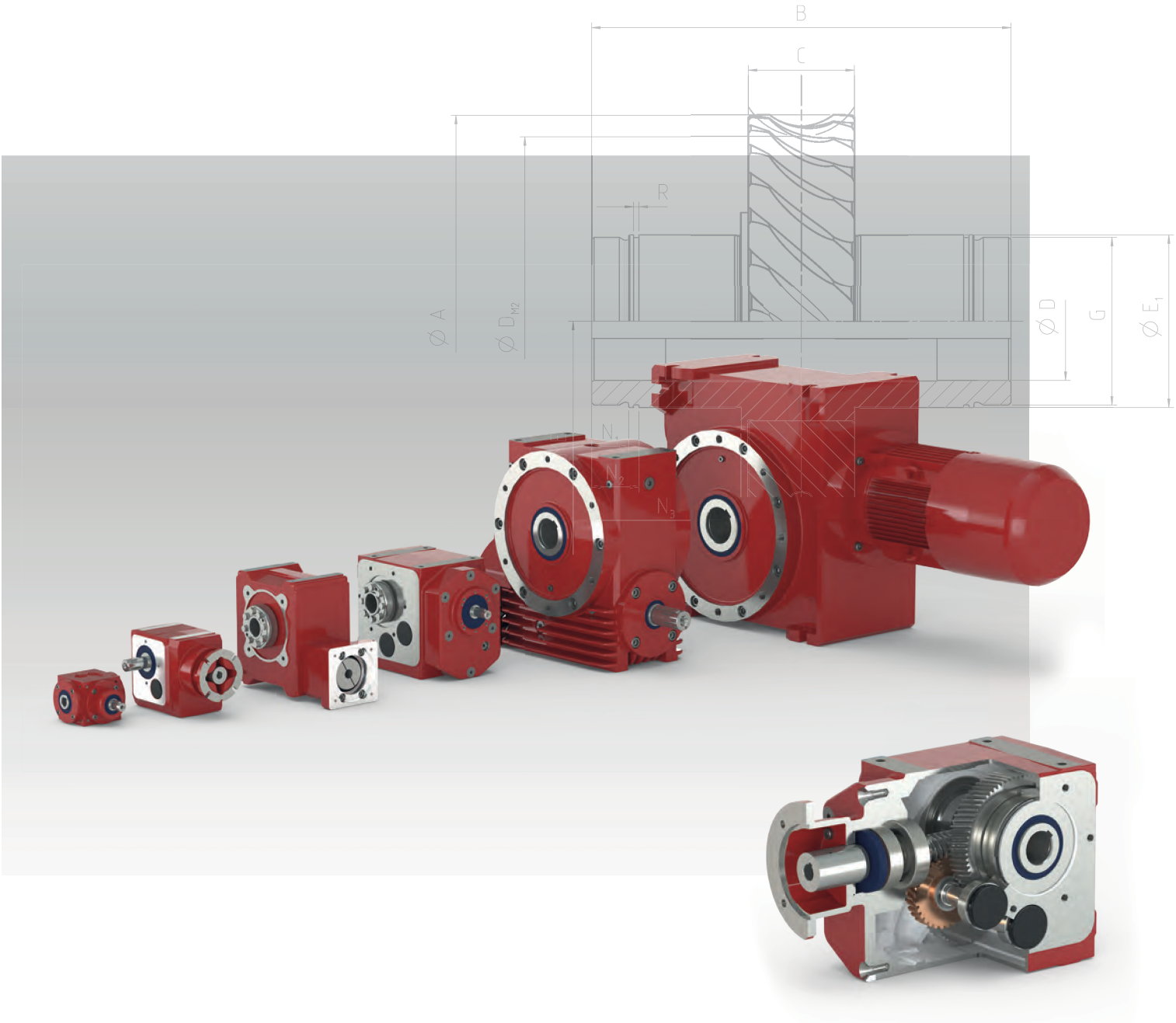
ANTRIEBSSYSTEME

ZAE OPERATING INSTRUCTIONS

GEAR UNITS AND GEARED MOTORS



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Revision history

Date	Revision	Description
2023-07-07	3.0	Chapter 10.2: Oil viscosities tables supplemented.
2022-06-24	2.0	Explanations on the identification of explosion-protected gear units added, new declarations of conformity, editorial changes.
2022-02-25	1.0	First issue

1 Introduction

Read through these operating instructions carefully prior to commissioning and before working on the gear unit or the geared motor. Always observe the safety and warning notices contained in this document.

If you require information that is not described in these operating instructions, contact the ZAE Service department.

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1.1 Content of the document

These operating instructions describe the assembly, commissioning, operation and maintenance of the following standard gear units and standard geared motors from ZAE.

Standard gear units	Unit sizes
Worm gear unit types E, M, S	040 to 400
Double worm gear unit types D, DM	050 to 400
Worm helical gear unit types E, M	012 to 513
Helical worm gear unit types GE, GM	050 to 200
Bevel gear unit types W, MW, SW	088 to 260

The operating instructions are also valid for gear units and geared motors that are approved and identified for use in potentially explosive areas.

1.2 Other applicable documents

The following documents must be observed in addition to the operating instructions:

- Design data for the gear unit or the geared motor
- Data sheet for the motor
- Instructions for the brake, if available
- Safety data sheet for the gear oil

1.3 Presentation conventions

In these operating instructions, warning notices are identified by a signal word. These are subdivided into levels depending on the differing severity of their consequences:

DANGER	The consequences are death or severe injuries.
WARNING	The consequences can be death or severe injuries.
CAUTION	The consequences can be minor injuries.
NOTICE	The consequences can be property damage.

In these operating instructions, the adjacent symbol identifies information of importance to explosion protection.

2 Safety

2.1 Use and usage restrictions

The gear units and geared motors are intended to be used as part of a drive system in machines and systems. The machine or system must not be put into operation until it has been determined that it can be operated safely with the gear unit or geared motor.

The machine or system into which the gear unit or geared motor has been incorporated must comply with the applicable regulations. All applicable safety and health protection requirements must be met. In particular, Machinery Directive 2006/42/EC must be observed in its scope.

WARNING! The gear units and geared motors may be used according to the ZAE design data and these operating instructions. Make sure that the rated stresses defined by ZAE are not exceeded during operation. If the gear unit is not used according to the design data and the operating instructions, it can result in personal injuries.

Do not make any changes to the gear unit or geared motor. If a vent is provided, it may only be sealed subject to consultation with ZAE. Do not drill any additional holes in the gear unit. Do not put a damaged gear unit or geared motor into operation.

If the failure of the gear unit could pose a hazard to persons, suitable protective measures must be provided.

The gear units and geared motors may only be operated in potentially explosive areas if they are identified for this, see Figure 3.2: 'Rating plate for operation in potentially explosive areas'.

2.2 Personnel qualifications

Qualified personnel

Only qualified personnel may undertake transport, storage, installation, commissioning and maintenance work.

Qualified personnel are persons with training and experience that enable them to recognise and avoid hazards.

Electrically skilled person

To work on the electrical components of the motor, the personnel must be trained as electrically skilled persons. An electrically skilled person is a person who, due to their technical training and experience, has sufficient knowledge regarding:

- Switching on, shutting off, isolating, earthing and identifying electrical circuits and devices
- The proper maintenance and application of protective equipment according to defined safety standards

2.3 Safety-related maintenance

Adhere to the maintenance schedule in these operating instructions to ensure your personal safety and to keep the gear unit in an appropriate operating condition.

2.4 Personal protective equipment

Suitable protective equipment must be provided for personnel for work on the gear unit and geared motor. This consists of:

- Protective work clothing
- Safety shoes
- Protective gloves
- Safety helmet
- Safety glasses

2.5 Hazards

2.5.1 Hazards during transport and lifting

Persons can be severely injured if the gear unit falls down or due to swinging movements. Therefore, comply with the following instructions.

- Generously cordon off the danger zone. Ensure sufficient space to avoid swinging loads.
- Never walk beneath suspended loads.
- Use adequately dimensioned transport equipment that is suitable for the application. Refer to the order documents or the catalogue for the weight of the gear unit.
- The gear units are equipped with threaded holes into which eyebolts can be screwed. Lift the gear unit only at the intended eyebolts. The eyebolts must be screwed in completely. Only pull vertically on the eyebolts, never transversely or obliquely. Use the eyebolts only to lift the gear unit without other components. The eyebolts are not designed to bear the weight of the gear unit with attaching parts. When lifting a geared motor, use the eyebolts on the gear unit and the motor at the same time. If the motor does not have a suitable hole for an eyebolt, secure the motor properly in another manner, e.g. with a strap.

2.5.2 Hazards during operation

Danger of drawing in due to rotating parts

There is a danger of drawing in at rotating parts. Besides the shafts, this concerns e.g. fans as well as drive and output elements such as belt drives, chain drives, shrink disks and couplings.

All rotating parts must be secured to prevent unintentional contact. Give consideration to possible machine run-on in this case.

Burning on hot surfaces

Gear unit and geared motor components can become so hot that there is a risk of burning.

Provide for contact protection if there is a risk of persons touching the gear unit during and shortly after operation.

After operation, touch the gear unit with protective gloves only or allow the gear unit or the geared motor to cool down before working on them.

Protective covers

The protective covers must not be removed during operation.

2.5.3 Hazards during installation and maintenance work

Risk of accident due to slippery surfaces

Slippery surfaces can occur due to the escape of gear oil.

Due to an oily surface, the gear unit can be slippery and slip out of your hands. If gear oil has been spilled, there is a risk of slipping on the patch of oil.

- Therefore, regularly pay attention to escaped gear oil and soak up spilled gear oil with a binding agent.

Hazards due to substances

Chemical substances that are used with the gear unit can be toxic. If the substances get into your eyes, it can lead to eye damage. Contact with cleaning agents, lubricants and adhesives can lead to skin irritation.

Oil mist can escape when removing screws on the vent.

- When working with chemical substances, wear protective gloves and work clothing that are resistant to chemicals. Wash your hands after work.
- Wear safety glasses if chemicals can spray out, e.g. when pouring in gear oil or during cleaning work.
- If a chemical gets into the eyes, immediately flush it out with plenty of cold water. In the event of complaints, consult a physician.
- Observe the safety data sheets of the chemicals. Keep the safety data sheets available in the vicinity of the gear unit.

Electric shock on live parts

There is a life-threatening risk due to electrical current on damaged or non-insulated electrical components on the motor.

- Before all work, disconnect the motor from the power supply to rule out an electric shock. Make sure that power supply cannot be switched on again unintentionally.
- Energy can remain stored in capacitors even after shutting off the voltage supply. Before working on electrical components, always check that they are voltage-free.
- Regularly check whether a component or a cable's insulation is damaged. Make sure that damaged components or cables are immediately exchanged.

2.6 Operation in potentially explosive areas

The gear units and geared motors comply with the explosion protection requirements of Directive 2014/34/EU for the category specified on the rating plate. They are intended for operation in potentially explosive areas according to the data on the rating plate, see chapter 3.3.

The gear units or geared motors may only be operated with components intended for use in potentially explosive areas.

No mixture of atmospheres involving gases, vapours, mists and dusts may be present during operation. The gear units or geared motors are not approved for a hybrid mixture.

Also pay attention to the following notes in order to guarantee sufficient explosion protection in the long term.

Operating limits

- Gear units and geared motors must be designed properly. Note the information on the drive design and the nominal data in the catalogue. Overloads can lead to the breakage of components. This can cause sparks. Contact the ZAE Service department if you have any further questions regarding the design of the gear unit or geared motor.
- The explosion protection extends exclusively to the areas as per the identification on the rating plate: the device category and the type of potentially explosive atmosphere. Make sure that the gear unit type and all technical data for the gear unit correspond to the system or machine project planning data. Conscientiously check all data on the rating plate before the gear unit or the geared motor is installed. If there are multiple operating points, the maximum input power, the torque or the rotational speed must not be exceeded at any operating point. The gear unit may only be installed and operated in the operating position defined by ZAE.
- Input and output elements may only introduce the maximum permissible shaft forces into the gear unit. The permissible values can be found in the catalogue. In the event of doubt, contact ZAE.
- The gear unit housing must not be subjected to extreme stresses such as impacts and shocks. Damage to the housing can lead to oil loss.

Attaching parts and equipment

- Equipment attached to the gear unit, such as couplings, belt pulleys, cooling systems, pumps and sensors, etc. as well as drive motors must also be suitable for operating in the zone with a potentially explosive atmosphere. Their identification for the potentially explosive areas must correspond to the system or machine project planning data.
- For operation with gear units of device category 2D, the motor must have at least protection type IP6x.

Gear oil

- An impermissible temperature increase can occur if an unsuitable gear oil is used. Therefore, use only synthetic gear oils according to the data on the rating plate. The lubricant table can be found in the appendix to these operating instructions, see chapter 10.3.

Installation and commissioning

- Errors during set-up lead to stresses and impermissibly high loads. This leads to increased surface temperatures. Observe the set-up and assembly instructions in these operating instructions. Avoid shaft, sprocket and belt pulley alignment errors. Secure sprockets and belt pulleys axially.
- Observe the correct tension of belts and chains. Additional loads due to hub imbalance are not permissible. Make sure that no contact with upright components occurs and that the gap dimensions in dusty areas are sufficiently large (>3 mm).
- Prior to commissioning, perform all of the checks specified in these operating instructions in order to ensure that errors which can lead to a risk of explosion are detected in good time. Perform a trial run; check for impermissible temperatures and unusual noises, see chapter 6.5.
- Do not put the gear unit into operation if anomalies are discovered during the checks. Consult the ZAE Service department.
- The gear unit housing must be earthed to dissipate electrostatic charging so that sparking is avoided. Check the earthing before commissioning.
- Insufficient lubrication leads to temperature increases and spark formation. Check the oil level before commissioning.

Operating conditions

- If gear units are exposed to direct sunlight or comparable radiation or if the gear unit is operated at a standard elevation over 1,000 m, the output must be reduced as per the catalogue. In this regard, contact the ZAE Service department.
- Do not place highly flammable objects on the gear unit.

Maintenance work

- No explosive atmosphere may be present during any work, such as e.g. transport, storage, installation, electrical connection, commissioning or maintenance.
- Perform all of the maintenance work specified in these operating instructions conscientiously in order to avoid a risk of explosion due to malfunctions and damage. If anomalies are detected during operation, the drive must be shut down and the ZAE Service department must be consulted.
- Insufficient lubrication leads to temperature increases and spark formation. Check the oil level regularly according to the information in these operating instructions.
- Dust and dirt deposits lead to temperature increases. Dust can also accumulate inside covers that are not dust-tight. Regularly remove deposits according to the information in these operating instructions.

Protection against electrostatic charging

- Non-conductive coatings can become electrostatically charged. Sparks can occur during discharge. It must be ensured that subsequent paintwork has the same properties as the original paintwork.
- To prevent electrostatic discharge, belts must be manufactured using conductive material.
- Clean the surfaces of the gear unit using a cloth moistened with water only in order to prevent electrostatic charging.

Brakes

- The brake and other attaching parts are dimensioned so that excessive mechanical and thermal stresses can be ruled out during nominal operation. Continuous brake pad rubbing must be ruled out.

3 Description

3.1 Gear units

The ZAE gear units are worm gear units, worm helical gear units, helical worm gear units and bevel gear units, each in the form of gear units or geared motors.

Illustrations of the design of the gear units can be found in the form of exploded drawings in the appendix, see chapter 10.5.

Unless otherwise specified in the order documents, gear units and geared motors are supplied coated with a two-component epoxy resin primer in white.

3.1.1 Worm gear units

High-quality cast iron (EN-GJL-200) is used for all housing parts and ductile iron (EN-GJS-400-15) for the hollow hubs as of size 100.

The worm shafts are hardened and ground. The worms are made of alloyed case-hardened steel. The worm gear rims are made of high-quality bronze with outstanding sliding properties. As of size 100, the worm gear rim and hub are joined with close tolerance shank bolts in accordance with DIN 610.

Gear unit types

- **Worm gear units**
  These are single-stage worm gear units that differ in terms of their design depending on their centre distance.
- **Double worm gear units**
  These are two-stage worm gear units.
- **Worm helical gear units**
  These are two- or three-stage gear units consisting of a worm gear stage and one or two downstream spur gear stages. The spur gears are made of hardened steel.
- **Helical worm gear units**
  These are two-stage gear units consisting of a spur gear stage with a downstream worm gear stage. The spur gears are made of hardened steel.

3.1.2 Bevel gear units

These are single-stage bevel gear units. The bevel gear unit housings are made of cast iron (EN-GJL-200). The bevel gear sets have spiral toothing and are made of alloyed case-hardened steel and hardened.

The type W and MW gear unit housings have a cube design. All six housing sides are machined and equipped with threaded holes. Three sides also each have a centring bore.

3.1.3 Gear unit ventilation

The gear units are equipped with a ventilation valve or a ventilation filter made of steel. The exceptions are the size 040 worm gear unit, the size 012 worm helical gear unit and bevel gear unit W088. No ventilation system is provided for these. Instead of a ventilation system, some gear units are equipped with a pressure equalisation diaphragm.

Gear unit ventilation helps to ensure that the permissible gear unit surface temperatures are not exceeded – provided that the permissible operating conditions are adhered to.

The position of the ventilation system depends on the operating position. If the operating position is changed, the ventilation system may be rendered useless under certain circumstances. This would result in significant damage.

3.2 Motors

Motors complying with IEC standards as well as custom-built motors can be delivered as three-phase motors.

Motors can be equipped with spring-loaded brakes. The spring-loaded brakes are usually located beneath the fan shroud, between the motor bearing plate and fan blade.

When the motor is started, the brake is supplied with DC voltage via a rectifier.

3.3 Rating plates

Figure 3.1: Rating plate

1	Manufacturer's address
2	Customer ID number
3	Gear unit type, size and operating position (see chapter 3.5)
4	Order number
5	Gear unit ratio
6	Gear oil type
7	QR code with rating plate data

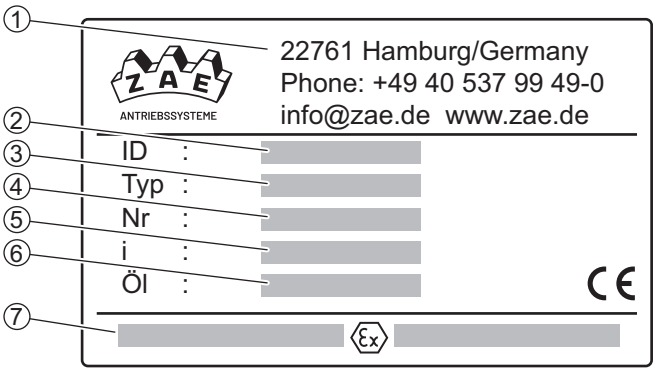


Figure 3.2: Rating plate for operation in potentially explosive areas

1	Manufacturer's address
2	Customer ID number
3	Gear unit type, size and operating position (see chapter 3.5)
4	Order number
5	Gear unit ratio
6	Gear oil type
7	Identification of explosion-protected operating equipment

3.4 Identification of explosion-protected operating equipment

Examples:
II 2G Ex h IIC T4 Gb
II 2D Ex h IIIC T135°C Db

Characters	Meaning
II	Device group II (not mining)
2G/2D	Device category 2: high level of safety in gas atmosphere/dust atmosphere
Ex h	Ignition protection type constructive safety
IIC/IIIC	Explosion group (IIC: e.g. hydrogen, acetylene; IIIC: conductive dusts)
T4/T135°C	Temperature class (surface temperature max. 135°C)
Gb/Db	Device protection level: high level of safety in gas atmosphere/ dust atmosphere

3.5 Type code

3.5.1 Structure of the type code

Worm gear units

Example:
M 040 F - 1315 / 2 5 - 000 - 40:1 - 1500 - 120 - 19×40

Characters	Meaning of the position of the character
M	Gear unit type
040	Size
F	Model
1315	Build
2	Operating position (identification of the side lying at the bottom)
5	Attachment side
000	Variants
40:1	Nominal ratio
1500	Input speed
120	Motor flange diameter (types M and DM only)
19×40	Motor shaft dimensions (types M and DM only)

Geared motors

Example:
M 212 F - 71S/4 - BR 6 - 26.5 - 1315 / 2_5 - 000 - 40:1 - 1500 - 120 - 14×30

Characters	Meaning of the position of the character
M	Gear unit type
212	Size
F	Model
71S/4	Motor size
BR	Brake attachment
6	Braking torque
26.5	Output speed
1315	Build
2	Operating position (identification of the side lying at the bottom)
5	Attachment side
000	Variants
40:1	Nominal ratio
1500	Input speed
120	Motor flange diameter
14×30	Motor shaft dimensions

Bevel gear units

Example:
W - 110 - 0003 / 2 2 - 000 - 2:1 - 1500 - 090

Characters	Meaning of the position of the character
W	Gear unit type
110	Size
0003	Build
2	Operating position (identification of the side lying at the bottom)
2	Attachment side
000	Variants
2:1	Nominal ratio
1500	Input speed
090	Motor size (type MW only)

3.5.2 Gear unit type

Designation	Gear unit type
Gear unit with free shaft ends	
E*	Worm gear units, sizes 040 to 315 Worm helical gear units, sizes 112 to 513
D	Double worm gear units, sizes 050 to 315
W	Bevel gear units, sizes 088 to 260
Gear units suitable for attaching motors complying with IEC standards	
M	Worm gear units, sizes 040 to 315 Worm helical gear units, sizes 012 to 513
DM	Double worm gear units, sizes 050 to 315
MW	Bevel gear units, sizes 088 to 156
Geared motors	
M	Worm geared motors, sizes 040 to 315 Worm-helical geared motors, sizes 012 to 513
GM	Helical worm geared motors, sizes 050 to 200
DM	Double worm geared motors, sizes 050 to 315

3.5.3 Model

Designation	Model
B	Basic model with 4 to 5 attachment sides
G	Foot type
F	Flange type
A	Slot-on version with torque support

3.5.4 Variants

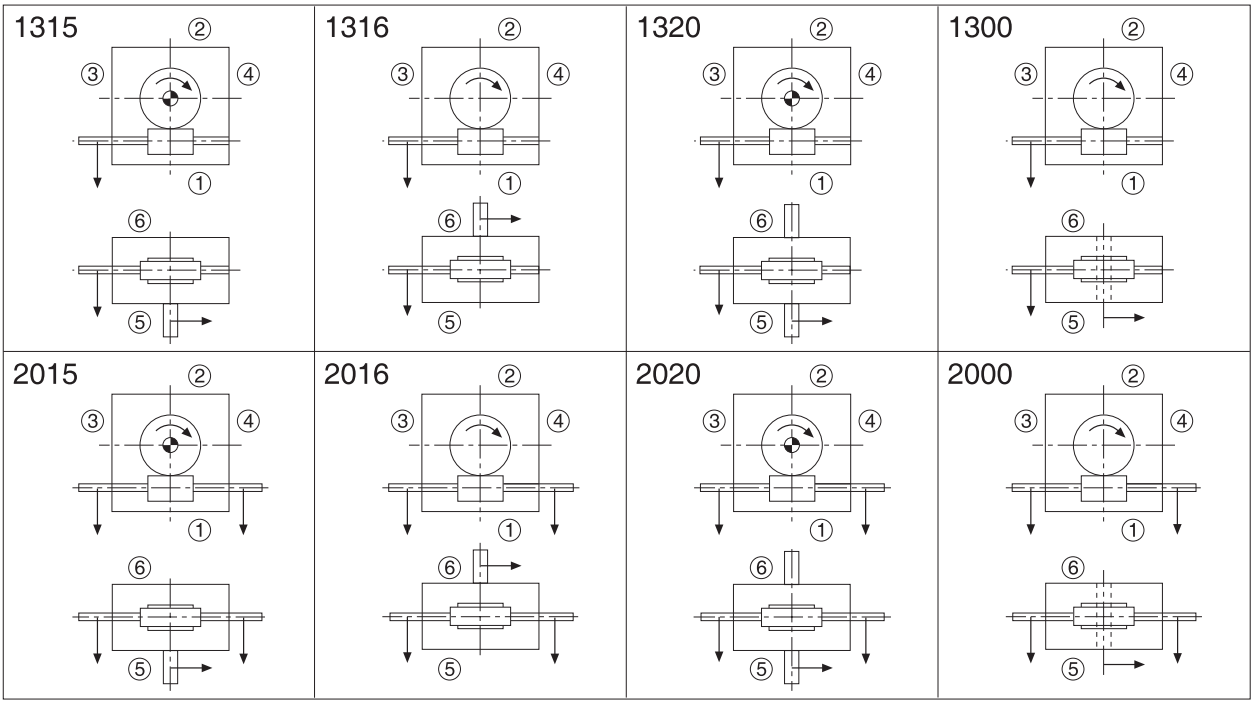
Designation	Variant
000	Without variants
H00	Hollow shaft version with shrink disk connection
R00	With integrated safety slip clutch, sizes 040 to 125
0V0	With reinforced gear wheel shaft, sizes 100 to 315, 312 to 513
0A0	With low-backlash gear toothing
00X	Special designs

3.5.5 Brake attachment

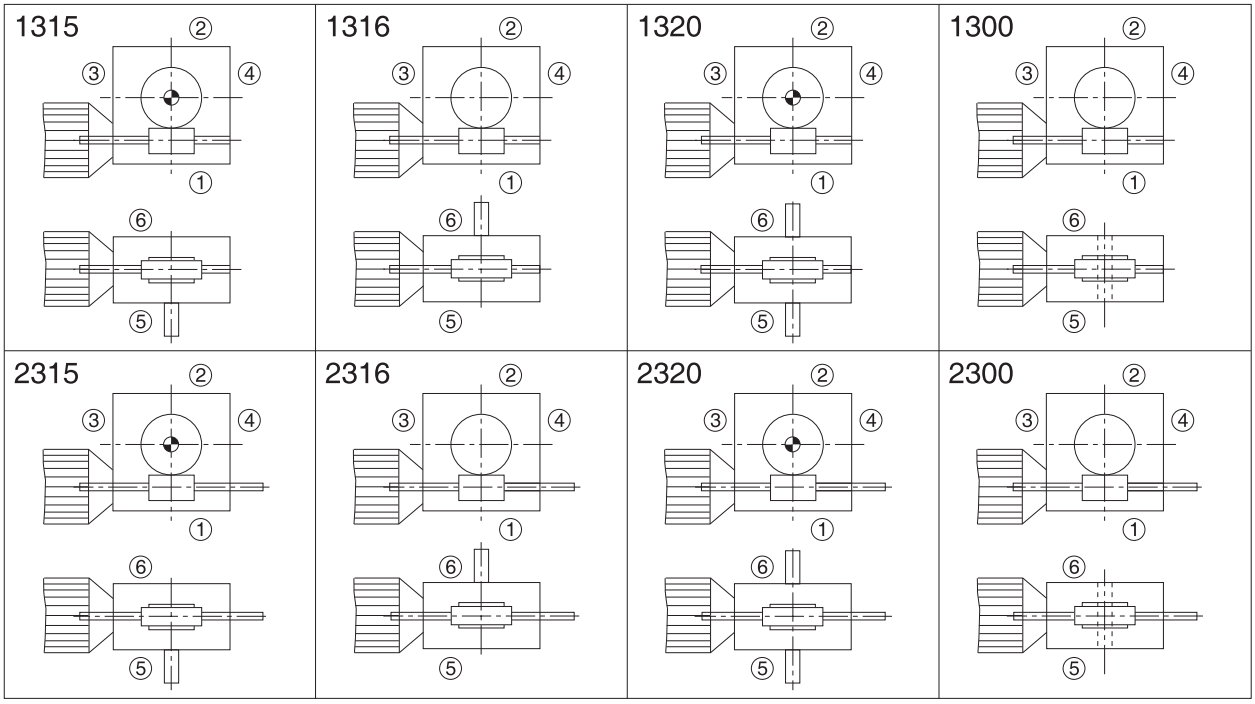
Designation	Brake attachment
BR	Brake motor

3.5.6 Build and gear unit sides

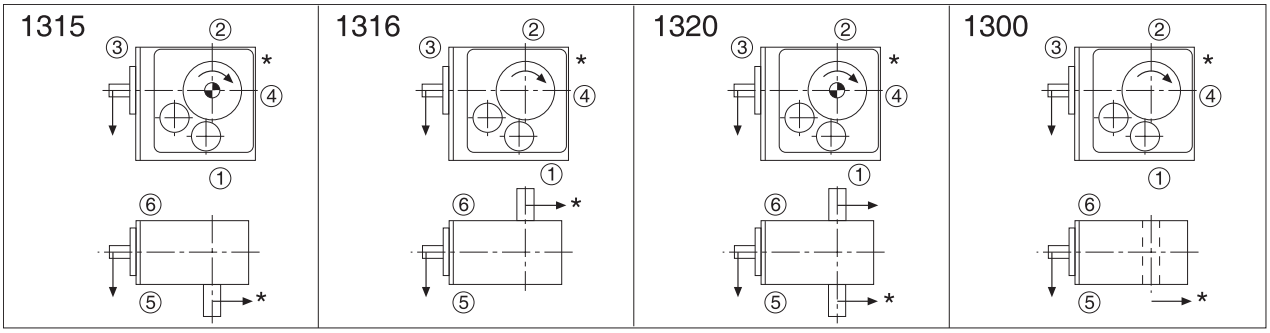
Types E 040 - E 315



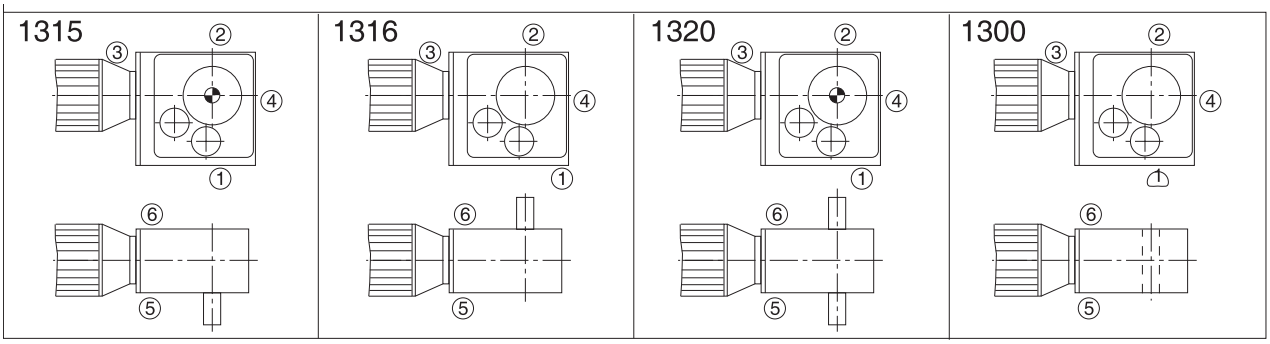
Types M 040 - M 315



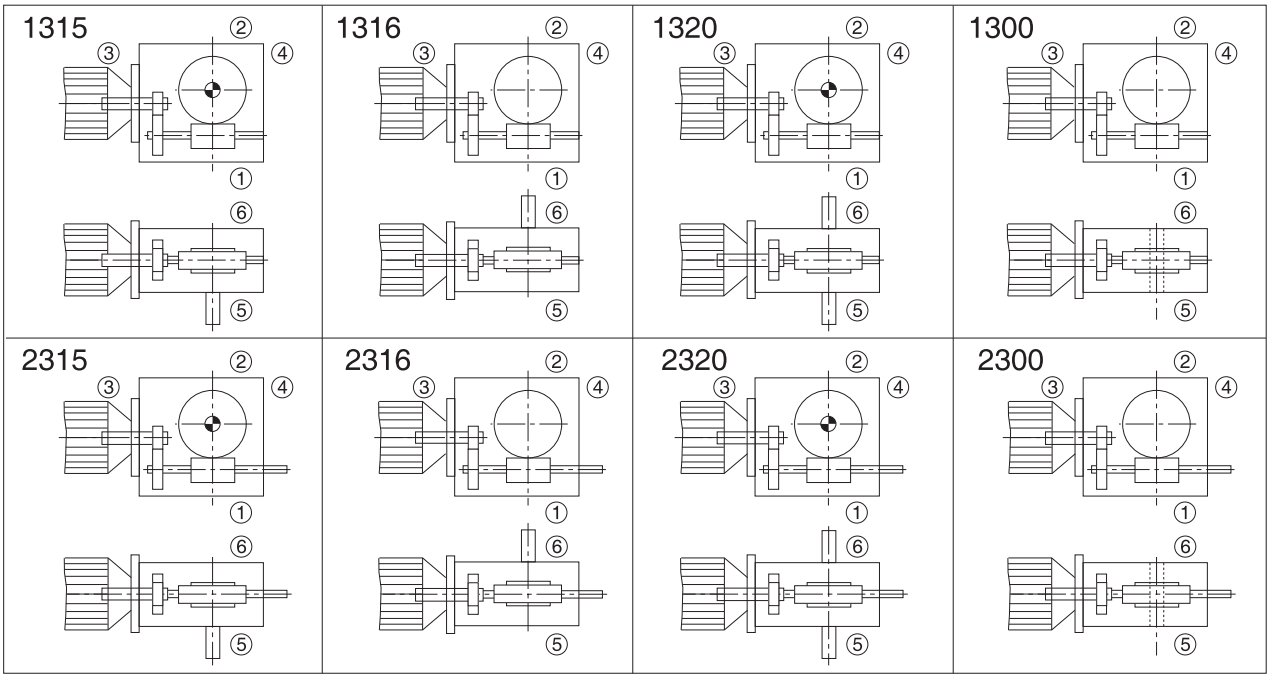
Types E 112 - E 513



Types M 012 - M 513



Types GM 050 - GM 125



Type DM

See catalogue.

Types W, MW

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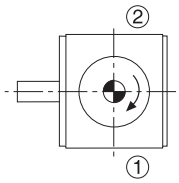
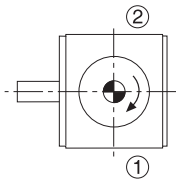
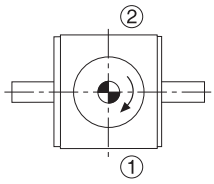
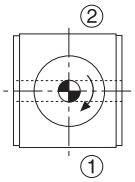
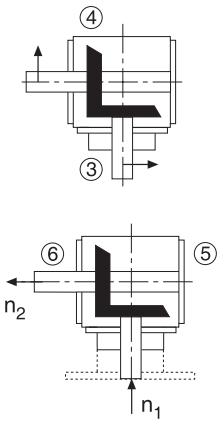
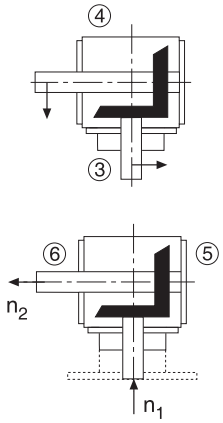
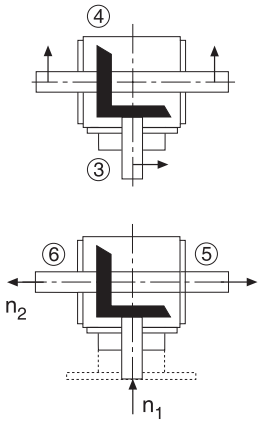
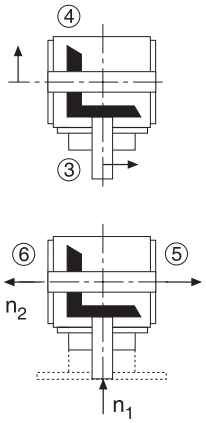
			
			

4 Delivery, transport, storage

4.1 Delivery

Gear units and geared motors are supplied filled with gear oil unless otherwise specified in the order documents. Couplings and – if present – ventilation components are supplied loosely.

Check the delivery for transport damage and completeness on receipt. Immediately report damage to the transport company. Damaged gear units and geared motors must not be put into operation. Contact the ZAE Service department to clarify the further procedure.

4.2 Transport

Use only adequately dimensioned transport equipment that is suitable for the application to transport the gear unit. A crossbeam or similar aids facilitate attachment and transport.

Data on the weight of the gear unit can be found in the order documents.

⚠WARNING

Danger due to falling loads

Severe crushing.

– Generously cordon off the danger zone.
– Ensure sufficient space to avoid swinging loads.
– Never walk beneath suspended loads.
– Note the centre of gravity of the gear unit.

The gear units are equipped with threaded holes. Eyebolts can be screwed in there to attach the gear unit.

The eyebolts must be screwed in completely. Lift the gear unit only at the intended eyebolts. Only pull vertically on the eyebolts, never transversely or obliquely.

Use the eyebolts only to lift the gear unit without other components. The eyebolts are not designed to bear the weight of the gear unit with attaching parts. When lifting a geared motor, use the eyebolts on the gear unit and the motor at the same time. If the motor does not have a suitable hole for an eyebolt, secure the motor properly in another manner, e.g. with a strap.

Impacts or blows onto free shaft ends lead to damage within the gear unit. Transport the gear unit carefully.

4.3 Storage

If the gear unit or the geared motor is first placed into temporary storage, the storage area should be dry and not be subject to extensive temperature fluctuations.

The storage area should meet the following conditions:

- Dry, relative humidity less than 60%
- Temperature without extensive fluctuations in the 10°C bis 40°C range
- No direct exposure to sunlight, no direct UV light
- No aggressive, corrosive substances (contaminated air, ozone, gases, solvents, acids, alkalis, salts, radioactivity, etc.) in the environment
- No shocks or vibrations

Set the gear unit down as follows in the storage area:

- In the operating position
- Secured against falling
- Bare gear unit housing surfaces and shafts slightly oiled

Turn the shafts of the gear unit regularly to prevent the shaft seal rings from sticking. After a storage period of five years, the gear oil should be changed.

5 Installation

5.1 Installation location

- Maximum ambient temperature 40°C.
- Maximum standard elevation 1000 m. On operation at more than 1000 m over standard elevation zero, the gear unit cannot be operated at the maximum output specified in the catalogue. Contact ZAE in cases of doubt.
- The environment is free of aggressive or corrosive substances.
- Adequate circulation of cooling air is taken into consideration.
  The space around the gear unit must enable unimpeded air circulation. With geared motors, the motor fan's cooling air must also be able to flow onto the gear unit unimpeded.
- If present, oil fittings such as the vent, control screw and drain on the gear unit are freely accessible.

5.2 Notes regarding installation

Pay attention to the following points to avoid damage on installation and during operation:

- No welding work on the gear unit
  Welding work on the gear unit is impermissible. Nor may the gear unit be used as an earthing point for welding work, as the bearings or the gear toothing are otherwise damaged.
- Attach the gear unit housing without tension
  Make sure that all fasteners on the gear unit are mounted tension-free. Depending on equipment, this refers to the gear unit feet, the torque support and the fastening on the flange or foundation.
- Note the operating position of the gear unit
  The oil quantity and the correct function of the vent – if present – are dependent on the operating position. Make sure that the gear unit is mounted in the specified operating position.
- Do not damage the gear unit housing
  On installation, make sure that the housing wall and any oil sight glass are not damaged during positioning and alignment.
- Install fastening screws completely
  Make sure that all screws are installed completely and tightened to the specified torques on the flange or mounting feet. A table containing the tightening torques can be found in the appendix, see chapter 10.1.
- Earth the gear unit and geared motor
  During assembly, make sure that the gear unit is earthed properly to conduct electrostatic charges away.
- Secure moving parts with covers
  Secure moving parts such as free shaft ends with covers. This prevents spark formation and injuries.

5.3 Set up gear unit or geared motor

Observe the following sections depending on the variant and version of the gear unit or geared motor.

- The foundation or flange to which the gear unit is to be fastened is torsionally stiff and level.
- On gear units with a free shaft end, make sure that the gear unit and the machine to be driven are mounted together on one and the same foundation.
- On gear units with a flange, the gear unit is mounted directly on the machine to be driven.
- On gear units with a hollow shaft, no additional forces may be introduced into the machine shaft as a result of assembly. The gear unit must be mounted tension-free.
- Carefully aligning the shafts ensures the operating safety of the gear unit and fosters low-noise operation. If the shafts have not been aligned correctly, temperature increases, bearing damage and shaft damage can occur. In an explosive atmosphere, this can lead to explosions. ZAE recommends the use of compensating couplings to compensate for minor assembly deviations.
- Secure the fasteners properly so that they cannot come loose during the operating period.

5.4 Mount hubs

DANGER

Temperature increase due to radial forces

Excessively high forces or high leverages can cause the gear unit to heat up impermissibly. In potentially explosive areas, this can lead to explosions.

– Make sure that radial forces are input as close to the gear unit as possible.

NOTICE

Impermissible impacts on shafts

Tooth flanks, roller bearings and retaining rings can be damaged due to impacts on shafts during assembly.

– Use a suitable pull-on device to mount components on the input and output shaft.
– Never hammer on the shaft to mount couplings or hubs.

Hubs may only be pulled onto the shafts using pull-on devices.

Observe the following notes depending on the type of connection:

- Positive shaft-hub connection

  Avoid excessive play or impermissible alignment errors when installing a positive shaft-hub connection (i.e. with keys, splined shafts. Damage due to impact stress, fretting corrosion or additional forces can otherwise occur. This would result in the failure of the connection. Also lubricate spline shafts and key shafts with a lubricant prior to assembly to prevent fretting corrosion. A suitable lubricant is enclosed or can be purchased from ZAE.

- Frictional shaft-hub connections

  Adhere to the tolerances specified by the manufacturer in the case of frictional shaft-hub connections. Pay attention to surface qualities and a grease-free joint.

- Bonded shrink-fit connections

  Use a suitable adhesive for bonded shrink-fit connections.

Hubs may only be mounted on the shafts using pull-on devices. Use the face-end thread of the shafts for the pull-on device. For easier assembly, coat the hub with assembly paste.

Make sure that the hub is axially secured. Avoid shaft, gear wheel, chain wheel and belt pulley alignment errors.

5.5 Mount hollow shaft

The hollow shaft can be mounted on the machine shaft with a feather key or a shrink disk.

- Lubricate spline shafts and key shafts prior to assembly in order to prevent fretting corrosion and the premature failure of the connection.
- No additional forces may be introduced into the machine shaft due to assembly. The gear unit must be mounted tension-free. Bearing damage can otherwise occur.

NOTICE

Do not tighten tensioning screws too early

If the tensioning screws of a shrink disk are tightened before the shaft has been installed, the hollow shaft can be deformed.

– Only tighten the tensioning screws once the shaft has been installed.

- Pay particular attention to adherence to tolerances and surface qualities in the case of clamping sets or shrink disk connections.
- Make sure that the mounting surfaces are grease-free prior to assembly.
- Tighten the screws of the clamping sets or shrink disks to the specified tightening torque and in the correct manner.

Torque overload of a frictional clamping set or a shrink disk connection just once can severely reduce the torque that can be transferred. Additional axial and bending stresses also reduce the loadability of the connection. Significant heat input can occur in the event of slipping.

Ensure that the permissible torques and forces are not exceeded.

5.6 Mount torque support

Always mount the torque support on the machine side to avoid additional bending stresses. Pay attention to safe and stress-free assembly.

5.7 Mount ZAE motor coupling

Excessive play and impermissible axial and radial misalignments must be avoided when installing ZAE motor couplings. This could lead to damage due to impact forces, fretting corrosion or additional forces which cause the coupling to fail. It must also be ensured that the gear toothing of the ZAE couplings is lubricated with the enclosed grease prior to assembly. The couplings must be secured axially on the motor shaft using stud bolts.

- Servo couplings

  The servo couplings must be secured using screws tightened to the specified tightening torques, see Appendix, chapter 10.1.

- Slip clutches

  Gear units with slip clutches are supplied with slipping torques pre-set in the factory. The slipping torque can be adjusted.

  Constant slipping must be ruled out with a slip clutch. This can be achieved with temperature and anti-slip monitoring and corresponding shut-off mechanisms. Repeated or constant torque overload of a slip clutch can reduce the transferable torque.

  Make sure that the permissible torques are not exceeded and that the coupling is set correctly.

5.8 Mount motor

Motors that are to be mounted on a gear unit must reveal reduced concentricity deviations and axial run-outs as per DIN SPEC 42955 - R. This prevents damage to bearings, shafts and couplings.

5.9 Mount upstream or downstream gear units

Upstream or downstream gear units must reveal reduced concentricity deviations and axial run-outs as per DIN SPEC 42955 - R. Mount the gear unit shafts aligned and tension-free. Tighten fasteners to the specified tightening torque. Secure the fasteners to prevent unintentional loosening.

5.10 Electrical connection

⚠WARNING

Danger of electric shock

– The electrical connection may only be established by an electrically skilled person.

Procedure

1. De-energise the motors and secure to prevent them from being switched on again.
2. Check whether the frequency and mains voltage correspond to the data on the rating plate.
3. Establish the electrical connection as described in the instructions for the motor. The wiring diagrams, both for the connection of a motor and for the brake, are located in the respective terminal box.
4. Check whether the motors and gear units are earthed.

5.11 Subsequently paint

⚠DANGER

Unsuitable paintwork for the potentially explosive area

Risk of explosion due to electrostatic charging with excessive coat thicknesses.

– Subsequent paintwork must have the same properties as the original paintwork. The coat thickness may be max. 0.2 mm.

When subsequently painting the gear unit, the shaft seal rings, rubber elements, vent, rating plate, stickers and motor coupling parts must not come into contact with paints or solvents, as these parts could otherwise be damaged or become illegible.

6 Commissioning

6.1 Check oil level

⚠DANGER

Risk of explosion due to a lack of gear oil

Starting without gear oil or with an insufficient oil level can lead to the creation of ignition sources and therefore explosions.

– Check the oil level each time before commissioning.

Check oil level

Starting without gear oil immediately leads to a total failure. Therefore, check the oil level each time before commissioning.

The correct oil level is reached as soon as oil escapes from the oil level checking screw. In this regard, see chapter 8.2.6.

If insufficient gear oil is present or a gear unit has been supplied without an oil filling, gear oil of the type specified on the rating plate must be poured in. In this regard, see chapter 8.2.7.

6.2 Mount ventilation system

⚠DANGER

Damaged ventilation system

The gear unit's ventilation system must not be damaged or its function impaired due to dust and dirt during installation. A faulty ventilation system can increase the internal pressure in the housing and therefore lead to a temperature increase, which can cause an explosion.

– Protect the ventilation system from damage, dirt and dust.

The gear unit is always supplied with a sealed gear unit housing. Once the gear unit has been installed at the installation location, the ventilation system can be mounted.

NOTE: No ventilation system is supplied with worm gear units of size 040, helical worm gear units of size 012 or bevel gear unit W088. In the case of gear units without a ventilation system, open the screw plug at the final installation location and close it again to equalise the pressure.

Remove the screw plug and replace it with the ventilation system. When doing this, note the position of the ventilation system depending on the operating position, see chapter 10.6.

6.3 Check fan

Make sure that the fan wheel does not strike anywhere and therefore potentially cause frictional heat or sparks.

Make sure that the fan shroud is mounted.

6.4 Check brake

Make sure that the brake pads do not rub continuously during operation. Observe the operating instructions for the brake.

6.5 Trial run

⚠WARNING

Risk of injury due to expelled feather key

– Before the trial run, secure the feather key so that it cannot be expelled.

Before final commissioning, the machine or system should undergo a trial run.

The trial run is mandatory in the case of gear units and geared motors that are installed in potentially explosive areas.

The trial run should take place over a period of at least four hours under real operating conditions. During the trial run, check the gear unit for permissible temperatures, leaks and unusual noises.

Check temperatures

The surface temperature of gear units must not exceed 80°C at an ambient temperature of 20°C.

Check leak tightness at shafts

Check all dynamic sealing points between the shaft surfaces and the sealing edges for leak tightness and cleanliness immediately after commissioning.

Check noises at bearings

Faulty installation of the gear unit can lead to significant additional forces in the roller bearings for which the bearing points are not designed. The bearings can fail prematurely as a result of these additional forces.

Pay attention to noises and high temperatures. These can indicate stressed bearings.

7 Fault table

If you notice any faults during operation, first attempt to identify the type of fault and to remedy it using the overview below. If this involves a fault that you cannot remedy yourself, contact the ZAE Service department.

During the warranty period, the gear units may only be opened with the express permission of ZAE. Otherwise, any warranty entitlements are voided.

⚠CAUTION

Slippery surfaces due to leaks

Escaped gear oil causes slippery surfaces and floors. Slipping off surfaces or slipping on floors can lead to injuries.

– Immediately remove escaped gear oil.

Fault	Possible cause	Solution
Oil is leaking: • at the drive-side shaft seal ring • at the output-side shaft seal ring • at the gear unit cover • at the motor flange • at the motor shaft seal ring	Shaft seal ring defekt or shaft damaged	Contact the ZAE Service department
	O-ring on the gear unit cover leaking	
	Surface seal damaged	Retighten screws on the gear unit cover and monitor gear unit. If oil continues to escape: contact the ZAE Service department
	Gear unit not ventilated	Check ventilation. Gear unit without ventilation: open screw plug and close again
Oil leaking at the ventilation system	Too much oil in the gear unit	Correct the oil quantity, see chapter 8.2.6
	Drive inserted in the wrong operating position, ventilation system in wrong position	Mount ventilation system correctly (see designs) and correct oil level
	Frequent cold start (oil foams)	Check oil viscosity and oil level
Unusual, regular running noises	Meshing, grinding noise: bearing damage	Check oil, exchange bearings, contact the ZAE Service department
	Knocking noise: irregularity in gear toothing	
Unusual, irregular running noises	Foreign substances in oil	Check oil, shut down drive, contact the ZAE Service department
Unusually high housing temperatures	Insufficient oil	Check oil level and correct if necessary
	Gear toothing or bearing defective	Contact the ZAE Service department
Output shaft does not rotate although motor is running or drive shaft is being rotated	Shaft-hub connection or gear toothing broken	Send gear unit/motor for repair

8 Maintenance

So that the gear unit runs reliably, it must be regularly inspected, cleaned and serviced after commissioning. These measures ensure the operational capability of your machine or system, prevent unexpected malfunctions and minimise the risk of accidents.

The maintenance intervals are extensively dependent on the operating conditions. A gear unit that only occasionally performs positioning tasks in a clean environment at room temperature requires less effort than a gear unit that is used in three-shift operation in a dirty environment and at high temperatures.

To ensure increased reliability as regards this point, the gear unit can be equipped with sensors to continuously monitor its current status, e.g. current consumption, torques, temperatures, vibrations.

During the warranty period, ZAE gear units may only be opened with ZAE's express permission, as all claims under the warranty otherwise become void.

8.1 Maintenance schedule

Interval	Work	See …
Regularly, after 2,000 hours of operation at the latest	Visual inspection	chapter 8.2.1
	Check shaft-hub connection and couplings	chapter 8.2.2
	Check surface temperature of the housing	chapter 8.2.3
	Check current consumption	–
	Check slip or temperature monitoring	–
	Check fan	chapter 8.2.4
	Check torque support	chapter 8.2.5
	Check air gap on the brake	Brake instructions
	Check oil level	chapter 8.2.6
3,000 to 4,000 hours of operation	Oil change for mineral gear oils	chapter 8.2.8
8,000 hours	Check roller bearings and exchange if necessary	chapter 8.2.9
12,000 hours	Check gear wheels and exchange if necessary	chapter 8.2.10
15,000 hours of operation, after 5 years at the latest	Oil change for synthetic gear oils	chapter 8.2.8

8.2 Maintenance work

8.2.1 Perform visual inspection

The drive must be regularly subjected to a visual inspection.

Pay attention to the following when doing so:

- Soiling
- Condition of housings, covers and fasteners
- Condition of the shaft
- Condition and function of the vent
- Leaks at shaft seal rings and seals
- Bearing noises
- Toothing noises
- Escape of oil
- Lubricant condition, oil sample

Soiling

Layers of dust and dirt on the housing surface may affect heat dissipation and therefore lead to impermissible temperature build-up. Dust in gaps produces frictional heat that can lead to ignition. In the potentially explosive area, clean the surfaces of the gear unit using a cloth moistened with water only in order to prevent electrostatic charging.

Dust, dirt and water in the lubricant can severely impair the lubrication of the moving parts. Make sure that no dust, dirt or water enters the interior of the gear unit.

Sealing points and the vent can also be damaged as a result of soiling. Therefore, avoid excessive dust and dirt deposits at sealing points or the vent. A defective sealing point or vent must be appraised and repaired by qualified personnel.

When cleaning the gear unit, no strong cleaning spray should impact on seals or the vent.

Condition of housings, covers and fasteners

Cracks can occur in the housing wall due to overloading the gear unit. The cover and fastener on the housing may also have come loose.

- Pay attention to damage (such as cracks) in the housing wall through regular inspections.
- Pay attention to discolouration. This can indicate increased temperature. Perform a temperature measurement if necessary, see chapter 8.2.3.
- On large gear units, make sure that the housing cover is firmly mounted and that none of its fastening screws have come loose.
- On small gear units, it should be ensured that the housing flanges are held firmly by the retaining rings on the housing.

Condition of the shaft

Pay attention to any cracks due to overloading in a shaft.

Condition and function of the vent

The gear unit's vent can be impaired or clogged, e.g. due to:

- Application of violent force on the gear unit
- Dust and dirt
- Too much gear oil
- Incorrect gear oil

If the gear unit is no longer ventilated sufficiently, the internal pressure can increase and cause the temperature to increase excessively.

Therefore carry out regular inspections to ensure that the gear unit's vent remains undamaged and operational.

Leaks at shaft seal rings and seals

Pay attention to clean and undamaged sealing points at shafts.

Seals can be damaged due to mechanical, thermal or chemical influences or due to the loosening of fasteners such as screws or retaining rings and therefore cease functioning. Gear oil can escape.

Carry out regular inspections to ensure that leaks are detected and eliminated in good time. In the event of a significant loss, the cause of the leak must be rectified and the corresponding gear oil refilled, see chapter 8.2.7.

Bearing noises

Unusual noises and high temperatures can indicate stressed bearings. The bearings can fail prematurely as a result of these additional forces.

Pay attention to bearing noises during regular inspections.

Toothing noises

Unusual noises or vibrations on the gear unit could indicate damage. In this case, the oil level should be checked and the ZAE Service department contacted.

Lubricant condition, oil sample

Regularly take an oil sample and analyse it or have it analysed in a laboratory. Pay attention to odour, colour, particles and foaming.

If the gear oil is contaminated, it must be changed. Then perform a trial run. Check the surface temperature of the gear unit during this, see chapter 6.5. If the oil contains large quantities of foreign substances, the gear unit must be replaced or properly repaired and cleaned.

8.2.2 Check shaft-hub connections and couplings

Positive shaft-hub connection and motor couplings

Regularly check the component's lubrication and regrease if necessary. Regularly check the component for impermissible play and damage as well as transferable torques.

Slip clutches

Regularly check the slip clutches for transferable torques.

8.2.3 Check surface temperature

The surface temperature of the gear unit must be checked regularly during operation. If the temperature exceeds 80°C, the gear unit must be taken out of operation.

8.2.4 Clean and check fan

Dust and dirt in the fan can reduce its cooling capacity and cause impermissible heating due to friction.

Regularly check the fan on the gear unit for soiling and clean it regularly.

8.2.5 Check torque support

Check whether the torque support fasteners have come loose and whether the compensating bushings are still functional. Check the torque support for cracks and other damage.

8.2.6 Check oil level

The oil level must be checked regularly. The exceptions to this are worm gear units of sizes 040 to 080 and bevel gear units of size 088. These gear units are lifetime-lubricated.

Location of the oil level screw, see chapter 10.6.

Some gear units are equipped with an oil sight glass.

Prerequisites

- The gear unit motor is switched off and secured to prevent switching on again.
- The gear unit housing has cooled down.

Procedure

1. Unscrew the oil level checking screw.
2. Check the oil level. If the oil level is at the height of the oil level checking screw, the oil level is correct.

In the event of significant loss, the corresponding gear oil must be refilled.

8.2.7 Refill gear oil

⚠DANGER

Risk of explosion due to temperature increase

Oil loss may be caused by damage that also leads to impermissibly high temperatures.

– After a more extensive oil loss, perform a trial run, checking the surface temperature of the gear unit, see chapter 6.5.

⚠DANGER

Risk of explosion due to unsuitable gear oil

In areas with a potentially explosive atmosphere, unsuitable gear oils can trigger explosions.

– Use only the gear oil specified on the rating plate.

NOTICE

Incorrect type of oil

When filling in or refilling gear oil, choosing the incorrect gear oil can lead to property damage.

– When changing the oil, never use mineral oil in a ZAE gear unit designed for synthetic gear oils. In addition, not all synthetic gear oils can be mixed with one another.
– Only fill in the type of oil specified on the rating plate.

When opening and after opening the gear unit, make sure that no dirt enters the gear unit.

The lubricant table can be found in chapter 10.3.

The location of the oil fittings can be found in chapter 10.6.

Prerequisites

- The gear unit is in its operating position.
- The motor's power supply is switched off and secured to prevent switching on again.
- A sufficient quantity of the appropriate type of oil is ready.
- A fine strainer for pouring in the new gear oil is ready.

Procedure

1. Remove the vent (ventilation filter or ventilation valve). On gear units without ventilation, release the screw plug.
2. If fitted, unscrew the oil level checking screw.
3. Pour in gear oil through a fine strainer.
4. Stop as soon as oil escapes from the opening of the oil level checking screw or is visible in the oil sight glass.
5. Screw in the oil level checking screw and mount the vent or the screw plug.

8.2.8 Perform oil change

Gear oil may only be changed by qualified personnel. Only the gear oil specified on the rating plate or by the manufacturer may be used for this.

When opening and after opening the gear unit, make sure that no dirt falls into the gear unit.

DANGER

Risk of explosion due to unsuitable gear oil

In areas with a potentially explosive atmosphere, unsuitable gear oils can trigger explosions.

– Use only the gear oil specified on the rating plate.

NOTICE

Incorrect type of oil

When filling in or refilling gear oil, choosing the incorrect gear oil can lead to property damage.

– When changing the oil, never use mineral oil in a ZAE gear unit designed for synthetic gear oils. In addition, not all synthetic gear oils can be mixed with one another.
– Only fill in the type of oil specified on the rating plate.

If you would like to use a different type of oil, contact the ZAE Service department beforehand. As the efficiency and service life are extensively dependent on the type of oil that is used, pour in only the type of oil specified on the gear unit rating plate or in the lubricant tables.

If you wish to switch to a different gear oil, ZAE recommends flushing the gear unit with the new gear oil before filling it.

The lubricant table can be found in chapter 10.3.

Prerequisites

- The gear oil in the gear unit is hot.
- The oil drain screw is located at the lowest point of the gear unit.
- A sufficient quantity of the appropriate type of oil is ready.
- A fine strainer for pouring in the new gear oil is ready.
- The motor's power supply is switched off and secured to prevent switching on again.
- A container for collecting the old gear oil is ready.

Procedure

1. Remove the vent (ventilation filter or ventilation valve). On gear units without ventilation, release the screw plug.
2. Place the collecting container beneath the oil drain screw.
3. Unscrew the oil drain screw and completely drain the gear oil.
4. If fitted, unscrew the oil level checking screw.
5. Screw in the oil drain screw again.
6. Pour in gear oil through a fine strainer. Use the housing opening for the vent for this.
7. Stop as soon as oil escapes from the opening of the oil level checking screw or is visible in the oil sight glass.
8. Screw in the oil level checking screw and mount the vent or the screw plug.

8.2.9 Check roller bearings and exchange if necessary

All roller bearings are equipped with oil or lifetime grease lubrication. When the gear unit is aligned optimally, its service life at rated torque is at least 8,000 hours. After that, the bearings must be checked and exchanged if necessary. Pay attention to noises, increased play or unusual heating.

Inspections and repairs may only be carried out by service personnel.

8.2.10 Check gear wheels and exchange if necessary

Premature failure of the gear wheel material is not to be expected under permissible load conditions. The calculated service life of the gear wheels at rated torque is at least 12,000 hours. After that, the gear wheel sets must be checked and exchanged if necessary.

Temporary or permanent torque peaks can lead to the failure of tooth flanks or tooth roots.

Repairs on gear wheels may only be performed by qualified personnel.

9 Recycling

After reaching the end of their service lives, gear units and geared motors from ZAE should be disassembled and the sorted components sent for material recycling. ZAE can assist its customers in disposal, if so desired.

The following components contain the main recyclable materials:

- Housing parts (steel, cast iron, aluminium)
- Gear wheels (steel and bronze)
- Motors (steel, cast iron, aluminium, copper, rare earths)
- Lubricants (petrochemical raw materials)

Seal materials are special waste products that cannot be recycled. However, they can be disposed of properly by ZAE on request.

10 Appendix

10.1 Tightening torques

Shank screws in general, strength class 8.8

Thread	Tightening torque [Nm]
M5	4.8
M6	8.3
M8	20
M10	40
M12	69
M16	170
M20	340
M24	590
M30	1200

Screws for Rotex GS Compact servo couplings

Size	Thread	Tightening torque [Nm]
19	M6	10
24	M6	10
28	M8	25
38	M10	49

10.2 Oil viscosities

10.2.1 Worm gear unit

Worm Shaft Speed [min^{-1}]		Oil Viscosity (ISO VG)
From	To	
1.500	3.000	220
300	1.500	460
	300	680

10.2.2 Bevel gear units

Speed of High-Speed Shaft in [min^{-1}]		Gear Unit Size and ISO VG Lubricant Viscosity					
From	To	088	110	136	156	199	260
2000	3000	100					
1500	2000						
1000	1500	220					
750	1000						
500	750						
250	500						
bis	250						

Bevel helical gear unit types E/M/S 222–523 are usually filled with ISO VG 220 lubricants.

10.3 Lubricant table

Lubricants based on different substances or from different manufacturers must not be mixed. The base oils, additives and thickeners may be incompatible with one another and seriously deteriorate the properties of the lubricant.

Lubricant type	Quality/ ISOVG	Castrol	Castrol	Fuchs	Klüber	Mobil	Shell
Standard industrial lubricants							
Mineral oils	CLP 100	Alpha SP 100	Optigear 1100/100	Renolin CLP 100	Klüberoil GEM 1-100 N	Mobilgear 600 XP 100	Omala S2 GX 100
	CLP 220	Alpha SP 220	Optigear 1100/220	Renolin CLP 220	Klüberoil GEM 1-220 N	Mobilgear 600 XP 220	Omala S2 GX 220
	CLP 460	Alpha SP 460	Optigear 1100/460	Renolin CLP 460	Klüberoil GEM 1-460 N	Mobilgear 600 XP 460	Omala S2 GX 460
	CLP 680	Alpha SP 680	Optigear 1100/680	Renolin CLP 680	Klüberoil GEM 1-680 N	Mobilgear 600 XP 680	Omala S2 GX 680
Poly-α-olefins	CLP HC 100	–	Optigear Synthetic PD 100 ES	Renolin Unisyn XT 100	Klübersynth GEM 4-100 N	Mobil SHC 627	–
	CLP HC 220	Alphasyn EP 220	Optigear Synthetic PD 220 ES	Renolin Unisyn XT 220	Klübersynth GEM 4-220 N	Mobil SHC Gear 220	Omala S4 GXV 220
	CLP HC 460	Alphasyn EP 460	Optigear Synthetic PD 460 ES	Renolin Unisyn XT 460	Klübersynth GEM 4-460 N	Mobil SHC Gear 460	Omala S4 GXV 460
	CLP HC 680	Alphasyn EP 680	Optigear Synthetic PD 680 ES	Renolin Unisyn XT 680	Klübersynth GEM 4-680 N	Mobil SHC Gear 680	Omala S4 GXV 680
Ester	CLP E 100	–	–	Plantogear 100 HVI[a]	Klüberbio EG 2-100[1]	–	Naturelle S4 Gear Fluid 100
	CLP E 220	Performance Bio GE 220 ESS	–	Plantogear 220 S[1]	–	–	–
	CLP E 460	–	–	Plantogear 460 S[1]	–	–	–
	CLP E 680	–	–	–	–	–	–
Polygly-cols	CLP PG 100	–	Optigear Synthetic 800/100	Renolin PG 100	Klübersynth GH 6-100	–	–
	CLP PG 220	Alphasyn PG 220	Optigear Synthetic 800/220	Renolin PG 220	Klübersynth GH 6-220	Mobil Gly-goyle 220	Omala S4 WE 220
	CLP PG 460	Alphasyn PG 460	Optigear Synthetic 800/460	Renolin PG 460	Klübersynth GH 6-460	Mobil Gly-goyle 460	Omala S4 WE 460
	CLP PG 680	–	Optigear Synthetic 800/680	Renolin PG 680	Klübersynth GH 6-680	Mobil Gly-goyle 680	Omala S4 WE 680
Greases (roller bearings + radial shaft seal rings)		Spheerol EPL 2	Tribol GR 100-2 PD	RenolitT LZR 2 H	CEN-TOPLEX 2 EP	Mobilgrease XHP 222	Gadus S2 V220 2

Lubricant type	Quality/ ISOVG	Castrol	Castrol	Fuchs	Klüber	Mobil	Shell
H1 lubricants (NSF-registered products for the food industry)							
Poly-α-olefins	CLP HC 100	–	Optileb GT 100	Cassida HF 100	Klüberoil 4 UH1-100 N	–	–
	CLP HC 220	–	Optileb GT 220	Cassida GL 220	Klüberoil 4 UH1-220 N	Mobil SHC Cibus 220	–
	CLP HC 460	–	Optileb GT 460	Cassida GL 460	Klüberoil 4 UH1-460 N	Mobil SHC Cibus 460	–
	CLP HC 680	–	–	Cassida GL 680	Klüberoil 4 UH1-680 N	Mobil SHC Cibus 680	–
Poly-glycols	CLP PG 100	–	–	Cassida WG 150	Klübersynth UH1 6-100	–	–
	CLP PG 220	–	Optileb GT 1800/220	Cassida WG 220	Klübersynth UH1 6-220	Mobil Gly-goyle 220	–
	CLP PG 460	–	Optileb GT 1800/460	Cassida WG 460	Klübersynth UH1 6-460	Mobil Gly-goyle 460	–
	CLP PG 680	–	Optileb GT 1800/680	Cassida WG 680	Klübersynth UH1 6-680	Mobil Gly-goyle 680	–
Greases (roller bearings + radial shaft seal rings)		–	Optileb GR UF 1	Cassida Grease EPS 1	Klübersynth UH1 14-222	Mobilgrease FM 222	–

a.Biologically degradable in accordance with OECD 301

Not all products can be listed in the table due to space reasons. Lubricants from further manufacturers such as Total, Lubcon and Bechem as well as alternative products from the listed manufacturers can be requested from ZAE.

Lubricant designations can change. Ask the lubricant manufacturers if necessary.

Always consult the ZAE Service department if you would like to use an alternative product.

10.4 Oil quantities

Unless otherwise specified, the stated oil quantities are valid for the operating positions and ratios of the gear units in which the highest oil quantities are required.

However, the oil level checking screw is always authoritative as regards the correct oil quantity. Check the correct oil level there.

10.4.1 Worm gear unit types E, M and servo gear unit type S

Oil quantity in [dm³]

	Operating position			
Size	**1**	**2**	**3 + 4**	**5 + 6**
040	0.2	0.25	0.2	0.2
050	0.3	0.6	0.45	0.45
063	0.6	1.1	0.7	0.8
080	1.0	2.1	1.4	1.6
100	1.6	4.2	3.4	2.8
125	2.6	7.0	5.0	4.1
140	2.9	7.8	5.2	4.8
160	4.3	15.0	9.5	8.4
175	5.9	16.1	11.0	10.0
200	8.0	28.0	18.0	16.0
250	14.0	44.0	28.0	22.0
315	19.0	–	–	45.0
400	20	150	85	85

10.4.2 Worm helical gear unit types E and M

Oil quantity in [dm³]

	Operating position				
Size	**1**	**2**	**3**	**4**	**5 + 6**
012	0.85	0.85	0.85	0.85	1.1
112/113	1.4	2.0	1.9	1.6	2.4
212/213	3.5	3.8	3.6	3.8	4.1
312/313	5.2	6.0	5.2	5.2	8.0
512/513	17.0	19.0	19.0	18.0	25.0

10.4.3 Double worm gear unit types D and DM

The oil quantity arises from the quantities of the individual stages depending on the operating position as per chapter 10.4.1.

10.4.4 Helical worm gear unit types GE and GM

Oil quantity in [dm³]

	Operating position				
Size	**1**	**2**	**3**	**4**	**5 + 6**
050	0.5	1.0	1.0	1.0	0.8
063	0.8	1.5	1.5	1.8	1.2
080	1.3	2.5	2.5	3.2	2.0
100	2.5	5.5	5.5	6.9	3.75
125	4.3	8.2	8.2	8.9	5.5
200	11.2	31.5	25.5	35.5	21.5

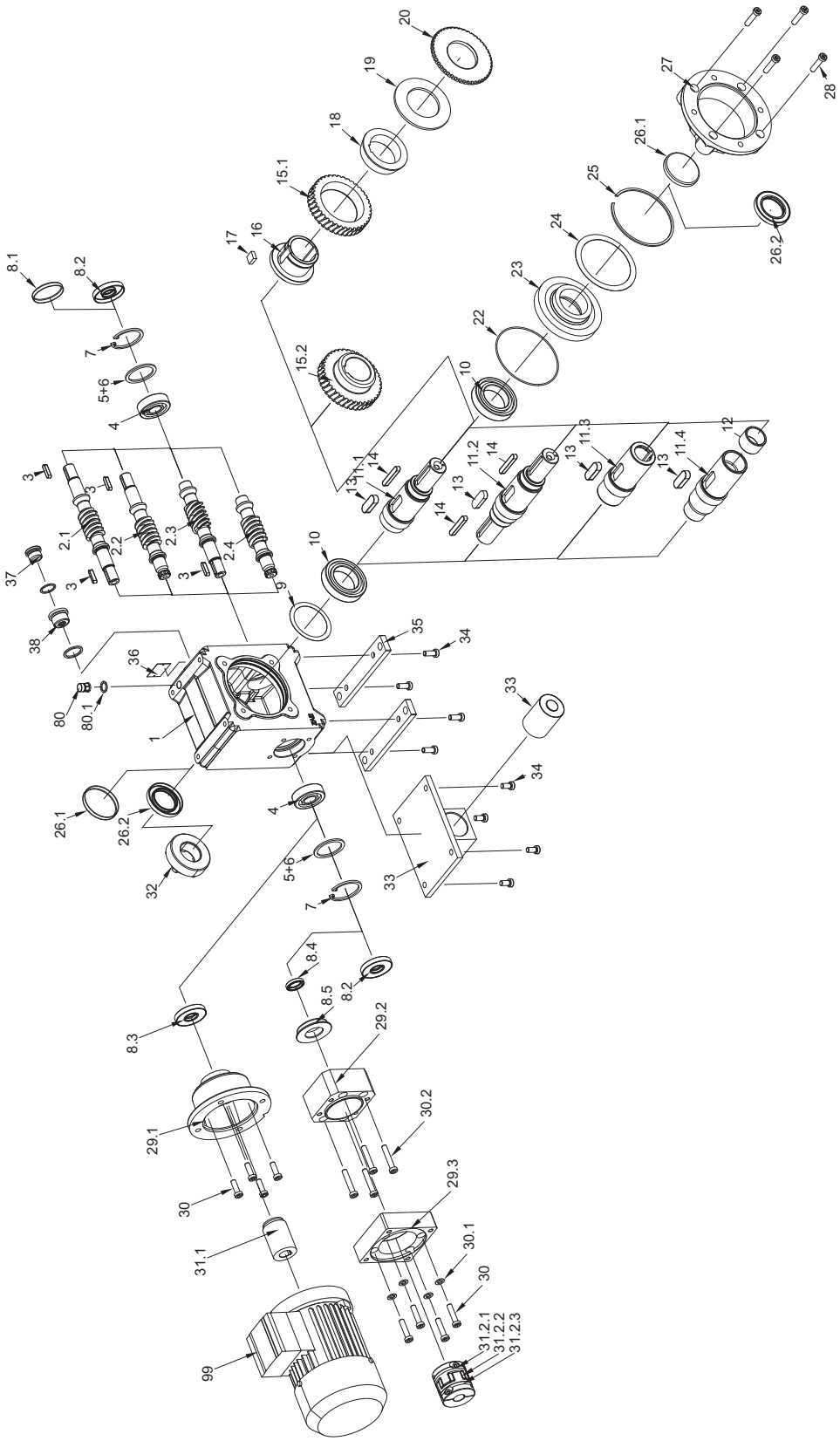
10.4.5 Bevel gear unit and bevel gear motor types W, MW, SW

Size	**Approx. oil quantity [dm³]**
088	0.15
110	0.3
136	0.55
156	0.75
199	2.2
260	4.5

10.5 Exploded drawings

10.5.1 Worm gear units and worm geared motors

Types E, M, S 040 – 080



1	Gear unit housing	20	Adjusting ring
2.1	Double-sided worm	22	O-ring
2.2	Double-sided motor worm	23	Housing cover
2.3	Single-sided worm	24	Set of shim rings
2.4	Single-sided motor worm	25	Circlip
3	Key	26.1	Shaft cap
4	Angular contact ball bearing	26.2	Radial shaft seal ring
5	Set of shim rings	27	Housing F flange
6	Support washer	28	Cylinder screw
7	Retaining ring	29.1	Lantern and motor flange
8.1	Shaft cap	29.2	Servo lantern
8.2	Radial shaft seal ring	29.3	Lantern and motor flange
8.3	Radial shaft seal ring	30	Cylinder screw
8.4	Radial shaft seal ring	30.1	Lock washer
8.5	Seal ring holder	30.2	Cylinder screw
9	Set of shim rings	31.1	Coupling
10	Deep groove ball bearing	31.2	KTR Rotex GS
11.1	Single-sided gear wheel shaft	31.2.1	Clutch hub
11.2	Double-sided gear wheel shaft	31.2.2	Sprocket
11.3	Hollow shaft	31.2.3	Clutch hub
11.4	Hollow shaft clamping set version	32	HSD clamping set
12	Sliding bushing for clamping set version	33	Torque support + bushing
13	Key	34	Cylinder screw
14	Key	35	Gear mounting foot
15.1	Worm gear for slip clutch	36	Notice sign
15.2	Worm gear	37	Screw plug + seal ring
16	Clutch hub	38	Screw plug + seal ring
17	Key	80	Screw plug/vent
18	Cone ring	80.1	Seal ring
19	Disk spring	99	Motor

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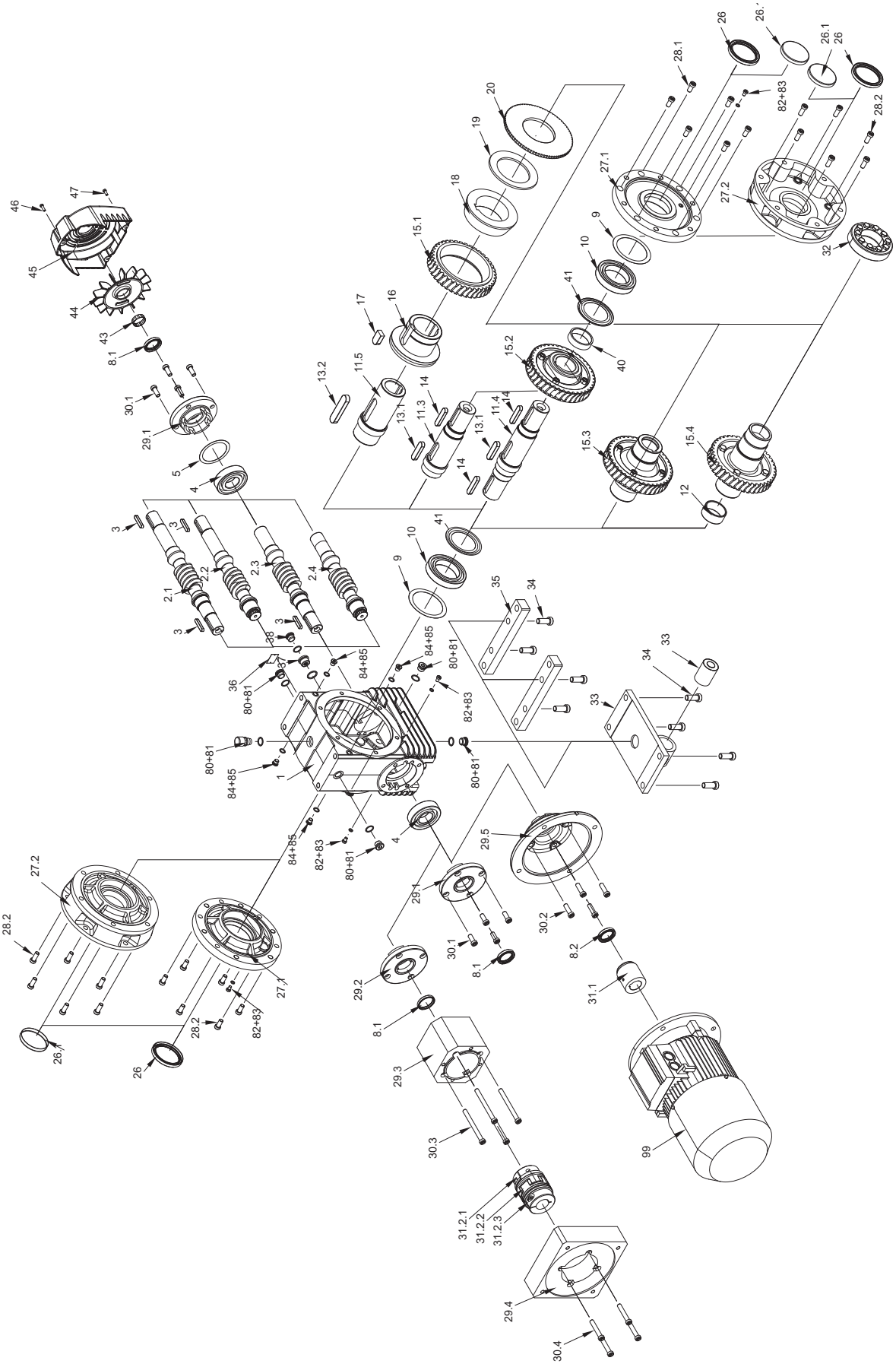
Types E, M, S 100 – 200



1	Gear unit housing	29.2	Lantern and motor flange
2.1	Double-sided worm	29.3	Servo motor flange
2.2	Double-sided motor worm	29.4	Intermediate flange
2.3	Single-sided worm	29.5	Motor lantern
2.4	Single-sided motor worm	30.1	Cylinder screw
3	Key	30.2	Cylinder screw
4	Angular contact ball bearing	30.3	Cylinder screw
5	Set of shim rings	30.4	Cylinder screw
8.1	Radial shaft seal ring	31.1	Coupling
8.2	Radial shaft seal ring	31.2	KTR Rotex GS
9	Set of shim rings	31.2.1	Clutch hub
10	Deep groove ball bearing	31.2.2	Sprocket
11.3	Single-sided gear wheel shaft	31.2.3	Clutch hub
11.4	Double-sided gear wheel shaft	32	HSD clamping set
11.5	Slip clutch hollow shaft	33	Torque support + Megi bushing
12	Sliding bushing for clamping set version	34	Cylinder screw
13.1	Key	35	Gear mounting foot
13.2	Key	36	Notice sign
14	Key	37	Screw plug + seal ring
15.1	Worm gear for slip clutch	38	Screw plug + seal ring
15.2	Worm gear	40	Spacer ring
15.3	Worm gear with hollow hub	41	Nilos ring
15.4	Worm gear with hollow hub + hollow shaft seal ring	43	Tolerance ring
16	Clutch hub	44	Fan
17	Key	45	Fan shroud
18	Cone ring	46	Cylinder screw
19	Disk spring	47	Cylinder screw
20	Adjusting ring	80	Screw plug/vent
26	Radial shaft seal ring	81	Seal ring
26.1	Shaft cap	82	Cylinder screw
27.1	Housing C flange	83	Seal ring
27.2	Housing F flange	84	Seal plug
28.1	Cylinder screw	85	Seal ring
28.2	Cylinder screw	99	Motor
29.1	Circumference cover		

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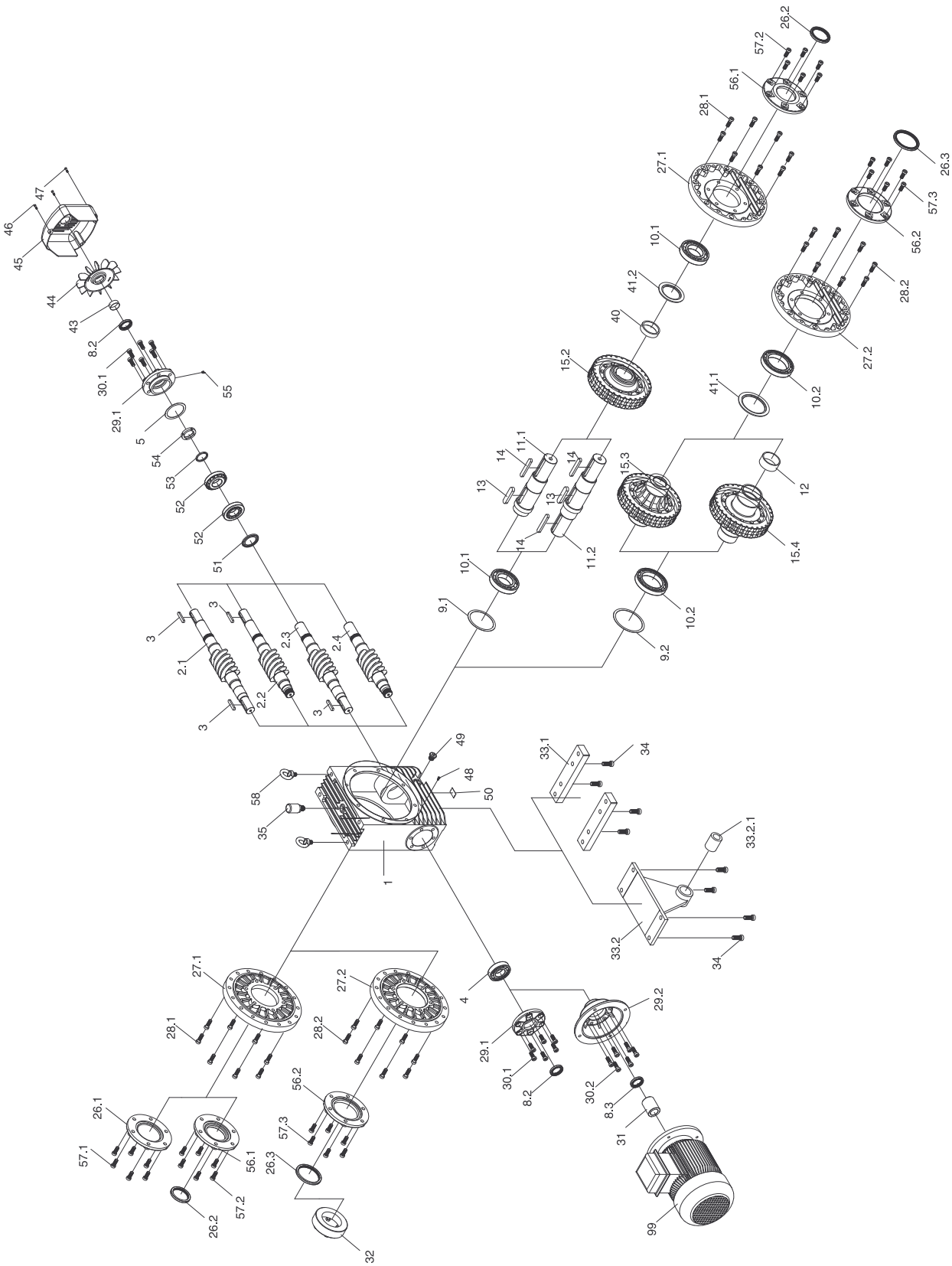
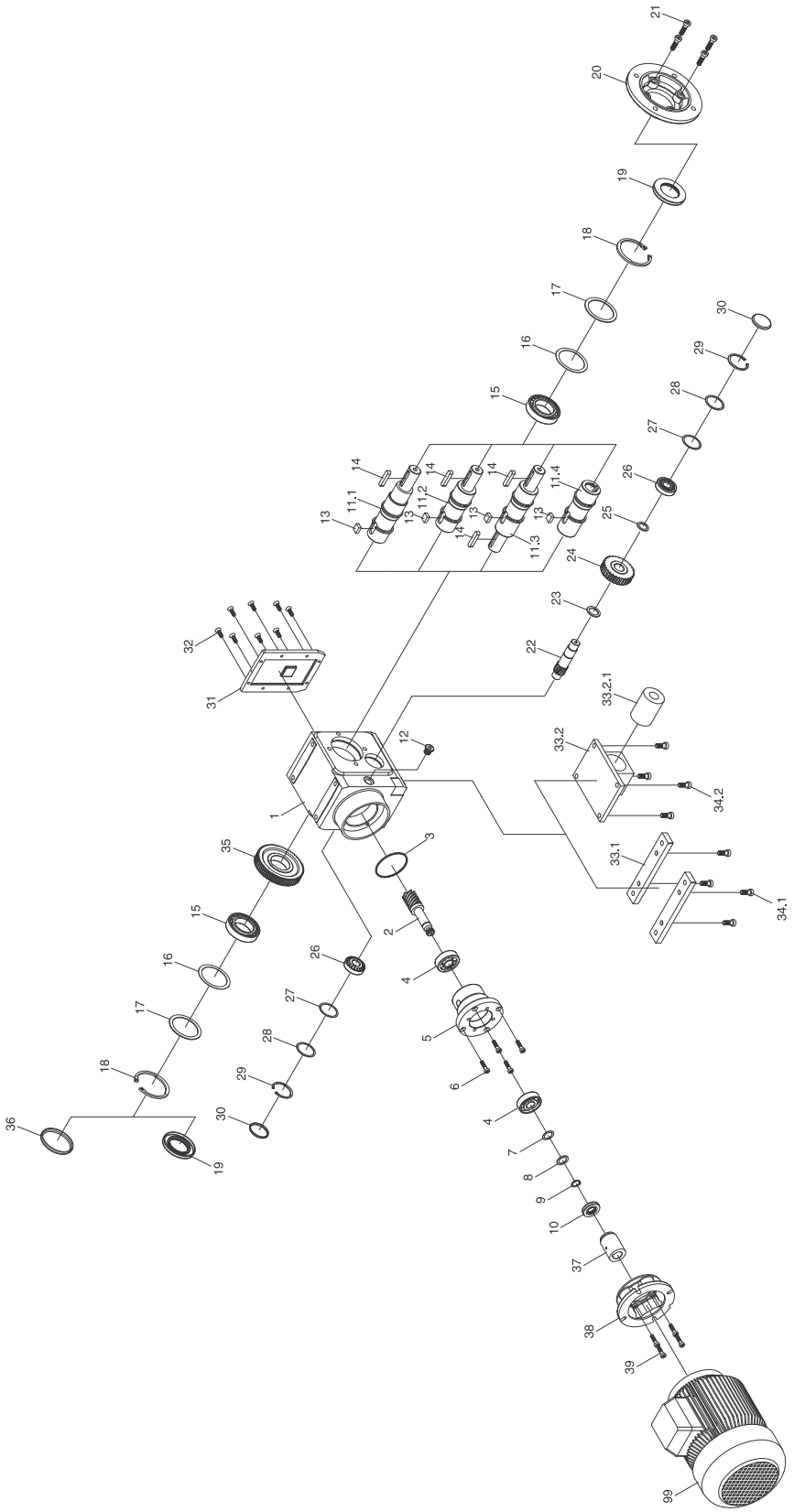
E, M, S 250, 315, 400



1	Gear unit housing	30.1	Cylinder screw
2.1	Double-sided worm shaft	30.2	Cylinder screw
2.2	Double-sided motor worm shaft	31	Coupling set
2.3	Single-sided worm shaft	32	Locking ring
2.4	Single-sided motor worm shaft	33.1	Gear unit feet
3	Key	33.2	Torque support
4	Deep groove ball bearing	33.2.1	Megi bushing
5	Set of shim rings	34	Cylinder screw
8.2	Radial shaft seal ring	35	Vent
8.3	Radial shaft seal ring	40	Spacer ring
9.1	Set of shim rings	41.1	Nilos ring
9.2	Set of shim rings	41.2	Nilos ring
10.1	Deep groove ball bearing	43	Tolerance ring
10.2	Deep groove ball bearing	44	Fan
11.1	Single-sided gear wheel shaft	45	Fan shroud
11.2	Double-sided gear wheel shaft	46	Cylinder screw
12	Sliding bushing for clamping set	47	Cylinder screw
13	Key	48	Cylinder screw
14	Key	49	Seal plug
15.2	Worm gear	50	Notice sign
15.3	Worm gear with hollow shaft	51	Nilos ring
15.4	Worm gear with hollow shaft for locking ring	52	Tapered roller bearing
26.1	Shaft cap	53	Spacer ring
26.2	Radial shaft seal ring for solid output shaft	54	Groove nut with locking plate
26.3	Radial shaft seal ring for hollow output shaft	55	Grease nipple
27.1	Housing flange for driven shaft	56.1	Circumference cover for driven shaft
27.2	Housing flange for hollow shaft	56.2	Circumference cover for hollow shaft
28.1	Cylinder screw	57.1-3	Cylinder screws
28.2	Cylinder screw	58	Eyebolt
29.1	Circumference cover	99	Motor
29.2	Motor lantern		

10.5.2 Worm helical gear units and worm-helical geared motors

Type M 012



1	Gear unit housing	21	Cylinder screw
2	Motor worm shaft	22	Pinion shaft
3	O-ring	23	Support washer
4	Angular contact ball bearing	24	Worm gear
5	Bearing neck	25	Support washer
6	Cylinder screw	26	Tapered roller bearing
7	Set of shim rings	27	Set of shim rings
8	Support washer	28	Support washer
9	Retaining ring	29	Retaining ring
10	Radial shaft seal ring	30	Shaft cap
11.1	Single-sided gear wheel shaft	31	Shaft cap
11.2	Single-sided gear wheel shaft	32	Countersunk screw
11.3	Double-sided gear wheel shaft	33.1	Gear mounting foot
11.4	Hollow shaft	33.2	Torque support
12	Seal plug	33.2.1	Megi bushing
13	Key	34.1	Cylinder screw
14	Key	34.2	Cylinder screw
15	Deep groove ball bearing	35	Spur gear
16	Set of shim rings	36	Shaft cap
17	Support washer	37	Coupling set
18	Retaining ring	38	Motor lantern
19	Radial shaft seal ring	39	Cylinder screw
20	Housing flange	99	Motor

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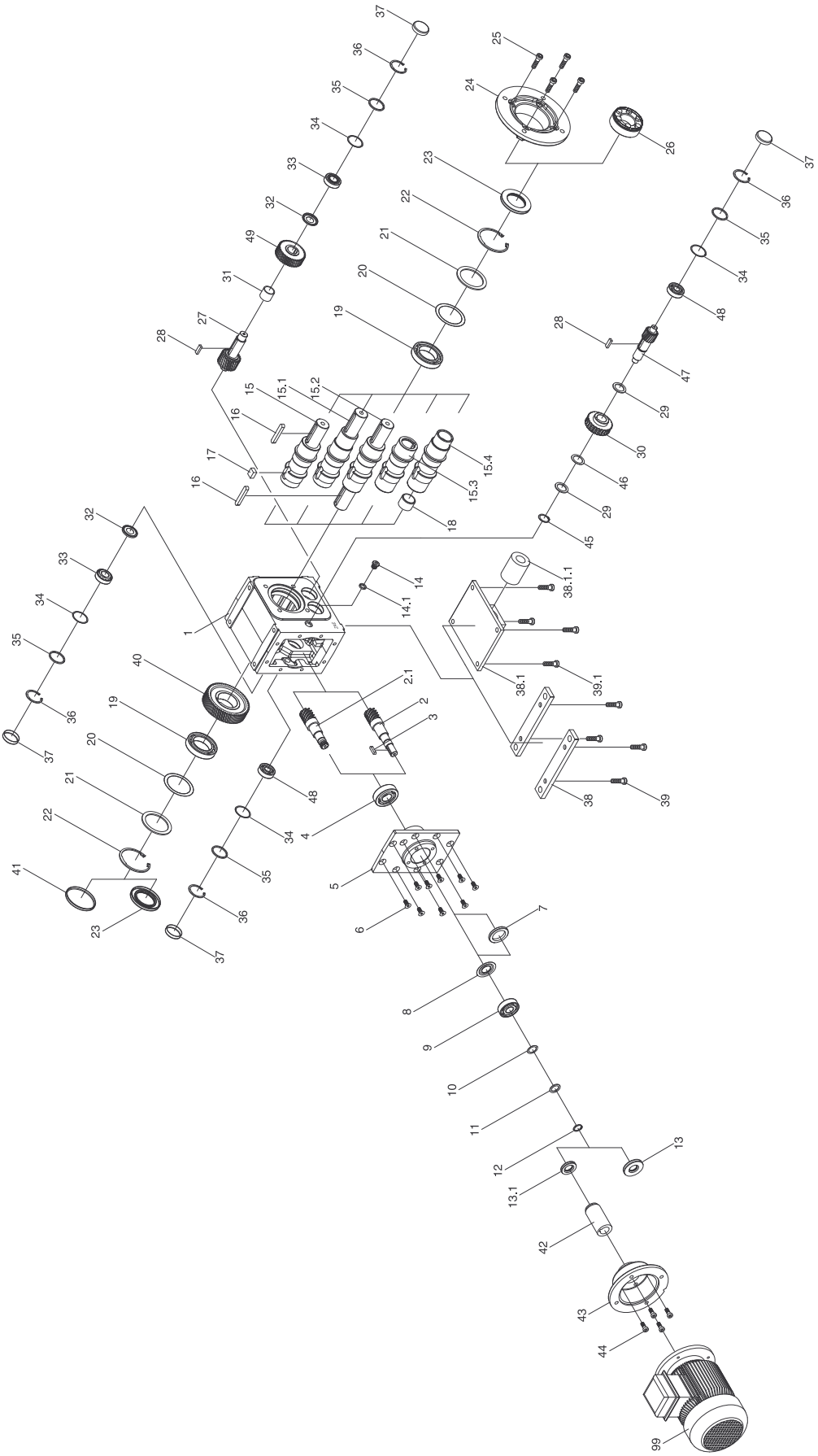
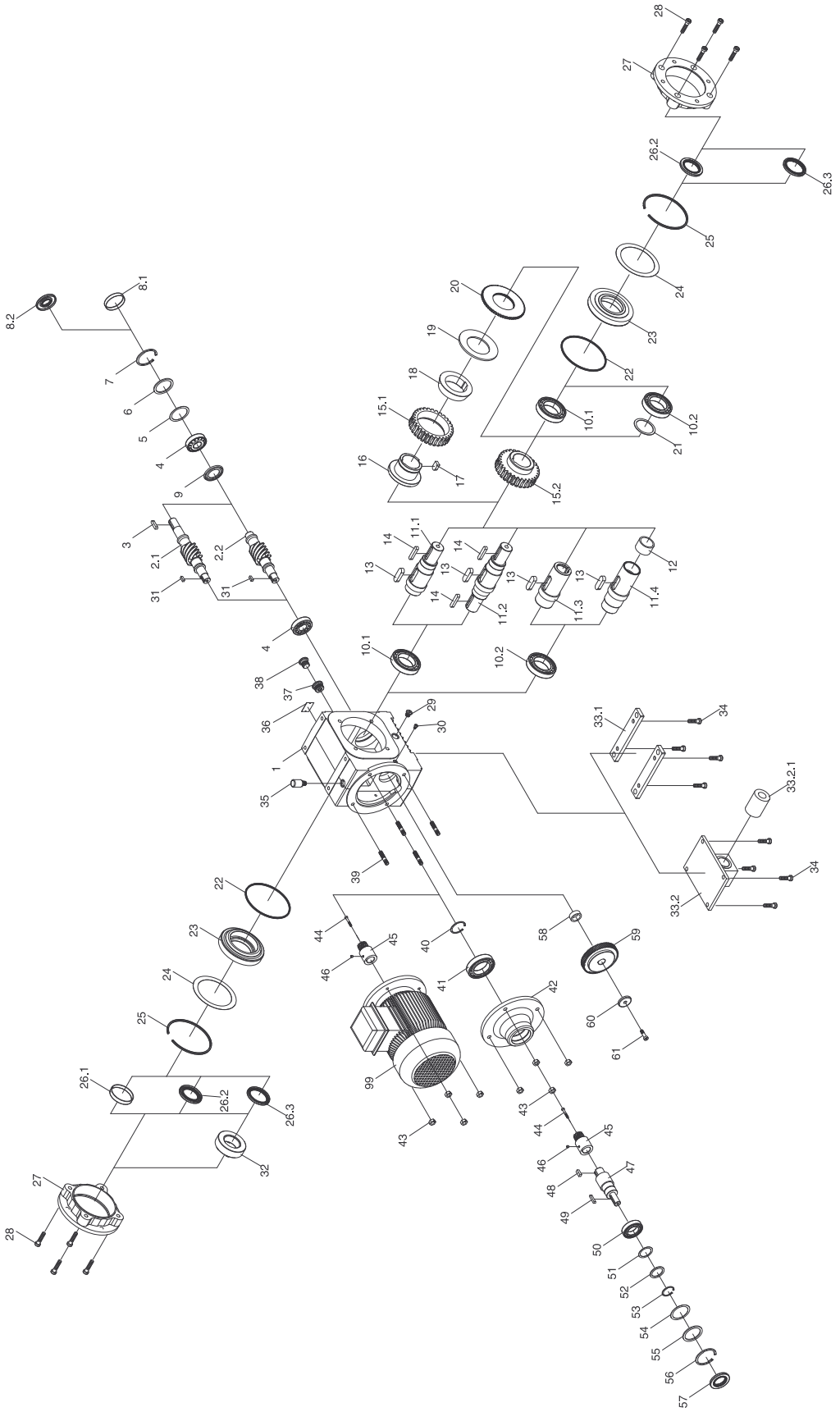
Types E, M 112 – 513



1	Gear unit housing	25	Cylinder screw
2	Worm shaft	26	Shrink-on disk
2.1	Motor worm shaft	27	Pinion shaft
3	Key	28	Key
4	Angular contact ball bearing	29	Support washer
5	Housing cover	30	Worm gear
6	Countersunk screw	31	Bushing
7	Spacer ring	32	Nilos ring
8	Nilos ring	33	Tapered roller bearing
9	Angular contact ball bearing	34	Set of shim rings
10	Set of shim rings	35	Support washer
11	Support washer	36	Retaining ring
12	Retaining ring	37	Shaft cap
13	Radial shaft seal ring	38	Gear mounting foot
13.1	Radial shaft seal ring	38.1	Torque support
14	Seal plug	38.1.1	Megi bushing
15	Single-sided gear wheel shaft	39	Cylinder screw
15.1	Single-sided gear wheel shaft	39.1	Cylinder screw
15.2	Double-sided gear wheel shaft	40	Spur gear
15.3	Hollow shaft	41	Shaft cap
15.4	Hollow shaft	42	Coupling set
16	Key	43	Motor lantern
17	Key	44	Cylinder screw
18	Bushing	45	Retaining ring
19	Deep groove ball bearing	46	Set of shim rings
19.1	Deep groove ball bearing	47	Pinion shaft
20	Set of shim rings	48	Deep groove ball bearing
21	Support washer	48.1	Deep groove ball bearing
22	Retaining ring	49	Spur gear
23	Radial shaft seal ring	99	Motor
24	Housing flange		

10.5.3 Helical worm gear units

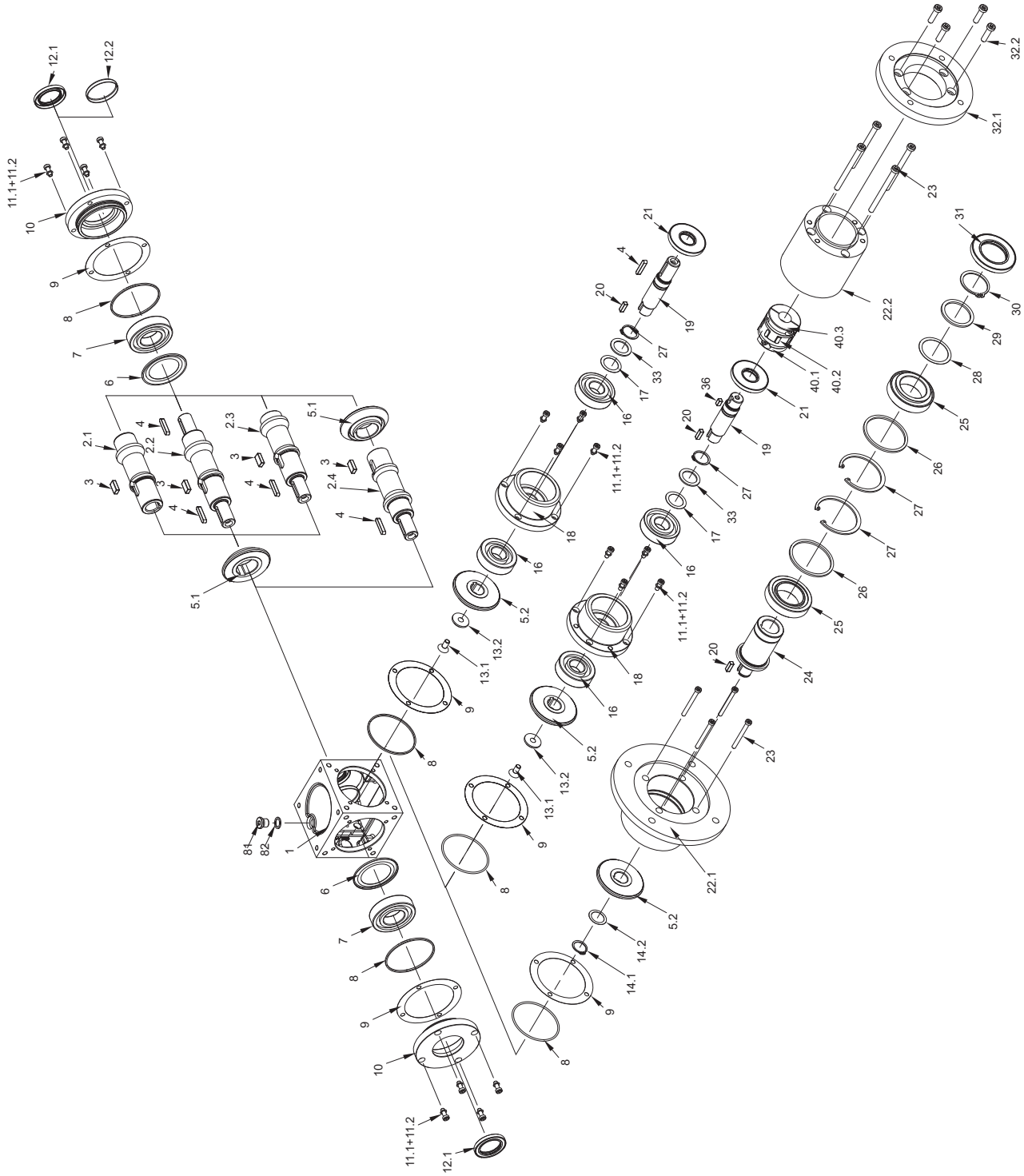
Types GE, GM 050 – 200



1	Gear unit housing	29	Seal plug
2.1	Double-sided worm shaft	30	Cylinder screw
2.2	Single-sided worm shaft	31	Key
3	Key	32	Locking ring
4	Tapered roller bearing	33.1	Gear unit feet
5	Set of shim rings	33.2	Torque support
6	Support washer	33.2.1	Megi bushing
7	Retaining ring	34	Cylinder screw
8.1	Shaft cap	35	Vent
8.2	Radial shaft seal ring	36	Notice sign
9	Nilos ring	37	Seal plug
10.1	Deep groove ball bearing	38	Seal plug
10.2	Deep groove ball bearing	39	Stud
11.1	Single-sided gear wheel shaft	40	Retaining ring
11.2	Double-sided gear wheel shaft	41	Deep groove ball bearing
11.3	Hollow shaft	42	Bearing neck
11.4	Hollow shaft for clamping set	43	Hex nut
12	Sliding bushing for clamping set	44	Cylinder screw
13	Key	45	Pinion
14	Key	46	Threaded pin
15.1	Worm gear for slip clutch	47	Pinion shaft
15.2	Worm gear	48	Key
16	Clutch hub	49	Key
17	Key	50	Deep groove ball bearing
18	Conical ring	51	Set of shim rings
19	Disk spring	52	Support washer
20	Adjusting ring	53	Retaining ring
21	Parallel disk	54	Set of shim rings
22	O-ring	55	Support washer
23	Housing cover	56	Retaining ring
24	Set of shim rings	57	Radial shaft seal ring
25	Circlip	58	Bushing
26.1	Shaft cap	59	Spur gear
26.2	Radial shaft seal ring	60	Countersunk washer
26.3	Radial shaft seal ring	61	Cylinder screw
27	Housing F flange	99	Motor
28	Cylinder screw		

10.5.4 Bevel gear units

Types W, MW, SW 088 – 260

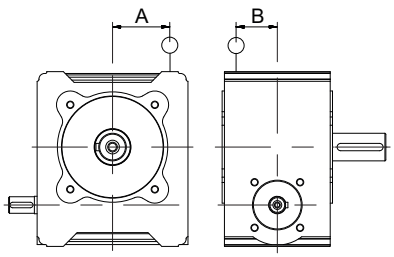
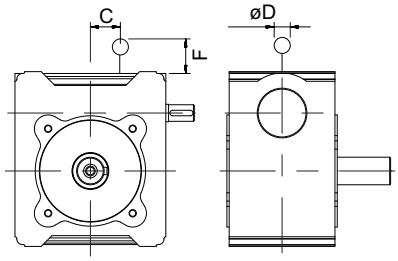
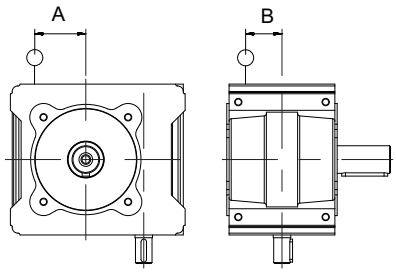
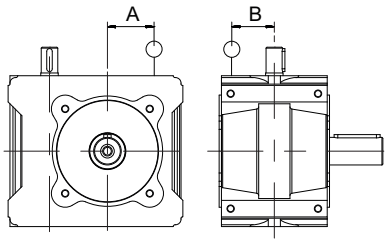
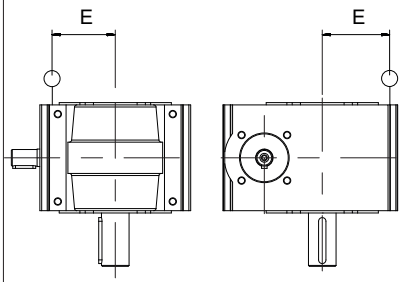
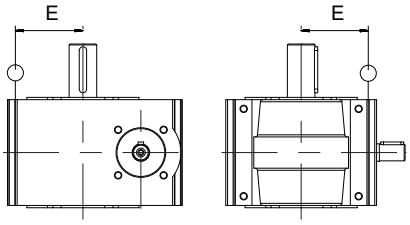


1	Housing	18	Bearing neck
2.1	Hollow shaft	19	Pinion shaft
2.2	Double-sided gear wheel shaft	20	Key
2.3	Single-sided gear wheel shaft	21	Radial shaft seal ring
2.4	Single-sided gear wheel shaft	22.1	Lantern (V version)
3	Key	22.2	Lantern
4	Key	23	Cylinder screw
5.1	Bevel gear	24	Pinion shaft
5.2	Bevel pinion	25	Tapered roller bearing
6	Nilos ring	26	Support washer
7	Deep groove ball bearing/tapered roller bearing	27	Retaining ring
8	O-ring	28	Set of shim rings
9	Set of shim rings	29	Support washer
10	Annular cap	30	Retaining ring
11.1	Cylinder screw	31	Radial shaft seal ring
11.2	Lock washer	32.1	Intermediate flange
12.1	Radial shaft seal ring	32.2	Cylinder screw
12.2	Shaft cap	33	Support washer
13.1	Countersunk screw	40.1	Clutch hub
13.2	Countersunk washer	40.2	Sprocket
14.1	Retaining ring	40.3	Clutch hub
14.2	Set of shim rings	81	Vent screw plug
16	Angular contact ball bearing/tapered roller bearing	82	Seal ring

10.6 Location of fittings

10.6.1 Worm gear units and worm geared motors

Types E/M/S 40 - 80

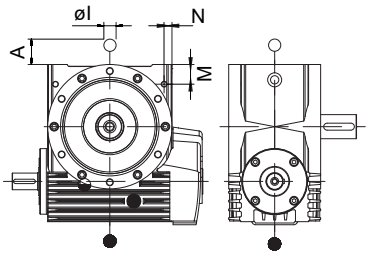
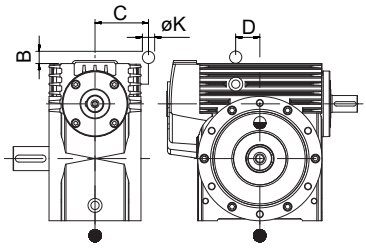
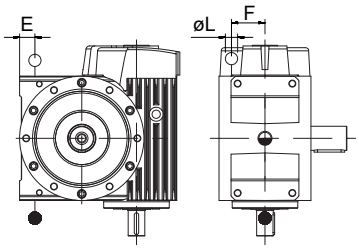
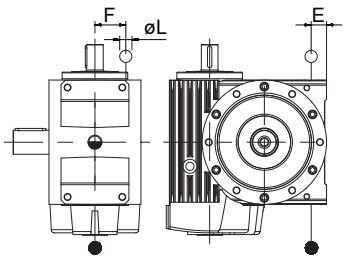
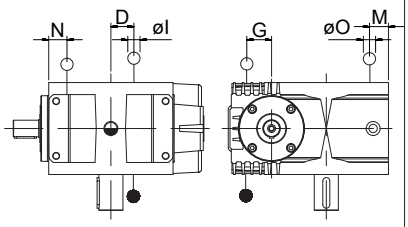
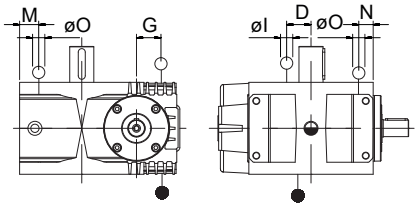
Operating position 1	Operating position 2	Operating position 3
		
Operating position 4	**Operating position 5**	**Operating position 6**
		

Size	A	B	C	D	E*	F
040	–	–	–	–	–	–
050	50	20	33	22	58	25
063	62.5	27.5	37	22	67	25
080	77.5	32.5	57	22	82	25

Size 040 without vent

○ = vent

Types E/M 100 - 400

Operating position 1	Operating position 2	Operating position 3
		
Operating position 4	**Operating position 5**	**Operating position 6**
		

Size	A	B	C	D	E*	F	G	I	K	L	M	N	O	P	R	S
100	32	40	110	50	33	52	60	28	28	28	43	14	22	26	5.5	2.5
125	30	37	140	55	35	55	67	45	28	28	45	18	22	32	6.0	2.0
140	17	40	136	55	38	38	45	28	28	28	50	21	22	–	–	–
160	39	42	130	70	60	68	85	45	45	28	55	20	22	39	7.0	2.0
175	39	41	143	95	60	–	78	45	45	45	58	22	14	39	7.0	2.0
200	39	41	150	80	110	84	109	45	45	28	65	25	22	39	7.0	2.0
250	39	35	160	125	100	90	113	45	45	45	–	–	–	39	–	–
315	39	–	–	135	–	–	118	45	–	–	–	–	–	39	4.0	–
400	22	–	–	–	–	–	–	45	–	–	–	–	–	–	–	–

○ = vent

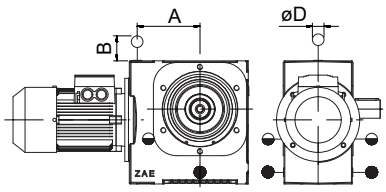
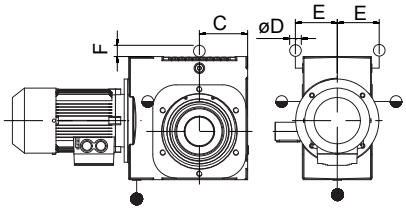
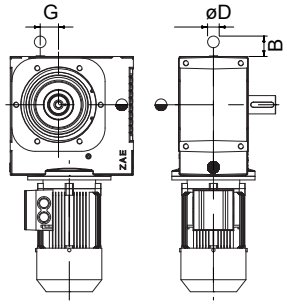
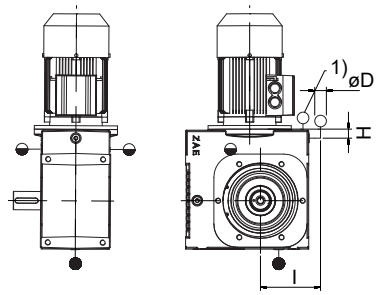
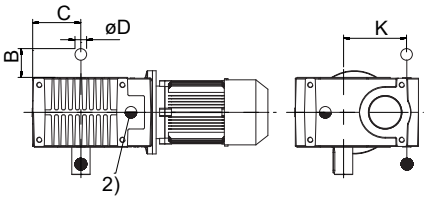
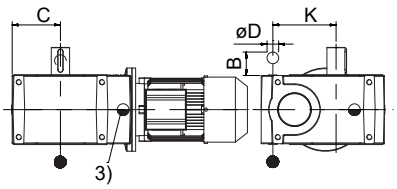
● = oil drain

◒ = oil level checking screw

1) = opposite output side / mounting side

10.6.2 Helical worm gear units and helical worm geared motors

Type GM 050 - 200

Operating position 1	Operating position 2	Operating position 3
		
Operating position 4	**Operating position 5**	**Operating position 6**
		

Size	A	B	C	D	E*	F	G	H	I	K
050	98	23	70	20	62	6	25	10	80	78
063	105	23	82	20	69.5	6	35	10	92	93
080	126.5	23	102	20	79.5	7	42.5	5	111.25	124
100	155	30	123	28	112	18	33	27	140	142
125	188.5	30	145	28	122	21	55	30	161	190
200	260	25	225	28	145	–	130	5	260	301

○ = vent

● = oil drain

◒ = oil level checking screw

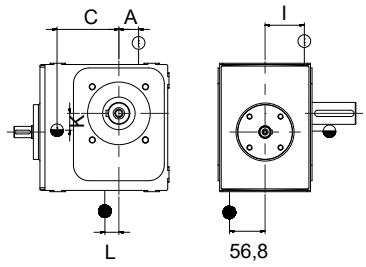
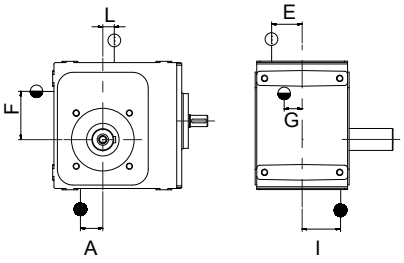
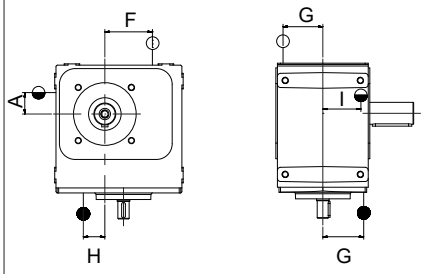
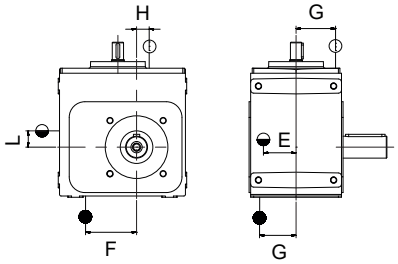
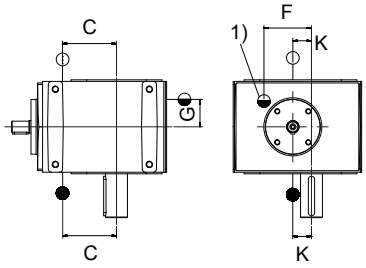
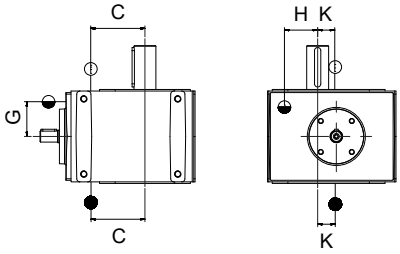
1) = vent on S. 3 possible with custom design

2) = vent on S. 1 possible with custom design

3) = alternatively on S. 2 or S. 4

10.6.3 Worm helical gear units and worm-helical geared motors

Types E/M 112/113 - 212/213

Operating position 1	Operating position 2	Operating position 3
		
Operating position 4	**Operating position 5**	**Operating position 6**
		

Vent: 

Size	A	B	C	D	E*	F	G	H	I	K	L
112/113	15	25	88	22	40.5	70	36.5	35	55	25	25
212/213	-17.5	25	146.5	22	50	72	40	-85	65	25	77.5

Size 012 without vent

1) = opposite the drive side

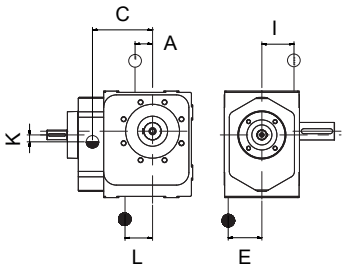
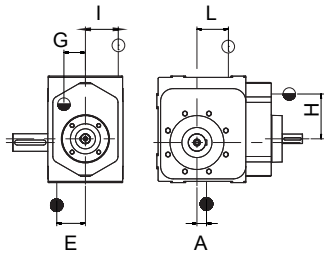
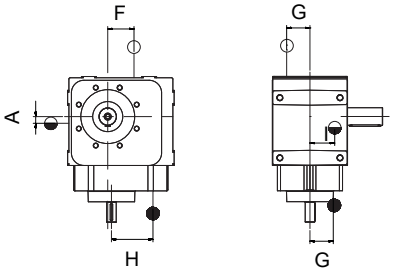
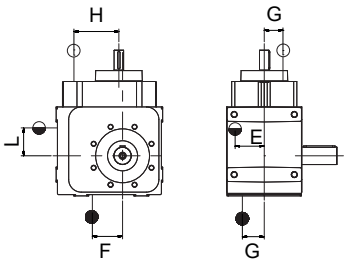
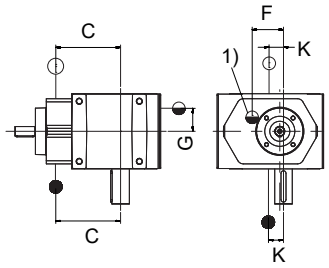
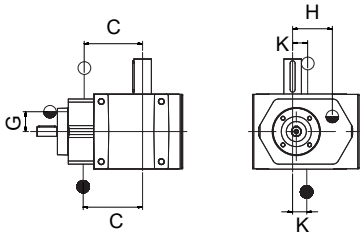
○ = vent

● = oil drain

◒ = oil level checking screw

ANTRIEBSSYSTEME

Types E/M 312/313 - 512/513

Operating position 1	Operating position 2	Operating position 3
		
Operating position 4	**Operating position 5**	**Operating position 6**
		

Vent: 

Size	A	B	C	D	E*	F	G	H	I	K	L
312/313	20	32	153	28	80	65	55	95	80	30	75
512/513	20	32	225	28	82.5	110	77.5	115	115	50	90

1) = opposite the drive side

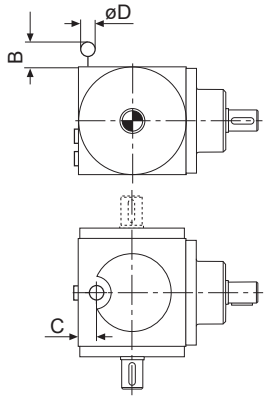
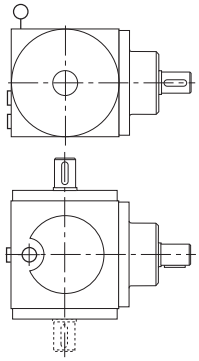
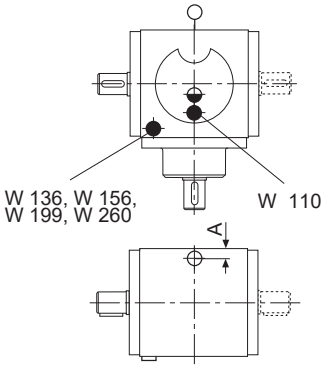
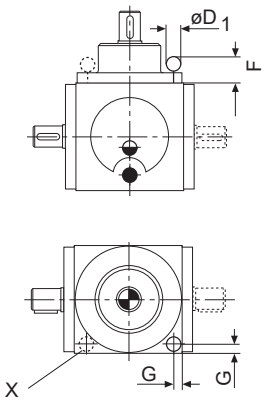
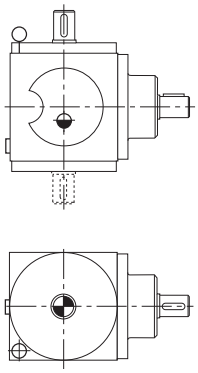
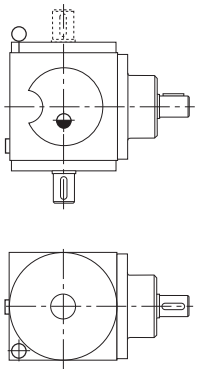
○ = vent

● = oil drain

◒ = oil level checking screw

10.6.4 Bevel gear units and bevel gear motors

Types W/MW/SW 110 - 260

Operating position 1	Operating position 2	Operating position 3
		
Operating position 4	**Operating position 5**	**Operating position 6**
		

Size	A	B	C	D	D_1	F	G
110	20	19.5	20	22	13.2	23	11
136	25	26	25	28	13.2	22	15.5
156	26	26	26	28	22	24.5	17
199	28	26	28	28	28	35.5	20
260	28	26	28	28	28	35.5	25

○ = vent
● = oil drain
◒ = oil level checking screw
X = location of the vent on build 0002

10.7 Declarations of conformity

EU-Konformitätserklärung
Declaration of Conformity

(im Sinne der Richtlinie 2014/34/EU, Anhang X)
(according to EU Directive 2014/34/EU, Appendix X)

ZAE – AntriebsSysteme **erklärt in alleiniger Verantwortung, dass die ZAE Schneckengetriebe, ZAE Schnecken-Stirnradgetriebe, ZAE Stirnrad-Schneckengetriebe, ZAE Kegelradgetriebe und ZAE Kegel-Stirnradgetriebe jeweils in Standardausführung (Typ E, D, W) der Kategorie 2G und 2D (EPL Gb und Db), auf die sich diese Erklärung bezieht, mit der**

declares in solo responsibility that the ZAE worm gear units, ZAE worm helical gear units, ZAE helical worm gear units, ZAE bevel gear units and ZAE bevel helical gear units each type standard (type E, D, W) in category 2G and 2D (EPL Gb and Db), that are subject to this declaration, are meeting the requirements set forth in

Richtlinie 2014/34/EU
Directive 2014/34/EU

übereinstimmen.

Angewandte Normen:	**DIN EN 1127-1:2019, DIN EN IEC 60079-0:2019 DIN EN 60529:2014, DIN EN ISO 80079-36:2016, DIN EN ISO 80079-37:2016**
Applicable standard:	DIN EN 1127-1:2019, DIN EN IEC 60079-0:2019 DIN EN 60529:2014, DIN EN ISO 80079-36:2016, DIN EN ISO 80079-37:2016

ZAE – AntriebsSysteme GmbH & Co KG hinterlegt die gemäß 2014/34/EU Anhang VIII geforderten Unterlagen bei benannter Stelle (IBExU ATEX 152/03):

ZAE – AntriebsSysteme GmbH & Co KG will archive the required documents according to 2014/34/EU, Appendix VIII at the following location (IBExU ATEX 152/03):

IBExU Institut für Sicherheitstechnik GmbH (NB 0637), Fuchsmühlenweg 7, D-09599 Freiberg

Unterzeichnet für und im Namen von ZAE-AntriebsSysteme GmbH & Co KG, Leunastraße 46, 22761 Hamburg

Hamburg, 30.06.2022

Arno Haase-Camper Geschäftsführer	ppa. Kaj Sellschopp Leiter Entwicklung + Konstruktion	i.V. Ralf Weißner Leiter Qualitätsmanagement

EU-Konformitätserklärung
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ANTRIEBSSYSTEME

EU-Konformitätserklärung

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Applicable standard: DIN EN 1127-1:2019,
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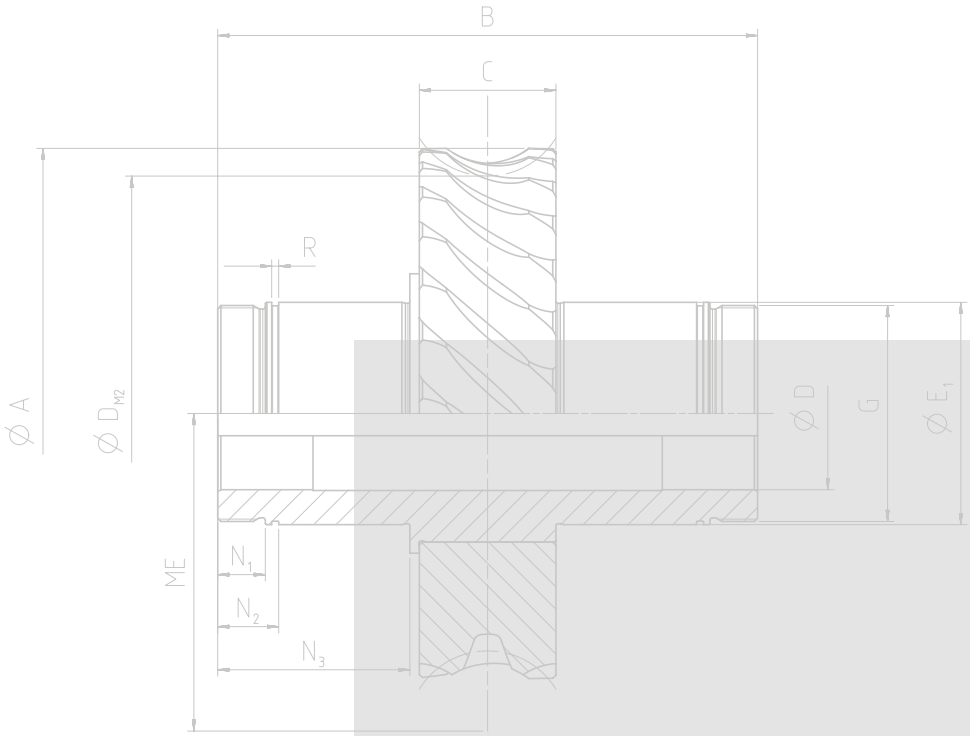

ANTRIEBSSYSTEME

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