

FLENDER GEAR UNITS

Double-screw-extruder gear unit

Assembly and operating instructions A5111-01en
Edition 07/2022

205 F 107, 261 F 200, 292 F 200, 316 F 200, 261 F 222, 292 F 222, 316 F 222, 292 F 311, 316 F 311,
349 F 311

Original assembly and operating instructions

A5111-01
Edition 07/2022

Copyright (©2022 Flender GmbH)

V7
29/09/2022
11:19:00

Table of contents

1	Introduction.....	11
1.1	Legal information	11
1.2	General information	12
1.3	Lubricants	14
2	Safety instructions	15
2.1	Security notes	15
2.2	The five safety rules.....	15
2.3	General information	15
2.4	General warnings and symbols.....	17
2.5	Special types of danger and personal protective equipment	17
2.6	Intended use	20
3	Description	23
3.1	General description.....	23
3.2	Housing.....	23
3.3	Bell housing	24
3.4	Lubrication and cooling	24
3.5	Rotary joints	25
3.5.1	Introduction	25
3.5.2	Rotary joint input shaft	25
3.5.3	Rotary joint intermediate shaft	26
3.6	Bearing arrangement of the shafts.....	26
3.7	Shaft seal	26
3.7.1	Rotary shaft sealing rings	26
3.7.2	Labyrinth seals.....	27
3.7.3	Taconite seal.....	27
3.8	Couplings	28
3.9	Gear changing	29
3.9.1	Gear change operation	29
3.9.2	"Tooth-to-tooth" position	29
3.9.3	Monitoring of the gear position.....	30
3.10	Heating.....	30

3.10.1	Oil-level monitoring system for the heating elements	32
3.11	Oil temperature monitoring	32
3.12	Oil level indicator	33
3.13	Oil level monitoring system	33
3.14	Bearing monitoring	34
3.14.1	Bearing monitoring (vibration monitoring)	34
3.14.2	Bearing monitoring (vibration monitoring or shock-pulse transducer).....	34
3.14.3	Bearing monitoring using a Pt 100 resistance thermometer	35
3.15	Torque monitoring	35
3.16	Speed monitoring	36
3.17	Auxiliary drive	36
3.17.1	Auxiliary gear unit	37
3.17.2	Auxiliary drive motor	38
3.17.3	Coupling	38
3.17.4	Overrunning clutch	39
3.18	Ventilation and bleeding	40
3.18.1	Air filters	40
3.18.2	Wet-air filters	40
3.18.3	Venting valve	40
3.19	Hose lines	41
4	Application planning	43
4.1	Scope of delivery	43
4.2	Transport.....	43
4.3	Attachment points	45
4.4	Special aspects of gear unit lubrication and preservation.....	45
4.4.1	Special aspects of temporary storage.....	45
5	Assembly.....	47
5.1	General assembly instructions	47
5.2	Unpacking the gear unit	48
5.3	Gear unit assembly	49
5.3.1	Foundation	49
5.3.2	Description of assembly work	50
5.3.2.1	Aligning	51
5.3.2.2	Mounting on a concrete foundation using foundation blocks	53
5.4	Couplings	54
5.4.1	Assembling the coupling	55

5.4.2	Aligning the coupling	56
5.5	Connecting components	58
5.5.1	Gear units with mounted components	58
5.5.2	Connecting up air supply "Rotary joint input shaft"	58
5.5.3	Connecting components in preparation for inertisation.....	59
5.5.4	Installing a separate oil supply system	59
5.5.5	Connecting the heating element	60
5.5.6	Connecting the oil-level monitoring system	60
5.5.7	Connecting the Pt 100 resistance thermometer.....	61
5.5.8	Connecting the bearing monitoring system.....	61
5.5.9	Connecting a speed encoder	61
5.5.10	Gear unit with auxiliary drive.....	62
5.5.11	Electrical connections	62
5.6	Tightening procedure	63
5.6.1	Introduction	63
5.6.2	Tightening torques and preload forces	64
5.6.2.1	Hub connection bolts	64
5.6.2.2	Foot fastening bolt connections	64
5.6.2.3	Other bolt connections	65
5.7	Final work.....	66
6	Commissioning.....	67
6.1	Measures prior to commissioning	67
6.1.1	Inerting	68
6.1.2	Gear units with an oil supply system.....	69
6.1.3	Gear unit with auxiliary drive.....	70
6.2	Measures during commissioning	71
6.2.1	Initial test run.....	71
6.2.2	Gear unit with heating	72
6.2.3	Oil level monitoring system	72
7	Operation.....	73
7.1	Operating data	73
7.2	Irregularities in operation	74
7.3	Taking the unit out of service	75
8	Servicing	77
8.1	General maintenance information.....	77
8.2	Maintenance schedule	78
8.3	Maintenance and servicing work.....	80
8.3.1	Checking the oil temperature	80

8.3.2	Measuring the vibration levels of the rolling-contact bearings	80
8.3.3	Measuring the temperature at the rolling-contact bearings.....	81
8.3.4	Inspecting the control gear bearing.....	81
8.3.5	Inspecting the running gear and the control gear	82
8.3.6	Inspecting the sight glass plates	82
8.3.7	Inspect the overrunning clutch.....	83
8.3.8	Checking the auxiliary drive	83
8.3.9	Checking the speed monitoring of the auxiliary drive	83
8.3.10	Cleaning the gear unit and bell housing.....	83
8.3.11	Cleaning the venting valve.....	84
8.3.12	Inspecting the rotary shaft sealing ring	84
8.3.13	General inspection of the gear unit.....	85
8.3.14	Check that all of the fastening bolts are tight.....	85
8.3.15	Final work.....	85
8.4	Possible faults.....	85
9	Service & Support.....	91
9.1	Contact.....	91
10	Disposal.....	93
11	Spare parts	95
A	Declaration of incorporation.....	97
A.1	Declaration of Incorporation	97
B	Technical data.....	99
B.1	General technical data	99
B.2	Ambient temperature	100
B.3	Weights	100
B.4	Enveloping surface sound pressure level	100
	Index	101

List of tables

Table 2-1	Symbols and markings	16
Table 2-2	General warnings	17
Table 3-1	Information about the specific heat output	31
Table 5-1	Preload forces and tightening torques for foot fastening bolts	64
Table 5-2	Preload forces and tightening torques for other bolt connections	65
Table 7-1	Operating data.....	73
Table 8-1	Maintenance and servicing activities.....	78
Table 8-2	Possible faults and how to rectify them	86

List of figures

Figure 3-1	Rotary shaft sealing ring.....	27
Figure 3-2	Labyrinth seal.....	27
Figure 3-3	Taconite seal.....	28
Figure 4-1	Transport symbols.....	45
Figure 5-1	Gap dimension at grease labyrinth	51
Figure 5-2	Alignment surface.....	52
Figure 5-3	Foundation block.....	53
Figure 5-4	Possible displacements.....	57
Figure 5-5	Alignment process based on the example of a flexible coupling.....	57
Figure B-1	Rating plate	99

Introduction

1

1.1 Legal information

Warning system

These instructions contain information you must observe for your own personal safety as well as to avoid damage to property and persons. The information regarding your personal safety is highlighted with a warning triangle. Information exclusively regarding property damage alone is not marked with a warning triangle. Depending on the hazard class, the warnings shall be depicted as follows, in descending order.

DANGER

means that death or severe physical injury **will** occur if the relevant precautionary measures are not taken.

WARNING

means that death or severe physical injury **may** occur if the relevant precautionary measures are not taken.

CAUTION

means that mild physical injury may occur if the relevant precautionary measures are not taken.

NOTICE

means that damage to property may occur if the relevant precautionary measures are not taken.

If multiple hazard classes come into play, the warning for the highest level in question shall always be used. If a warning containing the warning triangle warns of harm to individuals, the same warning may also include a warning regarding damage to property.

Information



Information

Information offers additional notes, assistance and tips for handling the product.

Qualified personnel

The product/system associated with this documentation may only be used by **qualified personnel** trained to perform the relevant tasks, taking into account the associated documentation for the relevant tasks, particularly the safety information and warnings included therein. Due to their qualification and experience, qualified personnel are capable of detecting risks and avoiding potential hazards when dealing with these products/systems.

Intended use of Flender products

Please note the following:

WARNING

Flender products are only suitable for the uses set out in the catalogue and associated technical documentation. If third-party products and components are used, these must be recommended and/or authorised by Flender. Safe and flawless operation of the products requires proper transport, proper storage, setup, assembly, installation, commissioning, operation and maintenance. The permissible environmental conditions must be adhered to. Instructions in the associated documentation must be followed.

Trademarks

All designations marked with the trademark symbol ® are registered trademarks of Flender GmbH. Other designations in this document may be trademarks whose use by third parties for their own purposes may violate the rights of the owner.

Liability disclaimer

We have assessed the contents of these instructions for compliance with the hardware and software described. However, deviations cannot be ruled out, so we are unable to accept liability for full compliance. The details in these instructions are regularly reviewed and necessary corrections are contained in subsequent editions.

1.2 General information

Purpose of the operating instructions

These instructions describe the gear unit and inform you about its handling, from installation to maintenance.

Keep these instructions for later use. Read the instructions before handling the gear unit. Follow the instructions.



Information

Liability disclaimer

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

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

The described gear unit represents the state of the art at the time these instructions were printed.

In the interest of further development, Flender reserves the right to make such changes to the individual assembly units and accessories that increase performance and safety whilst maintaining the essential features.

Required basic knowledge

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

- Application planning
- Assembly
- Commissioning
- Maintenance

Documentation landscape

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

These 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
- Instructions 7300 on gear unit lubrication and preservation
- Instructions for mounted components
- Instructions for third-party devices

Copyright

The copyright for these instructions is held by Flender.

Without the authorisation of Flender, these 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 the Customer Services address (Page 91).

1.3 Lubricants

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

To avoid misunderstandings, Flender points out that, by making this recommendation, it is not approving the product in the sense of expressing a warranty for the quality of the lubricants supplied by your supplier. Every lubricant manufacturer is required to guarantee the quality of his/her products.

Information such as oil type, oil viscosity and required oil quantity can be found on the rating plate of the gear unit and in the documentation supplied with the gear unit.

The oil quantity specified on the rating plate is an approximate value. The actual quantity of oil required is determined by the marking on the oil dipstick or oil sight glass.

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

The oils listed there undergo continuous testing. As a result, the recommended oil types might in future be removed from the list or replaced by more advanced oils.

Flender recommends regular inspection to ascertain whether the selected lubricating oil is still approved by Flender. If it is not, another brand of oil should be selected instead.

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

In order to protect yourself and prevent any damage to property, always observe the safety relevant information and the following five safety rules (as per EN 50110-1 "Working on isolated equipment") when working on electrical components of the plant.

Prior to starting work on the machine, follow the safety rules listed below:

1. Disconnect
Also disconnect auxiliary circuits such as the anti-condensation heater
2. Safeguard against restart
3. Ensure that the system is de-energised
4. Earth and short circuit
5. Cover or cordon off adjacent live parts

When all the work is complete, cancel the safety measures in the reverse sequence.

2.3 General information
















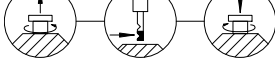
Introduction

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

2.3 General information

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:

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		
Do not unscrew		
Alignment surface, horizontal		
Alignment surface, vertical		
These symbols indicate the oil level checking procedure using the oil dipstick.		

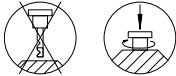
Points labelled on the gear unit	Symbol	Coloured markings
These symbols indicate that the oil dipstick must be firmly screwed in.		

Table 2-1: Symbols and markings

2.4 General warnings and symbols

The following table contains general warnings and their associated symbols.









ISO	ANSI	Warning
		Warning – hazardous electrical voltage
		Warning – explosive substances
	---	Warning – entanglement hazard
	---	Warning – hot surfaces
	---	Warning – corrosive substances
	---	Warning – suspended load
	---	Warning – hand injuries

Table 2-2: General warnings

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 work on the gear unit when it is stopped.
- Disconnect electrical systems from the power supply.

2.5 Special types of danger and personal protective equipment


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
- Protective gloves
- Safety glasses

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 glasses.

Dangers during operation

Damage to the gear unit is possible.

Stop the gear unit immediately by switching off the drive aggregate if inexplicable changes are noticed during operation. Such changes may include unusual gear unit noise or increased 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 during gear unit downtime. Do not walk or stand on shaft ends, protective covers, mounted components or pipework.


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.

Secure rotating and/or moving parts against contact using safeguards.

Surface temperature

Depending on operating conditions, the gear unit may reach extreme surface temperatures.



! WARNING

Risk of burns

Possible risk of serious burn injury from hot surfaces (> 55 °C).
Wear appropriate protective gloves and protective clothing.

! WARNING

Danger of scalding

Risk of serious injury possible through escaping hot operating media when these are being changed.
Wear suitable protective gloves, safety glasses, and protective clothing.

! WARNING

Danger due to cold temperatures

Possible risk of serious injuries due to frost (pain, numbness, frostbite) on cold surfaces (< 0 °C).
Wear appropriate 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 instructions on how to handle cleaning agents and solvents. Wear suitable protective equipment (gloves, safety glasses). Remove any spilled solvent immediately with binding agents.

! 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 information in the data sheets of the oil used. Wear suitable protective equipment (gloves, safety glasses). Immediately clean up any spilt oil using a binding agent.

Danger of explosion

An explosion might occur in a potentially explosive atmosphere.


! DANGER
Danger of explosion through ignition of a potentially explosive atmosphere

Danger to life through ignition of a potentially explosive atmosphere possible when operating the gear unit.

Do not use the gear unit in potentially explosive atmospheres.

2.6 Intended use

Only use the gear unit according to the conditions specified in the service and delivery contract and the technical data in the Annex (Page 99). Deviating operating conditions are considered improper use. The user or operator 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 instructions. This also applies to the guards designed to prevent accidental contact.
- Only ever use original replacement parts.
Other replacement parts are not tested and approved by Flender. Non-approved replacement 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 replacement parts. The same applies to any accessories which were not supplied by Flender.

If you have any questions, please contact Customer Service (Page 91).

! WARNING
Risk of falling

Risk of 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, protective covers, mounted components or pipe-work.

Using the gear unit

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 and repaired by authorised, trained, instructed and qualified personnel.
- The relevant occupational safety and environmental protection provisions must be taken into account in transport, assembly and dismantling, operation, servicing and maintenance.
- Cleaning the outside of the gear unit with a high-pressure cleaning device is not permitted.

- Do not perform any welding work anywhere on the gear unit or connected parts. Do not use the gear unit or connected parts as an earthing point for electric-welding operations. Gear parts and rolling-contact bearings may be irreparably damaged by welding.
- Perform potential equalisation in accordance with the applicable regulations and directives.
If there are no threaded holes on the gear unit for an earth connection, other suitable measures must be taken. This work must be carried out by specialists in electrical engineering.
- 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 gears. 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 guards, store their fixings in a safe place.
- Removed guards must be re-fitted prior to starting.
- Observe the notices mounted on the gear unit, e.g. rating plate, direction of rotation arrow symbol, etc. The notices must be kept free from paint or dirt. Replace any missing, illegible or damaged plates.
- Screws which have become unusable during assembly and dismantling must be replaced with new screws of the same strength class and design.

 **DANGER**

Danger to life when the system is switched on

Death or serious injury will occur.

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

- Turn off the key-operated switch.
- Remove the fuses in the power supply.
- Attach an information notice to the start switch, clearly stating that work is being carried out on the gear unit.
- Ensure that the entire system is not under a load to avoid danger during dismantling work.

Further use of the gear unit

When integrating the gear unit in machines or systems, the machine or system manufacturer is obliged to include the provisions, instructions and descriptions contained in this set of instructions in their machine instructions.

2.6 Intended use

3.1 General description

The FLENDER® gear unit (referred to below simply as "gear unit") described in these operating instructions has been developed to drive twin-screw extruders.

The gear unit has been approved for only one direction of rotation. The direction of rotation of the motor must match the direction of rotation arrow marked on the input shaft of the gear unit. Looking straight at the input shaft stub, the rotation of direction is counter-clockwise.

The input shaft and the output shafts are positioned in parallel in a dividing plane. The input shaft is drilled hollow in order to allow air supply to the overload friction clutch at the input end. The gear unit has two output shafts. The output shafts are connected to the process section by a bell housing. The axial forces generated by the extrusion process are absorbed by thrust bearings.

Inertisation

Depending on the order specification, the gear unit (interior space) can be designed for inertisation (nitrogen blanketing). Inerted gear units are sealed gas-tight.

DANGER

Risk of suffocation

There is a risk of suffocation in atmospheres enriched with nitrogen.

Make sure that the operating area is adequately ventilated. Shut down the gear unit immediately if the pressure exceeds the maximum or drops below the minimum positive pressure (Page 68).

Further information

You can find additional information and a detailed illustrated description of the gear unit in the drawings in the complete documentation of the gear unit.

3.2 Housing

Introduction

The housing is made of cast iron and consists of multiple parts.

The standard version of the gear unit housing has the following features:

- Attachment points for moving the gear unit
- Inspection and assembly cover for inspection and oil filling
- Oil level indicator for checking the oil level
- Oil drain valve for changing the oil
- Air filter, wet-air filter or venting valve for ventilation and bleeding

3.3 Bell housing

More information

Further information and a detailed illustrated description of the gear unit can be found in the drawing in the complete documentation for the gear unit.

3.3 Bell housing

The bell housing is the piece that connects the gear unit to the process section (supplied by the operator) and must be permanently bolted to the screw housing of the process section.

The bell housing is made of cast iron. The bell housing can also be manufactured out of steel if necessary.

Inertisation

The bell housing (interior space) is designed for inertisation (nitrogen blanketing). Inerted bell housings are sealed gas-tight.



Risk of suffocation

There is a risk of suffocation in atmospheres enriched with nitrogen.

Make sure that the operating area is adequately ventilated. Shut down the gear unit immediately if the pressure exceeds the maximum or drops below the minimum excess pressure (Page 68).

Sight glass plates

Sight glass plates can be mounted on inerted bell housings to allow visual inspection of the worm shaft seal.

Further information

You will find further information, a detailed illustration of the gear unit and the position of the bell housing in the drawing in the complete documentation for the gear unit.

You will find further information about the sight glass plates in the sight glass plate operating instructions in the complete documentation for the gear unit.

You will find further technical data in the separate data sheet and in the list of equipment in the complete documentation for the gear unit.

3.4 Lubrication and cooling

Separate oil supply system

The geared components and the rolling-contact bearings are lubricated and cooled by oil continually circulating in the pressurised circuit using a separately installed oil supply system.

The geared components and the bearings are lubricated and cooled by oil continually circulating in the pressurised circuit using a separately installed oil supply system.

For gear units with an oil supply system, all of the monitoring devices must be connected up and function-tested before commissioning.

The main gear unit and the auxiliary gear unit (if installed) are supplied with lube oil and cooling oil by the oil supply system. The oil is drawn in from the gear unit and fed into the top half of the housing and the auxiliary gear unit. An oil pressure chamber from which the oil is distributed is installed in the top half of the housing of the main gear unit.

WARNING

Risk of injury as a result of rupture of bolt connections or covers

Injuries may result if the oil pressure causes bolt connections or covers to rupture.

Never open the cover of the oil pressure chamber while the oil supply system is in operation.

More information

Additional information and a detailed illustrated description of the gear unit and the oil supply system can be found in the drawings in the complete gear unit documentation.

You can find additional information about the oil supply system in the separate data sheet, in the list of equipment and in the oil supply system operating instructions provided in the complete gear unit documentation.

3.5 Rotary joints

3.5.1 Introduction

The purpose of rotary joints is to supply oil or air from a stationary source (such as a supply pipe) into a rotating machine shaft.

Further information

You will find further information and a detailed illustration of the gear unit and the position of the rotary joints in the drawings in the complete documentation for the gear unit.

3.5.2 Rotary joint input shaft

A rotary joint is mounted on the input shaft (opposite the main drive) in order to supply air to the overload friction clutch (Page 28). This rotary joint also supplies lube oil to the connecting sleeve on the input shaft.

3.5 Rotary joints

Further information

You can find further information about operation and maintenance of the rotary joint in the rotary joint operating instructions in the complete documentation for the gear unit.

You will find technical data in the separate, order-specific data sheet and in the list of equipment in the complete documentation for the gear unit.

3.5.3 Rotary joint intermediate shaft

A rotary joint is mounted on the intermediate shaft to supply lube oil to the control gearing and coupling sleeve.

Further information

You can find further information about operation and maintenance of the rotary joint in the rotary joint operating instructions in the complete documentation for the gear unit.

You will find technical data in the separate, order-specific data sheet and in the list of equipment in the complete documentation for the gear unit.

3.6 Bearing arrangement of the shafts

All shafts are mounted in rolling-contact bearings.

Thrust bearings are integrated in the gear unit to absorb the axial forces generated by the worm gears.

Supplementary cylindrical roller thrust bearings apply preload to the main thrust bearings for no-load operation and fix the extruder shafts axially in the discharge direction.

3.7 Shaft seal

Introduction

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

3.7.1 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.

Hardened rings or protective sleeves are provided for all rotary shaft sealing rings.

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

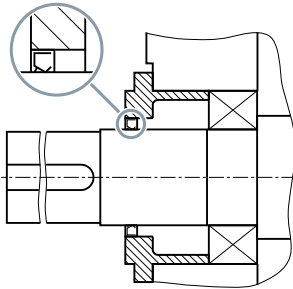


Figure 3-1: Rotary shaft sealing ring

3.7.2 Labyrinth seals

Labyrinth seals as non-contact seals prevent shaft wear. They do not require any maintenance and improve the temperature behaviour of the gear unit.

A labyrinth seal is illustrated in the diagram below:

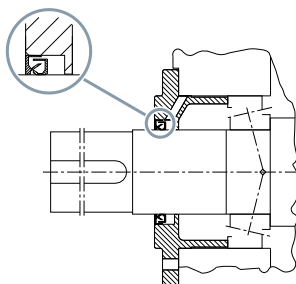


Figure 3-2: Labyrinth seal

To work reliably, labyrinth seals must be installed in stationary, horizontal positions without dirty water or any substantial amount of dust. Overfilling the gear unit can result in leaks, the same applies to oil with a high foam content.

3.7.3 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**

Regrease the labyrinth seals at the specified regreasing intervals. The regreasing intervals are specified in the Maintenance schedule (Page 78).

A taconite seal is illustrated in the diagram below:

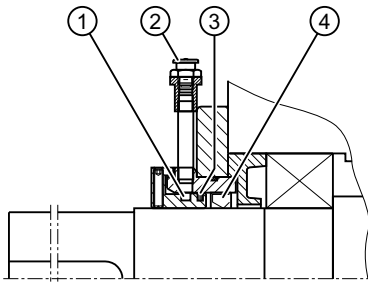


Figure 3-3: Taconite seal

- | | |
|--|-----------------------------|
| ① Labyrinth, filled with grease, can be re-greased | ③ Lamellar seal |
| ② Grease nipple | ④ Rotary shaft sealing ring |

NOTICE**Sparking, inadmissible temperature rise and shaft seal wear due to insufficient gap dimension**

An insufficient gap dimension can cause sparking, inadmissible temperature rise and shaft seal wear.

If the shaft is sealed by 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.

3.8 Couplings

An overload friction clutch is generally used to drive the gear unit. Unless otherwise contractually agreed, this clutch or clutch hub (to be provided by the customer) is mounted on the input shaft of the main gear unit.

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 installing the drives, align the individual components with each other precisely to minimise restoring forces due to angular and axial misalignments and to prevent premature wear of flexible coupling elements.

Further information

You will find further information about the overload friction clutch in the operating instructions for the overload friction clutch in the complete documentation for the gear unit.

3.9 Gear changing

3.9.1 Gear change operation

Introduction

Depending on the order specification, the gear unit can be fitted with a gear change mechanism for two speeds (1st gear and 2nd gear).

NOTICE

Damage to the gear unit due to changing gear when gearing is rotating

The gear unit can sustain damage if the gear is changed when the gearing is rotating.

It is not permissible to change gear when the gearing is rotating. Take measures to electrically lock out the main motor so that it cannot be restarted while gear changing is in progress.

Procedure

Proceed as follows to perform a gear change:

1. Switch the main motor of the gear unit to position "Off".
2. Wait until the main drive has reached a standstill.
3. Manually release the locking knob with locking pin. The gear can now be changed by the gear lever.
The limit switches signal the engaged gear to the control room. The new gear position is displayed after a gear change.
4. Engage the locking knob with locking pin again.

Result

The gear unit can now be started up.

Further information

Further information and a detailed illustrated description of the gear unit can be found in the drawings in the complete documentation of the gear unit.

3.9.2 "Tooth-to-tooth" position

Introduction

The gearing might move into a "tooth-to-tooth" position when the gear is changed. In this case, further operation of the gear unit becomes impossible.

3.9 Gear changing

⚠ DANGER**Danger to life as a result of removal of the bell housing protective device (auxiliary drive)**

If you remove the bell housing protective device, there is danger that rotating and moving parts may catch hold of you or pull you in.

Do not remove the protective equipment unless the system is at a standstill and the gear unit is safely locked out.

Procedure

Proceed as follows to engage the gear lever in its end position again:

1. Remove the touch guard at the bell housing (auxiliary drive).
2. Stand so that you are looking straight at the auxiliary drive shaft stub and turn the clutch between the auxiliary drive motor and the auxiliary gear unit slightly to the left. Only in this direction of rotation can it be ensured that the overrunning clutch will engage.
3. If necessary, move the gear lever to its end position by operating the auxiliary drive motor in inching mode.

3.9.3 Monitoring of the gear position

Overview

Two limit switches or pulse encoders and a locking knob with locking pin are installed in the gear unit in order to monitor and protect the gear change mechanism.

Connect the limit switches to an evaluation unit provided by the customer.

Further information

You will find further information and a detailed illustration of the gear unit and the position of the limit switches or pulse encoders in the drawings in the complete documentation for the gear unit.

You will find technical data in the separate, order-specific data sheet and in the list of equipment in the complete documentation for the gear unit.

You can find further information about operation and maintenance of the limit switches or pulse encoders in the operating instructions for the limit switches or pulse encoders in the complete documentation for the gear unit.

3.10 Heating

Introduction

At low temperatures, it may be necessary to preheat the gear unit oil before the drive is switched on or also during operation.

Heating elements

Depending on the order specification, the gear unit can be fitted with heating elements. Heating elements convert electricity into heat and transfer this to the oil in which they are immersed. The heating inserts of the heating elements are installed in protective tubes in the housing so that they can be replaced without draining off the oil first.

Make sure that the heating elements are fully immersed in the oil bath by mounting the gear unit in the correct position as shown in the drawings in the complete documentation, and by keeping the oil topped up to the minimum level.

Heating elements may only be used in combination with an oil-level monitoring system (Page 32) and a temperature limitation.



WARNING

Explosion and fire hazard

Exposed heating elements pose a fire hazard.

Do not switch on the heating elements unless you have checked that they are completely immersed in the oil bath.

If heating elements are retrofitted, the heat output at the outer surface of the heating element must not exceed the maximum values stated in the table below.

The following table contains information about the specific heat output P_{HO} as a function of ambient temperature:

P_{HO} in W/cm^2	Ambient temperature in $^{\circ}C$
0.9	10 to 0
0.8	0 to -25
0.7	-25 to -50

Table 3-1: Information about the specific heat output

After a prolonged outage period with the heating system switched on, radiant heaters must be used in addition to the integral heating system to raise the temperature to the startup temperature of $18\text{ }^{\circ}C$ if the ambient temperature is below $10\text{ }^{\circ}C$.

Control of the heating elements

The heating elements can be controlled by a temperature monitor or an oil-temperature monitoring system (Page 32). The temperature monitor provides a signal to be amplified when the minimum and maximum temperatures are reached.



Information

All heating elements can be controlled by a Pt 100 installed in the oil sump and a temperature limiter for each two heating elements.

More information

You can find additional information about the position of the mounted components and a detailed illustration of the gear unit in the drawing in the complete documentation for the gear unit.

3.10 Heating

Further information about heating elements can be found in the separate data sheet, in the list of equipment and in the heating element operating instructions in the complete documentation for the gear unit.

You can find additional information about the temperature monitor as well as control instructions in the list of equipment and the temperature monitor operating instructions in the complete documentation for the gear unit.

3.10.1 Oil-level monitoring system for the heating elements

Introduction

Depending on the order specification, the gear unit can be equipped with an oil level monitoring system. Heating elements may only be used in combination with an oil level monitoring system and temperature limitation.

This monitoring checks the minimum oil level of the gear unit for immersing the heating elements.

Principle of operation

Connect up the "Oil level too low" signal in such a way that it causes the heating elements to be switched off. An "oil level too low" signal must not be bypassed while the unit is in operation.

This guarantees that the heating elements are only operated if they are completely immersed in the oil.



Fire hazard

Exposed heating elements pose a fire hazard.

Do not switch on the heating elements unless you have checked that they are completely immersed in the oil bath.

3.11 Oil temperature monitoring

The gear unit is equipped 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 is fitted with a connector head for the wiring. A two-wire circuit is provided by the manufacturer, but customers can also configure a three or four-wire circuit.

A thermocouple or a temperature regulator can be fitted as an alternative method of monitoring the oil temperature in the oil sump.

Further information

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

Further information about oil temperature monitoring (such as control instructions) and the technical data can be found in the operating instructions for the oil temperature monitor and in the list of equipment in the complete documentation for the gear unit.

3.12 Oil level indicator

For visual monitoring of the oil level, an oil level indicator is mounted on the gear unit.

Note the oil filling and operating oil level.

Oil level when filling oil

When filling oil, check the oil level during gear unit downtime, when the oil supply system is switched off and the oil is cool.

Operating oil level

Check the operating oil level when the gear unit is rotating and the oil supply system is running.

More information

You can find additional information about the oil level indicator in the instructions 7300 in the complete documentation for the gear unit.

You can find additional information and a detailed illustration of the gear unit and the position of the mounted components in the drawing in the complete documentation for the gear unit.

3.13 Oil level monitoring system

Introduction

Depending on the order specification, the gear unit can be equipped with an oil-level monitoring system based on a level monitor, a level switch, pressure transmitter or a filling-level limit switch.

The oil-level monitoring system is a fill-level monitor that checks the oil level of the gear unit.

Mounting position

When an oil-level monitoring system is used, pay special attention that the gear unit is mounted in the specified position.

3.14 Bearing monitoring

Principle of operation

Connect the signal so that an alarm is raised when “oil level too low” signal is active.

Further information

You can find additional information and a detailed illustration of the gear unit and the position of the mounted components in the drawing in the complete documentation for the gear unit.

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

3.14 Bearing monitoring

3.14.1 Bearing monitoring (vibration monitoring)

Depending on the order specification, the gear unit can be equipped with vibration sensors, “SPM” sensors or with connection threads for monitoring the rolling-contact bearings or gearing.

You will find information about the bearing monitoring system design in the separate data sheet in the complete documentation for the gear unit.

Further information

You can find additional information and a detailed illustration of the gear unit and the position of the mounted components in the drawing in the complete documentation for the gear unit.

You can find additional information about the components in the component operating instructions in the complete documentation for the gear unit.

You can find additional information about the technical data in the separate data sheet or in the list of equipment in the complete documentation for the gear unit.

3.14.2 Bearing monitoring (vibration monitoring or shock-pulse transducer)

Depending on the order specification, the gear unit can be equipped with vibration sensors, “SPM” sensors shock-pulse transducers or with threads for connecting equipment for monitoring the rolling-contact bearings or gearing.

You will find information about the bearing monitoring system design in the separate data sheet in the complete documentation for the gear unit.

Further information

You can find additional information and a detailed illustration of the gear unit and the position of the mounted components in the drawing in the complete documentation for the gear unit.

You can find additional information about the components in the component operating instructions in the complete documentation for the gear unit.

You can find additional information about the technical data in the separate data sheet or in the list of equipment in the complete documentation for the gear unit.

3.14.3 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, or prepared for the installation of such thermometers.

You must connect the Pt 100 resistance thermometers to an evaluation unit supplied by the customer to be able to measure temperatures or temperature differences. The resistance thermometers have 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.

The gear unit can be equipped with thermocouples as an alternative.

You will find information about the bearing monitoring system design in the separate data sheet in the complete documentation for the gear unit.

Switching points

Proceed as follows to adjust the switching points:

- Minimum temperature:
Actual temperature (after approx. 100 operating hours) + 20 °C (maximum 80 °C)
 $x = T_{(\text{actual})} + 20 \text{ °C}$
Alarm at a temperature of > x °C
- Maximum temperature:
Trip at a temperature of > 100 °C

More information

You can find additional information and a detailed illustration of the gear unit and the position of the mounted components in the drawing in the complete documentation for the gear unit.

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

You can find additional information about the technical data in the separate data sheet or in the list of equipment in the complete documentation for the gear unit.

3.15 Torque monitoring

Depending on the order specification, the gear unit can be equipped with a torque monitoring system (sensor telemetry system). This monitors the two output shafts of the main gear unit.

Sensor telemetry system

The sensor telemetry system is capable of monitoring or detecting the following phenomena:

- Static or dynamic torques
- Forces
- Accelerations
- Temperatures

3.16 Speed monitoring

- Pressures
- Speeds

The sensor telemetry system comprises the following components:

- Sensor signal amplifier (rotating element)
- Receiving antenna (stationary element)
- Receiver with evaluation and display unit

Further information

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

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

Further information about the technical data can be found in the separate data sheet or in the list of equipment in the complete documentation for the gear unit.

3.16 Speed monitoring

Depending on the order specification, an inductive proximity switch can be fitted.

Customers must establish the wiring and provide the evaluation unit required.

Depending on customer requirements, this inductive proximity switch monitors the distributor shaft 400 or the output shaft 200.

Further information

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

You will find further information about the inductive proximity switch (such as control instructions) and technical data in the operating instructions for the inductive proximity switch and in the list of equipment provided in the complete documentation for the gear unit.

3.17 Auxiliary drive

Introduction

For specific applications, the gear unit can be equipped with an auxiliary drive. The auxiliary drive enables the main gear unit to be operated at a lower output speed in the same direction of rotation.

The auxiliary drive comprises the following components:

- Auxiliary gear unit
- Auxiliary drive motor
- Coupling
- Overrunning clutch

The auxiliary drive is connected to the main gear unit through the overrunning clutch. The auxiliary drive is mounted onto a connection flange, which in turn is attached to the main gear unit.

Further information

You can find further information, a detailed illustration of the gear unit and the position of the auxiliary drive in the drawing in the complete documentation for the gear unit.

You can find further information about the auxiliary drive in the auxiliary drive operating instructions in the complete documentation for the gear unit.

Further information about these technical data can be found in the separate data sheet and the drawings in the complete documentation for the gear unit.

3.17.1 Auxiliary gear unit

Introduction

The auxiliary gear unit is a standard gear unit that is flanged to the main gear unit through an intermediate flange and coupled to the main gear unit by an overrunning clutch. The overrunning clutch is mounted in the intermediate flange, and is integrated in the oil circuit of the main and auxiliary gear units.

Oil supply for the auxiliary gear unit


The auxiliary gear unit is supplied with oil by the oil supply system.

Speed monitoring

To avoid overspeeds if the overrunning clutch were to malfunction, the drive combination is equipped with a speed monitoring system for safety reasons. The speed monitoring system comprises a pulse encoder which is mounted on the penultimate gear unit shaft (T.300).

The speed monitoring device must be connected so that for a speed of "> n" at the penultimate gear unit shaft (T.300) of the auxiliary drive, the main drive is automatically switched off (for the value of speed "n", refer to the separate, order-specific data sheet and the list of equipment). For safety reasons, the switch off function must be tested at regular intervals, at least four times a year. The auxiliary drive is switched on to test the switch off function. If the speed monitoring system responds - checked e.g. using a warning light - then it is functioning correctly. Connect the speed encoder to an evaluation unit provided by the customer.



 DANGER
<p>Severe injury as a result of rupture of the auxiliary drive</p> <p>If the overrunning system develops a fault, due to the high resulting speeds, the auxiliary drive can suddenly break apart explosively.</p> <p>The speed monitoring function is mandatory for safety reasons.</p>

3.17 Auxiliary drive

Further information

You can find further information, a detailed illustration of the gear unit and the position of the auxiliary gear unit in the drawing in the complete documentation for the gear unit.

You can find further information about the auxiliary drive in the auxiliary gear unit operating instructions in the complete documentation for the gear unit.

Further information about these technical data can be found in the separate data sheet and the drawings in the complete documentation for the gear unit.

3.17.2 Auxiliary drive motor

Introduction

The auxiliary drive motor is flanged to the auxiliary gear unit via a motor bell housing and coupled to the auxiliary gear unit.

Connecting the auxiliary drive motor

Before connecting the motor, identify the phase sequence of the three-phase mains using a phase sequence instrument. Then connect the motor so that it rotates in the defined direction.

Observe the note attached to the gear unit.

Overload

The motors used must not exceed the following values:

- Starting torque $M_{\text{starting}} / M_{\text{rated}} = 160 \%$
- Breakdown torque $M_{\text{breakdown}} / M_{\text{rated}} = 160 \%$

NOTICE

Overloading of the auxiliary drive

Overloading the auxiliary drive can result in damage (possibly irreparable) to the drive. It may only be operated in idle mode under no-load conditions.

3.17.3 Coupling

N-EUPEX couplings are generally used to drive the auxiliary gear unit. These are mounted in the motor bell housing.

Further information

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

3.17.4 Overrunning clutch

Overview

If an auxiliary drive is coupled to the gear unit in addition to the main drive, then this coupling is realised using an overrunning clutch.

When the auxiliary drive is used to drive the gear unit, the overrunning clutch allows torque to be transferred in one direction of rotation, while "free-wheeling operation" applies when driven by the main drive.

The output shaft of the main drive rotates in the same direction of rotation, irrespective of whether the main drive is used or the auxiliary drive.

Principle of operation

The overrunning clutch has centrifugally-operated sprags. When the main gear unit rotates with the specified direction of rotation, the inner ring with the sprags rotates, while the outer ring remains stationary. Above a certain speed (disengagement speed) the sprags disengage simultaneously, and the overrunning clutch operates without any wear.

When the auxiliary unit drive motor is used as drive via the outer ring, then the overrunning clutch is also driven; this means that the main gear unit is slowly rotated in the selected direction of rotation. In this case, the input shaft of the main gear unit and possibly the main motor also slowly rotate simultaneously.

Please note the following measures:

- In Chapter Commissioning, observe Chapter Gear unit with auxiliary drive (Page 70).
- When driven by the auxiliary drive, the input shaft of the main gear unit also slowly rotates. It is not permissible that this rotary motion is prevented.

 **WARNING**

Severe injury as a result of rupture of the auxiliary drive

Severe injury may result if the auxiliary drive ruptures as a result of overspeed.

Perform a function test on the overrunning clutch prior to commissioning. The disengagement speed must not be allowed to drop below the minimum value during operation.

To avoid the risk of damage, the maximum permissible driving speed under torque must not be exceeded.

Oil supply

The overrunning clutch is mounted in the intermediate flange, and is integrated in the oil circuit of the main and auxiliary gear units. Oil is supplied by the oil supply system.

Further information

You can find further information about operation and maintenance of the overrunning clutch in the operating instructions for the overrunning clutch.

You will find technical data in the data sheet and in the list of equipment in the complete documentation for the gear unit.

3.18 Ventilation and bleeding

Introduction

The gear unit can be equipped with the following ventilation and bleeding equipment depending on requirements:

- Air filters
- Wet-air filters
- Venting valves

3.18.1 Air filters

Standard air filters are used in low-humidity atmospheres. These air filters prevent contaminants from mixing with the oil.

More information

You can find additional information and a detailed illustration of the gear unit and the position of the mounted components in the drawing in the complete documentation for the gear unit.

You will find further information about air filters in the operating instructions for the air filters as well as in Instructions 7300 in the complete documentation for the gear unit.

You can find additional information about the technical data in the separate data sheet or in the list of equipment in the complete documentation for the gear unit.

3.18.2 Wet-air filters

Wet-air filters are used in high-humidity atmospheres. Wet-air filters prevent water and contaminants from mixing with the oil.

More information

You can find additional information and a detailed illustration of the gear unit and the position of the mounted components in the drawing in the complete documentation for the gear unit.

You will find further information about wet-air filters in the operating instructions for the wet-air filters as well as in Instructions 7300 in the complete documentation for the gear unit.

You can find additional information about the technical data in the separate data sheet or in the list of equipment in the complete documentation for the gear unit.

3.18.3 Venting valve

Venting valves are used for versions designed for inertisation (nitrogen blanketing).

The venting valve opens and vents briefly at an excess pressure of 0.2 - 0.3 bar.

Further information

You can find additional information and a detailed illustration of the gear unit and the position of the mounted components in the drawing in the complete documentation for the gear unit.

You can find additional information about venting valves in the venting valve operating instructions in the complete documentation for the gear unit.

You can find additional information about the technical data in the separate data sheet or in the list of equipment in the complete documentation for the gear unit.

3.19 Hose lines

Among other this, hoses are used to supply oil to the gear unit and air to the overload friction clutch.

More information

You can find additional information and a detailed illustration of the gear unit and the position of the mounted components in the drawing in the complete documentation for the gear unit.

You will find further information about inspecting hoses in the Instructions 7300 in the complete documentation of the gear unit.

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 91) 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 auxiliary drive, couplings, oil supply system, pipework and valves may be delivered separately packaged, as necessary.

Transportation instructions and the positions of the attachment points can be found in the transport drawing or the dimension drawing. This drawing is attached to the gear unit.

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

- The gear unit may only be transported using suitable means of transport.
- Transport the gear unit emptied of oil 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 pipework 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 a component that becomes detached because the hoisting gear and load suspension device are not suitable for handling it.

When lifting, please observe the load distribution information on the packaging.

When the product is in a raised position, transport it slowly and carefully to avoid injury to persons or damage to the gear unit.

- Watch for damage while transporting the gear unit.

4.2 Transport

NOTICE**Damage to the gear unit**

When transporting the gear unit, the packing and/or the gear unit paint coating can be damaged.

When the product is in a raised position, transport it slowly and carefully to avoid damaging the packing and/or the paint coating.

NOTICE**Damage to the gear unit caused by shock/blows applied to the free shaft ends**

The gear unit can be damaged due to shock/blows applied to the free shaft ends.

When the product is in a raised position, transport it slowly and carefully to avoid injury to persons or damage to the gear unit.

Avoid that the free shaft ends are subject to any shock or load.

Attaching the load

For transport, only attach the gear unit at the marked 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
- When using loading suspension devices with several load hooks, ensure the load is evenly distributed
- Be aware that the centre of gravity may not be in the centre
- Ensure that lifting equipment is 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 the tip
- Only set down products on a flat, non-slip and strong base

**! DANGER****Falling load**

There is a risk of fatal injury from falling loads if these have not been securely attached to the lifting equipment.

Never stand or sit under suspended loads. Do not exceed the load limits of the lifting equipment.

Packaging

The gear unit is delivered fully assembled. Any additional equipment is supplied in separate packaging where applicable.

The way the gear unit is packaged may vary, depending on the transport route and size.

The symbols which appear on the packaging must be observed.

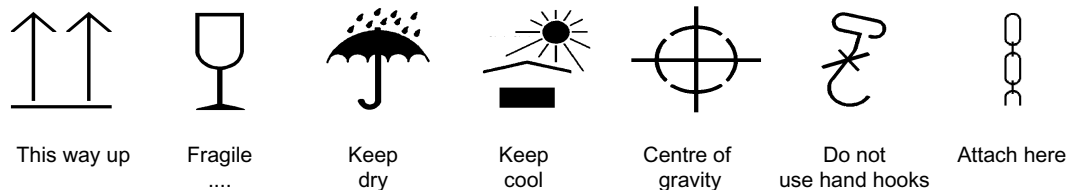


Figure 4-1: Transport symbols

4.3 Attachment points

Lifting eyes

Lifting eyes are fitted to the individual housing sections and used to transport the unit during assembly.

Carefully ensure that the angle of the vertical load at the gear units lifting eyes does not exceed 45°.

Transport shackles

Transport shackles are lifting devices that are used when the gear unit is transported. These shackles are fitted to the lifting eyes of the gear unit.

The position of the transport shackles is shown in the transport drawing or dimension drawing.

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 transport drawing and the dimension drawing in the complete documentation of the gear unit.

Drive units with additional components mounted on the gear unit (such as drive motor, coupling, etc.) may require an extra attachment point owing to the displacement in the centre of gravity caused by the mounted components.

4.4 Special aspects of gear unit lubrication and preservation

4.4.1 Special aspects of temporary storage

If the gear unit is temporarily stored for a longer period (> 12 months), check the interior and exterior preservation and replace if necessary. Please observe the relevant information in the separately enclosed Instructions 7300.

Special aspects for rolling-contact bearings

The position of the rolling elements in the rolling-contact bearings must be changed. To do this, turn the input shaft until the output shaft rotates by more than one revolution. The input and output shafts must be in different positions to those they were in before you started turning the shaft. Repeat and document this procedure every 6 months until the unit is commissioned.



Information

Keep the documentation in a safe place

Archive the report together with these instructions.

5.1 General assembly instructions

Assembly work must be performed very carefully by authorised, trained and suitably instructed personnel. Liability is excluded 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.
- 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 hoisting gear is available.
- Observe the foundation and installation plan as well as the installation instructions for the Extruder.

Mounting position and attachment points

During the actual planning phase, be sure to allow for sufficient space around the gear unit to enable subsequent upkeep and maintenance work. Take suitable measures to ensure that unhindered convection across the housing surface is possible so that the gear unit does not overheat.

Do not use incorrect attachment points (Page 45). The position of the attachment points is shown in the dimension drawing or the transport drawing in the complete documentation for the gear unit. To ensure that the unit is properly lubricated during operation, please observe the mounting position specified in the dimension drawings.

More information

Further information about dimensions, space requirements and arrangement of supply connections can be found in the drawings in the complete documentation of the gear unit.

5.2 Unpacking the gear unit

NOTICE

Heating of the gear unit by external heat sources

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

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

- A sun shield
- An additional cooling device
- A temperature monitoring device with trip function in the oil sump

If you use a sun shield, this may cause a build-up of heat.

If you use a temperature monitoring device, it must be capable of issuing 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.



WARNING

Ignition of vapours emitted from solvents.

There is a risk of injury due to ignition of vapours emitted from solvents when carrying out cleaning work.

Please note the following:

- Ensure adequate 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 by the content of the packing sliding

There is a risk of being crushed when opening the packing in which the part is transported.

While being transported, the content of the packing can slide.

Carefully open the packing.

Wear suitable 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 put the gear unit into operation if any damage is visible.

Contact Customer Services (Page 91).

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 prematurely if the packaging is designed 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. Perform a visual inspection for damage and accumulations of dirt.
3. Immediately report any damaged and/or missing parts to Customer Services (Page 91).
4. Dispose of packaging material and transport devices in accordance with regulations.

5.3 Gear unit assembly

5.3.1 Foundation

Properties of the foundation

The foundation must have the following properties:

- Horizontal and level
- Stable
- The foundation must be designed for torsional rigidity
- Reaction forces from the gear unit must be braced

Requirements of the foundation

The foundation must meet the following requirements:

5.3 Gear unit assembly

- 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 any elastic deformation that may be caused by operating forces into account.
- Install lateral stops to prevent displacement if external forces are acting on the gear unit.

NOTICE
<p>Lack of stable foundation for the gear unit</p> <p>Damage to the gear unit is possible if it is not mounted on a stable foundation.</p> <p>Use bolts of at least strength class 8.8. Information and guidance on the tightening torque can be found in chapter Tightening procedure (Page 63). Tighten the fastening bolts and nuts to the specified tightening torque. When tightening the fastening bolts, make sure that the gear unit is free of mechanical stress.</p>

5.3.2 Description of assembly work



⚠ CAUTION
<p>Risk of chemical burns from chemical substances</p> <p>There is a risk of chemical burns when handling aggressive cleaning agents.</p> <p>Please observe the manufacturer's instructions on how to handle cleaning agents and solvents. Wear suitable protective equipment (gloves, safety glasses). Remove any spilled solvent immediately with binding agents.</p>

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

- Use a suitable cleaning agent to remove the corrosion protection from the shafts and mounting surfaces.
- Do not allow the cleaning agent to come into contact with the shaft sealing rings.
- Remove the sealing plugs and locking flanges.
- Install the separately supplied valves in accordance with the drawings in the complete documentation for the gear unit.
- Mount the input and output elements (e.g. coupling parts) on the shafts and lock them securely. See the Couplings (Page 54) chapter.
- Use suitable hoisting gear to place the gear unit in position.

More information

Further information about removing the corrosion protection can be found in the instructions 7300 in the complete documentation for the gear unit.

You can find more information on attaching gear units to hoisting gear in cases where the weight of the gear unit necessitates the use of hoisting gear in the Application planning (Page 43) chapter.

If the gear unit is to be transported with mounted parts and components, then it may be necessary to use additional attachment points. The position of these attachment points can be found in the order-specific transport drawing or dimension drawing in the complete documentation for the gear unit.

Gap dimension at grease labyrinth

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

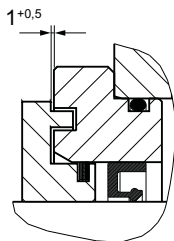


Figure 5-1: Gap dimension at grease labyrinth

NOTICE

Sparking, inadmissible temperature rise and shaft seal wear due to insufficient gap dimension

An insufficient gap dimension can cause sparking, inadmissible temperature rise and shaft seal wear.

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.

5.3.2.1 Aligning

Introduction

Depending on the order specification, machined surfaces (alignment surfaces) are provided on the gear unit to assist with prealignment in the horizontal and vertical axes.

 **DANGER**

Danger to life 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 components 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 or cardan shafts). See also the relevant operating instructions, for example, for the requirements of couplings.

Procedure

The gear unit can be equipped with alignment threads in the housing feet to make it simpler to align.



Figure 5-2: Alignment surface

Proceed as follows to align the gear unit at the alignment surface:

1. For the precise position of the alignment surfaces, refer to the dimension drawings in the complete documentation.
2. Note the values inscribed in the alignment surfaces.
3. Using these alignment surfaces as a guide, horizontally and vertically align the gear unit so that perfect gear unit operation is ensured.
4. Fill in the alignment record and enclose a copy with the acceptance documentation for the complete system.
You can find the alignment record in the drawings, which are part of the complete documentation of the gear unit.

Tools

The following tools are needed to perform the final fine alignment (Page 56) work on the shaft axes of the gear unit and the equipment installed on the input and output sides.

- Rulers
- Spirit level
- Dial gauge
- Laser alignment system
- Feeler gauge etc.

Once the gear unit is finely aligned, tighten the foundation bolts and check the settings again. Record the alignment dimensions and keep the alignment record in a safe place together with these operating instructions.

5.3.2.2 Mounting on a concrete foundation using foundation blocks

Requirements

The lower side of the gear unit mounting feet must be clean.

Mounting gear units using foundation blocks

The following diagram shows a foundation block:

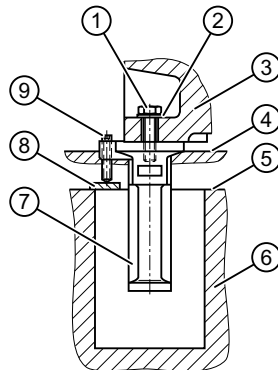


Figure 5-3: Foundation block

- | | |
|--------------------------------------|--------------------|
| ① Fastening bolt | ⑥ Foundation |
| ② Washer | ⑦ Foundation block |
| ③ Gear unit foot | ⑧ Flat steel plate |
| ④ Height of the completed foundation | ⑨ Set screw |
| ⑤ Height of the prepared foundation | |

Proceed as follows to mount the gear unit using foundation blocks:

1. Attach the foundation blocks with washers and fastening bolts in the foundation mounting points in the gear unit housing.
2. Tighten the fastening bolts until the housing feet are lying flat on the foundation blocks.
3. Using a suitable crane or lifting gear, place the gear unit down on the concrete foundation.
4. Align the gear unit so that the input and output shafts are horizontal using the set screws (if available) (Page 51).
5. For higher external forces, if necessary, use lateral stops to prevent the gear unit shifting.
6. Before casting the foundation, close the openings in the foundation blocks using a suitable material (e.g. using polystyrene).
7. Pour concrete into the recesses in the concrete foundation for the foundation blocks.
8. After the concrete has set, tighten the fastening bolts of the foundation blocks with the specified tightening torque (Page 63).
9. Record the alignment dimensions and keep the report in a safe place together with these operating instructions.


NOTICE
<p>Damage caused by unevenly tightening the fastening bolts</p> <p>The gear unit can be damaged by unevenly tightening the fastening bolts.</p> <p>Evenly tighten the fastening bolts. Ensure that the gear unit is not deformed or distorted when tightening the fastening bolts.</p>

5.4 Couplings

Introduction

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

- If necessary, carry out the following preparatory work in accordance with the operating instructions for the coupling:
 - Machine 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
<p>Danger of injury due to coupling rupture</p> <p>Flying fragments can cause fatal injury.</p> <p>Observe the operating instructions for the couplings.</p>

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

Further information

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

5.4.1 Assembling the coupling

Introduction

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

Assemble the coupling as described in the operating instructions or the installation 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 components 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 components.

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 appropriate 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 drawings in the operating instructions for the coupling.
- Unless otherwise instructed, heat the coupling parts by an induction burner, 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 drawings in the operating instructions for the coupling.

Gear units with hollow output shaft or output flange 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 output flange shaft onto the shaft of the customer's driven machine.

More 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 assembly
- During operation:
 - 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. Be sure to take the following precautions:

- Make sure that the maximum permissible displacement 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 displacement 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 displacement might occur simultaneously. Make sure that the total value of both displacements does not exceed the maximum permissible angular or radial displacement value.

The diagram below illustrates the potential displacements:

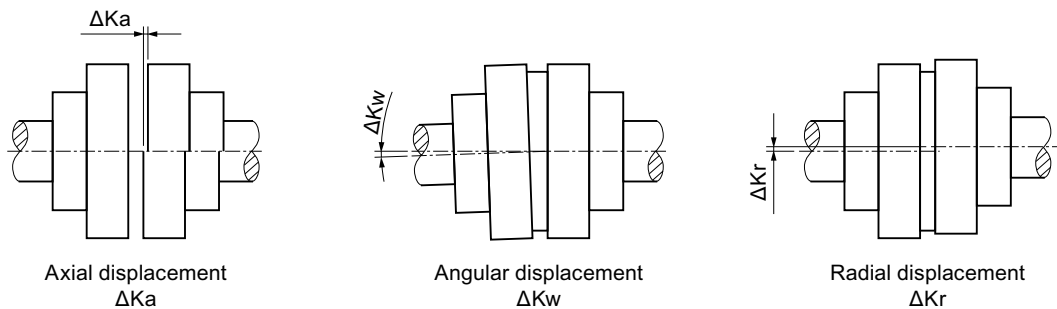


Figure 5-4: Possible displacements

Alignment

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

- Ruler (radial displacement)
- Feeler gauge (angular displacement)
- 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:

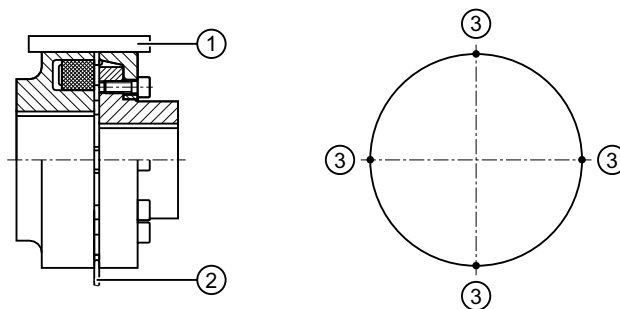


Figure 5-5: Alignment process based on the example of a flexible coupling

- ① Ruler
- ② Feeler gauge
- ③ Measuring points



Information

It is advisable to insert shims or metal sheets under the mounting feet in order 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

Further information about the permissible alignment errors can be found in the coupling operating instructions in the complete documentation for the gear unit, or contact the manufacturer in question.

5.5 Connecting components

5.5.1 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 associated operating instructions, provided in the complete gear unit documentation.

You can find the technical data of the mounted components in the contract-list of equipment provided in the complete gear unit documentation.

5.5.2 Connecting up air supply "Rotary joint input shaft"

Procedure

To connect up the air supply for the rotary joint at the input shaft, proceed as follows:

1. Before connecting up the compressed air line, remove the sealing cap from the air supply connection.
2. Connect the compressed air line with a flexible connection (e.g. a hose line).

CAUTION

Risk of injury due to loose or ruptured compressed air line

Use of rigid connecting pipes can result in injury if the compressed air line works loose or ruptures.

Make sure that the compressed air line is in perfect condition and correctly attached.

Use of flexible connecting lines

Further information

You will find further information and a detailed illustrated description of the gear unit and the connections in the drawing in the complete documentation for the gear unit.

You can find further information about the rotary joint in the rotary joint operating instructions in the complete documentation for the gear unit.

5.5.3 Connecting components in preparation for inertisation

Procedure



Information

Notices relating to purging with inert gas (nitrogen)

Pay attention to the notices relating to purging with inert gas (nitrogen) at the following locations:

- Nitrogen inlet
 - Nitrogen overflow
 - Nitrogen discharge
 - Vent (residual air)
-

To connect up the inert gas inlet and discharge lines, proceed as follows:

1. Remove the screw plugs from the main gear unit, the bell housing and the auxiliary gear unit (if installed).
2. Connect up the inert gas inlet and the vent lines for the main gear unit and the auxiliary gear unit (if installed).
3. Connect up the inert gas inlet and discharge lines and the vent line for the bell housings. Make sure that the inert gas discharge lines are routed out of the hazardous area.

Further information

You will find further information and a detailed illustrated description of the gear unit and the connections in the drawing in the complete documentation for the gear unit.

For more information about inertisation, refer to chapter Inerting (Page 68).

5.5.4 Installing a separate oil supply system

Procedure

To connect the oil supply system to the gear unit, proceed as follows:

1. Remove the dummy flange from the suction and delivery line before connecting the system.
2. Connect the system to the gear unit in accordance with the drawings in the complete documentation and install it as a separate system.
3. When installing the system, make sure that the pipework is not subjected to mechanical stresses.

More information

More information about the oil supply system can be found in the oil supply system instructions contained in the complete documentation for the gear unit.


5.5.5 Connecting the heating element

Procedure

To connect heating elements to the gear unit, proceed as follows:

1. Check that the heating element connection is not damaged.
2. Connect up the oil temperature monitoring system in the oil sump.
3. Install the electrical wiring for the oil level monitoring system.
4. Install the electrical wiring for the heating elements.



 WARNING
<p>Explosion and fire hazard</p> <p>Exposed heating elements pose a fire hazard.</p> <p>Do not put heating elements into service until you have checked that they are completely immersed in the oil bath.</p>

Further information

You can find additional information about the heating in the heating operating instructions in the complete documentation for the gear unit.

You can find additional information about the oil level monitoring system in the operating instructions for the oil level monitoring system components provided in the complete gear unit documentation.

You can find technical data in the separate data sheet and in the list of equipment in the complete gear unit documentation.

5.5.6 Connecting the oil-level monitoring system

Procedure

To connect the oil-level monitoring system to the gear unit, proceed as follows:

1. Ensure that the filling-level limit switch connection is not damaged.
2. Connect the electric wiring of the filling level limit switch.
3. Connect the signal so that the drive motor cannot start and an alarm is output when the “oil level too low” signal is given.
4. Make sure that this signal cannot be bypassed when the gear unit is in operation.

More information

You can find additional information about the oil-level monitoring system in the operating instructions for the oil level monitoring system components provided in the complete gear unit documentation.

You can find technical data in the separate data sheet and in the list of equipment in the complete gear unit documentation.

5.5.7 Connecting the Pt 100 resistance thermometer

Procedure

To connect the Pt 100 resistance thermometer, 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

Further information about the Pt 100 resistance thermometer can be found in the Pt 100 resistance thermometer operating instructions in the complete documentation for the gear unit.

5.5.8 Connecting the bearing monitoring system

Procedure

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

1. Make sure that the connections provided for holding the bearing monitoring equipment are undamaged.
2. Install the bearing monitoring equipment at the customer's site.

Further information

You can find additional information about the bearing monitoring system in the operating instructions for the bearing monitoring system components provided in the complete gear unit documentation.

5.5.9 Connecting a speed encoder

Procedure

To connect the air-oil cooler to the gear unit, proceed as follows:

1. Ensure that the speed encoder connection is not damaged.

2. Electrically connect the speed encoder.

Further information

You can find additional information on the speed encoder in the speed encoder operating instructions, provided in the complete gear unit documentation.

5.5.10 Gear unit with auxiliary drive

Procedure

To connect up the auxiliary drive motor, proceed as follows:

1. Make sure that the auxiliary drive motor connection is undamaged.
2. Bolt the auxiliary drive motor to the auxiliary gear unit.

Further information

You can find further information, a detailed illustration of the gear unit and the position of the auxiliary drive in the drawing in the complete documentation for the gear unit.

You can find further information about the auxiliary drive in the auxiliary drive operating instructions in the complete documentation for the gear unit.

5.5.11 Electrical connections

Requirements


Do not use any motor that exceeds the specified speeds of the gear unit as otherwise the gear unit may become damaged. The speeds are displayed on the rating plate.

Improper use can damage the gear unit. Be sure to 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
<p>Electric shock</p> <p>Live parts can cause electric shock.</p> <p>Ensure that the entire plant is de-energised before starting electrical installation work. Carefully observe the five safety rules (Page 15).</p>

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

1. Ensure that the connections of the motors and monitoring devices are not damaged.

2. Connect up the motors and monitoring devices according to the terminal diagram and the relevant operating instructions.
3. Insulate all cable entry points (glands) at electrical equipment as required for the environment in which the equipment will operate.

Further information

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

5.6 Tightening procedure

5.6.1 Introduction

Bolts

The bolts must have the following properties:

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



Information

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



Information

Using a lubricant

As a rule, lubricants may not be used, because this can result in the bolt connection becoming overloaded.

5.6 Tightening procedure

5.6.2 Tightening torques and preload forces

5.6.2.1 Hub connection bolts

All the tightening torques for the hub connection bolts of the gear unit housing and bell housing and for other bolts subject to axial loads are available on request from Customer Services (Page 91).

5.6.2.2 Foot fastening bolt connections

Bolt the specified bolted connections with the tightening torques 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 foot fastening bolt connections of strength classes 8.8 and 10.9:

Nominal thread diameter	Bolt strength class	Preload force	Tightening torque
d mm		$F_{M \text{ min.}}$ N	M_A Nm
M36	8.8	324 700	2 150
	10.9	382 000	2 530
M42	8.8	447 100	3 460
	10.9	526 000	4 070
M48	8.8	589 050	5 220
	10.9	693 000	6 140
M56	8.8	815 150	8 365
	10.9	959 000	9 840
M64	8.8	1 077 800	12 155
	10.9	1 268 000	14 300
M72x6	8.8	1 360 000	17 680
	10.9	1 600 000	20 800
M80x6	8.8	1 657 500	24 565
	10.9	1 950 000	28 900
M90x6	8.8	2 167 500	35 405
	10.9	2 550 000	41 650
M100x6	8.8	2 720 000	49 130
	10.9	3 200 000	57 800

Table 5-1: Preload forces and tightening torques for foot fastening bolts

5.6.2.3 Other bolt connections

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

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

The following table lists the preload forces and tightening torques for other bolt connections of strength classes 8.8 and 10.9:

Nominal thread diameter	Strength class of the bolt	Preload force	Tightening torque
d mm		$F_{M \text{ min.}}$ N	M_A Nm
M10	8.8	26,200	49
	10.9	36,900	69
M12	8.8	38,300	86
	10.9	54,000	120
M16	8.8	73,000	210
	10.9	102,000	295
M20	8.8	114,000	410
	10.9	160,000	580
M24	8.8	164,000	710
	10.9	230,000	1,000
M30	8.8	262,000	1,450
	10.9	368,000	2,000
M36	8.8	382,000	2,530
	10.9	538,000	3,560
M42	8.8	526,000	4,070
	10.9	740,000	5,720
M48	8.8	693,000	6,140
	10.9	975,000	8,640
M56	8.8	959,000	9,840
	10.9	1,350,000	13,850
M64	8.8	1,268,000	14,300
	10.9	1,784,000	21,000

Table 5-2: Preload forces and tightening torques for other bolt connections

5.7 Final work

Measures

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

- Check whether all devices dismantled for transportation have been reassembled.
- Check all bolt 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 drainage 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.
- Perform potential equalisation in accordance with the applicable regulations and directives. If no threaded holes are available on the gear unit for an earth connection, please take suitable alternative measures. This work must be carried out by specialists in electrical engineering.
- Protect the cable entries against penetrating moisture.

More information

You can find additional information about the gear unit and all mounted or separately supplied components in the operating instructions of the relevant components included in the complete documentation for the gear unit.

You can find more technical specifications in the separate data sheet in the complete gear unit documentation.

6.1 Measures prior to commissioning

Take the following measures before commissioning the gear unit:

- Read and observe the instructions.
- Check the direction of rotation of the motor and gear unit. The direction of rotation of the motor and gear unit must match. Observe the arrow indicating direction of rotation.
- Replace the screw plug with the air filter, the wet-air filter or the venting valve. Note the instructions 7300 for this.

NOTICE

Excess pressure in the gear unit

Closed ventilation and venting valves can lead to leakages in the gear unit in the event of excess pressure.

- Ensure that all ventilation and air release points are open.

- Gear unit with auxiliary drive: Take the appropriate measures before commissioning gear units with an auxiliary drive.
- Purge with inert gas (nitrogen): Take the appropriate measures to bleed the components at the connections provided before commissioning the gear unit (Page 68).
- Fill the gear unit with oil up to the marking (oil filling point) on the oil level indicator. Start up the oil supply system briefly (3 to 5 minutes) while you do this. If necessary, top up the oil until it reaches the marking.
- Gear unit with oil supply system: Check that the oil supply system is working properly.
- Check the oil level when the gear unit is not rotating, when the oil supply system is out of operation, and when the pipework and components of the gear unit and oil supply system are filled with oil.
- Check the gear unit for leaks.
- Check whether the monitoring devices are connected and switched on.
- Check whether fitted isolation valves are open.
- Gear unit with oil supply system: Take the appropriate measures before commissioning gear units with an oil supply system (Page 69).
- Ensure that all pipes and components are filled with oil.
- Restarting: Make sure that the drive cannot be restarted after safety equipment has responded unless the restarting lockout is cancelled.

NOTICE

Low ambient temperatures

If the ambient temperature is below the minimum startup temperature (Page 73), contact Customer Services (Page 91) for advice or take suitable measures to warm up the gear unit to the minimum startup temperature. Use the heating elements (if these are integrated) to warm up the gear unit, or alternatively use heat plates, heat radiator or similar devices.

6.1 Measures prior to commissioning

More information

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

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

6.1.1 Inerting

Introduction

Vent or purge the components that are designed for inertisation so that the residual oxygen can escape. This must be done prior to commissioning and prior to every startup with inert gas (nitrogen). Refer to chapter Connecting components in preparation for inertisation (Page 59) for information about connecting up components. In order to ensure that all the residual oxygen can escape, five times the purging volume is required for both processes.



Risk of suffocation

There is a risk of suffocation in atmospheres enriched with nitrogen.

Make sure that the operating area is adequately ventilated. Shut down the gear unit immediately if the pressure exceeds the maximum or drops below the minimum excess pressure.

Please pay particular attention to the following when inerting the components:

- The inerting process requires an excess pressure of $0.02 \text{ bar} \leq p < 0.2 \text{ bar}$.
- The nitrogen temperature must be approximately the same as the ambient temperature.
- Shut down the gear unit immediately if the pressure drops below the minimum excess pressure or exceeds the maximum excess pressure.

Procedure - purging with inert gas

In order to purge components designed for inertisation with inert gas, proceed as follows:

1. Connect a nitrogen supply line to the connections on the components marked "Nitrogen supply".
2. Connect a nitrogen discharge line to the components. Proceed as follows:
 - Connect a nitrogen discharge line to the connection marked "Nitrogen discharge" on the bell housing.
 - Replace the venting valve on the gear unit by a nitrogen discharge line.
 - Route these nitrogen discharge lines out of the hazardous area.
3. Purge the components continuously with an inert gas (nitrogen).
4. Vent the bell housing at the connection marked "Nitrogen vent" so that the remaining oxygen can escape from the bell housing.

Procedure - pressurising with inert gas

In order to pressurise components designed for inertisation with inert gas, proceed as follows:

1. Connect a nitrogen supply line to the connections on the components marked "Nitrogen supply".
2. Connect a venting valve (pressure relief valve) at the connection marked "Nitrogen discharge" on the bell housing. Provide the gear unit (if applicable) with additional connections "Nitrogen overflow".
The venting valve opens at a pressure of > 0.2 to 0.3 bar.
3. Pressurise the components with the inert gas.
4. Vent the components at the connections marked "Nitrogen vent" so that the remaining oxygen can escape from the components. Route this nitrogen discharge line out of the hazardous area.

Further information

You will find further information and a detailed illustrated description of the gear unit and the connections in the drawing in the complete documentation for the gear unit.

6.1.2 Gear units with an oil supply system

Take the following measures before commissioning a gear unit with an oil supply system:

- Make sure that the pressure in the oil supply system components does not exceed the maximum permissible pressure.
- Ensure that the maximum permissible temperature of the oil supply system components is not exceeded.
- Using the oil supply system, lubricate the gear unit for 15 minutes in a pre-lubrication phase. During this time, the rolling-contact bearings and gearing are supplied with sufficient oil for starting.
- Check that the oil level is correct in the auxiliary gear unit. If the oil has not reached this level in the auxiliary gear unit after 15 minutes, extend the pre-lubrication phase until the correct oil level is reached.

The oil chambers in the auxiliary and main gear units are separated only by a single-element labyrinth seal. When the oil supply system is shut down, the oil in the auxiliary gear unit drops to well below the required minimum level.

- In order to prevent oil foaming, operate the oil supply system without the gear unit running only until the oil for the auxiliary gear unit reaches the required level. (Until the end of the pre-lubrication phase for gear units without auxiliary drive.)

NOTICE

Damage to the gear unit caused by inadequate or complete loss of lubrication or insufficient cooling

The gear unit can sustain damage as a result of inadequate or complete loss of cooling or lubrication.

Fully open the shutoff valves in the coolant inflow and outflow lines of the coolant system. Check that the connecting pipes are firmly seated and tight.

6.1 Measures prior to commissioning

Further information

You can find additional information on the oil supply system in the data sheet, in the list of equipment and in the operating instructions for the oil supply system which are included in the complete documentation for the gear unit.

6.1.3 Gear unit with auxiliary drive

Take the following measures before commissioning a gear unit with auxiliary drive:

- Please observe the information provided in the operating instructions for the auxiliary drive.
- Fill the overrunning clutch with oil via the intermediate flange. Use the same oil type and viscosity as for the gear unit itself.
- Check that the overrunning clutch can be easily rotated in the free-wheeling direction without having to exert excessive force.
To do this, rotate the motor shaft of the auxiliary drive in the opposite direction to the direction of rotation arrow to the gear unit.
- Before connecting the motor, identify the phase sequence of the three-phase power system using a phase sequence indicator. Connect the motor corresponding to the defined direction of rotation.
- When starting the main gear unit using the auxiliary drive, the input shaft of the main gear unit is run-up by the auxiliary drive (rated speed of the auxiliary drive motor times the auxiliary gear unit transmission ratio).
When the operating feedback signal of the auxiliary drive is reached, the enable signal to switch-on the main drive is output.
The auxiliary drive is decoupled from the 2nd shaft end of the input shaft of the main gear unit using an overrunning clutch (freewheeling).
The auxiliary drive must be secured so that it is not driven by the main drive, which could result in an inadmissible speed being reached (freewheeling monitoring).
Once the operating speed of the main motor has been reached, the auxiliary drive must be automatically shut down.
The freewheeling monitoring must be active in all operating states.
- The driven machine can be emptied using the auxiliary drive (at rated speed of the auxiliary drive motor times the transmission ratio of the auxiliary gear unit). Operation in the jog mode (inching mode) is not permitted.
- Check the shutdown function of the speed monitoring (Page 83).

NOTICE**The overrunning clutch and the gear unit can be damaged**

If you run the overrunning clutch against the blocking direction of the overrunning clutch, the overrunning clutch and the gear unit can be damaged.

Do not operate the gear unit against the blocking direction of the overrunning clutch. Observe the information on the plate attached to the gear unit.

Further information

You can find further information about the auxiliary drive in the auxiliary drive operating instructions in the complete documentation for the gear unit.

6.2 Measures during commissioning

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

Observe the following procedure to avoid damaging the gear unit:

1. Switch on the DS control drive.
2. Switch on the main drive DA after reaching full motor speed.
 - Check that the oil supply system is working properly.
 - Check the oil level.

The oil level drops slowly after the gear unit starts up. As the gear unit continues to warm up, the oil will settle around the correct oil level.
Measure the operating oil level when the gear unit and the oil supply system are in operation.

There is no need for concern if the operating oil level is between the two markings on the oil level indicator (oil filling and operating oil level).
 - Measure the oil sump temperature (Page 80) after the gear unit has run in.
 - Check the tightness of the shaft seal on the gear unit (Page 26).
 - Check for leakage at the gear unit and the bell housing during the inerting process (inertisation depending on order specification).
 - Bell housing with sight glass plates: Check for leakage at the sight glass plates.
 - Check that all rotating parts are free to move.
 - Check whether the shutoff valves are open.
 - Check that all of the oil drain valves are closed.
 - Ensure that all of the other shutoff valves are open.
 - Check that the connecting pipes are firmly seated and tight.
 - Gear unit with bearing monitoring based on vibration measurement: Measure the vibration levels of the rolling-contact bearings (Page 80) to create initial and comparison values. Record and archive these values.
 - Gear unit with bearing temperature monitoring system: Measure the temperature at the rolling-contact bearings (Page 81) to create initial and comparison values. Record and archive these values.
 - Limit the period of no-load operation on the gear unit to a minimum. If the gear unit does not heat up because the load applied is too low, throttle the cooling water supply. in order to reduce the formation of oil foam.

More information

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

More information about the oil supply system can be found in the oil supply system instructions contained in the complete documentation for the gear unit.

6.2.1 Initial test run

Restrict the period of no-load operation of the gear unit to a maximum of 15 minutes.

6.2 Measures during commissioning

When the gear unit is put into operation for the first time, monitor it closely for the first two hours in operation under load so that you can shut down the main motor immediately if unforeseeable complications develop.

6.2.2 Gear unit with heating

Please observe the following measures to commission the gear unit with heating:

- Ensure that the heating elements are not exposed.
- Check the switching points of the temperature monitor.

WARNING

Fire hazard

Exposed heating elements pose a fire hazard.

Do not put heating elements into service until you have checked that they are completely immersed in the oil bath.

Further information

You can find additional information about heating elements in the heating element operating instructions in the complete documentation for the gear unit.

6.2.3 Oil level monitoring system

Depending on the order specification, the gear unit can be equipped with an oil level monitoring system based on a level monitor, a level switch, a pressure transmitter or a filling-level limit switch.

The oil level monitoring system is a fill-level monitor that checks the oil level of the gear unit.



Information

Connect the signal so that the drive motor cannot start when the "oil level too low" signal is active and so that an alarm is output. Make sure that this signal cannot be bypassed when the gear unit is in operation.

Operation

7

7.1 Operating data

Introduction

To ensure correct, trouble-free operation of the system, observe the operating values of the gear unit and, depending on the order specification, the data in the operating instructions for the oil supply system.

The operating values specified in the Annex Technical data (Page 99) apply.

Operating data of the gear unit

The following operating data apply to the oil:

Startup temperature of gear unit	≥ 18 °C	
Operating temperature	40 - 70 °C	is applicable for mineral oil, API groups I or II and saturated synthetic ester
Maximum operating temperature (briefly)	90 °C	is applicable for mineral oil, API groups I or II and saturated synthetic ester

Table 7-1: Operating data

Operating data of the oil supply system

The following operating data apply to the oil supply system:

Type / size: 205 F 107	
Starting temperature of the oil supply system	10 °C
Oil flowrate (at operating temperature of approx. 50 °C)	Minimum 750 l/min Maximum 830 l/min
Inlet oil pressure (at operating temperature of approx. 50 °C)	Minimum 1.5 bar Maximum 4 bar
Inlet oil temperature	Minimum 40 °C Maximum 55 °C

7.2 Irregularities in operation

Type / size: 261 F 200, 292 F 200, 316 F 200	
Type / size: 261 F 222, 292 F 222, 316 F 222	
Starting temperature of the oil supply system	10 °C
Oil flowrate (at operating temperature of approx. 50 °C)	Minimum 1100 l/min Maximum 1250 l/min
Inlet oil pressure (at operating temperature of approx. 50 °C)	Minimum 1.5 bar Maximum 4 bar
Inlet oil temperature	Minimum 40 °C Maximum 55 °C

Type / size: 292 F 311, 316 F 311, 349 F 311	
Starting temperature of the oil supply system	10 °C
Oil flowrate (at operating temperature of approx. 50 °C)	Minimum 1650 l/min Maximum 1850 l/min
Inlet oil pressure (at operating temperature of approx. 50 °C)	Minimum 1.5 bar Maximum 4 bar
Inlet oil temperature	Minimum 40 °C Maximum 55 °C

Further information

You can find further information about operation and maintenance of the oil supply system in the operating instructions for the oil supply system.

You will find further information about the oil pressure in the data sheet, in the list of equipment or in the drawing in the complete documentation for the gear unit.

You can find additional information about the technical data of the gear unit in the data sheet and the list of equipment in the complete documentation for the gear unit.

7.2 Irregularities in operation

Introduction

Switch off the drive aggregate immediately if it exhibits irregular behaviour during operation.

A few irregularities are listed below as examples:

- Oil temperature exceeds the maximum permissible value
- Alarm tripped by the pressure monitor in the oil cooling system or oil supply 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 assembly immediately if any fault condition develops.

NOTICE**The gear unit can sustain damage if it becomes misaligned.**

Operating a gear unit when it is misaligned can result in gear unit damage. If you notice changes at the active tooth flanks, carry out another alignment check even if the shafts were positioned correctly when the gear unit was initially installed.

Rectifying irregularities in operation

Proceed as follows to rectify any irregularities in operation:

1. Switch off the drive aggregate if it exhibits irregular behaviour during operation
2. Refer to the "Fault information" (Page 85) to find the cause of the fault.
3. If you still cannot determine the cause of the fault, contact Flender Customer Service (Page 91).

7.3 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 aggregate.
In this case, the oil supply system must remain in operation until the main gear unit reaches a standstill.
- Start up the gear unit briefly for 5 – 15 minutes every 4 weeks if it is taken out of service for up to 6 months.
- Take measures to preserve the gear unit if it is to be out of service for a prolonged period. Follow the procedure described in instructions 7300.
- For gear units with a separate oil supply system or separate oil cooling system, perform the following steps before you preserve the gear unit:
 - Disconnect the gear unit from the separate oil supply system or separate oil cooling system.
 - Seal the openings in the gear unit, separate oil supply system and separate oil cooling system so that they are air-tight.

7.3 Taking the unit out of service

8.1 General maintenance information

The operator must ensure compliance with the stipulated time limits. 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.

Document all maintenance and servicing activities that are carried out.

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
- Gear unit input speed 1200 rpm, 1500 rpm or 1800 rpm
- Average oil temperature in the oil sump (see Instructions 7300)



WARNING

Danger to life when the system is switched on

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 aggregate. Attach a notice stating clearly that work is being performed on the gear unit.

DANGER

Risk of suffocation

Close any supply of nitrogen before doing work on the gear unit.



Information

Apply inert gas (nitrogen) to the relevant components through the connections provided prior to commissioning and prior to every startup.

Special aspects with a bearing monitoring system with 26 measuring points

Model / size: 261 F 200, 292 F 200, 316 F 200

Model / size: 261 F 222, 292 F 222, 316 F 222

Applicable only to gear unit version with a bearing monitoring system with 26 measuring points: Before dismantling the housing top half of the intermediate gear, remove the vibration sensors or the "SPM" sensors from measuring points 4 and 24 including the relevant cover (if fitted).

Special aspects with a bearing monitoring system with 28 measuring points

Model / size: 292 F 311, 316 F 311, 349 F 311

Applicable only to gear unit version with a bearing monitoring system with 28 measuring points: Before dismantling the bottom half of the bracket, remove the vibration sensors or the “SPM” sensors from measuring point 13 including the adapter and the relevant cover (if fitted).

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.

Intervals and time limits	Measures
As required	<ul style="list-style-type: none"> Clean the gear unit housing Clean the air filter Clean the bell housing Clean the venting valve Replace the wet-air filter Replace the rolling-contact bearings Replace the control gear bearing Perform function test at the venting valve Check the auxiliary drive
Prior to each startup of the gear unit	<ul style="list-style-type: none"> Check the oil level
Daily	<ul style="list-style-type: none"> Check the oil temperature Check for changes in the gear unit noise Check the oil level Inspect rotary shaft sealing rings for leakages Check gear unit for leakages Check the oil pressure Check the condition of the oil cooler Clean the oil filter
400 operating hours after commissioning	<ul style="list-style-type: none"> 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 2,000 operating hours	<ul style="list-style-type: none"> Oil inspection Check the water content of the oil

Intervals and time limits	Measures
Every 3 months	Clean the air filter Clean venting valve, and if necessary, perform function test Measure the vibration levels of the rolling-contact bearings Measure the temperature of the rolling-contact bearings Inspect the wet-air filter Inspect the sight glass plates Inspect the overrunning clutch Test the shutdown function of the speed monitor for the auxiliary drive
Every 3,000 operating hours, at least every 6 months	Regrease Taconite seal
Every 12 months	Clean the gear unit housing Clean the bell housing Inspect the rolling-contact bearings Inspect the control gear bearing Check the condition of the control gear tooth flanks Check the condition of the gear tooth flanks on the running gears Inspect the hoses Check the internal condition
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 water-oil cooler (the same time as you change the oil)
Every 2 years	Carry out a general inspection of the gear unit Check that the fastening bolts are tight
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 sampling)
6 years after the stated date of manufacture	Change the hoses
At the end of the bearing service life	Replace the rolling-contact bearings Replace the control gear bearing

Table 8-1: Maintenance and servicing activities

More information

You can find more information on additional maintenance and servicing activities in the separate data sheet and in instructions 7300 in the complete documentation for the gear unit.

More information about installed components can be found in the instructions for the components in the complete documentation for the gear unit.

8.3 Maintenance and servicing work

Introduction

You can find maintenance and servicing measures relating to gear unit lubrication and preservation, which are not provided in this chapter, in instructions 7300 in the complete documentation for the gear unit.

8.3.1 Checking the oil temperature

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

The gear unit can sustain damage due to insufficient 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 reach its normal operating temperature.
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 73).
5. Immediately stop the gear unit if the maximum permissible oil temperature is exceeded. Contact Flender Customer Service (Page 91).

8.3.2 Measuring the vibration levels of the rolling-contact bearings

Procedure

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

1. Measure the vibrations 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. Replace defective rolling-contact bearings.
5. Archive the report together with these instructions.

NOTICE

Damage to the gear unit

A defective rolling-contact bearing may cause damage to the gear unit.

Replace the rolling-contact bearings at the latest when they reach the end of their service life.

Further information

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

8.3.3 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. Replace defective rolling-contact bearings.
5. Archive the report together with these instructions.

NOTICE

Damage to the gear unit

A defective rolling-contact bearing may cause damage to the gear unit.

Replace the rolling-contact bearings at the latest when they reach the end of their service life.

Further information

You can find additional information about measuring the temperature at the rolling-contact bearings in the operating instructions of the relevant components in the complete documentation for the gear unit.

8.3.4 Inspecting the control gear bearing

Wear

Control gear bearings are susceptible to wear ("brinelling"). Change over to the other gear in each case several times per year (at least every 3 months) to prevent them from wearing. See Chapter Gear changing (Page 29) for further information.

Procedure

Proceed as follows to check the control gear bearings:

1. Remove the inspection cover.
Use a crane to do this.
2. Inspect the control gear bearings.
3. Replace any control gear bearings that are found to be damaged.
4. Reinstall the inspection cover with new seals or sealant.
5. If you notice any anomalies, contact Customer Services (Page 91) and check whether the damage is spreading.

NOTICE

Damage to the gear unit

Defective control gear bearings may cause damage to the gear unit.

Replace the control gear bearings at the latest when they reach the end of their service life.

8.3.5 Inspecting the running gear and the control gear

Procedure

Proceed as follows to inspect the running gear and the control gear:

1. Remove the inspection cover. Use a crane to do this.
2. Inspect the running gear and the control gear: When doing this, pay particular attention to the following:
 - Inspect the surface condition and the contact pattern of the running gear tooth flanks.
 - Inspect the splines of the control gear for wear. The design of these components makes them susceptible to wear.
3. Reinstall the inspection cover with new seals or sealant.
4. If you notice any anomalies, contact Customer Services (Page 91) and check whether the damage is spreading.

8.3.6 Inspecting the sight glass plates

Introduction

Sight glass plates can become damaged due to excessive aging or external influences.

Procedure

Proceed as follows to inspect the sight glass plates:

1. Arrange for the sight glass plates to be inspected for damage.

2. Replace any sight glass plates that are found to be damaged.

8.3.7 Inspect the overrunning clutch

Further information

Information about inspecting the overrunning clutch can be found in the operating instructions of the relevant overrunning clutch in the complete documentation for the gear unit.

8.3.8 Checking the auxiliary drive

Further information

You can find information on checking the auxiliary drive in the auxiliary drive operating instructions, provided in the complete gear unit documentation.

8.3.9 Checking the speed monitoring of the auxiliary drive

Procedure

Proceed as follows to check the speed monitoring of the auxiliary drive:

1. Switch on the auxiliary drive.
2. Check whether the speed monitoring system responds.

Result

If the speed monitoring system does not respond, repair it or, if necessary, replace it.

Further information

You can find further information about the auxiliary drive in the auxiliary drive operating instructions in the complete documentation for the gear unit.

8.3.10 Cleaning the gear unit and bell housing

Introduction

Layers of dust may affect the dissipation of heat through the surface of the gear unit, resulting in overheating. Depending on the operating conditions, it may therefore be necessary to clean the gear unit, the auxiliary drive and the bell housing more frequently than stated in the maintenance schedule.

Procedure

To clean the gear unit and the bell housing, proceed as follows:

1. Use a hard brush to remove any stubborn dirt from the gear unit and bell housing. Never use a high-pressure cleaning device.
2. Remove any spots of corrosion.

8.3.11 Cleaning the venting valve

Cleaning interval

For dust deposits, you must clean the venting valve 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 venting valve, please proceed as follows:

1. Unscrew the venting valve.
2. Do not allow foreign matter to enter the gear unit.
3. Wash the venting valve with cleaning solvent or a similar cleaning agent.
4. Dry the venting valve and blow it out using compressed air.
5. Perform a function test on the venting valve.
6. Replace the venting valve if necessary.

8.3.12 Inspecting the rotary shaft sealing ring

Service life of rotary shaft sealing rings

Rotary shaft sealing rings are wearing parts that need to be replaced after the wear limit is reached. The service life of rotary shaft sealing rings is influenced by many different parameters:

- Circumferential speed at the sealing lip
- Temperature
- Internal pressure in the gear unit
- Lubricant viscosity
- Chemical composition of and additives in lubricants
- Mounting position (supply of lubricant to sealing lip)

- Dirt particles or metal abrasion dust in the lubricant
- Shaft sealing ring material

As a result of these many influencing parameters, it is not possible to make a definitive statement about the likely service life of rotary shaft sealing rings. It is therefore important to inspect them regularly. Only in this way is it possible to detect the signs of lubricant loss in the gear unit.

8.3.13 General inspection of the gear unit

Arrange for Flender Customer Services to perform a general inspection on the gear unit. Thanks to their experience, these engineers are best placed to assess whether and which gear unit components need to be replaced.

8.3.14 Check that all of the fastening bolts are tight

Note the following points when checking that the fastening bolts are tight:

- Observe the data regarding connection classes, preload forces and tightening torques (Page 64).
- Replace any bolts that are no longer fit for use by bolts of the same strength class and type.

8.3.15 Final work

After you have finished all the work listed in the maintenance schedule, replace any bolts that are no longer fit for use by 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 Service to attempt a repair.

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



Information

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 replacement parts.

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

8.4 Possible faults

Possible faults and how to rectify them

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

Possible faults	Causes	Possible remedies
Pressure monitor triggers an alarm	Oil pressure has dropped below minimum value	<ul style="list-style-type: none"> • 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 • If required, replace the oil filter
Noise	Damage to the gears	<ul style="list-style-type: none"> • Contact Customer Service • Inspect the gear components • If necessary, replace damaged components
	The bearing play is excessive	<ul style="list-style-type: none"> • Contact Customer Service • Adjust bearing play
	Defective rolling-contact bearings	<ul style="list-style-type: none"> • Contact Customer Service • Replace defective rolling-contact bearings
	Gear unit fastening has worked loose	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Seal housing cover or joints
	Labyrinth seals soiled with oil or incorrect transport position	<ul style="list-style-type: none"> • Check oil filling • Clean the labyrinths
Main drive motor does not start	Motor direction of rotation incorrect	<ul style="list-style-type: none"> • Change polarity of motor
	Overrunning clutch blocked	<ul style="list-style-type: none"> • Contact Customer Service • Replace the overrunning clutch
	Overrunning clutch cage with sprags incorrectly installed or defective.	<ul style="list-style-type: none"> • Contact Customer Service • Rotate the overrunning clutch cage 180° – or replace
Auxiliary drive motor does not start	Overload at the output	<ul style="list-style-type: none"> • Reduce the load at the output
	Defective auxiliary drive motor	<ul style="list-style-type: none"> • Repair or replace motor
The auxiliary drive motor starts, the main gear unit output shaft does not turn	Motor direction of rotation incorrect	<ul style="list-style-type: none"> • Change polarity of motor
	Overrunning clutch cage with sprags incorrectly installed	<ul style="list-style-type: none"> • Contact Customer Service • Rotate the overrunning clutch cage 180° – or replace
	Defective overrunning clutch	<ul style="list-style-type: none"> • Contact Customer Service • Replace the overrunning clutch
Leakage	Defective rotary shaft sealing rings	<ul style="list-style-type: none"> • Inspect the rotary shaft sealing rings and replace if necessary

Possible faults	Causes	Possible remedies
Wet-air filter is severely discoloured	Wet-air filter is spent	<ul style="list-style-type: none"> • Replace the wet-air filter
Wet-air filter is becoming discoloured from the top downwards	Water in the oil	<ul style="list-style-type: none"> • 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 is foaming in the gear unit	Preservation agent not completely drained off	<ul style="list-style-type: none"> • Change the oil
	Oil supply system left in operation for too long at low temperatures	<ul style="list-style-type: none"> • Switch off the oil supply system • Degas the oil
	Gear unit too cold in operation	<ul style="list-style-type: none"> • Switch off the gear unit • Degas the oil • Start up without cooling water during cold restart
	Water in the oil	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Examine the oil • Change the oil if necessary
	Unsuitable mixture of oils	<ul style="list-style-type: none"> • Examine the oil • Change the oil if necessary
Oil escaping from the gear unit	Inadequate sealing of the housing cover or joints	<ul style="list-style-type: none"> • Check the seals and if required, replace • Seal housing cover or joints • Check the compression seals and retighten screws if necessary
	Leaking pipes	<ul style="list-style-type: none"> • Check the pipes, and replace or seal if necessary
Oil supply system malfunction	-	<ul style="list-style-type: none"> • Observe the operating instructions for the oil supply system
Elevated temperature during operation	Oil level in the gear unit housing too high	<ul style="list-style-type: none"> • Check the oil level • If required, correct the oil level
	Oil is too old	<ul style="list-style-type: none"> • Check when the last oil change was performed • Change the oil if necessary
	Oil is severely contaminated	<ul style="list-style-type: none"> • Change the oil
	Oil supply system defective	<ul style="list-style-type: none"> • Check the oil supply system • Replace defective components if necessary • Observe the operating instructions for the oil supply system

8.4 Possible faults

Possible faults	Causes	Possible remedies
Elevated temperature during operation	Ambient temperature outside permissible range	<ul style="list-style-type: none"> Shut down the gear unit
	Gear unit with oil cooling system: Coolant flow too low or too high	<ul style="list-style-type: none"> Adjust the valves of the supply and return lines completely Check the water-oil cooler for free flow
	Gear unit with oil cooling system: Inadequate oil flow through the oil cooler	<ul style="list-style-type: none"> Check the oil filter and coarse filter If required, replace the oil filter or clean the coarse filter
	Coolant temperature too high	<ul style="list-style-type: none"> Check the temperature Correct the temperature if necessary
	Defective oil pump	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> Check the oil level at room temperature If required, correct the oil level
	Inadequate oil flow rate through the gear unit housing	<ul style="list-style-type: none"> Inspect the separate oil supply system and top up with oil if necessary Check the oil pressure at the inlet
	Oil is too old	<ul style="list-style-type: none"> Check when the last oil change was performed Change the oil if necessary
	Oil supply system defective	<ul style="list-style-type: none"> Check the oil supply system Replace defective components if necessary Observe the operating instructions for the oil supply system
	Defective rolling-contact bearings	<ul style="list-style-type: none"> Contact Customer Service Inspect the rolling-contact bearings and replace if necessary
Elevated temperature at overrunning clutch	Damaged overrunning clutch	<ul style="list-style-type: none"> Contact Customer Service Inspect the overrunning clutch and replace if necessary
Increased vibration amplitude at the bearing points	Defective rolling-contact bearings	<ul style="list-style-type: none"> Contact Customer Service Inspect the rolling-contact bearings and replace if necessary
	Gear wheels defective	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> Change over the double change-over filter as described in the separate operating instructions Clean the filter element

Possible faults	Causes	Possible remedies
Water in the oil	Oil supply system defective	<ul style="list-style-type: none"> • Check the oil supply system • Replace defective components if necessary • Observe the operating instructions for the oil supply system
	Machinery compartment fan is blowing cold air onto gear unit: Water condenses	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Contact Customer Service • Use wet-air filter if necessary
	Oil foams in the oil sump	<ul style="list-style-type: none"> • Take test tube sample to examine oil condition for water penetration • Have the oil examined by a chemical lab

Table 8-2: Possible faults and how to rectify them

9.1 Contact

When ordering replacement 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

More information

Further information about service and support can be found on the Internet:
Service & Support (<https://www.flender.com/service>)

Disposal of the gear unit

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

- Remove operating oil, preservative 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.

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.



Information

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 that are not supplied from Flender.

The contact address of Flender Customer Services can be found under Service & Support (Page 91).

Information required when ordering spare parts

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

When ordering spare parts, please provide the following information:

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

Declaration of incorporation

A

Declaration of Incorporation

Business name and full address of manufacturer:

Flender GmbH
Am Industriepark 2
46562 Voerde
Germany

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

Mark Zundel
Flender GmbH
Am Industriepark 2
46562 Voerde
Germany

Description and identification of the partly completed machine:

Double-screw-extruder gear units
205 F 107,
261 F 200, 292 F 200, 316 F 200,
261 F 222, 292 F 222, 316 F 222,
292 F 311, 316 F 311, 349 F 311
to drive machines

The following "Essential Health and Safety Requirements" from – Directive 2006/42/EC Official Journal L 157, 9 June 2006, pages 24-86, Annex I, are applied and are fulfilled:

1.1, 1.1.2, 1.1.3, 1.1.5, 1.1.6; 1.2.2, 1.2.4.4, 1.2.6; 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, 1.4.2.1, 1.4.2.2, 1.4.3, 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, 1.6.4, 1.7.1, 1.7.1.1, 1.7.1.2, 1.7.2, 1.7.3, 1.7.4, 1.7.4.1, 1.7.4.2, 1.7.4.3

The relevant technical documentation according to Annex VII Part B has been created.

The manufacturer undertakes to send national authorities electronic copies of the relevant technical documentation for the partly completed machine following a reasoned request.

The partly completed machine may only be put into operation if it has been determined, where applicable, that the machine in which the partly completed machine is to be incorporated meets the specifications of the Directive 2006/42/EC.

Representative for issuing this Declaration of Incorporation on behalf of the manufacturer:

Flender GmbH



Voerde, 2022-07-18

Mark Zundel, Vice President, Industrial Gears, Plant Voerde

Translation of the Declaration of Incorporation

Technical data

B

B.1 General technical data

Rating plate

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

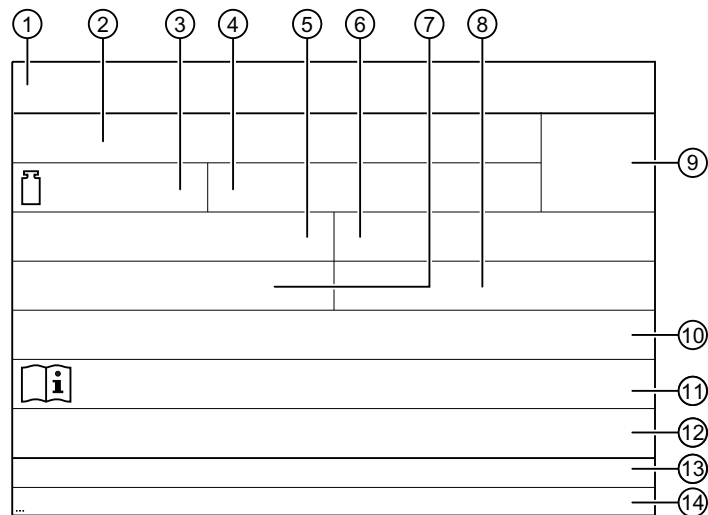


Figure B-1: Rating plate

- | | |
|--|---|
| ① Company logo | ⑧ Speed n_2 |
| ② Serial no.: Plant code / order no. - Item - Serial no. / Year of manufacture | ⑨ Optional DMC (Data Matrix Code) |
| ③ Total weight in kg | ⑩ Oil data: Oil type, oil viscosity, oil quantity |
| ④ For special information | ⑪ Number(s) of instructions, including issue date |
| ⑤ Model, size | ⑫ For special information |
| 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 |

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.

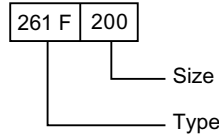
More information

You can find additional information about these technical data in the separate data sheet and the drawings in the complete documentation for the gear unit.

You can find additional information about all major accessories including their technical data and control instructions in the order-specific list of equipment in the complete documentation for 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 100) and Enveloping surface sound pressure level (Page 100).

You can find additional information about these technical data in the separate data sheet and the drawings in the complete documentation for the gear unit.

B.2 Ambient temperature

Unless otherwise contractually agreed, the gear unit must not be exposed to any harmful atmospheres or substances such as aggressive chemical products. 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 and specified in the order text.

B.3 Weights

The precise weights are specified in the drawings in the complete documentation for the gear unit, or on the rating plate.

All stated weights refer to units without oil filling.

B.4 Enveloping surface sound pressure level

The enveloping surface sound pressure level of the gear unit at a distance of 1 m is specified in the separate data sheet.

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

The workplace of the operators 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 an input speed n_1 and output power P_2 according to the rating plate. 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.

Index

A

- Air filter, 40
- Attachment points, 47
- Auxiliary drive, 83
 - Commissioning, 70
 - Connecting up the auxiliary drive motor, 62

B

- Bearing monitoring, 61
 - for vibration monitoring, 34
 - Resistance thermometer, 35
 - Vibration monitoring, 34
- Bell housing, 24

C

- Clutch, 28
- Coloured markings, 16
- Control gear, 82
- Control gear bearing, 81
- Copyright, 13

D

- Danger of explosion, 19
- Direction of rotation, 23
- Disposal, 93
- Documentation landscape, 13

E

- Environmental protection, 93
- Equipment features, 23

F

- Fastening bolts
 - Bolts, 63
 - Checking for tightness, 85
 - Mating threads, 63
- Fault, 85
- Fault rectification, 86
- Fault-finding, 85
- Final work, 66

G

- Gear unit housing, 23
- Gear unit markings, 16
- Gear unit use, 20
- General inspection of the gear unit, 85

H

- Heating
 - Commissioning, 72
 - Function, 30
 - Heating elements, 31
 - Oil level monitoring system, 32
 - Temperature monitor, 31
- Hoses, 41

I

- Inertisation, 23, 24, 59, 68
- Integration note, 21
- Interval, 78
- Irregularities in operation, 74

L

- Labyrinth seal, 27
- Liability disclaimer, 12
- Lubricant, 14

M

- Maintenance, 78
- Maintenance information, 77
- Maintenance schedule, 78
- Measures
 - during commissioning, 71
 - Prior to commissioning, 67
- Mounting position, 47

N

- Notes regarding assembly, 47

O

- Oil, 14
- Oil level indicator, 33

Oil supply system
 Commissioning, 69
Oil temperature, 80
Oil temperature monitoring, 32
Oil-level monitoring system, 60
 Filling level limit switch, 33
Operating data
 Oil, 73
 Oil supply system, 73
Operating values
 Compliance with, 73
Ordering spare parts, 95
Overrunning clutch, 83

P

Pressure lubrication, 24, 25
Protective equipment, 18

R

Rating plate, 99
 Example of model and size, 100
Resistance thermometer, 32, 61
Rolling-contact bearings
 Measure temperature, 81
 Measuring the vibration levels, 80
Rotary joint input shaft, 58
Rotary shaft sealing ring, 26, 27
 Service life, 84
Running gear, 82

S

Safety rules, 15
Scope of delivery, 43
Sensor telemetry system, 35
Separate oil supply system, 24, 25, 59
Servicing activities, 78
Shaft bearings, 26
Shaft seal, 26
Shipping documents, 43
Sight glass plates, 24, 82
Speed encoder, 61
Speed monitoring, 83

T

Taconite seal, 27
Taking out of service, 75
Technical specifications, 99
Torque monitoring, 35
Transport note, 43
Transport symbol, 44

Type of danger, 17

U

Unpacking, 48
Used oil, 93

V

Ventilation and bleeding, 40
Venting valve, 40, 84

W

Warning symbols, 17
Wet-air filter, 40

FLENDER GEAR UNITS

Double-screw-extruder gear unit
Assembly and operating instructions A5111-01en
Edition 07/2022

[Flender GmbH](#)
Alfred-Flender-Straße 77
46395 Bocholt
Germany