# Table of Contents

1 Service Contact Information ........................................................................................................... 5
2 Preface and Safety .......................................................................................................................... 6
   2.1 Product Safety Information ....................................................................................................... 6
   2.2 Product Warranty Information ................................................................................................. 6
   2.3 DANGER, WARNING, CAUTION, and NOTE Statements ...................................................... 7
3 About this document ....................................................................................................................... 8
   3.1 Validity .................................................................................................................................. 8
   3.2 Applicable documents ............................................................................................................ 8
   3.3 Revision index ....................................................................................................................... 8
   3.4 Additional information ........................................................................................................... 8
   3.5 Symbols and markings ............................................................................................................ 9
4 Safety ............................................................................................................................................ 10
   4.1 Intended use .......................................................................................................................... 10
   4.2 Duties of the owner ............................................................................................................... 10
   4.3 Qualifications of personnel ................................................................................................. 10
   4.4 Personal protective equipment ............................................................................................. 11
   4.5 Protective equipment ............................................................................................................ 11
      4.5.1 Protective covers .......................................................................................................... 11
      4.5.2 Emergency off/emergency stop control circuits ......................................................... 11
   4.6 Basic safety instructions ....................................................................................................... 11
   4.7 Residual risks ....................................................................................................................... 12
      4.7.1 Danger from torn off cable ........................................................................................... 12
      4.7.2 Danger to life due to electrical current ......................................................................... 12
      4.7.3 Hot surfaces .................................................................................................................. 12
      4.7.4 Swinging loads .............................................................................................................. 13
      4.7.5 Substances hazardous to the environment ............................................................... 13
      4.7.6 Health risks posed by gear oil .................................................................................... 13
      4.7.7 Risk of slipping posed by escaping gear oil .............................................................. 13
      4.7.8 Preventing property damage on the gears ................................................................. 13
5 Description .................................................................................................................................... 15
   5.1 Spiral version ........................................................................................................................ 15
      5.1.1 Type ............................................................................................................................ 15
      5.1.2 Layout .......................................................................................................................... 15
   5.2 Cylindrical version ............................................................................................................... 16
      5.2.1 Type ............................................................................................................................ 16
      5.2.2 Layout .......................................................................................................................... 16
   5.3 Function .................................................................................................................................. 17
      5.3.1 General ....................................................................................................................... 17
      5.3.2 Function of the device ................................................................................................. 17
      5.3.3 Function of the drive unit ............................................................................................ 17
      5.3.4 Cable .......................................................................................................................... 18
   5.4 Operating states ...................................................................................................................... 18
      5.4.1 Normal mode .............................................................................................................. 18
      5.4.2 Manual mode ............................................................................................................... 19
   5.5 Device application examples ................................................................................................. 19
   5.6 Device usage types ................................................................................................................ 19
      5.6.1 Device mounted in a fixed location, customer connection to movable unit .............. 20
      5.6.2 Device mounted on moveable unit, customer connection in a fixed location ........... 21
5.6.3 Work area from the device to the fixed point ................................................................. 22
5.7 Rating plate ....................................................................................................................... 22
5.8 Sign with pull-down direction of the reeling cable .......................................................... 22
5.9 Specifications .................................................................................................................. 22
6 Transport and storage ......................................................................................................... 23
   6.1 Checking the delivery .................................................................................................... 23
   6.2 Transporting the device ............................................................................................... 23
      6.2.1 Transporting the device with a lifting cart .............................................................. 23
      6.2.2 Transporting the device with lifting equipment ....................................................... 23
   6.3 Storage .......................................................................................................................... 24
7 Installing the device in its installation location ................................................................... 24
8 Electrical installation of the device .................................................................................... 25
   8.1 Layout of the slip ring assembly (example) ................................................................. 26
   8.2 Spiral version .................................................................................................................. 27
      8.2.1 Removing the brush holder from the slip ring assembly .......................................... 27
      8.2.2 Connecting the permanently routed cable to the brush holders .............................. 27
      8.2.3 Connecting the reeling cable to the slip rings .......................................................... 28
      8.2.4 Connecting the reeling cable to the terminal strip .................................................... 30
   8.3 Cylindrical version ........................................................................................................ 31
      8.3.1 Removing the slip ring assembly ............................................................................ 31
      8.3.2 Connecting the permanently routed cable to the brush holders .............................. 31
      8.3.3 Connecting the reeling cable to the slip rings .......................................................... 32
      8.3.4 Connecting the reeling cable to the terminal strip .................................................... 34
   8.4 Placing the reeling cable on the reel body ..................................................................... 35
9 Placing the device into operation ....................................................................................... 37
10 Device decommissioning and removal ........................................................................... 37
11 Disposal and recycling .................................................................................................... 38
12 Maintenance ..................................................................................................................... 38
   12.1 Regular repeat checks and inspections during operation ........................................... 38
   12.2 Cleaning and care ....................................................................................................... 38
   12.3 Maintenance intervals ............................................................................................... 39
13 Detecting and remedying faults ....................................................................................... 40
14 Drive components ........................................................................................................... 40
   14.1 Motor ............................................................................................................................ 40
       14.1.1 Maintenance ......................................................................................................... 40
   14.2 Permanent magnetic coupling ................................................................................... 41
   14.3 Gears ........................................................................................................................... 41
       14.3.1 Bevel gear designs .................................................................................................. 41
       14.3.2 Please observe the following before commissioning .............................................. 41
       14.3.3 Checking the gear oil ............................................................................................ 42
       14.3.4 Checking the gear oil ............................................................................................ 43
       14.3.5 Replacing the gear oil ........................................................................................... 44
       14.3.6 Checking the gears for leaks ............................................................................... 45
       14.3.7 Disposal and recycling ......................................................................................... 46
       14.3.8 Maintenance ......................................................................................................... 46
       14.3.9 Detecting and remedying faults .......................................................................... 47
15 Spare parts drawings ......................................................................................................... 50
   15.1 Motorised cable reel .................................................................................................... 50
       15.1.1 Spiral version ......................................................................................................... 50
       15.1.2 Cylindrical version ............................................................................................... 51
   15.2 Slip ring rotary joint (example) .................................................................................. 52
16 Accessories ....................................................................................................................... 53
16.1 Spooling device ......................................................................................................................... 53
16.2 Gearbox cam limit switch ........................................................................................................... 53
16.3 Cable pulling grip ......................................................................................................................... 54
16.4 Roller payout guide ..................................................................................................................... 54
16.5 Double deflection rollers .......................................................................................................... 55
16.6 Deflection and guide rollers ....................................................................................................... 56
16.7 Cable deposit roller .................................................................................................................... 57
16.8 Cable entry guide ....................................................................................................................... 57
16.9 Deflection horn .......................................................................................................................... 58
16.10 Stationary heater ....................................................................................................................... 59

17 Appendix ........................................................................................................................................ 59
17.1 Screws and tightening torques ................................................................................................. 59
  17.1.1 Gear plate and fixing flange ................................................................................................. 59
  17.1.2 Slip ring assembly ................................................................................................................ 60
  17.1.3 Cable screw connection ....................................................................................................... 60
  17.1.4 Motor terminal board connections ....................................................................................... 60
17.2 Exchange brush holders ........................................................................................................... 61
  17.2.1 Establishing the wear limit of the carbons .......................................................................... 61
1 Service Contact Information

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(1-866-624-7378)

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E-mail:  mhcustomerservice@magnetek.com

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Magnetek, Inc. has additional satellite locations for Canada and the United States. For more information, please visit http://www.magnetek.com.

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2 Preface and Safety

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2.1 Product Safety Information

Magnetek, Inc. (Magnetek) offers a broad range of radio remote control products, control products and adjustable frequency drives, industrial braking systems, and power delivery products for material handling applications. This manual has been prepared by Magnetek to provide information and recommendations for the installation, use, operation and service of Magnetek’s material handling products and systems (Magnetek Products). Anyone who uses, operates, maintains, services, installs or owns Magnetek Products should know, understand and follow the instructions and safety recommendations in this manual for Magnetek Products.

The recommendations in this manual do not take precedence over any of the following requirements relating to cranes, hoists, lifting devices or other equipment which use or include Magnetek Products:

- Instructions, manuals, and safety warnings of the manufacturers of the equipment where the Magnetek Products are used,
- Plant safety rules and procedures of the employers and the owners of the facilities where the Magnetek Products are being used,
- Regulations issued by the Occupational Health and Safety Administration (OSHA),
- Applicable local, state, provincial, or federal codes, ordinances, standards and requirements, or
- Safety standards and practices for the industries in which Magnetek Products are used.

This manual does not include or address the specific instructions and safety warnings of these manufacturers or any of the other requirements listed above. It is the responsibility of the owners, users and operators of the Magnetek Products to know, understand and follow all of these requirements. It is the responsibility of the employer to make its employees aware of all of the above listed requirements and to make certain that all operators are properly trained.

No one should use Magnetek Products prior to becoming familiar with and being trained in these requirements and the instructions and safety recommendations for this manual.

2.2 Product Warranty Information

Magnetek, hereafter referred to as Company, assumes no responsibility for improper programming and/or installation of a device (such as a drive or radio) by untrained personnel. A device should only be programmed/installed by a trained technician who has read and understands the contents of the relevant manual(s). Improper programming/installation of a device can lead to unexpected, undesirable, or unsafe operation or performance of the device. This may result in damage to equipment or personal injury. Company shall not be liable for economic loss, property damage, or other consequential damages or physical injury sustained by the purchaser or by any third party as a result of such programming. Company neither assumes nor authorizes any other person to assume for Company any other liability in connection with the sale or use of this product.

For information on Magnetek’s product warranties by product type, please visit www.magnetek.com.
2.3 DANGER, WARNING, CAUTION, and NOTE Statements

Read and understand this manual before installing, operating, or servicing this product. Install the product according to this manual and local codes.

The following conventions indicate safety messages in this manual. Failure to heed these messages could cause fatal injury or damage products and related equipment and systems.

DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury. This signal word is to be limited to the most extreme situations.

WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury. It may also be used to alert against unsafe practices.

NOTE: A NOTE statement is used to notify people of installation, operation, programming, or maintenance information that is important, but not hazard-related.
3 About this document

These operating instructions are a part of the device.
In this document, the term "device" is used to refer to the product HGN.
Read the operating instructions, and especially the safety notes and warnings, before using the
device and make sure that they are observed for all work on and with the device.
In the event that there is a change of ownership of the device, the operating instructions are to be
handed over to the new owner.
If the device is installed in a higher-level system, these operating instructions must be included
in the operating instructions of the higher-level system.

3.1 Validity

These operating instructions exclusively refer to the device as identified by its rating plate (→ 5.7,
page 22).

3.2 Applicable documents

• Installation instructions for the permanent magnetic coupling

3.3 Revision index

<table>
<thead>
<tr>
<th>Date</th>
<th>Version</th>
<th>Revision note</th>
</tr>
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<tr>
<td>23/02/2017</td>
<td>V1</td>
<td>First edition</td>
</tr>
<tr>
<td>04/08/2017</td>
<td>V2</td>
<td>• Corrected headers.</td>
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<td></td>
<td></td>
<td>• Redesigned symbols and markings in table 3.5</td>
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<tr>
<td></td>
<td></td>
<td>• ANSI-compliant warnings</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Device delivery variants modified in chapter 8.0 “Electrical</td>
</tr>
<tr>
<td></td>
<td></td>
<td>installation of the device”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Removed chapter 9.0 “Placing the device into operation”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Replace &quot;slip ring housing&quot; with &quot;slip ring assembly housing&quot; in spare parts</td>
</tr>
<tr>
<td></td>
<td></td>
<td>drawing</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Various adaptations</td>
</tr>
</tbody>
</table>

3.4 Additional information

In addition to these operating instructions, the following information must also be observed:

• Details in the order confirmation
• Installation instructions
• Dimension sheet
• Circuit diagram
### 3.5 Symbols and markings

The following symbols and markings are used in these operating instructions:

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Signal word</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>⚠️</td>
<td>DANGER</td>
<td>A danger that will result in serious injury or death.</td>
</tr>
<tr>
<td>⚠️</td>
<td>WARNING</td>
<td>A danger that may result in serious injury or death.</td>
</tr>
<tr>
<td>⚠️</td>
<td>CAUTION</td>
<td>A danger that may result in minor or moderate injury.</td>
</tr>
<tr>
<td></td>
<td>ATTENTION</td>
<td>A note that facilitates general understanding or the optimisation of work.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Marking</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>✔️</td>
<td>A prerequisite for an action.</td>
</tr>
<tr>
<td>➤</td>
<td>Single/step action.</td>
</tr>
<tr>
<td>1, 2, 3, …</td>
<td>Multi-step action sequence (observe the order of the steps).</td>
</tr>
<tr>
<td>→</td>
<td>Cross-reference to additional information.</td>
</tr>
<tr>
<td>➔</td>
<td>Action(s) for warnings.</td>
</tr>
<tr>
<td>⇋</td>
<td>Several statements in a note.</td>
</tr>
</tbody>
</table>
4 Safety

4.1 Intended use

The device supplies a mobile unit with electricity. The device is either installed in a fixed location or mounted to a mobile unit. The reeling cable is unwound from the reel body by tensile force and wound on the reel body by motor force.

The intended use requires that the operating conditions and operating instructions as well as the additional information are observed.

The device is not suitable for all types of load movement.

4.2 Duties of the owner

The operating instructions, especially the "Safety" section, must be read and understood and must be followed.

The device must only be operated and maintained with due consideration of the following documents and regulations:

- Operating instructions
- Additional information
- Local regulations: Laws, standards and guidelines
- Accident prevention regulations
- Health & safety regulations

The following must be observed with regard to personnel:

- Only use qualified and trained personnel.
- Carry out regular training on the device.
- Check the safety consciousness of the personnel at regular intervals.
- Provide personal protective equipment.

Make sure that the personnel fulfil the following requirements:

- The applicable accident prevention regulations and safety regulations are known and observed.
- Personal protective equipment is worn.

Make sure that the workplace fulfils the following requirements:

- The workplace is adequately lit.
- The workplace is adequately ventilated.

4.3 Qualifications of personnel

Make sure that the following work is carried out exclusively by qualified personnel:

- Mechanical installation
- Electrical installation
- Commissioning
- Maintenance
- Troubleshooting
4.4 Personal protective equipment

The following personal protective equipment must be worn:

- Safety shoes
- Hard hat
- Safety gloves
- Safety goggles
- Fall protection equipment (if applicable)

4.5 Protective equipment

4.5.1 Protective covers

Protective covers on motors, gears, couplings, belts, chains, and gearwheels protect the operator from the following:

- Injury due to rotating parts
- Injury due to parts that jump out of the equipment
- Burns

Only operate the device with a protective cover.

Do not insert any objects into the protective cover.

4.5.2 Emergency off/emergency stop control circuits

- The system owner must integrate the device into the on-site emergency stop/emergency off control circuits.
- The owner must ensure that the emergency off/emergency stop control circuits are fully functional.

4.6 Basic safety instructions

Always observe the five safety rules when carrying out electrical work on the device:

- Disconnect the device from the power supply.
- Secure the device so that it cannot be reactivated inadvertently.
- Make sure that the device is voltage-free.
- Earth and short circuit the device.
- Cover or fence off any adjacent parts with a voltage.

Personnel

Work on the device may only be carried out by qualified personnel.

Installation, operation

Carefully read the operating instructions before installing and operating the device and keep them for future reference. Always observe the safety notes and warnings.

- Observe occupational health and safety and environmental protection regulations.
- All local accident prevention and safety regulations must be complied with.
- Observe the notes on the rating plate.
- Observe the notes on the pull-down direction of the reeling cable (as per the order confirmation) on the covering hood.
- Keep signs free from paint and dirt. Missing and illegible plates and signs must be exchanged immediately.
- To transport the device, attach round loops and only use suitable lifting equipment.
- Before the device is installed in a higher-level system, disconnect the mains voltage from the higher-level system (all-pole disconnection) and secure it against unintended reactivation.
- Fasten the device in its installation location with the screws and torques that are recommended by the manufacturer in order to ensure that it is secure and to avoid damage to
the connection.
• The device may only be operated in the correct technical condition.
• In the case of faults or if the operating behaviour of the device changes, the device and higher-level system must be shut down immediately and the fault must be corrected.

Maintenance
The observance of the regular maintenance intervals is a prerequisite for the safe and reliable operation of the device.
• Remove all dirt from the outside and inside of the device.
• Remedy all technical defects immediately.
• Only use genuine spare parts.

Conversion and repair
Incorrect alterations to and modifications of the device may result in injury and/or property damage.
• Exchange all live cables whose insulation is faulty immediately.
• Only use original accessories.

Disposal
The device gears contain gear oil.
• In the event of decommissioning, remove the device properly and dispose of all components in accordance with the local regulations.
• Before disposing of the gears, carry out the following steps:
  − Drain the gear oil and store it in suitable containers until disposal, separated by waste code.
  − Clean the gears before disposal.

4.7 Residual risks

4.7.1 Danger from torn off cable
The reeling cable may tear off during operation, whip around in an uncontrolled manner, and fall down. This can cause injury and/or property damage.
• Only operate the system with the installed safety device in the area of the reeling cable.
• Secure the work area against unauthorised access.

4.7.2 Danger to life due to electrical current
Always proceed with extreme caution when working on electrical cables or parts:
• The installation and electrical work on the unit may only be carried out by a qualified electrician.
• Before opening the device, disconnect the mains voltage from the device and the higher-level system (all pole disconnection) and secure them against unintended reactivation.
• Make sure that the unit is voltage-free (all pole disconnection).
• Check the cable reel for electrical insulation.
• Check the continuity of the protective conductor system (test current according to EN 60204-1 Sec. 18.2.2. 0.2 A  \( \leq I_{\text{test}} \leq 10 \) A. Slip rings \( \geq 60 \) A can also be measured with a maximum test current of 30 A).
• Do NOT use the PE protective conductor system as a PEN system.
• Observe EN, VDE, and locally applicable safety regulations.

4.7.3 Hot surfaces
The surfaces of the following drive components can reach high temperatures during operation:
• Permanent magnetic coupling
• Gears
• Motor
Do NOT touch the housing surface: Risk of burns!
Observe the following points to protect yourself against burns:
• Let the drive components cool down before touching them.
• Do not touch the drive components during or immediately after operation.
• Wear personal protective equipment.

4.7.4 Swinging loads
Due to the heavy weight of the device and its components, the following dangers are posed during transport and installation:
• Risk of jamming, crushing, and impact posed by the device moving or tilting.
• Danger due to device and/or accessories falling.
Persons may be hit or jammed in by swinging loads. Pay attention to the following on personal protection:
• Never walk, stand or sit under swinging loads.
• Never stand between the load and a wall.
• Wear personal protective equipment.
• Only use prescribed transport and sling gear.

4.7.5 Substances hazardous to the environment
Gear oil can escape from the gears.

Oils and lubricating greases
• In addition to the operating instructions, the generally applicable and legally binding regulations on environmental protection must be observed.
• The applicable safety regulations must be observed when handling oils and lubricating greases.
• Oils and lubricating greases must be stored in suitable containers and disposed of in accordance with locally applicable regulations.

Electronic waste
Electronic waste must be collected separately and disposed of in accordance with locally applicable regulations.

4.7.6 Health risks posed by gear oil
Contact with gear oil may cause skin rashes and other health risks.
• Avoid any skin contact with gear oil.
• Wear safety gloves and goggles.
• Thoroughly clean all body parts that have been in contact with gear oil.
• Observe the safety instructions of the gear oil manufacturer.

4.7.7 Risk of slipping posed by escaping gear oil
Puddles of gear oil may cause serious accidents.
• Immediately remove puddles of gear oil with a suitable binder.
• Dispose of the binder in accordance with regional regulations.

4.7.8 Preventing property damage on the gears
An incorrect amount of oil can damage the gears.
• Open the pressure release valve.
• Thirty minutes after switching off the drive, check the oil level in the pressure release valve whilst the system is still warm.
• Correct the oil volume if required.
  During the correction of the oil volume, dirt can penetrate the gears through the opening (locking screw → 14.3.4 page 43).
  
• Close the pressure release valve after carrying out the correction.
5  Description

ATTENTION

⇒ The device is delivered with or without the cable.
⇒ Cable data see order confirmation.

5.1  Spiral version

5.1.1  Type

These operating instructions describe the following device:

G2-M7-T12301-36P7-IP55 (example)

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>G2</td>
<td>Bevel gear size 2</td>
</tr>
<tr>
<td>M7</td>
<td>Permanent magnetic coupling size 7</td>
</tr>
<tr>
<td>T12301</td>
<td>Reel body: 1200 inner diameters / 3000 outer diameters / 1 winding chamber 36P7</td>
</tr>
<tr>
<td></td>
<td>36 Amperage / 7 numbers of pols</td>
</tr>
<tr>
<td>IP55</td>
<td>Protection class</td>
</tr>
</tbody>
</table>

5.1.2  Layout

![Figure 1  Layout of motorised cable reel](image)

1  Drive unit with bevel gears, permanent magnetic coupling, and motor
2  Reel body with reeling cable
3  Cable enclosure with slip ring assembly (optional limit switch and/or heater)
4  Covering hood
5.2 **Cylindrical version**

5.2.1 **Type**

These operating instructions describe the following device:

**G2-M7-T03001-36P7-IP55 (example)**

- **G2**: Bevel gear size 2
- **M7**: Permanent magnetic coupling size 7
- **T03001**: Reel body: 300 inner diameters / 1 winding chamber 36P7
- **36P7**: 36 Amperage / 7 numbers of poles
- **IP55**: Protection class

5.2.2 **Layout**

![Diagram of motorised cable reel]

**Figure 2** Layout of motorised cable reel

1. Drive unit with bevel gears, permanent magnetic coupling, and motor
2. Reel body with reeling cable
3. Cable enclosure with slip ring assembly (optional limit switch and/or heater)
4. Covering hood
5.3 Function

5.3.1 General

The device supplies a mobile unit with electricity. The device is either installed in a fixed location or mounted to a mobile unit. The reeling cable is unwound from the reel body by tensile force and wound on the reel body by motor force. The reeling cable transmits electrical energy and/or data signals.

5.3.2 Function of the device

The device constantly winds the reeling cable onto the reel body using an electric motor. The motor must always be switched on during operation. The drive of the device ensures that the torque on the reel body is constant. The reeling cable is constantly under tensile stress during operation. When the reeling cable is unwound from the reel body, it is pulled from the device against the tensile stress and only by external forces. The reeling cable is wound on the reel body by motor force. The motor can be turned off during periods of inactivity. The integrated motor brake or an attached return stop prevents the cable from unwinding accidentally during periods of inactivity.

5.3.3 Function of the drive unit

![Diagram of device, drive unit with reel body](image)

Figure 3 Block diagram of device, drive unit with reel body

1. Brake rectifier
2. Motor brake
3. Motor
4. Primary side permanent magnetic coupling
5. Secondary side permanent magnetic coupling
6. Gears
7. Reel shaft
8. Cable reel with reeling cable
9. External unwinding force

The motor (→ Figure 3, item 3) of the device is subject to constant mechanical rotation in the winding direction. The permanent magnetic coupling (items 4 and 5), which is attached to the motor shaft, transmits the motor torque to the gears (item 6). The permanent magnetic coupling has two functions: Torque transfer and creation of a speed slip between the motor and gears.
• Unwinding the reeling cable
The higher-level machine unwinds the reeling cable with a high permanent magnetic coupling speed slip.

• Winding the reeling cable
The higher-level machine winds the reeling cable with a low permanent magnetic coupling speed slip.

• Standstill of the higher-level system
If the higher-level system is at a standstill, the device continues to try to wind up the reeling cable.
The reel body does not rotate. The speed slip of the permanent magnetic coupling during standstill is in the middle range.

Device period of inactivity:

✅ The motor of the device is turned off and the motor brake is activated.

The torque transmitted from the gears to the cable reel is largely independent of the speed slip.
During the winding of the reeling cable, the reel body, gears, and secondary side of the permanent magnetic coupling rotate in the direction of the motor. A slight speed slip arises on the permanent magnetic coupling. During unwinding, there is a higher speed slip on the permanent magnetic coupling.

5.3.4 Cable

ATTENTION

⚠️ Do not use cable clamps to absorb the cable tensile force.

The reeling cable of the device is subject to high mechanical loads.
The following points should be observed to achieve the highest possible service life:

• Do not glide the cable over fixed points. Use cable deposit rollers.
• Do not crush the cable.
• Absorb the cable tensile force on the cable reel: For strain relief purposes, two safety windings of the reeling cable must always remain on the reel body and are not allowed to be used during operations.
• Absorb the cable tensile force on the fixed point with the following accessories:
  – Cable pulling grip: For cable unwinding in one direction.
  – Cable entry guide: For the crossing of a central feed and cable unwinding in two directions.
• A strain relief with two windings of reeling cable in the cable entry guide (→ 16.8, page 57) can enable higher cable tensile forces than the cable pulling grip depending on the cable layout (carrying body).

5.4 Operating states

5.4.1 Normal mode

The drive of the cable reel is switched on for five seconds before the start of operations to tighten the reeling cable. The stationary heater of the motor is switched off during operation. The heater in the cable enclosure is always switched on. A PTC thermistor integrated into the motor monitors the temperature of the motor.
We recommend that you leave the reel drive switched on during short operational interruptions to avoid switching the drive on and off too frequently.

Malfunctions during normal operation
The following malfunctions are reported by various accessories (→ see brackets) and require that the system be stopped quickly:
5.4.2 Manual mode

WARNING

For manual mode, it is indispensable to have an emergency off/emergency stop function that affects the entire system in order to protect personnel.

For maintenance and repair work, it is useful to set up a manual operation level. This is realised with the touch control mode which is operated via a button. For this purpose, a reversing contactor circuit is used for winding and unwinding.

5.5 Device application examples

- Ship cranes
- Container cranes
- Bridge cranes
- Construction cranes
- Gripper and magnetic systems
- Bucket-wheel excavators
- Conveyor systems
- Hall cranes
- Light and stagecraft

5.6 Device usage types

The device is used for horizontal or vertical power supply. The device can either be installed in a fixed location or mounted to a mobile unit.

Vertical power supply:

- The reeling cable is unwound downwards from a fixed-mounted device.
- The reeling cable is unwound upwards from a fixed-mounted device.
Horizontal power supply:

- The device is fixed-mounted. The reeling cable is drawn out in one direction by a mobile unit on which the fixed point is located. The cable is deposited on cable deposit rollers.
- The device is mounted onto a mobile unit, with the reeling cable connected onto the stationary fixed point. The cable is unwound by the mobile unit.
- The device is mounted onto a mobile unit. The cable is routed via the guide rollers. The mobile unit crosses a central feed. The reeling cable is routed under the mobile unit. The cable is unwound in two directions.

The arrows in the following illustration show the directions for winding and unwinding the reeling cable.

Tension is released on the reeling cable as follows:

- Tension release with cable grip on the fixed point (without central feed).
- Strain relief through cable entry guide with cylinder if the fixed point is crossed by a mobile unit during operation (central feed).

5.6.1 Device mounted in a fixed location, customer connection to movable unit

Figure 4  Horizontal cable unwinding with cable deposit rollers

Figure 5  Cable unwinding vertically upwards
Figure 6  Cable unwinding vertically downwards
5.6.2 Device mounted on moveable unit, customer connection in a fixed location

Figure 7  Horizontal cable unwinding

Figure 8  Horizontal cable unwinding (crossing of central feed) with cable deflection rollers and cable entry guide
5.6.3 Work area from the device to the fixed point

ATTENTION

Unwind the reeling cable of the spiral or cylindrical reel body in alignment with the fixed point or the first cable deflection of the device. Dimension $\alpha = 4^\circ$.

Cylindrical version

Spiral version

5.7 Rating plate

The rating plate is located on the covering hood. The rating plate displays the following information:

- Type designation
- Serial number
- Specifications

5.8 Sign with pull-down direction of the reeling cable

5.9 Specifications

For specifications on the device, please see the order confirmation and rating plate.
6 Transport and storage

The device is packed for shipment in accordance with the transport route and the size of the device.

The sea freight packaging corresponds with the packaging guidelines of the German HPE (Bundesverband Holzpackmittel Paletten Exportverpackungen e. V., Association of Wooden Packaging Materials, Pallets and Export Packaging).

6.1 Checking the delivery

- Inspect the device for completeness and damage while unpacking it.
- Notify the manufacturer of missing parts or damage immediately.

6.2 Transporting the device

<table>
<thead>
<tr>
<th>CAUTION</th>
<th>High device weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Back injuries from lifting are possible.</td>
<td></td>
</tr>
<tr>
<td>➔ Use a lifting cart.</td>
<td></td>
</tr>
<tr>
<td>➔ Use lifting equipment.</td>
<td></td>
</tr>
</tbody>
</table>

6.2.1 Transporting the device with a lifting cart

- Transport the device to its installation location secured on a wooden palette.

6.2.2 Transporting the device with lifting equipment

Transport the device to its installation location suspended from lifting equipment as follows:

1. Attach round loops to the device (➔ Figure 12, page 23).
2. Lift the device with the lifting equipment.
3. Make sure that the weight of the device is evenly distributed.
4. Position the device in its installation location.

Figure 12 Positions of the round loop on the device
6.3 Storage

**DANGER**

Swinging or falling loads.

Injury or property damage.

⇒ Never walk, stand or sit under swinging loads.

⇒ Never stand between the load and a wall.

When storing the device, do not stack it. Protect it from moisture, frost, dirt and dust.

7 Installing the device in its installation location

The base must ensure that no resonance vibrations occur and no vibrations can be transferred to adjacent bases.

The base construction on which the gears will be installed must be warp-resistant. It must be designed in accordance with the weight and the torque of the unit while taking into account the forces that act on the gears. Bases that are not sufficiently stable will result in radial and axial offset which cannot be measured during standstill. If the device is installed on a base consisting of two parts, both parts must have the same height.

Prevent displacement by external forces resulting from side impacts.

Observe the tightness and tightening torques of the screws (→ 17.1, page 59).

**ATTENTION**

⇒ The gearbox plate must not warp when tightening the mounting screws.

⇒ Any deviations in flatness of the gear support may not exceed the following values:
   - up to gear size 3: 0.1 mm
   - from gear size 4: 0.2 mm

⇒ The slip ring rotary joint housing must be fitted with a stable and secure base.

✓ The device has been unpacked and is ready for assembly in its installation location.

✓ The installation location is even and free from contamination.

**DANGER**

Swinging or falling loads.

Injury or property damage.

⇒ Never walk, stand or sit under swinging loads.

⇒ Never stand between the load and a wall.

1 Attach the round loops to the transport points of the device (→ Figure 12, page 23).
2 Lift the device with the lifting equipment.
3 Position the device in its installation location.
4 Align the device.
5 Secure the gears with the mounting feet at the installation location and check the tightening torques of the screw connections (→ 17.1, page 59).
8 Electrical installation of the device

**ATTENTION**

- Observe the tightening torques of the screws (→17.1, page 59).
- In the case of devices without a terminal strip, the slip ring assembly must be dismantled before the reeling cable is connected up (→ 8.2.1, page 25 and → 8.3.1, page 31).
- Reinstall the slip ring assembly when the cable is being connected (→ 8.1, page 26).
- Exchange any old or damaged insulation.

The device is delivered in various variants. Depending on the scope of delivery, different installation steps are required before the device can be commissioned (observe the correct sequence).

Device delivery variants:
1) The device is wired up by Magnetek.
2) The device is wired up by the customer.

<table>
<thead>
<tr>
<th>Tasks</th>
<th>Slip rings</th>
<th>Brush holders</th>
<th>Terminal strip</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer-wired</td>
<td>X</td>
<td>X</td>
<td>--</td>
</tr>
<tr>
<td>Customer-wired</td>
<td>O</td>
<td>X</td>
<td>O</td>
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<tr>
<td>Customer-wired</td>
<td>O</td>
<td>X</td>
<td>--</td>
</tr>
<tr>
<td>Customer-wired</td>
<td>O</td>
<td>O</td>
<td>--</td>
</tr>
</tbody>
</table>

- X Must be carried out by the customer
- O Already wired
- -- Not present

The following working steps are described in section 6:

- Remove the slip ring assembly.
- Connect the permanently routed cable to the brush holders.
- Connect the reeling cable to the slip rings.
- Connect the reeling cable in the terminal strip cable enclosure.
- Wind the reeling cable on the reel body.
- Electrical installation of the device by the customer.
8.1 Layout of the slip ring assembly (example)

Figure 13 Slip ring assembly

1 Hexagon nut, flat disc, spring ring
2 Brush holder phase
3 Brush holder PE
4 Insulating pipe
5 Insulating pipe
6 Pipe
7 Brush bolts
8 Hexagon nut, flat disc, spring ring
9 Insulating pipe
10 Slip ring phase
11 Insulating pipe
12 Slip ring bolts
13 Slip ring PE
14 Slip ring carrier
8.2 Spiral version

8.2.1 Removing the brush holder from the slip ring assembly

1. Remove the covering hood (→ 15.1.1, item 16, page 50) on the cable enclosure (item 12).
2. Disconnect the wires of the permanently routed cable on all brush holders (→ 8.1, items 2 & 3, page 26).
3. Remove the hexagon nuts, flat discs and spring rings (→ item 1) from the brush bolts of the brush holders (→ item 7).
4. Loosen the clamping screws on the brush holders (→ items 2 & 3).
5. Remove the brush holder phase (→ item 2).
6. Remove the brush holder phase insulating pipes (→ items 4 & 5).
7. Remove the brush holder PE (→ item 3).
8. Remove the brush holder PE brass pipe (→ item 6).
9. Remove the brush bolts from the brush device (→ item 7).
10. Remove the hexagon nuts, flat discs and spring rings (→ item 8) from the slip ring bolts (→ item 12) of the slip ring carrier (→ item 14).
11. Remove the short insulating pipes (→ item 9), slip rings phase (→ item 10) and long insulating pipes (→ item 11).

8.2.2 Connecting the permanently routed cable to the brush holders

ATTENTION

Make sure that the connected wires do not touch any other parts during the rotation movement.
Use insulated cable shoes or retrofit insulation.

✓ The covering hood has been removed.
✓ Brush holders are mounted
1. Loosen the cable screw connection (→ 15.1.1, item 13, page 50) on the cable enclosure.
2. Insert the permanently routed cable through the cable screw connection from the outside to the inside.
3. Strip the permanently routed cable in accordance with the required connection length.
4. Strip the ends of all wires and fit them with insulated cable lugs.
5. Connect all wires to the brush holders (→ 8.1, items 2 & 3, page 26). The first brush holder as viewed from the hollow shaft is the PE brush holder (→ item 3).
6. Check the continuity of the PE connection.
7. Check the continuity of the phases and all other connections.
8. Tighten the cable screw connection (→ 15.1.1, item 13, page 50) on the cable enclosure (→ item 13). In this way, the cable tension is removed and the slip ring room is sealed against the ingress of moisture and dust.
9. Install the covering hood.
8.2.3 Connecting the reeling cable to the slip rings

ATTENTION

ówi Install the slip ring assembly when connecting the reeling cable so that the wires on the slip rings are always offset by 120° from the neighbouring wires after the connection has been made (→ Figure 14, page 28).

⚠ Ensure that the minimum bending radius of the reeling cable does not undershoot the specification before inserting it into the hollow shaft.

Figure 14 Connections on the slip rings are offset by 120°

1 Connection slip ring PE
2 Connection slip ring phase
3 Connection slip ring phase
4 Connection slip ring phase
Figure 15 Routing the reeling cable for connection to the slip rings

1. Strain relief clamp, reeling cable pull-down direction to the left
2. Strain relief clamp, reeling cable pull-down direction to the right

✓ The covering hood has been removed.
✓ The slip ring assembly has been removed.
1. Guide the reeling cable along the drum body to the cross spoke on the reel body.
2. Guide the reeling cable through the strain relief clamp, cable screw connection and hollow shaft in the cable enclosure.
3. Strip the cable in accordance with the required connection length.
4. Strip the cable ends of the wires and fit them with ring cable lugs.
5. Connect the PE wire to the PE slip ring with the provided brass screw (→ 8.1, item 13, page 26).
6. Connect the phase wires to the phase slip rings (→ item 10) while the slip ring assembly is being assembled.
7. Check the continuity of the PE connection.
8. Check the continuity of the phases and all other connections.
9. Number the connections on the slip rings and wires of the permanently routed cable if required.
10. Screw on the strain relief clamp.
11. Tighten the cable screw connection on the hollow shaft.
12. Install the covering hood on the cable enclosure.
8.2.4 Connecting the reeling cable to the terminal strip

**ATTENTION**

Ensure that the minimum bending radius of the reeling cable does not undershoot the specification before inserting it into cable screw connection on the terminal strip cable enclosure.

![Diagram of routing the reeling cable](image)

1. Strain relief clamp, reeling cable pull-down direction to the left
2. Strain relief clamp, reeling cable pull-down direction to the right
3. The slip rings are connected to the terminal strip inside the device by a cable.
4. The cover has been removed.
5. Loosen the cable screw connection on the terminal strip cable enclosure (→15.1.1, item 7, page 50).
6. Guide the reeling cable along the drum body to the cross spoke on the reel body.
7. Guide the reeling cable through the strain relief clamp (item 6) and cable screw connection (8) into the terminal strip cable enclosure.
8. Strip the cable in accordance with the required connection length.
9. Strip the cable ends of all wires and fit them with insulated ring cable lugs if required (consult customer service).
10. Connect all wires to the terminal strip in accordance with the assembly.
11. Check the continuity of the PE connection.
12. Check the continuity of the phases and all other connections.
13. Screw on the strain relief clamp.
14. Tighten the cable screw connection on the terminal strip cable enclosure. In this way, the cable tension is removed and the reel body interior is sealed against the ingress of moisture and dust.
15. Install the cover.
8.3 Cylindrical version

8.3.1 Removing the slip ring assembly

1. Remove the covering hood (→ 15.1.2, page 51, item 13) from the reel body (item 5).
2. Disconnect the wires of the permanently routed cable on all brush holders (→ 8.1, items 2 & 3, page 26).
3. Remove the hexagon nuts, flat discs and spring rings (→ item 1) from the brush bolts of the brush holders (→ item 7).
4. Loosen the clamping screws on the brush holders (→ items 2 & 3).
5. Remove the brush holder phase (→ item 2).
6. Remove the brush holder phase insulating pipes (→ items 4 & 5).
7. Remove the brush holder PE (→ item 3).
8. Remove the brush holder PE brass pipe (→ item 6).
9. Remove the brush bolts from the brush device (→ item 7).
10. Remove the hexagon nuts, flat discs and spring rings (→ item 8) from the slip ring bolts (→ item 12) of the slip ring carrier (→ item 14).
11. Remove the short insulating pipes (→ item 9), slip rings phase (→ item 10) and long insulating pipes (→ item 11).

8.3.2 Connecting the permanently routed cable to the brush holders

**ATTENTION**

⇒ Make sure that the connected wires do not touch any other parts during the rotation movement.
⇒ Use insulated cable shoes or retrofit insulation.

✓ The covering hood has been removed.
1. Loosen the cable screw connection (→ 15.1.2, item 10, page 51) on the cable enclosure.
2. Insert the permanently routed cable through the cable screw connection from the outside to the inside.
3. Strip the permanently routed cable in accordance with the required connection length.
4. Strip the ends of all wires and fit them with insulated cable lugs.
5. Connect all wires to the brush holders (→ 8.1, items 2 & 3, page 26). The first brush holder as viewed from the hollow shaft is the PE brush holder (→ item 3).
6. Check the continuity of the PE connection.
7. Check the continuity of the phases and all other connections.
8. Tighten the cable screw connection (→ 15.1.2, item 10, page 51) on the cable enclosure (→ item 9, page 51). In this way, the cable tension is removed and the slip ring room is sealed against the ingress of moisture and dust.
9. Install the covering hood.
8.3.3 Connecting the reeling cable to the slip rings

ATTENTION

Install the slip ring assembly when connecting the reeling cable so that the wires on the slip rings are always offset by 120° from the neighbouring wires after the connection has been made (→ Figure 17, page 32).

Ensure that the minimum bending radius of the reeling cable does not undershoot the specification before inserting it into the hollow shaft.

Figure 17 Connections on the slip rings are offset by 120°

1 Connection slip ring PE
2 Connection slip ring phase
3 Connection slip ring phase
4 Connection slip ring phase
Figure 18 Routing the reeling cable for connection to the slip rings

- The cover has been removed.
- The covering hood has been removed.
- The slip ring assembly has been removed.

1. Loosen the cable screw connection in the reel body.
2. Route the reeling cable on the reel body (→ 15.1.2, item 5, page 51) all the way to the cable entry.
3. Insert the reeling cable through the cable screw connection (item 6) into the hollow shaft and on to the cable enclosure (item 9).
4. Strip the cable in accordance with the required connection length.
5. Strip the cable ends of the wires and fit them with ring cable lugs.
6. Connect the PE wire to the PE slip ring with the provided brass screw (→ 8.1, item 13, page 26).
7. Connect the phase wires to the phase slip rings (→ item 10) while the slip ring assembly is being assembled.
8. Check the continuity of the PE connection.
9. Check the continuity of the phases and all other connections.
10. Number the connections on the slip rings and wires of the permanently routed cable if required.
11. Tighten the cable screw connection. In this way, the cable tension is removed and the reel body interior is sealed against the ingress of moisture and dust.
12. Install the covering hood.
13. Install the cover.
8.3.4 Connecting the reeling cable to the terminal strip

**ATTENTION**

Ensure that the minimum bending radius of the reeling cable does not undershoot the specification before inserting it into the cable screw connection.

---

Figure 19 Routing the reeling cable for connection to the terminal strip

- Slip rings are connected to the terminal strip inside the device by a cable.
- The cover has been removed.

1. Loosen the cable screw connection in the reel body.
2. Guide the reeling cable up to the cable entry on the reel body (→ 15.1.2, item 5, page 51).
3. Guide the reeling cable through the reel body cable screw connection (item 6) into the inside of the reel body.
4. Strip the cable in accordance with the required connection length.
5. Strip the cable ends of all wires and fit them with insulated ring cable lugs if required (consult customer service).
6. Connect all wires to the terminal strip in accordance with the assembly.
7. Check the continuity of the PE connection.
8. Check the continuity of the phases and all other connections.
9. Tighten the cable screw connection in the reel body. In this way, the cable tension is removed and the reel body interior is sealed against the ingress of moisture and dust.
10. Install the cover.
8.4 Placing the reeling cable on the reel body

---

**DANGER**

Tipping loads

- Use an untippable cable unwinder with a reel brake.
- Ensure the cable reel is fitted securely on the cable unwinder before starting the winding process.
- Keep a minimum distance of 5 m between the cable reel (cable for winding) and the reel body of the device.

---

Figure 20 Example of an untippable cable unwinder with reel brake

---

**ATTENTION**

- In addition to the required cable length, use two extra safety windings for strain relief. The safety windings must always stay on the reel body when the device is being operated.

---

- The reeling cable is connected to the device.
- Distance a is at least 5 m (→ Figure 21, page 36).
- Under strain, wind the reeling cable layer by layer in a parallel and twist-free manner (→ Figure 22 & Figure 23, page 36).
- Secure the cable end of the reeling cable on the already placed cable with cable ties.
Exchanging the reeling cable

ATTENTION

During cable replacement, the reel body remains on the device and in its installation location.

The following aids can be useful during cable replacement:

- Crane with work cage/platform
- Lifting equipment for the cable
- Feed-in box on drive with pendant control panel for touch control mode
- Clamp mountings with eyelet
- Cable pulling grip

At least four people are required for cable replacement at a great height:

- One person controls the feed-in box on the drive by means of the pendant control panel for touch control mode.
- One person is on the slip ring assembly side.
- Two people are on the opposite side.
9 Placing the device into operation

**ATTENTION**

- Listen and watch out for bearing noise and vibration during the commissioning of the device.
- Make sure that the cable is pulled off and wound correctly.
- During the operation of the unit, two safety windings for strain relief must always remain on the reel body.

- The cable route is clear of obstacles.
- The tightening torques of the screw connections on the gear base or gear plate have been checked.

- Unwind or wind the cable at reduced speed (manual mode) or in operating conditions.

**Check the following when unwinding and winding the reeling cable:**

- Parallel winding of the reeling cable onto the reel body.
- Taut position of cable on reel body.
- Cable tensile force during the winding and unwinding of the reeling cable (→ Figure 24, page 37).

![Figure 24 Cable tensile force when unwinding and winding the reeling cable](image)

10 Device decommissioning and removal

**DANGER**

**Electric current**

*Electric shock*

- The electrical installation and work on electrical parts may only be carried out by a qualified electrician.
- Disconnect the mains voltage from the device and the higher-level system (all pole disconnection), secure them against unintended reactivation and establish a voltage-free state.
- Observe EN, VDE, and locally applicable safety regulations.

**Swinging or falling loads.**

*Injury or property damage.*

- Never walk, stand or sit under swinging loads.
- Never stand between the load and a wall.

1. Remove the reeling cable from the device.
2. Attach the device to suitable lifting equipment using a round loop (→ Figure 12, page 23).
3. Tighten the round loop and maintain its tension.
4. Remove the device from the fixing flange.
5. Lift the device onto a pallet for transport using a lifting cart and secure the device.
11 Disposal and recycling

► The components, cables and packaging materials of the device must be reused or disposed of correctly in accordance with locally applicable regulations.

12 Maintenance

**DANGER** Electric current

Electric shock

► The electrical installation and work on electrical parts may only be carried out by a qualified electrician.

► Disconnect the mains voltage from the device and the higher-level system (all pole disconnection), secure them against unintended reactivation and establish a voltage-free state.

► Observe EN, VDE, and locally applicable safety regulations.

**DANGER** Swinging or falling loads.

Injury or property damage.

► Never walk, stand or sit under swinging loads.

► Never stand between the load and a wall.

12.1 Regular repeat checks and inspections during operation

1. Inspect the unit for visible damage.
2. Check the screw connections.
3. Listen and watch out for bearing noise and vibration.
4. Check the electrical insulation of the cables.

• Do not use equipment that is faulty until all defects have been corrected.
• Remedy all defects and their causes immediately.

12.2 Cleaning and care

**ATTENTION**

☞ A heater prevents condensation in the slip ring room (→ 16.10, page 59).
☞ Do not use any cleaning agents that chafe or contain acids or chlorine!
☞ Do not use compressed air to clean the slip ring room.

► Wipe the external surfaces of the device with a moist cloth or a mild cleaning agent (detergent, neutral cleaning agent).
► To clean the slip ring enclosure, remove the covering hood and use an industrial vacuum cleaner.
► Remove any moisture from the slip ring room with a clean cloth.
### 12.3 Maintenance intervals

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Initial Interval</th>
<th>Further Intervals</th>
<th>1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Reel body check</td>
<td>1 week</td>
<td>6 months</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Tight fit of all screw connections</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Clean cable winding and unwinding</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>• Running noise and vibration</td>
<td></td>
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<tr>
<td>2</td>
<td>Drive check</td>
<td>1 week</td>
<td>6 months</td>
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</tr>
<tr>
<td></td>
<td>• Tight fit of all screw connections</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Running noise and vibration</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>3</td>
<td>Check of gear oil fill level (→ 14.3.4, page 43)</td>
<td>Following commissioning</td>
<td>monthly</td>
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<tr>
<td>4</td>
<td>Slip ring rotary joint check</td>
<td>1 week</td>
<td>6 months</td>
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<td>• Tight fit of all wire screw connections</td>
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<tr>
<td></td>
<td>• Wear limit of brush holders2) (→ 17.1.2, page 60)</td>
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<td></td>
<td>(The data of the slip ring assembly is indicated on the rating plate, e.g. 36 amperes.)</td>
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<td></td>
<td>• Mobility of the brush holders</td>
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<td></td>
<td>• Contact pressure between the brush holders and slip rings2)</td>
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<tr>
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<td>• Dirt (→ 12.2, page 38)</td>
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<td>• Condensation/moisture (→ 12.2, page 38)</td>
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<td></td>
<td>• Electrical insulation</td>
<td></td>
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<tr>
<td></td>
<td>• Continuity of the PE protective earth conductor system (→ 4.7.2, page 12).</td>
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<tr>
<td>5</td>
<td>Cable check</td>
<td>1 week</td>
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<td>• Insulation of all cables</td>
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<tr>
<td></td>
<td>• Tight fit of all wire screw connections on the fixed point</td>
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<td>• Tight fit of all wire screw connections of the cable which has been permanently routed by the customer</td>
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<td>• Function/condition of all strain reliefs (cable pulling grip, cable entry guide etc.)</td>
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<tr>
<td></td>
<td>• Deposit roller fixation</td>
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<tr>
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<td>• Clean course of cable</td>
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</tbody>
</table>

1) Based on 40 operating hours per week. For a higher number of operating hours, the maintenance interval must be shortened appropriately.
2) If a brush holder has reached the wear limit, always check how the two complete brush holders press onto the slip ring. To ensure the secure transmission of electricity/data, exchange the entire brush holder if required.
13 Detecting and remedying faults

Contact the customer service centre with regard to the warranty and repairs.

<table>
<thead>
<tr>
<th>Fault description</th>
<th>Cause</th>
<th>Action(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No winding of the reeling cable.</td>
<td>The reel body rotates on its axle. The feather key on the axle is missing or broken.</td>
<td>Contact customer service. Install or exchange the feather key.</td>
</tr>
<tr>
<td></td>
<td>The application is not suitable for the configuration of the device.</td>
<td>Contact customer service.</td>
</tr>
<tr>
<td></td>
<td>Faulty drive part(s).</td>
<td>Contact customer service.</td>
</tr>
<tr>
<td>The reeling cable does not wind neatly.</td>
<td>The reel body and the cable routing are misaligned.</td>
<td>Align the cable route (→ 5.6.3, page 22).</td>
</tr>
<tr>
<td></td>
<td>The hollow shaft is not precisely horizontal or perpendicular to the unwinding/winding direction.</td>
<td>Align the device.</td>
</tr>
<tr>
<td></td>
<td>The reeling cable has not been placed in a twistfree manner or has become twisted.</td>
<td>Untwist reeling cable. If the cable cannot be untwisted, exchange the reeling cable.</td>
</tr>
<tr>
<td>The reeling cable unwinds automatically when the motor is stopped.</td>
<td>Return stop is faulty. Motor brake is faulty.</td>
<td>Contact customer service.</td>
</tr>
<tr>
<td>Faults in the transmission of the electrical current/data.</td>
<td>Loose screw connections on the slip rings or brush holders.</td>
<td>Check the screw connections on the brush holders and slip rings and re-tighten them if required.</td>
</tr>
<tr>
<td></td>
<td>Very dirty brush holders or slip rings.</td>
<td>Clean any dirty parts with contact spray.</td>
</tr>
<tr>
<td></td>
<td>Carbons are worn.</td>
<td>Exchange the brush holders.</td>
</tr>
<tr>
<td></td>
<td>High moisture levels in the cable enclosure. Stationary heater is missing or faulty.</td>
<td>Install stationary heater. Repair or exchange the stationary heater. Retrofit ventilation. Exchange the faulty seal.</td>
</tr>
<tr>
<td></td>
<td>The device is exposed to unusual vibrations.</td>
<td>Level uneven travel ways. Eliminate any strong vibrations in the direct vicinity caused by other machinery.</td>
</tr>
<tr>
<td>Interruption of the power/data transmission.</td>
<td>Flashover between phase and PE.</td>
<td>Switch off device. Contact customer service.</td>
</tr>
<tr>
<td></td>
<td>One (several) open electrical connection(s).</td>
<td>Check connection(s) for continuity. Establish connection(s).</td>
</tr>
</tbody>
</table>

14 Drive components

14.1 Motor

14.1.1 Maintenance

⚠️ DANGER

Unintentional start-up of drive.

Injury or property damage

- Disconnect the mains voltage from the device and the higher-level system (all pole disconnection), secure them against unintended reactivation and establish a voltage-free state.
- Observe EN, VDE, and locally applicable safety regulations.

⚠️ ATTENTION

- Property damage from incorrect maintenance.
- Maintenance may only be carried out by qualified and trained personnel.
Observe the fundamental safety instructions during maintenance (→ 4.6, page 11).

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Initial Interval</th>
<th>Further intervals</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Check the smoothness of the motor (bearing noises).</td>
<td>3 months</td>
<td>12 months</td>
</tr>
<tr>
<td>2</td>
<td>Check all screw connections on the terminal board for tight fit (→ 15.1.4, page 59).</td>
<td>3 months</td>
<td>12 months</td>
</tr>
<tr>
<td>3</td>
<td>Check motor for leakages (oil, lubricating grease, water).</td>
<td>3 months</td>
<td>3 months</td>
</tr>
<tr>
<td>4</td>
<td>Use dry compressed air to remove any dirt from the entire surface.</td>
<td>3 months</td>
<td>12 months</td>
</tr>
<tr>
<td>5</td>
<td>Remove any dirt from the condensate drain holes.</td>
<td>3 months</td>
<td>As required</td>
</tr>
<tr>
<td>6</td>
<td>Open closed condensate drain holes and then close them again.</td>
<td>3 months</td>
<td>As required</td>
</tr>
</tbody>
</table>

14.2 Permanent magnetic coupling

Other applicable document (→ see permanent magnetic coupling installation instructions)

14.3 Gears

14.3.1 Bevel gear designs

Symbols

- **Figure 25 Ventilation**
- **Figure 26 Oil fill level/oil inspection glass**
- **Figure 27 Oil drainage**
- **Figure 28 Oil filling**
- **Figure 29 M1**
- **Figure 30 M4**

14.3.2 Please observe the following before commissioning

Gears with long-term conservation are delivered completely filled with oil. For storage periods longer than 24 months, we recommend that you exchange the oil completely (→ 14.3.5, page 44).
Check the oil fill level and correct if required.

14.3.3 Checking the gear oil

### WARNING

Burns

Hot gear oil and extreme surface temperatures on gears.

- Allow the gear oil to cool down below +30 °C before working on the gears.
- Allow the surface of the gears to cool down before touching them.

### ATTENTION

Damage to/in the gears.

Damage due to incorrect oil volume in gears.

- For gear sizes up to and including size 5, the oil level may be up to 3 mm below the specified level and from gear size 6 upwards it may be up to 5 mm below the specified level.

#### Gearbox oil volumes

<table>
<thead>
<tr>
<th>Gearbox size</th>
<th>Design</th>
<th>M1</th>
<th>M4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (SK 9022)</td>
<td>1,3</td>
<td>3,8</td>
<td></td>
</tr>
<tr>
<td>2 (SK 9032)</td>
<td>1,8</td>
<td>6,8</td>
<td></td>
</tr>
<tr>
<td>3 (SK 9042)</td>
<td>4,4</td>
<td>10,7</td>
<td></td>
</tr>
<tr>
<td>4 (SK 9052)</td>
<td>6,5</td>
<td>21,5</td>
<td></td>
</tr>
<tr>
<td>5 (SK 9072)</td>
<td>10,0</td>
<td>36,0</td>
<td></td>
</tr>
<tr>
<td>6 (SK 9082)</td>
<td>17,0</td>
<td>71,5</td>
<td></td>
</tr>
</tbody>
</table>
14.3.4 Checking the gear oil

**WARNING**

Hot surface

Burns

⇒ Allow the gear oil to cool down below +30 °C before working on the gears.
⇒ Allow the surface of the gears to cool down before touching them.

**ATTENTION**

Damage to gears

⇒ Damage due to incorrect oil volume in gears.
⇒ You must observe the minimum prescribed oil volume.

Checking the oil fill level

**ATTENTION**

⇒ The volume of gear oil increases with rising temperatures. In the case of large temperature fluctuations, the fill volume can vary by several litres.
⇒ Thirty minutes after switching off the drive, check the oil fill level while the oil is still warm from operation.

![Figure 31 Oil fill level in the oil inspection glass](image)

The following oil fill levels of the gears are visible from the oil inspection glass (→ Figure 31, page 43):

- Oil fill level in the centre of the inspection glass ① if the gear oil has cooled down for 30 minutes after switching off the drive.
- When the drive has just been switched off, the oil fill level is above the centre of the inspection glass.
- The oil fill level is below the centre of the inspection glass when the gear oil has completely cooled down after switching off the drive.

5 Check the oil fill level from the oil inspection glass.
6 Correct the oil volume in the gears if required.
7 Re-check the oil volume from the oil inspection glass.

Checking the quality of the gear oil

Influences acting on the oil can be identified by means of a visual inspection. Fresh oil is visually clear, has a typical smell and a product-specific colour. Clouding or a flaky appearance indicates the presence of water and/or soiling. A dark or black colouration indicates residue formation, a strong thermal decomposition or soiling.

✔ The drive was switched on shortly, and therefore wear particles and contamination still float in the oil shortly after switching off.

1 De-energise the drive.
2 Remove the pressure release valve.
3 Extract a small amount of oil using a suction pump and a flexible hose.
4 Check the condition of the sealing ring on the closing element and exchange it if required.
5 Install the vent valve.
6 Check the quality of the gear oil. If abnormalities are detected, the oil must be exchanged immediately.
7 Check the oil fill level in the dismounted pressure release valve.
8 Correct the oil volume in the gears if required.
9 Check the oil fill level in the dismounted pressure release valve again.

14.3.5 Replacing the gear oil

**WARNING**

- **Mixing the gear oil.**
- Property damage to gears.
- The volume of residual oil in the gears must be kept as low as possible when changing the oil (same type of oil).
- Rinse the gears with the new gear oil when changing the oil (different type of oil, same quality).
- When switching from mineral oil to polyglycol (PG) or vice versa, the gears must be rinsed twice with the new gear oil.
- Do not mix the gear oil with other substances.
- Paraffin oil and other cleaning agents are not suitable for cleaning the gears, since residue is always left behind.

**ATTENTION**

- Information on the type, viscosity and volume of oil can be found on the performance plate on the gears.
- Let the drive run for about 15-30 minutes before replacing the oil so that the gear oil can optimally run out of the gears.

**Draining the oil**

1 De-energise the drive.
2 Remove the pressure release valve.
3 Remove the oil inspection glass.
4 Place a collection container under the locking screw.
5 Remove the locking screw to allow the oil to drain into the collection container.
6 Check the condition of the sealing ring on the closing element and exchange it if required.
7 Install the locking screw.
8 Install the pressure release valve.

**Rinsing the gears**

The gears must be rinsed twice before switching between two incompatible gear oils.

**ATTENTION**

- Clean oil must be used for each rinsing process.
- For rinsing, use either the new oil or a cheaper oil that is compatible with the new oil.

1 Remove the pressure release valve.
2 For rinsing, fill the gears completely with gear oil through a filling filter (filter pore size max. 25 μm).
3 Install the pressure release valve.
4 Let the drive run for about 15 to 30 minutes under low load.
5 Place a collection container under the locking screw.
6 Remove the locking screw.
Let all the gear oil drain into the collection container.
Install the locking screw.
Repeat work steps 2 to 9 for the second rinsing process.
Install the pressure release valve.

**Filling the oil**

1. Remove the pressure release valve.
2. Fill the gears with fresh oil using a filling filter (filter pore size max. 25 μm).
3. Check the oil fill level in the dismounted pressure release valve.
4. Correct the oil volume in the gears if required.
5. Check the oil fill level in the dismounted pressure release valve again.
6. Check the condition of the sealing ring on the closing element and exchange it if required.
7. Install the pressure release valve.

**Topping up the gear oil**

In the event of a leak/leaks, observe the following procedure:

1. Identify the position of the leak(s).
2. Seal the leak(s).
3. Check the oil fill level from the oil inspection glass.
4. Correct the oil volume in the gears if required.
5. Re-check the oil volume from the oil inspection glass.
6. Install the pressure release valve.

The following gear oil (CLP-PG-220 according to DIN 51 502) has been used for the initial filling of the gearbox:

14.3.6 Checking the gears for leaks

~~ ATTENTION ~~- For functional reasons, oil mist might escape from a pressure release valve or labyrinth seal.
- During the first 24 operating hours of the gear run-in phase, minor quantities of oil can escape on the shaft sealing ring.

In the case of larger leaks or leaks that last when the run-in phase has finished, contact customer service in order to avoid follow-on damage.
A shaft sealing ring is subject to natural wear. The service life depends on the usage conditions.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Description</th>
<th>Action(s)</th>
<th>Note(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture film on shaft sealing ring.</td>
<td>Moisture film for functional reasons (apparent leak).</td>
<td>Wipe the moisture film with a clean cloth and keep it under observation.</td>
<td>There is no fault. The shaft sealing ring dries up during further operation.</td>
</tr>
<tr>
<td>Leak on shaft sealing ring.</td>
<td>A small trickle is visible. Formation of drops after the runin phase.</td>
<td>Contact customer service.</td>
<td>During the run-in phase, the shaft sealing ring engages in the shaft. A visible running track is visible on the shaft. Optimal sealing conditions are created after the runin phase.</td>
</tr>
</tbody>
</table>
14.3.7 Disposal and recycling

**CAUTION**

**Gear oil**

Damage to health and the environment due to improper disposal.

- Avoid contact with the skin.
- Wear safety gloves and goggles.
- Collect and eliminate any spilled gear oil by means of an oil binder.
- Store and dispose of gear oils in accordance with waste codes.

- Dispose of media that can endanger health and the environment such as gear oils in accordance with local regulations.
- The device components and packaging materials must be reused or disposed of correctly in accordance with local laws and regulations.

<table>
<thead>
<tr>
<th>Type of oil</th>
<th>Description</th>
<th>Waste code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mineral oil</td>
<td>CLP ISO VG220</td>
<td>130205</td>
</tr>
<tr>
<td>Polyglycols</td>
<td>CLP ISO PG VG220</td>
<td>130208</td>
</tr>
<tr>
<td></td>
<td>CLP ISO PG VG460</td>
<td></td>
</tr>
<tr>
<td>Poly-alpha-olefins</td>
<td>CLP ISO PAO VG68</td>
<td>130206</td>
</tr>
<tr>
<td></td>
<td>CLP ISO PAO VG220</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CLP ISO H1 VG460</td>
<td></td>
</tr>
<tr>
<td>Biodegradable oils</td>
<td>CLP ISO E VG220</td>
<td>130207</td>
</tr>
</tbody>
</table>

14.3.8 Maintenance

**DANGER**

Unintentional start-up of drive.

- Disconnect the mains voltage from the device and the higher-level system (all pole disconnection), secure them against unintended reactivation and establish a voltage-free state.
- Observe EN, VDE, and locally applicable safety regulations.

**WARNING**

Incorrect maintenance

Property damage

- Maintenance may only be carried out by qualified and trained personnel.
- Only use original parts and recommended gear oils (consult customer service).

Observe the fundamental safety instructions during maintenance (→ 4.6, page 11).
<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>First interval</th>
<th>Further intervals</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Check the drive for conspicuous noises, vibrations and changes.</td>
<td>Following commissioning</td>
<td>6 months</td>
</tr>
<tr>
<td>2</td>
<td>Check that the fixing screws of the gears and attached components are tight. Check covers and sealing plugs for secure attachment.</td>
<td>Following commissioning</td>
<td>6 months</td>
</tr>
<tr>
<td>3</td>
<td>Check oil fill level (→ 14.3.4, page 43).</td>
<td>Following commissioning</td>
<td>Every 3,000 operating hours</td>
</tr>
<tr>
<td>4</td>
<td>Check the consistency of the oil (→ 14.3.4, page 43).</td>
<td>6 months</td>
<td>6 months</td>
</tr>
<tr>
<td>5</td>
<td>Oil replacement (→ 14.3.5, page 44).</td>
<td>25,000 operating hours, at the latest after 5 years</td>
<td>25,000 operating hours, at the latest after 5 years</td>
</tr>
<tr>
<td>6</td>
<td>Check gears for leaks (→ 14.3.6, page 45).</td>
<td>Following commissioning</td>
<td>6 months</td>
</tr>
<tr>
<td>7</td>
<td>Clean or exchange the pressure release valve.</td>
<td>Clean monthly, exchange annually</td>
<td>Clean monthly, exchange annually</td>
</tr>
</tbody>
</table>

This information applies to an oil temperature of +80 °C. The maintenance intervals depend on operating conditions such as pollution/dust loads, the absolute number of revolutions and the top speed. The first two intervals should be observed. The owner can then adjust the intervals as seems appropriate. The purpose of the maintenance tasks is to maintain the safe functioning of the device and to ensure its long service life.

14.3.9 Detecting and remedying faults

**ATTENTION**

➤ Only our service centre is permitted to perform repairs on the gears if faults occur during the term and scope of the warranty that require repairs.

➤ In the event of faults whose cause cannot be clearly identified, we recommend that our customers take advantage of our customer service centre, even if the term and scope of the warranty has expired.

Our customer service centre requires the following information:

- Serial number of the motorised cable reel (→ 5.7, page 22).
- Type and extent of the fault
- Suspected cause
<table>
<thead>
<tr>
<th>Fault description</th>
<th>Cause</th>
<th>Action(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unusual noises coming from gears</td>
<td>Oil fill level is too low.</td>
<td>Check the oil fill level (→ 14.3.4, page 43).</td>
</tr>
<tr>
<td></td>
<td>Oil contains foreign matter (uneven noise).</td>
<td>Check the consistency of the oil, rinse the gears, change the gear oil (→ 14.3.5, page 44).</td>
</tr>
<tr>
<td></td>
<td>Increased bearing play/damaged bearings.</td>
<td>Contact customer service.</td>
</tr>
<tr>
<td></td>
<td>Damaged gear teeth.</td>
<td>Contact customer service.</td>
</tr>
<tr>
<td></td>
<td>The fixing screws are not tightened properly.</td>
<td>Tighten the screws and nuts.</td>
</tr>
<tr>
<td></td>
<td>Transport damage</td>
<td>Check the gears for transport damage.</td>
</tr>
<tr>
<td></td>
<td>Damage due to a blockage during commissioning.</td>
<td>Contact customer service.</td>
</tr>
<tr>
<td>Unusual noise from the drive unit</td>
<td>Drive unit bearings are not lubricated.</td>
<td>Check the oil fill level (→ 14.3.4, page 43).</td>
</tr>
<tr>
<td></td>
<td>Increased bearing play and/or damaged bearings.</td>
<td>Contact customer service.</td>
</tr>
<tr>
<td></td>
<td>The fixing screws are not tightened properly.</td>
<td>Tighten the screws and nuts.</td>
</tr>
<tr>
<td>Unusual noise from the motor</td>
<td>Increased bearing play and/or damaged bearings.</td>
<td>Contact customer service.</td>
</tr>
<tr>
<td></td>
<td>The parameter settings of the converter are incorrect</td>
<td>Correct the parameter settings of the converter.</td>
</tr>
<tr>
<td>Fault description</td>
<td>Cause</td>
<td>Action(s)</td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>-----------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Oil leak</td>
<td>Too much pressure due to missing pressure release valve.</td>
<td>Install the pressure release valve.</td>
</tr>
<tr>
<td></td>
<td>Too much pressure due to dirty pressure release valve.</td>
<td>Clean the pressure release valve.</td>
</tr>
<tr>
<td></td>
<td>Shaft seals are damaged.</td>
<td>Contact customer service.</td>
</tr>
<tr>
<td></td>
<td>Cover/flange screws are not tightened properly.</td>
<td>Tighten the screws and nuts. Keep the gears under observation.</td>
</tr>
<tr>
<td></td>
<td>Transport damage (e.g. hairline cracks)</td>
<td>Check the gears for transport damage.</td>
</tr>
<tr>
<td>Oil leak from the gear ventilation</td>
<td>Frequent cold starts with foaming oil.</td>
<td>Contact customer service.</td>
</tr>
<tr>
<td>Increased play on drive/output unit</td>
<td>Elastic elements are worn (e.g. in the case of couplings).</td>
<td>Contact customer service.</td>
</tr>
<tr>
<td></td>
<td>Positive connection disconnected by overload.</td>
<td>Contact customer service.</td>
</tr>
<tr>
<td>Gears get too hot.</td>
<td>The fan hood of the motor and/or gears are heavily soiled.</td>
<td>Clean the fan hood and the surface of the gear motor.</td>
</tr>
<tr>
<td></td>
<td>Wrong oil has been used (e.g. wrong viscosity).</td>
<td>Check the consistency of the oil (→ 14.3.4, page 43).</td>
</tr>
<tr>
<td></td>
<td>The gear oil is too old.</td>
<td>Check when the oil was last exchanged; exchange the oil if required (→ 14.3.5, page 44).</td>
</tr>
<tr>
<td></td>
<td>Increased bearing play and/or damaged bearings.</td>
<td>Contact customer service.</td>
</tr>
<tr>
<td></td>
<td>Power flow interrupted due to breakage on gears.</td>
<td>Contact customer service.</td>
</tr>
<tr>
<td>Output shaft does not rotate when the motor is running.</td>
<td>Excessively high load on drive/output unit.</td>
<td>Contact customer service.</td>
</tr>
<tr>
<td>Drive does not start or starts with difficulty.</td>
<td>Motor brake is not ventilated.</td>
<td>Contact customer service.</td>
</tr>
<tr>
<td></td>
<td>The drive hits the return stop.</td>
<td>Contact customer service.</td>
</tr>
</tbody>
</table>
15 Spare parts drawings

► Please specify the name of the spare part and the serial no. (SN) of the device when ordering spare parts.
   The SN is shown on the rating plate of the device (→ 5.7, page 22).

15.1 Motorised cable reel

15.1.1 Spiral version

1 Gears
2 Permanent magnetic coupling
3 Motor
4 Reel flange
5 Reel body
6 Strain relief clamp
7 Terminal strip housing
8 Cable screw connection
9 Terminal strip
10 Terminal strip housing cover
11 Terminal strip housing lock ring
12 Cable enclosure
13 Cable screw connection
14 Stationary heater
15 Slip ring rotary joint
16 Covering hood
17 Lock ring
15.1.2 Cylindrical version

1  Gears with gear plate
2  Permanent magnetic coupling
3  Motor
4  Reel flange
5  Reel body
6  Cable screw connection
7  Terminal strip
8  Cover
9  Cable enclosure
10 Cable screw connection
11 Stationary heater
12 Gearbox cam limit switch
13 Covering hood
14 Lock ring
15.2 Slip ring rotary joint (example)

ATTENTION

⇒ When replacing the brush holder, it is recommended that you exchange the corresponding insulating pipe at the same time. Our customer service centre will provide you with further information when you order spare parts.

1 Slip ring carrier
2 Slip ring PE 60 A
3 Slip ring phase 60 A
4 Brush holder PE 60 A
5 Brush holder phase 60 A
6 Slip ring phase 36A
7 Brush holder phase 36 A
8 Gearbox cam limit switch (optional)
16 Accessories

16.1 Spooling device

In cylindrically winding reel bodies, the spooling device is recommended for accurate winding of the reeling cable. Proper function is ensured by means of a diamond screw or by means of a roller chain with running carriage, in the case of large reel bodies.

16.2 Gearbox cam limit switch

The gearbox cam limit switch monitors the amount of cable on the reel body. The gearbox cam limit switch turns the drive off when the cable has been fully wound up or unwound. (Two safety windings always remain on the reel body to relieve the strain from the reel body.) The component is located either in the cable enclosure (a) or in its own housing, and is driven by a stainless steel chain (b). The component does not fulfil the function of an emergency off/emergency stop system.
16.3 Cable pulling grip

Figure 35 cable pulling grip

The cable pulling grip is aligned to the cable diameter. It ensures the strain relief of the reeling cable at the fixed point. The cable pulling grip distributes the strain relief across an area, thereby preventing any point loads. The cable pulling grip is designed with three times the maximum tensile force of a conventional strain relief device. The cable pulling grip is only suitable for horizontal unwinding.

16.4 Roller payout guide

Figure 36 Roller payout guide

The roller payout guide is used to deflect the cable in two directions. Typical areas of application include systems where the cable is deposited parallel to the travel axis and systems that use a central feed. There are several types:

- RUT type without slack and tight cable monitoring
- RUTS type with slack cable monitoring
- RUTS ST type with slack and tight cable monitoring

All roller payout guides with a monitoring function can be fitted with contact-free proximity switches or mechanical limit switches.

Proximity switch connection voltage: 15 – 250 VAC or 15 30 VDC
16.5 Double deflection rollers

Figure 37 UD type series

A double deflection roller is used for spiral-winding cable reels. It is used to deflect the cable which comes from the cable reel mounted above. Double deflection rollers are also used when passing the feed point.

Figure 38 UDQ type series

A double deflection roller with a lateral roller is used for cylindrically winding cable reels. It is used to deflect the cable which comes from the cable reel mounted above. Double deflection rollers are also used when passing the feed point.
16.6 Deflection and guide rollers

Deflection and guide rollers are used when the cable cannot be unwound directly from the cable reel. The roller diameter must be at least 15 times the cable diameter.
16.7 Cable deposit roller

Figure 41 Cable deposit roller

The cable deposit roller is used to minimise the contact between the cable and the ground. This prevents the cable from being soiled or getting damaged.

16.8 Cable entry guide

Figure 42 Type series ULTV up to a maximum of 1 kV cables

The ULTV cable entry guide is used for cable entry and strain relief at the feed point of cables up to a maximum of 1 kV. The ULTV cable entry guide is available in several sizes.
The ULTV-H cable entry guide is used for cable entry and strain relief at the feed point of cables up to a maximum of 24 kV. The ULTV-H cable entry guide is available in several sizes.

### 16.9 Deflection horn

The deflection horn prevents the cable from kinking when the feed point is passed. The deflection horn is aligned to the middle of the cable reel. The deflection horn may only be used for cable reels without a spooling device and link chain.
16.10 Stationary heater

A thermally controlled stationary heater with various output levels can be installed in the cable enclosure. At low temperatures or if there are large temperature fluctuations within a short period of time, we recommend the installation of a stationary heater. The heater must always be switched on when the device is in continuous operation.

17 Appendix

17.1 Screws and tightening torques

**ATTENTION**

- The faces of parts must be flush with the installation location when they are screwed into place.
- Exchange all grub screws that have become unusable with new ones of the same strength class.

### 17.1.1 Gear plate and fixing flange

<table>
<thead>
<tr>
<th>Thread size</th>
<th>Tightening torque, strength class 10.9 [Nm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>M 10</td>
<td>68</td>
</tr>
<tr>
<td>M 12</td>
<td>117</td>
</tr>
<tr>
<td>M 16</td>
<td>285</td>
</tr>
<tr>
<td>M 20</td>
<td>557</td>
</tr>
<tr>
<td>M 24</td>
<td>960</td>
</tr>
<tr>
<td>M 30</td>
<td>2100</td>
</tr>
<tr>
<td>M 36</td>
<td>3700</td>
</tr>
</tbody>
</table>
17.1.2 Slip ring assembly

<table>
<thead>
<tr>
<th>Thread size</th>
<th>Tightening torque [Nm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>M 3.5</td>
<td>0.8</td>
</tr>
<tr>
<td>M 4</td>
<td>1.2</td>
</tr>
<tr>
<td>M 5</td>
<td>2.0</td>
</tr>
<tr>
<td>M 6</td>
<td>3.0</td>
</tr>
<tr>
<td>M 8</td>
<td>6.0</td>
</tr>
<tr>
<td>M 10</td>
<td>10.0</td>
</tr>
<tr>
<td>M 12</td>
<td>15.5</td>
</tr>
<tr>
<td>M 16</td>
<td>30.0</td>
</tr>
</tbody>
</table>

17.1.3 Cable screw connection

The permanently routed reeling cable is guided through cable screw connections into the cable enclosure. The cable screw connections ensure the strain relief of the cable and seal the slip ring room against moisture and dust. The protection class is shown on the rating plate.

<table>
<thead>
<tr>
<th>Cable screw connection type</th>
<th>Cable diameter [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>M 20 x 1.5</td>
<td>8...13</td>
</tr>
<tr>
<td>M 25 x 1.5</td>
<td>11...17</td>
</tr>
<tr>
<td>M 32 x 1.5</td>
<td>15...21</td>
</tr>
<tr>
<td>M 40 x 1.5</td>
<td>19...28</td>
</tr>
<tr>
<td>M 50 x 1.5</td>
<td>26...35</td>
</tr>
<tr>
<td>M 63 x 1.5</td>
<td>32...56</td>
</tr>
<tr>
<td>M 75 x 1.5</td>
<td>42...58</td>
</tr>
<tr>
<td>M 80 x 2.0</td>
<td>50...70</td>
</tr>
</tbody>
</table>

17.1.4 Motor terminal board connections

<table>
<thead>
<tr>
<th>Thread size</th>
<th>Tightening torque [Nm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>M 4</td>
<td>1.0</td>
</tr>
<tr>
<td>M 5</td>
<td>2.2</td>
</tr>
<tr>
<td>M 6</td>
<td>3.5</td>
</tr>
<tr>
<td>M 8</td>
<td>7.0</td>
</tr>
<tr>
<td>M 10</td>
<td>11.0</td>
</tr>
<tr>
<td>M 12</td>
<td>17.0</td>
</tr>
<tr>
<td>M 16</td>
<td>34.0</td>
</tr>
</tbody>
</table>
17.2 Exchange brush holders

17.2.1 Establishing the wear limit of the carbons

Figure 47 Dimensions of the new (B) and worn carbon (A)

<table>
<thead>
<tr>
<th>Current strength [A]</th>
<th>Dimension A(^1) [mm]</th>
<th>Dimension B(^2) [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>26</td>
<td>12</td>
<td>18</td>
</tr>
<tr>
<td>32/36</td>
<td>12</td>
<td>18</td>
</tr>
<tr>
<td>40</td>
<td>9</td>
<td>13</td>
</tr>
<tr>
<td>42</td>
<td>9</td>
<td>13</td>
</tr>
<tr>
<td>60</td>
<td>14</td>
<td>20</td>
</tr>
<tr>
<td>125</td>
<td>14</td>
<td>20</td>
</tr>
<tr>
<td>150</td>
<td>14</td>
<td>20</td>
</tr>
<tr>
<td>220</td>
<td>16</td>
<td>25</td>
</tr>
<tr>
<td>265</td>
<td>16</td>
<td>25</td>
</tr>
<tr>
<td>500</td>
<td>16</td>
<td>25</td>
</tr>
</tbody>
</table>

\(^1\) When the wear limit A has been reached, exchange the brush holder.

\(^2\) Dimension for new brush holder