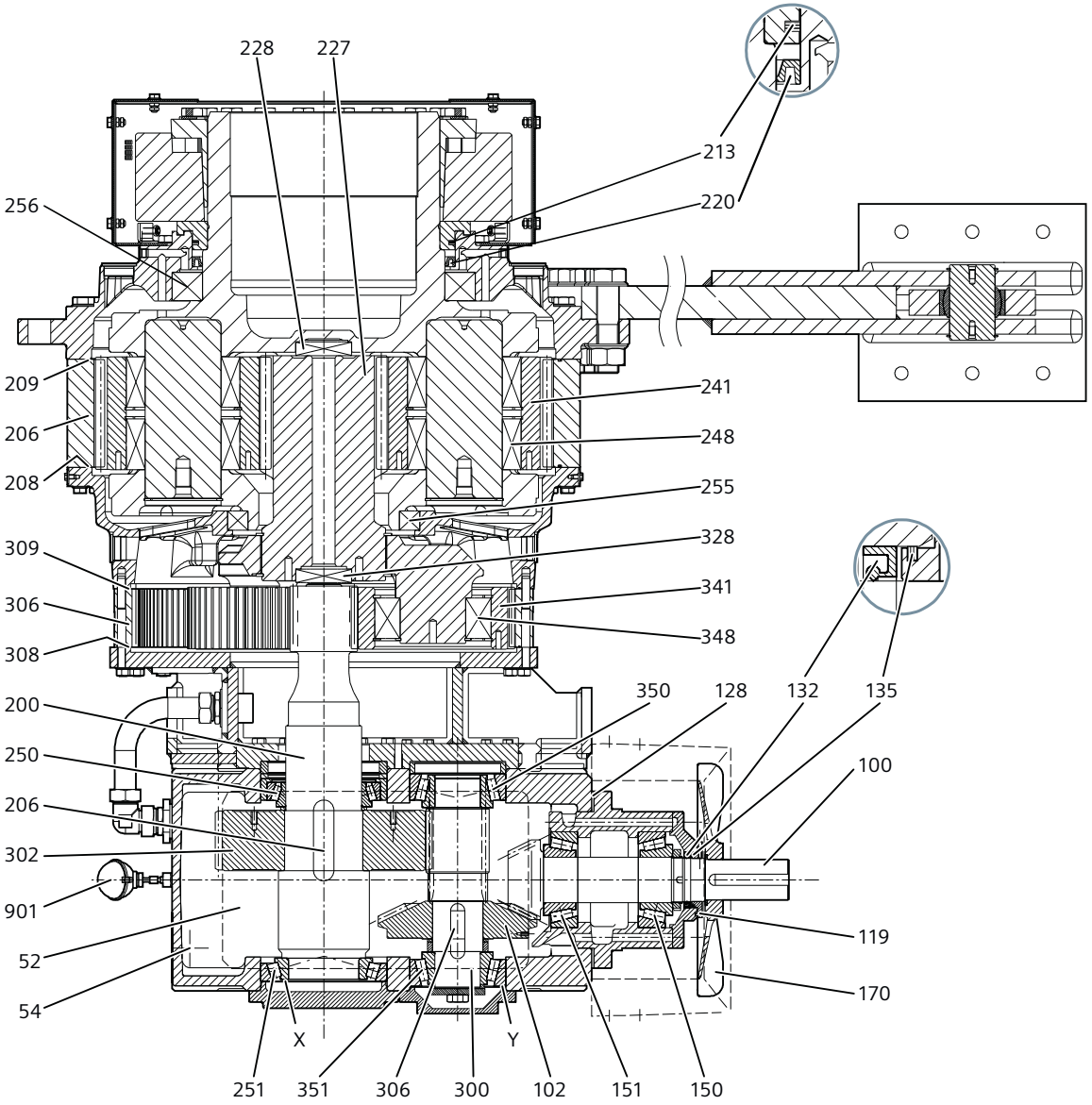


Figure 11-1 Spare parts drawing for type P.DB

11.2 Spare parts list

The following table lists the spare parts for the main gear unit:

Part No.	Quantity	Designation	Part No.	Quantity	Designation
52	1	Seal	228	1	Rolling bearing
54	1	Air filter	241	4	Planetary helical gear
100	1	Bevel gear shaft	248	8	Rolling bearing
102	1	Bevel gear	250	1	Rolling bearing
119	1	Ring carrier	251	1	Rolling bearing
128	1	Fitting ring	255	1	Rolling bearing
132	1	Shaft sealing ring	256	1	Rolling bearing
135	1	Laminar ring	300	1	Helical gear shaft
150	1	Rolling bearing	302	1	Helical gear
151	1	Rolling bearing	306	1	Helical gear (with internal teeth)
170	1	Fan	308	2.36 m	Round cord
200	1	Planetary-spur gear shaft	309	2.36 m	Round cord
206	1	Helical gear (with internal teeth)	328	1	Rolling bearing
208	2.85 m	Round cord	341	3	Planetary helical gear
209	2.85 m	Round cord	348	3	Rolling bearing
213	3	Laminar ring	350	1	Rolling bearing
220	1	Shaft sealing ring	351	1	Rolling bearing
227	1	Helical gear (central)	901	1	Resistance thermometer

Declaration of incorporation

A

Declaration of incorporation

Company name and full address of the manufacturer:

Flender GmbH
Am Industriepark 2
46562 Voerde
Deutschland - Germany

Name and address of the person authorised to compile the relevant technical documentation:

Mark Zundel
Flender GmbH
Am Industriepark 2
46562 Voerde
Deutschland - Germany

Description and identification of the partly completed machinery:

Helical bevel-planetary gear unit
P.DB
Sizes 345 to 775
for operating driven machines

The following "Essential health and safety requirements" of
– Directive 2006/42/EC Official Journal L 157, 9.6.2006, pages 24-86, Annex I,
are applied and complied with:

1.1, 1.1.2, 1.1.3, 1.1.5; 1.2.4.4; 1.3.1, 1.3.2, 1.3.3, 1.3.4, 1.3.6, 1.3.7, 1.3.8, 1.3.8.1; 1.4.1, 1.4.2.1; 1.5.1, 1.5.2, 1.5.4, 1.5.5, 1.5.6, 1.5.7, 1.5.8, 1.5.9, 1.5.10, 1.5.11, 1.5.13, 1.5.15; 1.6.1, 1.6.2; 1.7.1, 1.7.1.1, 1.7.2, 1.7.4, 1.7.4.1, 1.7.4.2, 1.7.4.3

The special technical documentation as described in Annex VII Part B has been prepared.

The partly completed machinery corresponds to
– Directive 2014/34/EU Official Journal L 96, 2014-03-29, Pages 309-356

The manufacturer undertakes, in response to a reasoned request by national authorities, to transmit relevant information about the partly completed machinery in electronic form.

The partly completed machinery must not be put into service until the machinery into which the partly completed machinery is to be incorporated has been declared to be in conformity with the provisions of Directive 2006/42/EC.

Person authorised to issue this declaration of incorporation on behalf of the manufacturer:

Flender GmbH

Voerde, 2021-09-30



Mark Zundel, Vice President, Industrial Gears, Plant Voerde

Original declaration of incorporation

Declaration of conformity

B

EU declaration of conformity

Product:
Helical bevel-planetary gear unit
P.DB
Sizes 345 to 775

Name and address of the manufacturer:
Flender GmbH
Am Industriepark 2
46562 Voerde
Deutschland - Germany

This declaration of conformity is issued under the sole responsibility of the manufacturer.

Object of the declaration is the product specified above.

The product described above and referred to in the declaration complies with the relevant legal harmonisation regulations of the European Union:
– Directive 2014/34/EU Official Journal L 96, 2014-03-29, Pages 309-356

Harmonised standards or other technical specifications,
on which the Declaration of Conformity is based:

EN 1127-1	: 2019
EN ISO 80079-36	: 2016
EN ISO 80079-37	: 2016
EN IEC 60079-0/AC	: 2020

The notified body, DEKRA Testing and Certification GmbH, ID number 0158, has received the technical documentation.

Signed for and on behalf of:

Flender GmbH

Voerde, 2021-09-30



Mark Zundel, Vice President, Industrial Gears, Plant Voerde

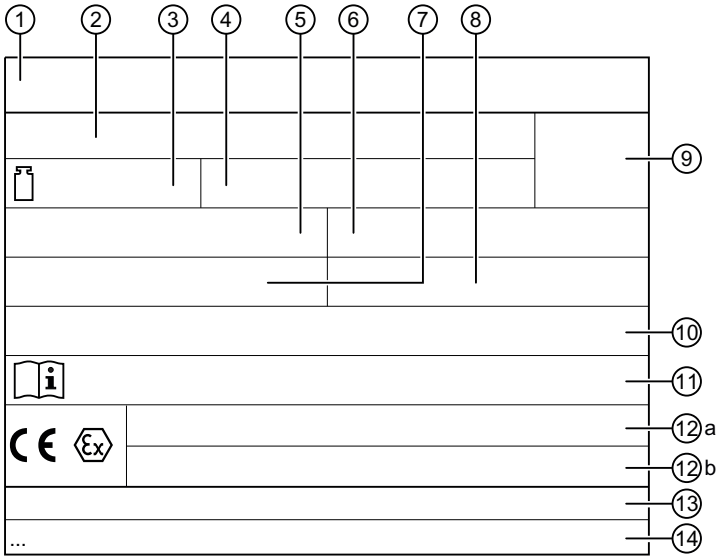
Technical data

C

C.1 General technical data

Rating plate

The rating plate of the gear unit contains the most important technical data.



①	Company logo	⑨	Optional DMC (Data Matrix Code)
②	Serial no.: production plant code/order no. item ser. no./year of manufacture	⑩	Oil data: Oil grade, oil viscosity, oil quantity
③	Total weight in kg	⑪	Number(s) of operating instructions, including issue date
④	For special information	⑫a	ATEX marking for explosion protection – gas marking
⑤	Type and size	⑫b	ATEX marking for explosion protection – dust marking
⑥	Power rating P_2 in kW or torque T_2 in Nm	⑬	Manufacturer documentation / Country of origin
⑦	Speed n_1	⑭	Hotline
⑧	Speed n_2		

Figure C-1 Rating plate

The limits of the intended use of the gear unit are defined on the basis of these data and the contractual agreements concerning the gear unit concluded between Flender and the customer.

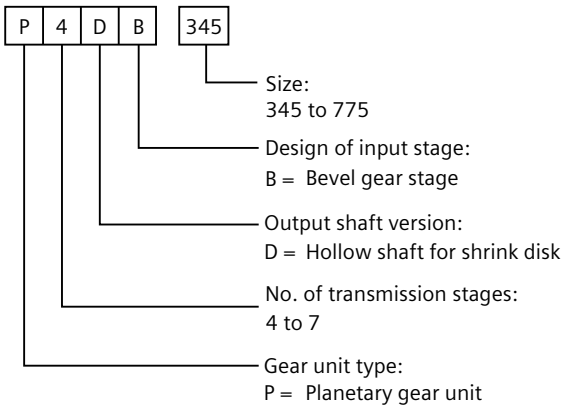
More information

You can find more information on the technical data in the separate data sheet, which is part of the complete documentation of the gear unit.

You can find more information on all important accessories, including their technical data in the list of equipment drawn up specifically for the order, which is part of the complete documentation of the gear unit.

Example code

The following is an example of the code printed in line 5 of the rating plate and explains the meaning of the individual letters and numbers.



More information

You can find more information on the weights and the enveloping surface sound pressure levels in chapters Weights (Page 101) and Enveloping surface sound pressure level (Page 101).

You can find more technical data in the separate data sheet and in the dimension drawings, which are part of the complete documentation of the gear unit.

ATEX marking

The ATEX marking for open cast mining applications is shown in the following table:

Table C-1 ATEX marking

Equipment group	Equipment category	Explosive atmosphere	dust group	Maximum surface temperature	Marking example
II	2, 3	Dust (D)	IIIA, IIIB, IIIC	120 °C, 150 °C, 200 °C	CE Ex II 2D Ex h IIIA T200 °C Db -20 °C ≤ T_a ≤ 40 °C

Please note the following points:

- **Only one** equipment category can be specified.
- **Only one** dust group can be specified for the dust Ex atmosphere.
- $T_{a\ min.} \leq T_a \leq T_{a\ max.}$ = permissible ambient temperature range in °C:
  $T_{a\ min.}$ = minimum permissible ambient temperature
  $T_{a\ max.}$ = maximum permissible ambient temperature
  T_a = ambient temperature code
- The equipment category, the dust group and maximum surface temperatures are specified as examples only.
- The gear unit is not designed for use in hybrid mixtures.

NOTICE
The gear unit can be damaged as a result of incorrect use
The gear unit may be damaged if used for a purpose other than the specified application.
The rating plate on the gear unit displays the marking for the current application.

C.2 Ambient temperature

The specifications in the ATEX directive are applicable for an ambient temperature range extending from -20 °C up to 40 °C. By applying various suitable measures, the gear unit can be used in the ambient temperature range extending from -40 °C up to 60 °C. However, this must always be authorised by Flender.

In each individual case, the ambient temperature range stamped on the rating plate always applies.

C.3 Weights

The precise weights are specified in the dimension drawings in the complete documentation or on the rating plate.

All stated weights refer to units without oil filling or mounted components.

C.4 Enveloping surface sound pressure level

The gear unit has an enveloping surface sound pressure level at a distance of 1 m, which can be taken from the following table.

The measurement is performed using the sound-intensity method according to DIN EN ISO 9614 Part 2.

The workplace of operating personnel is defined as the area on the measuring surface at a distance of 1 m around the gear unit and in the vicinity where persons may be present.

The sound pressure level applies to a gear unit in the warm condition at a drive speed n_1 and output power P_2 according to the rating plate, for measurements carried out on a Flender test bench. If more than one value is stated, the highest speed and power values apply.

The enveloping surface sound pressure level includes any mounted lubrication units. With outgoing and incoming pipes, the flange is considered to be the interface.

The sound pressure levels listed in the table were obtained based on statistical evaluations conducted by the Quality Control department. It can be assumed with statistical certainty that the gear unit complies with these sound pressure levels.

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FLENDER GEAR UNITS

Helical bevel-planetary gear unit
Assembly and operating instructions 9228en
Edition 09/2021

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