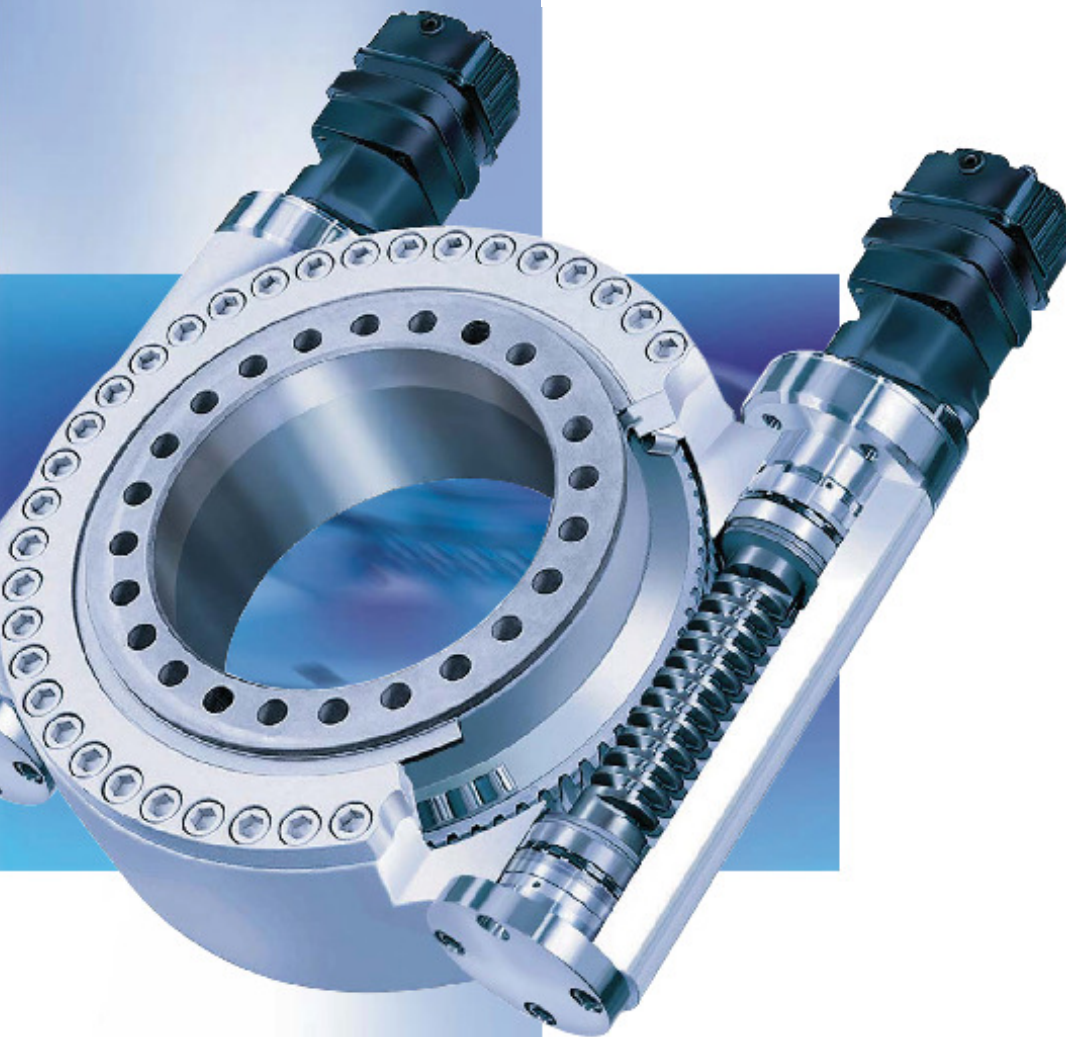


Installation and Operating Manual

Slew Drives

WD-L, WD-H, SP-L, SP-I, SP-M, SP-H



IO SD 1.00

Read the operating manual prior to starting all work!



This operating manual provides important instructions for working with the component. The specified instructions must be precisely followed, to protect yourself and others.

Inform yourself of the locally applicable accident prevention regulations and the general safety regulations.

The operating manual must be carefully read prior to starting any work! It is a component of the product and must be kept in the immediate vicinity of the component. It must be accessible to personnel at all times.

If this component is provided to a third party ensure that the operating manual is provided with the component.

The illustrations in this manual are provided for the purpose of better understanding. They are not necessarily true to scale and can deviate from the actual design of the component.

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1 Structure and function

1.1 Brief description

Slew drives are used for concurrent transmission of axial and radial forces, as well as transmission of tilting moments. Slew drives consist of a ball or roller slewing ring, hydraulic or electric drives, and a completely enclosing housing. Force is transmitted to the mounting structure through bolts. For this purpose through holes or threads are provided in the inner and outer ring.

1.2 Overview

Series WD slew drives are designed with worm gear. Series SP slew drives are designed with spur gear and straight toothing.

1.2.1 WD-L series (light series)

The lighter series is designated as the WD-L series. The drive motor (hydraulic/electric) is optional. Additional optional components are potentiometers, permanent brake or front-end brake.

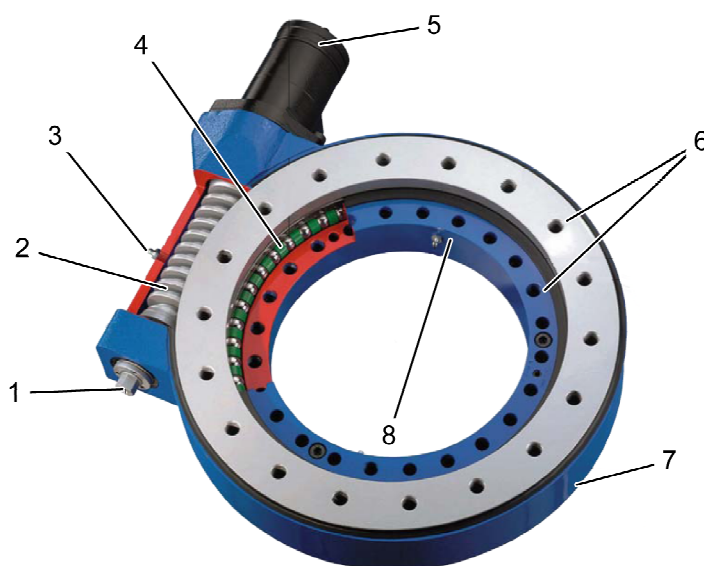


Fig. 1: Slew drive WD-L

- | | | | |
|---|---|---|--|
| 1 | Connection for options: Potentiometer, permanent brake or front-end brake | 5 | Option: Drive motor |
| 2 | Worm shaft | 6 | Bolted unions for the mounting structure |
| 3 | Lubricating nipple | 7 | Housing |
| 4 | Ball slewing ring | 8 | Lubricating nipple |

Structure and function

1.2.2 WD-H series (heavy series)

The heavy series is designated as the WD-H series. The drive motors (hydraulic/electric) are optional. Additional optional components are potentiometers, permanent brake or front-end brake.

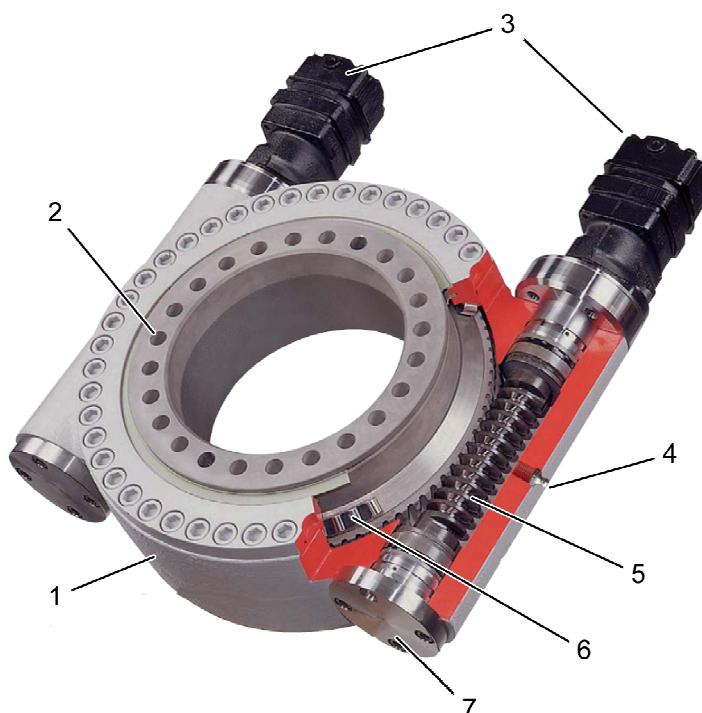


Fig. 2: Slew drive WD-H

- | | | | |
|---|--|---|---|
| 1 | Housing | 4 | Lubricating nipple |
| 2 | Bolted unions for the mounting structure | 5 | Worm shaft |
| 3 | Option: Drive motors | 6 | Roller slewing ring |
| | | 7 | Connection possibility for add-on parts |

1.2.3 SP series

The SP slew drive is powered by a pinion gear unit. The drive motor (hydraulic/electric) is optional.

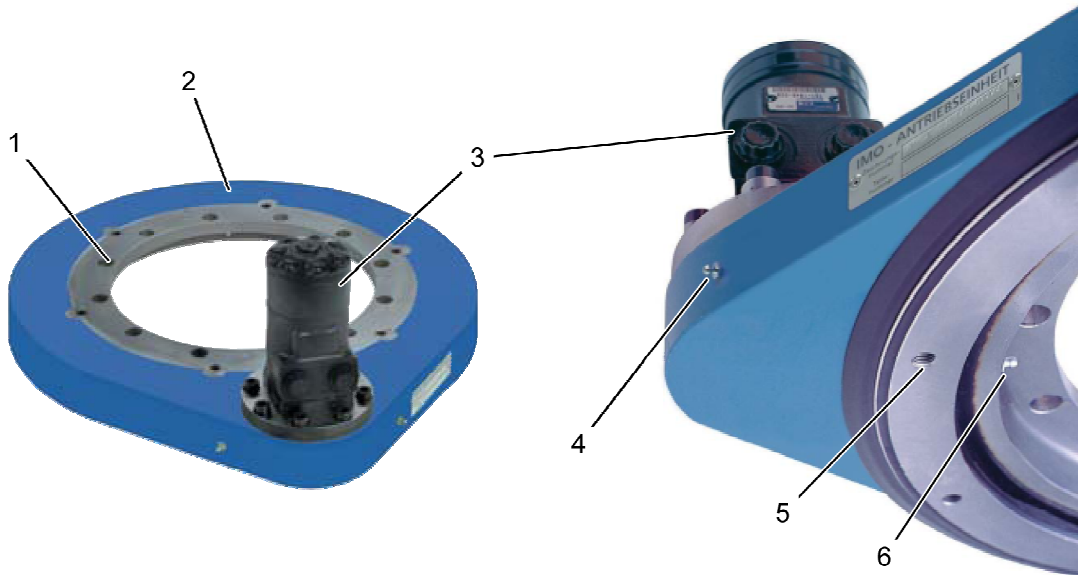
SP-L, light version

Fig. 3: Slew drive SP-L, light version

- | | |
|--|--|
| 1 Bolted unions for the mounting structure | 4 Lubricating nipple for tooth mesh |
| 2 Housing | 5 Bolted unions for the mounting structure |
| 3 Drive motors | 6 Lubricating nipple for raceway |

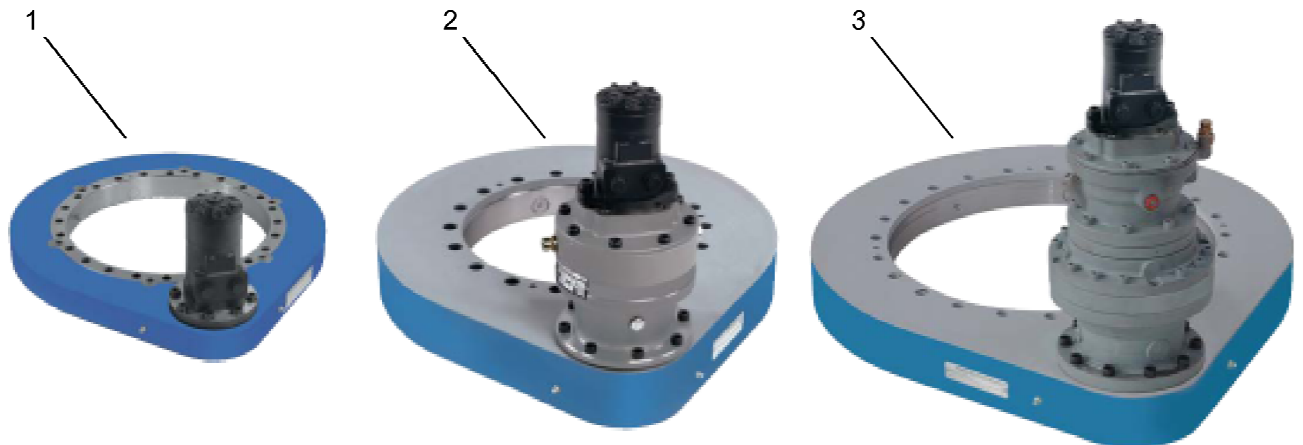
Additional versions

Fig. 4: Additional SP slew drives

- | |
|----------------------------|
| 1 SP-I, reinforced version |
| 2 SP-M, medium version |
| 3 SP-H, heavy version |

1.3 Intended use

⚠ WARNING

The component is not designed for use in potentially explosive atmospheres. Misuse of the component may cause dangerous situations.

The component has been designed and manufactured exclusively for the use according to this Installation and Operating Manual.

The slew drive is used

- as a drive for generating a rotary movement as well as the absorption of radial, axial forces and tilting moments. For example it is used as steering gear for crane undercarriages, manlift platforms, construction machines, mining and tunneling.

Modification, retooling, or changing the construction or individual parts of the equipment with the objective of changing the area of application or usability of the component is not permitted, as this is not considered intended use.

Claims of any type due to damage arising from improper use are excluded.

The customer is solely liable for all damage in the case of improper use.

2 General

2.1 Explanation of symbols

Warnings

Warnings in this operating manual are indicated by a warning symbol (▲) and/or signal words. The scope of the hazard is described by signal words.

The warnings must be strictly heeded; you must act prudently to prevent accidents, personal injury, and material damage, as well as life-threatening danger.

| Warning symbol / signal word | Explanation |
|--|--|
| <p style="text-align: center;">▲ DANGER or DANGER!</p> | Indicates an imminent dangerous situation that can result in death or serious injury if it is not avoided. |
| <p style="text-align: center;">▲ WARNING or WARNING!</p> | Indicates a possible dangerous situation that can result in death or serious injury if it is not avoided. |
| <p style="text-align: center;">▲ CAUTION or CAUTION!</p> | Indicates a possible dangerous situation that can result in minor injury if it is not avoided. |
| <p style="text-align: center;">IMPORTANT or IMPORTANT!</p> | Indicates a possible dangerous situation that can result in material damage if it is not avoided. |
| Tips and recommendations | Explanation |
| <p style="text-align: center;">i</p> | Indicates useful tips and recommendations as well as information for efficient and trouble-free operation. |

2.2 Limitation of liability

All information and instructions in this operating manual have been provided under due consideration of applicable guidelines, the current state of technology, as well as our many years of experience.

The manufacturer assumes no liability for damages due to:

- Failure to follow the instructions in this manual
- Non-intended use
- Deployment of untrained personnel
- Unauthorized conversions
- Technical changes
- Use of non-approved spare parts

The actual scope of delivery can vary from the explanations and graphic representations provided in this manual in the case of special versions, if supplemental order options are desired, or on the basis of the latest technical changes.

In all other respects the agreed obligations in the delivery contract, the general terms and conditions, as well as delivery conditions of the manufacturer, and the statutory regulations valid at the time the contract was concluded, apply.

We reserve the right to make changes in the interest of enhancements and improvement of the performance characteristics.

2.3 Copyright

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The information contained in this operating manual and/or in all parts, sub-sections, or sections of this manual is the intellectual property of IMO Antriebseinheit GmbH & Co. KG, and is subject to German and international copyright legislation and other laws that protect intellectual property.

The information contained in this manual is provided as in aid in operating, maintaining, and eliminating faults of the units described here.

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IMO Antriebseinheit GmbH & Co. KG reserves the right at any time and regardless of reason, to change or modify the information contained here, as well change and modify the system itself, with or without prior notice.

2.4 Original IMO parts

⚠ WARNING

Only use original IMO parts! Use of non-authorized, wrong, or defective spare parts may cause damage, and failures, or may impair the safety of the device and thus cause severe or fatal injuries.

Purchase original IMO parts from authorized dealers or direct from the manufacturer (⇒ page 2).

2.5 Customer Service

Our customer service is available for technical information (⇒ page 2).

Our employees are always interested in new information and experiences associated with the application, and which could prove valuable in improving our products.

3 Safety

This section provides an overview of all the important safety aspects for optimal protection of personnel, as well as for safe and trouble-free operation.

Significant hazards can occur if the handling instructions and safety instructions in this manual are not complied with.

3.1 Safety devices

Integration in an emergency-stop concept is required

The component is designed for utilization within a system. It does not have its own controller and does not have an autonomous emergency-stop function.

Before the component is placed in service, emergency-stop devices must be installed on the device and integrated in the safety chain of the plant control system.

The emergency-stop devices must be connected in such a manner that dangerous situations for persons and property are excluded in the event of power supply interruption, or activation of the power supply after an interruption.

The emergency-stop devices must always be freely accessible.

3.2 Special dangers

Residual risks are cited in the following section.

⚠ WARNING

Comply with the safety instructions listed here and the warning instructions in the other chapters of this manual to reduce health hazards and to avoid dangerous situations.

Electrical current

DANGER! Only have qualified electricians perform work on electrical components of the system!

Improper installation of components, or improper handling of electrical equipment may result in injuries and life-threatening danger.

If insulation is damaged immediately switch off the power supply and have the system repaired by a qualified electrician!

Keep moisture away from electrical components. Moisture can cause short circuits.

Hydraulic system

DANGER! Only have trained, specialized personnel perform work on the hydraulic equipment. De-pressurize the hydraulic system prior to starting work on the hydraulic system. Completely de-pressurize the pressure accumulator. Ensure that the system is de-pressurized. Do not change pressure settings to exceed the maximum values. Hydraulically powered parts may move unexpectedly.

Hydraulic energy may cause severe or fatal injuries.

VCI foil

DANGER! Keep out of reach of children and dispose of properly. If used improperly there is danger of suffocation. Avoid skin and eye contact with VCI foil. Repeated or longer skin contact may dissolve skin fat and cause dermatitis.

Moving parts

WARNING! Do not reach into moving parts or handle moving parts during operation. Do not open covers when the device is in operation. Pay attention to overtravel time: Prior to opening the cover ensure that all parts have come to a standstill. Wear tight-fitting work clothing in the danger zone. Rotating components and/or components with linear movements may cause serious injury!

Falling materials

WARNING! Never enter the danger zones during operation. In operation heavy material can fall uncontrolled or it may be accelerated out of the device and cause severe injuries.

Fouling and loose objects

CAUTION! Always keep the work area clean. Remove objects that are not being used. Mark stumbling hazards with a black/yellow marking tape. Fouling and loose objects on the ground pose slipping and stumbling hazards and may cause severe injuries.

3.3 Responsibility of the customer

Customer

The customer is the person or entity that operates the component himself for commercial or economic purposes, or who transfers the device to a third person for use/application, and who bears the legal responsibility for protecting the users or third parties.

The component is used in commercial applications. Consequently the owner of the component is subject to legal industrial safety obligations.

In addition to the safety instructions in this manual, generally valid safety and accident protection guidelines, and environmental protection guidelines must be heeded and complied with for the area of implementation of the component. In this regard:

- The customer must inform himself of applicable industrial safety regulations, and in a hazard analysis identify other hazards that may exist at the installation site of the component due to the special work conditions. Customer must convert this information relative to hazards into operating instructions for operation of the component.
- The customer must ensure during the entire period of component implementation that the operating instructions created by the customer correspond to the current state of legislation, and if necessary the customer must adapt these operating instructions.
- The customer must clearly regulate and specify responsibilities for installation, operation, maintenance, and cleaning.
- The customer must ensure that all employees who handle the component have read and understood this manual. In addition, customer must train personnel and inform personnel of the hazards at regular intervals.
- The customer must provide the required protective equipment for personnel.

Moreover the customer is responsible for ensuring that the component is always in faultless technical condition; consequently the following applies:

- The customer must ensure that the maintenance intervals described in this operating manual are observed.
- The customer must have all safety devices inspected regularly for function and for completeness.

The seals in the slew drive are subject to a certain amount of wear. From time to time it is necessary to check the seals for trouble-free seat and function. However depending on system runtime it may also be necessary to replace the seals. Thus the system manufacturer must ensure that sufficient space and accessibility for inspecting and replacing the seals are available on the total circumference of the slew drive.

3.4 Personnel requirements

Unauthorized person

WARNING! Unauthorized persons should not enter the work area! Unauthorized persons may cause dangerous situations.

Specialized personnel

Specialized personnel are personnel who thanks to their specialized training, skills, and experience, as well as knowledge of the applicable regulations are capable of executing the tasks assigned to them and of recognizing possible hazards on their own.

Qualified electrician

...is a person who thanks to his specialized training, skills, and experience, as well as knowledge of the applicable regulations is capable of executing work on electrical equipment and of recognizing possible hazards on his own. The qualified electrician is especially trained for the work environment in which he is active and knows all relevant standards and regulations.

In Germany the qualified electrician must meet the requirements set forth in the accident prevention guideline BGV A3 (e.g. master electrical contractor). Similar regulations apply in other countries.

3.5 Personal protective equipment

Wearing personal protective equipment is required to minimize the health hazards when working with the device.

- Always wear the protective equipment necessary for the respective task when working with the device.
- Follow the instructions that have been posted in the work area.

Always wear

For all tasks always wear:



Protective work clothing

is tight-fitting work clothing with low resistance to tearing, with tight sleeves, and without projecting parts. It is primarily used as a protection against entanglement by moving machine parts.

Do not wear rings, chains, or other jewelry.

**Safety footwear**

for protection against heavy falling parts and slipping on slippery substrates.

**Protective gloves**

to protect hands from friction, abrasion, puncture wounds, or deeper injuries, as well as from contact with hot surfaces.

For special tasks wear

Special protective equipment is required when executing special tasks. Separate reference is made to this equipment in the specific sections. This special protective equipment is explained below:

**Face protection**

to protect the eyes and face from solvents.

**Chemical-resistant protective gloves**

to protect hands from aggressive substances. Check protective gloves for leaks prior to use. Clean the gloves before pulling them off, store them in a well-ventilated location.

Transport, packaging, and storage

4 Transport, packaging, and storage

4.1 Safety instructions for transport

⚠ WARNING

Never position yourself under a suspended load! Swinging or falling parts may cause injury or life-threatening danger.

⚠ WARNING

Carefully supervise the lifting processes and transport. Only use the transport methods described here. A life-threatening crushing hazard exists if the slew drive falls.

IMPORTANT

Proceed with caution when transporting objects! Comply with instruction symbols on the packages and only use the prescribed attachment points. Improper transport may cause significant damage.

IMPORTANT

Avoid impact when transporting! Improper transport may cause significant damage to the component.

4.2 Transport

Transport by specialized personnel only!

Transporting packages

Packages that are not attached to pallets can be transported with a forklift or forklift truck under the following conditions:

- The forklift or forklift truck must be configured appropriately for the weight of the transport units.
- The operator must be authorized to operate the forklift.

Attachment:

1. Place sufficiently long and wide extensions (e.g. of wood or metal) between the forks and the package so that the weight is distributed on the support surface.
2. Drive in the forks, with extensions if needed, far enough that they protrude on the opposite side.
3. If there is an eccentric center of gravity, ensure that the package cannot tip.
4. Lift the package and start the transport.

Transport, packaging, and storage

Transporting pallets with the crane

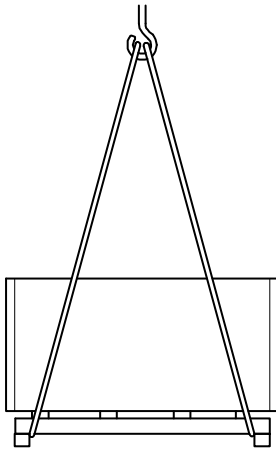


Fig. 5 Transporting with the crane

Packages that are attached to pallets can be transported with a crane under the following conditions:

- Crane and hoist must be designed for the weight of the packages.
- The operator must be authorized to operate the crane.

Attachment:

1. Attach ropes, straps, or multi-point suspensions to the pallet as shown in Fig. 5 and ensure that they cannot slip.
2. Ensure that the packages cannot be damaged by the lifting tackle. Use other lifting tackle if necessary.
3. Start the transport.

Transporting pallets with the forklift

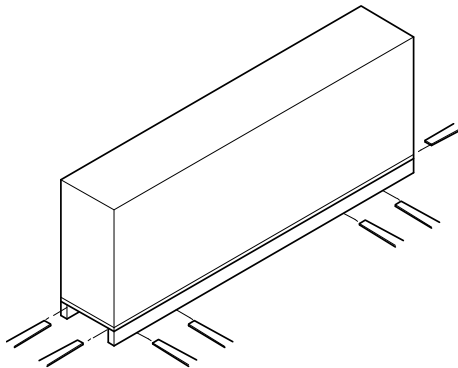


Fig. 6 Transporting with the forklift

Packages that are attached to pallets can be transported with a forklift under the following conditions:

- The forklift must be configured appropriately for the weight of the transport units.
- The operator must be authorized to operate the forklift.

Attachment:

1. Drive the forklift with the forks between or under the spars of the pallet.
2. Drive in the forks until they protrude on the opposite side.
3. If there is an eccentric center of gravity, ensure that the pallet cannot tip.
4. Lift the package and start the transport.

Transporting unpacked slew drives

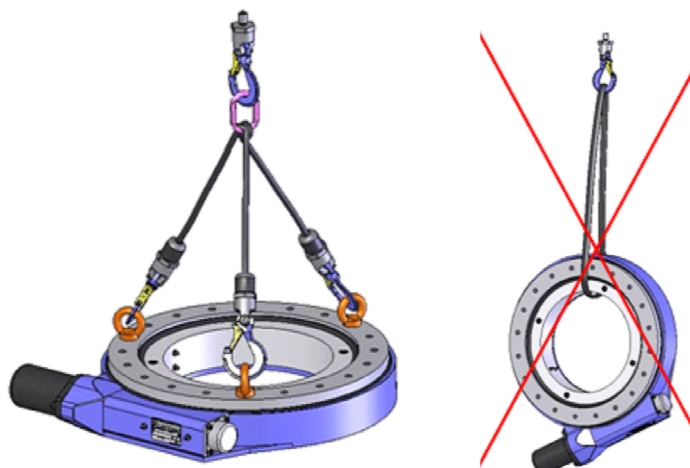


Fig. 7: Use suitable lifting gear/never transport product vertically

Transport, packaging, and storage

Unpacked slew drives can be transported with lifting gear when using eye bolts under the following conditions

- The lifting gear must be configured appropriately for the weight of the transport units.
- The ring bolts must be configured appropriately for the weight of the transport unit.
- The slew drive shall only be transported by itself, without attached parts.
- Maintain the insertion depth prescribed by the manufacturer. If insertion depth is not prescribed, then a minimum insertion depth of 1.5 x the bolt diameter must be selected.
- Transport within the company shall only be executed horizontally.

Attachment:

1. Screw the 3 eye bolts into the 3 threads that are distributed uniformly on the circumference of the slew drive.

WARNING! Screw in the eye bolts to the full thread length! Improperly attached, unsuitable, or damaged eye bolts may cause the slew drive to fall and cause life-threatening injuries.

2. Attach lifting gear to the eye bolts.
3. Start the transport.

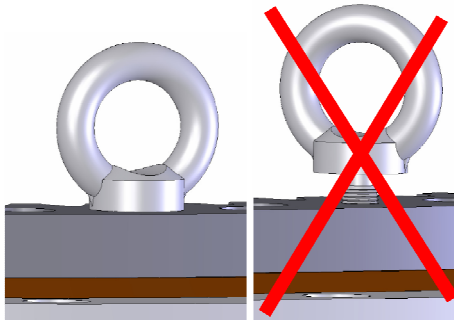


Fig. 8: Always use the full length of the thread

4.3 Transport inspection/incoming goods inspection

Check delivery immediately upon receipt to ensure that delivery is complete, and to identify any transport damage.

Proceed as follows if there is apparent external damage:

- Do not accept the delivery, or only accept it with reservation.
- Note the extent of transport damage on the transport documents or on the transport company's delivery ticket.
- Submit a complaint.

i Report any defect within 2 days of delivery of goods. Claims for damage compensation can only be enforced during this period of notification.

Transport, packaging, and storage

4.4 Packaging

Packaging

The individual boxes are packaged according to the expected transport conditions. Only environmentally-friendly materials have been used for the packaging.

The packaging is designed to protect the individual components against transport damage, corrosion, and other damage until installation. Therefore do not damage the packaging; remove it just before installation.

- If parts are not installed within the agreed storage period, then the customer must ensure that an appropriate preservation agent is applied to these parts.
- Unless otherwise agreed, it is assumed that the parts will be used within 8 weeks.

Handling packaging materials

If a separate agreement regarding handling of the packaging has not been concluded, then separate the materials according to type and size, and keep them on hand for subsequent use, or recycle.

***IMPORTANT!* Dispose of packaging materials in an environmentally responsible manner. Environmental damage may be caused by improper disposal.**

4.5 Symbols on the packaging

No user serviceable parts inside!
Unauthorized opening of the slew drive voids the manufacturer's warranty.



NO USER SERVICEABLE PARTS INSIDE! UNAUTHORIZED
OPENING OF THIS DEVICE VOIDS THE MANUFACTURER'S
WARRANTY.

If packed in foil:

Danger!
Choking and asphyxiation hazard!
This bag is not a toy!
Keep away from children!

⚠ DANGER

CHOKING AND ASPHYXIATION HAZARD!
This Bag is not a Toy!
Keep away from children!

Transport, packaging, and storage

4.6 Storage

Storage of packages

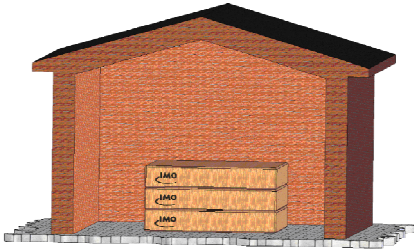


Fig. 9: Ensure protective storage

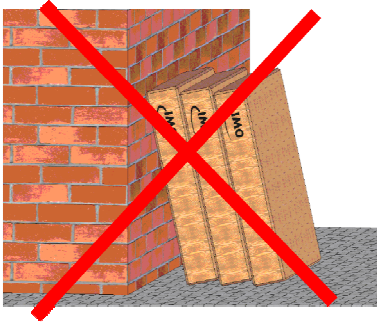


Fig. 10: Do not store vertically

Only store packages under the following conditions:

- Do not store outdoors.
- Store in a dry and dust-free location.
- Do not expose to aggressive media.
- If stacking, use stable intermediate layers.
- Protect from direct sunlight.
- Avoid mechanical vibration.
- Storage temperature: $>5^{\circ}\text{C}$ ($>41^{\circ}\text{F}$) to 40°C (104°F).
- Relative humidity: $< 65\%$.
- Do not store vertically.
- For longer periods of storage (> 2 months) regularly check the general status of the packages. Touch up or re-apply anti-corrosion agents as needed.

The anti-corrosion protection period is 12 months, if the aforementioned storage requirements are observed. We recommend to re-apply the preservation after 12 months.

Please refer to tab. 1 below for anti-corrosion agents.

Recommended anti-corrosion agents

| Manufacturer | Product name | Period of anti-corrosion protection |
|---------------------------------|---------------------------|-------------------------------------|
| Cortec | VpCI™ -329 | ≥ 12 months |
| Fuchs Europe Schmierstoffe GmbH | Anticorit OHK-F | ≥ 12 months |
| Schramm | Molecular Nato-Fluid-C634 | ≥ 12 months |

Tab. 1

Long-term preservation is possible for storages which are planned for several years and can already be discussed during the technical consultation. Re-application of anti-corrosion agents as well as initial greasing can be performed by our customer service (\Rightarrow page 2) prior to operation.

i Greased slew drives shall not be stored for a longer period than 3 years. Greases can change their chemical-physical behaviour during storage. Grease provisions can be diminished by a storage period of more than 3 years. The storage of slew drives shall not exceed 1 year if food lubricants are used.

i Under certain circumstances storage instructions are affixed to the packages that go beyond the requirements cited here. Comply with these instructions accordingly.

5 Installation and commissioning

5.1 Safety

⚠ DANGER

Prior to starting work switch off all energy supplies and safeguard them from being switched on again. If the power supply is switched on by unauthorized personnel, a life-threatening danger exists for persons in the danger zone.

⚠ WARNING

Prior to starting work ensure that there is adequate free space for installation. Handle open, sharp-edged components carefully. Ensure order and cleanliness at the installation location! Parts and tools that are lying loose or on top of each other are accident hazards! Mount components properly. Maintain the prescribed bolt torque and fastening torque. Secure the components so that they do not fall down or fall over. Improper installation and commissioning may cause serious personal injury and/or property damage.

⚠ WARNING

Never position yourself under a suspended load! Swinging or falling parts may cause injury or life-threatening danger.

⚠ WARNING

Carefully supervise the lifting processes and transport. Only use the transport methods described here. A life-threatening crushing hazard exists if the components fall.

IMPORTANT

Proceed with caution when transporting objects! Comply with instruction symbols on the packages and only use the prescribed attachment points. Improper transport may cause significant damage.

IMPORTANT


Avoid impact when transporting! Improper transport may cause significant damage.

IMPORTANT

Seals shall not be overpainted! Overpainting may cause significant damage.

IMPORTANT

Prevent damage to coating and painting of slew drives. Please refer to our customer service (⇒ page 2), if the coating is damaged.

 Follow the instructions provided in the operating manuals for the drive motors (hydraulic or electric), as well as the instructions provided with the optional potentiometer or permanent brake.

Personnel


- Only trained, skilled personnel should perform installation and commissioning work.

Installation and commissioning

Personal protective equipment

Wear the following protective equipment for all installation and commissioning work:

- Protective work clothing
- Safety footwear
- Protective gloves

 The warnings in this chapter make special reference to additional protective equipment that is required for certain tasks.

5.2 Preparation

5.2.1 Lubricating prior to commissioning

Slew drives have been lubricated in the factory prior to delivery. Nevertheless, prior to commissioning the slew drive must be lubricated (⇒ section 6.4.4 "Lubricating the slew drive").

5.2.2 Cleaning the slew drive and mounting structure

Wear the following additional protective equipment for cleaning work:



Face protection

to protect the eyes and face from solvents.



Chemical-resistant protective gloves

to protect hands from aggressive substances. Check protective gloves for leaks prior to use. Clean the gloves before pulling them off, store them in a well-ventilated location.

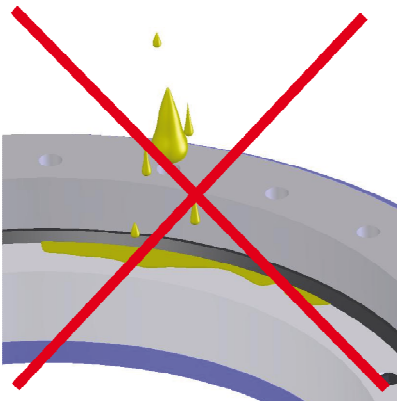


Fig. 11: Do not let cleaning agents get into the slew drive

Cleaning:

IMPORTANT! Only use cold solvents (e.g. white spirit, diesel oil, Kaltryl KEV) that do not corrode the sealing material. Ensure that the cleaning agent does not get into the slew drive. Do not use a high-pressure cleaner to clean the slew drive. Unsuitable trichloroethylene-based or perchloroethylene-based cleaning agents, or other aggressive cleaners damage the seal and may cause bearing damage.

Installation and commissioning

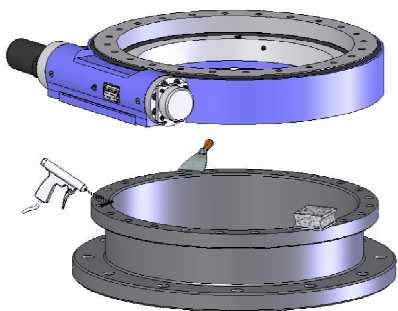


Fig. 12: Cleaning

- When using cleaning agents, ensure adequate ventilation.
- Maintain a strict ban on smoking.
- Remove old grease, dust, and fouling with lint-free cloths.
- Remove foreign material from the support surface of the mounting structure (including paint residue, welding beads, burrs).
- If necessary clean the support surface of the sleew drive.
- Strictly comply with industrial safety regulations.

5.2.3 Determination of flatness deviation, and perpendicularity deviation and deformation of the mounting structure

IMPORTANT

If there are impermissibly high deviations in flatness and perpendicularity in the mounting structure, then rotational resistance of the sleew drive may significantly increase and damage the entire sleew drive. In the worst case the sleew drive may block.

If the permissible values for flatness or perpendicularity deviation are exceeded, the mounting structure of the sleew drive shall be replaced or reworked.

Determination of flatness deviation, and perpendicularity deviation of the mounting structure

The mounting structure can be measured using a measuring plate and dial gauges.

Laser processes and measuring with 3D systems have also proven to be effective. These systems can be used without additional auxiliary material, and they can document the actual gradient of the mounting structure and process it accordingly.

Flatness deviation

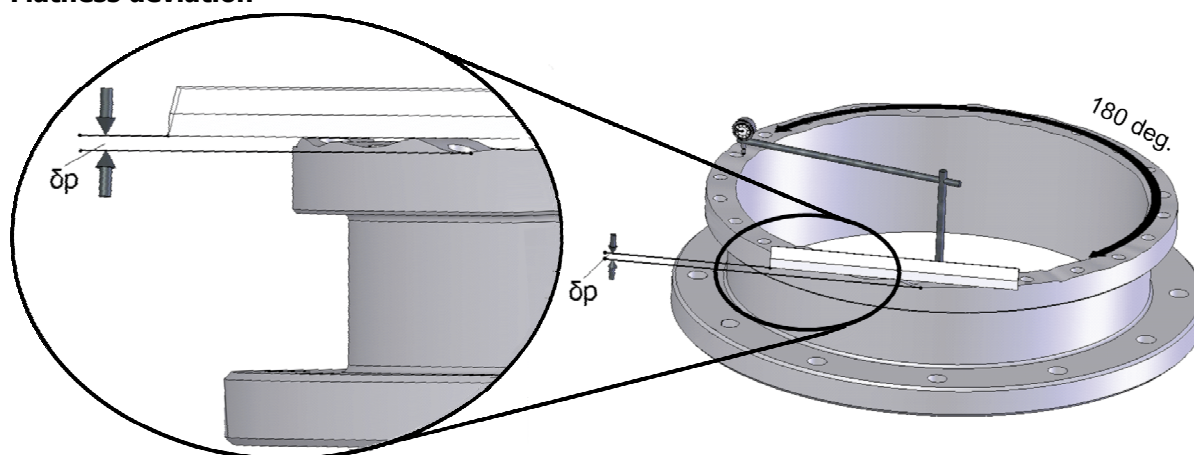
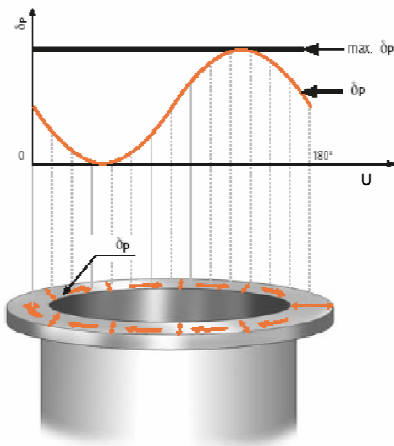


Fig. 13: Flatness deviation

Installation and commissioning



δp = flatness deviation
 max. δp = maximum flatness deviation
 U = circumference

- The maximum residual value for flatness deviation δp in the circumferential direction should only be reached once on half of the circumference. The gradient must look like a sinus curve that slowly rises or falls.

Abb. 14: Permissible flatness deviation of the mounting structure

Perpendicularity deviation

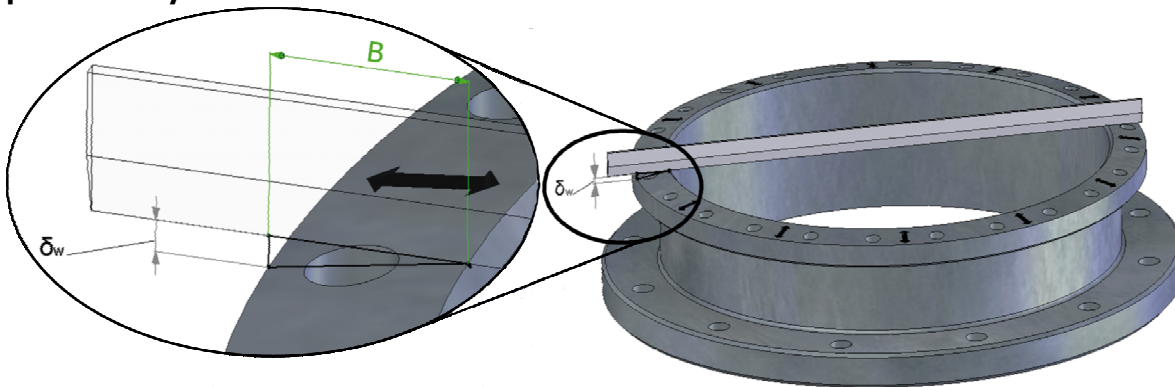


Fig. 15: Perpendicularity deviation

δw = perpendicularity deviation
 B = flange width

- The permissible perpendicular deviation δw (tilting) is based on the actual flange width and should only be half of the values from the tables below.

XX - X(X) XXXX / X - XXXXX
 1

Fig. 16: Drawing number

The size of the slew drive (WD-H) or of the running circle diameter D_L (WD-L/SP) is indicated in the drawing number at position (1) and is shown in all documents and the type plate.

- i For slew drives that are between the specified sizes, always assume the smaller value. For slew drives that are larger than the largest diameter, use the largest specified value.
- i The slew drive must be supported by the mounting structure up to the diameter specified in the slew drive drawing.

Installation and commissioning

Permissible flatness and perpendicularity deviation for series WD-L and SP slew drives

| Running circle diameter [mm] | | ≥100 | ≥250 | ≥500 | ≥750 | ≥1000 | ≥1250 |
|---|------|--------|--------|--------|--------|--------|--------|
| Permissible flatness deviation including perpendicularity deviation per support surface | [mm] | 0.04 | 0.06 | 0.08 | 0.09 | 0.10 | 0.11 |
| | [in] | 0.0016 | 0.0024 | 0.0032 | 0.0036 | 0.0040 | 0.0044 |

Tab. 2

Permissible flatness and perpendicularity deviation for series WD-H slew drives

| Size of the slew drive | | ≥146 | ≥220 | ≥300 | ≥373 | ≥490 | ≥625 |
|---|------|--------|--------|--------|--------|--------|--------|
| Permissible flatness deviation including perpendicularity deviation per support surface | [mm] | 0.06 | 0.06 | 0.07 | 0.07 | 0.08 | 0.09 |
| | [in] | 0.0024 | 0.0024 | 0.0028 | 0.0028 | 0.0032 | 0.0036 |


Tab. 3


Determining the deformation of the mounting structure

Under maximum operating load an appropriate deformation of the mounting structure occurs. The dimensions can be detected via dial gauges, laser measurement processes, or 3D measuring systems.

Because in some cases measurement in operation is difficult, determination of deformation can also be executed mathematically, e.g. with the finite element method.

Alternatively you can also reference comparable measurements on test rigs.

 For slew drives that are between the specified sizes, always assume the smaller value. For slew drives that are larger than the largest diameter, use the largest specified value.

 The slew drive must be supported by the mounting structure up to the diameter specified in the slew drive drawing. All the installed dimensions as specified in the drawing must be complied with.

Permissible deformation of the mounting structure, under maximum load for series WD-L and SP slew drives

| Running circle diameter [mm] | | ≥100 | ≥250 | ≥500 | ≥750 | ≥1000 | ≥1250 |
|---|------|--------|--------|--------|--------|--------|--------|
| Permissible deformation of the mounting structure per support surface | [mm] | 0.13 | 0.16 | 0.21 | 0.24 | 0.27 | 0.29 |
| | [in] | 0.0052 | 0.0063 | 0.0083 | 0.0095 | 0.0106 | 0.0114 |

Tab. 4

Permissible deformation of the mounting structure, under maximum load for series WD-H slew drives

| Size of the slew drive | | ≥146 | ≥220 | ≥300 | ≥373 | ≥490 | ≥625 |
|---|------|--------|--------|--------|--------|--------|--------|
| Permissible deformation of the mounting structure per support surface | [mm] | 0.10 | 0.11 | 0.12 | 0.13 | 0.15 | 0.16 |
| | [in] | 0.0040 | 0.0044 | 0.0048 | 0.0052 | 0.0059 | 0.0063 |

Tab. 5

Installation and commissioning

IMPORTANT

Axial deflection, tilting, radial extension (or radial contraction) of the mounting structure under max. load causes deformation of the mounting structure.

5.2.4 Selecting the mounting elements

CAUTION

Only use mounting elements of the correct size, number and quality. Do not reuse bolts, nuts, and washers. Using unsuitable mounting elements may cause the bolted union to fail and thus the entire construction to fail.

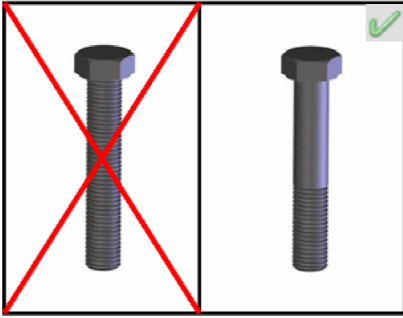


Fig. 17: Do not use continuous thread

The function and service life, as well as the durability of the bolted union are highly dependent on grip ratio, the type of bolt, and the dimensions of the bolts. Consequently select the mounting elements on the basis of the following:

- Do not use any bolts with a fully threaded shaft.
- Only use new, quality class 10.9 (metric) bolts or SAE Grade 8.
- Maintain the grip ratio (grip length to the diameter of the bolt) of at least ≥ 5 to maximum ≤ 10 .
- Select bolt length to ensure that the minimum insertion depth is reached (\Rightarrow Tab. 6).
- If the permissible interfacial pressure is exceeded use appropriate washers (\Rightarrow Tab. 7).

i If the specifications cannot be satisfied, please contact our customer service (\Rightarrow page 2).

Minimum bolt insertion depth depending on fracture strength of the mounting structure

| Fracture strength R_m of the mounting structure | | Minimum insertion depth (le) |
|---|------------------------|-------------------------------|
| in N/mm ² | in lbf/in ² | Strength class 10.9 / Grade 8 |
| 500 to 700 | 72520 to 101525 | le = 1.4*ds |
| 700 to 900 | 101525 to 130535 | le = 1.1*ds |
| over 900 | over 130535 | le = 0.9*ds |

Tab. 6

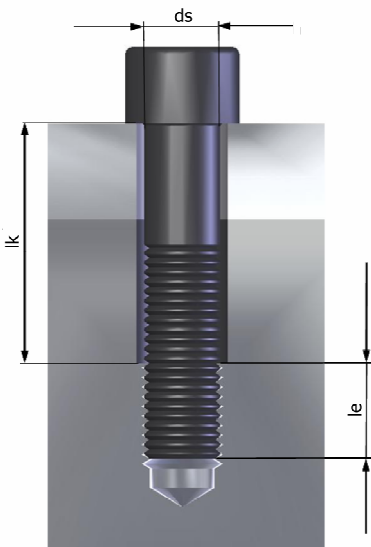


Fig. 18: Mounting element

i Mounting structures with fracture strength under 500 N/mm² or 72520 lbs/in² are prohibited.

ds = bolt diameter

lk = grip length

le = insertion depth

Permissible interfacial pressure for various materials

| Material | Max. surface pressure | |
|------------------|-----------------------|------------------------|
| | in N/mm ² | in lbs/in ² |
| St52/C45N/46Cr2N | 600 | 87023 |
| 46Cr4V/42CrMo4V | 800 | 116030 |

Tab. 7

5.2.5 Tightening bolts with a torque wrench

Normally the mounting bolts are adequately secured through correct pretension.

⚠ WARNING

Do not use impact screwdrivers. Using an impact screwdriver may cause impermissible deviations between the bolt tightening forces. Failure of the bolted union with the mounting structure may cause severe personal injury or material damage.

IMPORTANT

If there are shock loads or vibration additional screw-locking devices may be necessary. In this case use Loctite or Nord-Lock® bolt lock washers.

- Do not use split rings, spring washers, etc.
- Do not reuse bolts, nuts, and washers, etc.
- Only use hardened and tempered washers.
- Adjust the limit torque in accordance with bolt size and quality.
- Use a precisely indicating torque wrench.

Tightening torques and bolt tightening forces for metric coarse-pitched thread in accordance with DIN 13 when using a torque wrench:

| Mounting bolt dimensions | Tightening torque M_A ¹⁾ Strength class 10.9 in | | Mounting pretension force F_M ²⁾ Strength class 10.9 in | |
|--------------------------|--|--------|--|-------|
| | Nm | ft-lbs | kN | lbs |
| M4 | 3.31 | 2.44 | 5.95 | 1338 |
| M5 | 6.77 | 4.99 | 9.74 | 2190 |
| M6 | 11.5 | 8.5 | 13.7 | 3080 |
| M8 | 28.0 | 20.6 | 25.2 | 5665 |
| M10 | 55.8 | 41.2 | 40.2 | 9037 |
| M12 | 97.7 | 72.1 | 58.5 | 13151 |
| M16 | 246 | 181 | 111 | 24954 |
| M18 | 336 | 248 | 134 | 30124 |
| M20 | 481 | 355 | 173 | 38892 |
| M22 | 661 | 487 | 216 | 48559 |
| M24 | 830 | 612 | 249 | 55977 |
| M27 | 1230 | 907 | 328 | 73737 |
| M30 | 1661 | 1225 | 398 | 89474 |

Tab. 8

¹⁾ M_A in accordance with VDI guideline 2230 (February 2003) for $\mu K=0.08$ and $\mu G=0.12$

²⁾ F_M in accordance with VDI guideline 2230 (February 2003) for $\mu G=0.12$

Installation and commissioning


Tightening torques and bolt tightening forces for inch thread in accordance with ANSI B1.1 when using a torque wrench:


| Mounting bolt dimensions | Tightening torque M_A ¹⁾ Strength class Grade 8 in | | Mounting pretension force F_M ²⁾ Strength class Grade 8 in | |
|--------------------------|--|--------|--|-------|
| | Nm | ft-lbs | kN | lbs |
| | 0.1900 – 24 UNC | 4.80 | 3.54 | 7.15 |
| 0.2160 – 24 UNC | 7.69 | 5.67 | 10.1 | 2271 |
| 1/4 – 20 UNC | 11.7 | 8.6 | 13.2 | 2967 |
| 5/16 – 18 UNC | 24.4 | 18.0 | 22.1 | 4968 |
| 3/8 – 16 UNC | 43.7 | 32.2 | 33.0 | 7419 |
| 7/16 – 14 UNC | 70.1 | 51.7 | 45.4 | 10206 |
| 1/2 – 13 UNC | 108 | 80 | 61.0 | 13713 |
| 9/16 – 12 UNC | 156 | 115 | 78.6 | 17670 |
| 5/8 – 11 UNC | 216 | 159 | 97.8 | 21986 |
| 3/4 – 10 UNC | 386 | 285 | 146 | 32822 |
| 7/8 – 9 UNC | 625 | 461 | 202 | 45411 |
| 1 – 8 UNC | 938 | 692 | 266 | 59799 |
| 1 1/8 – 7 UNC | 1328 | 979 | 334 | 75086 |
| 1 1/4 – 7 UNC | 1889 | 1393 | 428 | 96218 |


Tab. 9

¹⁾ M_A in accordance with VDI guideline 2230 (February 2003) for $\mu_K=0.08$ and $\mu_G=0.12$


²⁾ F_M in accordance with VDI guideline 2230 (February 2003) for $\mu_G=0.12$

 For mounting bolts from M30 or 1 1/8 - 7 UNC use a hydraulic bolt-tensioning cylinder (⇒ chapter 5.2.6 "Tightening bolts with a hydraulic bolt-tensioning cylinder").

 When using bolts with fine-pitched thread or other bolt sizes or qualities, please contact our customer service (⇒ page 2).

 For further information about bolts, please refer to the IMO main catalogues.

5.2.6 Tightening bolts with a hydraulic bolt-tensioning cylinder

 Comply with the instructions provided in the operating manual for the hydraulic fixture! The operating manual for the hydraulic bolt-tensioning cylinder specifies how the hydraulic pressure is converted to the pretension force.

⚠ WARNING

The prescribed hydraulic pressure should not be exceeded when pretensioning the bolts. Excess hydraulic pressure may cause failure of the bolted union with the mounting structure and may cause severe personal injury or material damage.

IMPORTANT

When using other threaded bolts or other strength classes you have to contact our customer service (⇒ page 2).

Bolt tension forces when using a hydraulic bolt-tensioning cylinder for metric coarse-pitched thread in accordance with DIN 13:

| Mounting bolt dimensions | Mounting pretension force F_M ¹⁾ Strength class 10.9 in | |
|--------------------------|--|--------|
| | kN | lbs |
| M24 | 282 | 63396 |
| M27 | 367 | 82505 |
| M30 | 448 | 100714 |
| M33 | 554 | 124544 |
| M36 | 653 | 146800 |
| M42 | 896 | 201429 |
| M45 | 1043 | 234476 |
| M48 | 1177 | 264600 |
| M52 | 1405 | 315857 |
| M56 | 1622 | 364640 |
| M60 | 1887 | 424215 |
| M64 | 2138 | 480642 |
| M68 | 2441 | 548759 |

Tab. 10

¹⁾ F_M for hydraulic bolt-tensioning cylinder pretensioned to 85% of yield strength

Bolt tension forces when using a hydraulic bolt-tensioning cylinder for inch thread in accordance with ANSI B1.1:

| Mounting bolt dimensions | Mounting pretension force F_M ¹⁾ Strength class 10.9 in | |
|--------------------------|--|--------|
| | kN | lbs |
| 1 – 8 UNC | 301 | 67668 |
| 1 1/8 – 7 UNC | 379 | 85203 |
| 1 1/4 – 7 UNC | 481 | 108133 |
| 1 3/8 – 6 UNC | 573 | 128816 |
| 1 1/2 – 6 UNC | 697 | 156692 |
| 1 5/8 – 6 UNC | 832 | 187041 |
| 1 3/4 – 5 UNC | 942 | 211770 |

Installation and commissioning

| | | |
|-----------------|------|--------|
| 2 – 4.5 UNC | 1239 | 278538 |
| 2 1/4 – 4.5 UNC | 1608 | 361493 |
| 2 1/2 – 4 UNC | 1981 | 445347 |
| 2 3/4 – 4 UNC | 2442 | 548984 |

Tab. 11

¹⁾ F_M for hydraulic bolt-tensioning cylinder pretensioned to 85% of yield strength

5.3 Installing the slew drive

5.3.1 Hardness gap

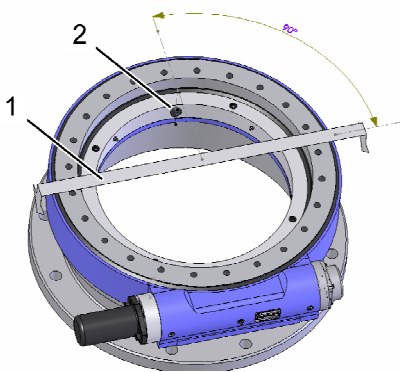


Fig. 19: Hardness gap marking

The hardness gap occurs with the raceway hardening and is located between the end and the beginning of the hardening. For the WD-L series the hardness gap must be arranged with an offset by 90° relative to the main load-carrying zone. The hardness gap is marked by a filling plug or a stamped "S".

- 1 Main load-carrying zone
- 2 Filling plug or S-mark

5.3.2 Positioning the slew drive

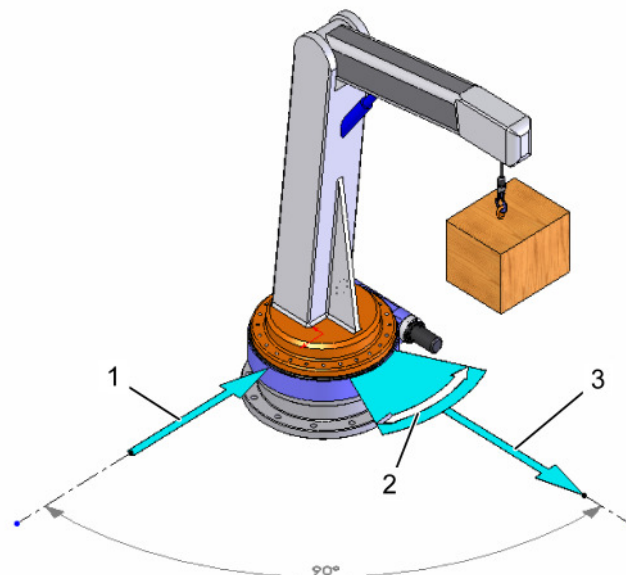


Fig. 20: Main load-carrying zone

- 1 Hardness gap
- 2 Main slewing range
- 3 Main load-carrying zone

1. Determine the main load-carrying zone.
The main load-carrying zone is that area of the slewing ring that is subject to the highest load, taking all aggressive forces and torques, and all occurring load cases into account.

2. Arrange the hardness gap (\Rightarrow section 5.3.1 "Hardness gap") of the bearing ring charged with point load so that it is offset by 90° relative to the main load-carrying zone. The main load-carrying zone is in the main slewing range.

CAUTION! The hardness gap or the filling plug in a slewing ring constitute a zone of decreased load-carrying capacity. The service-life of the slew drive will be reduced significantly, if the hardness gap is in the main slewing range. Fracture of bearing ring for example may cause slew drive failure. Consequently place this marked point in a reduced load zone if possible.

3. Use a feeler gauge to check whether the support surface of the slew drive is completely supported by the mounting structure. If this is not the case, the support surface of the mounting structure must be reworked (\Rightarrow section 5.2.3 "Determining flatness deviation, and perpendicularity deviation and deformation").

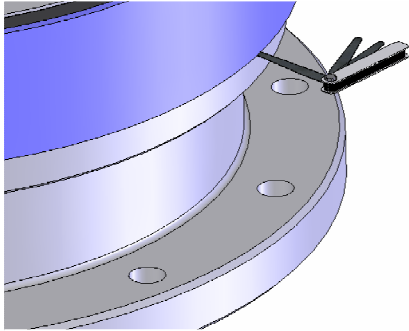


Fig. 21: Check the support surface

5.3.3 Bolting the slew drive

⚠ WARNING

Do not use impact screwdrivers. Using an impact screwdriver may cause impermissible deviations between the bolt tightening forces. Failure of the bolted union with the mounting structure may cause severe personal injury or material damage.

i Mount the slew drive in unstressed state.

Strictly comply with the procedure specified below to avoid impermissible deviations between the bolt tightening forces:

i First fasten the housing, then fasten the toothed bearing ring!

1. Lightly oil the bolt thread (not when using bolt locking devices with adhesive).
2. Pretension the bolts, with washers if required, crosswise in 3 steps, 30%, 80%, and 100% of the tightening torque, or the hydraulically applied pretension force.
3. In this process turn the unscrewed ring several times. Repeat the procedure for the bearing ring that has not yet been bolted.

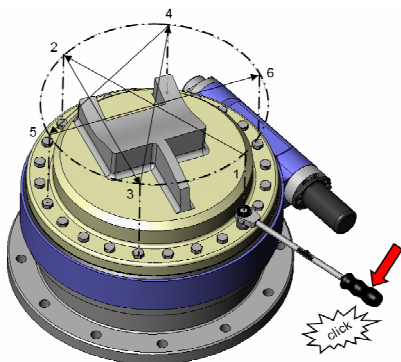


Fig. 22: Tighten crosswise

If using a hydraulic bolt-tensioning cylinder the tensioning forces for the bolt pretension should not exceed 90% of yield strength (\Rightarrow Tab. 10 and 11).

Installation and commissioning

- i The end customer or the operating company must be instructed which tightening process was used. The process must also be used when servicing the unit to check the bolted union.

Tightening torque M_A in Nm with incremental tightening

| Mounting bolt dimensions | Step 1 30% | Step 2 80% | Step 3 100% |
|--------------------------|--|---------------|----------------|
| | Tightening torque M_A in Nm Strength class 10.9 | | |
| M6 | 3.50 | 9.20 | 11.5 |
| M8 | 8.40 | 22.4 | 28.0 |
| M10 | 16.7 | 44.6 | 55.8 |
| M12 | 29.3 | 78.2 | 97.7 |
| M16 | 73.8 | 197 | 246 |
| M20 | 144 | 385 | 481 |
| M24 | 249 | 664 | 830 |
| M30 | 498 | 1329 | 1661 |

Tab. 12

Tightening torque M_A in Nm with incremental tightening

| Mounting bolt dimensions | Step 1 30% | Step 2 80% | Step 3 100% |
|--------------------------|---|---------------|----------------|
| | Tightening torque M_A in Nm Strength class SAE Grade 8 | | |
| 1/4 - 20 UNC | 3.50 | 9.30 | 11.6 |
| 5/16 - 18 UNC | 7.30 | 19.4 | 24.3 |
| 3/8 - 16 UNC | 13.1 | 34.9 | 43.6 |
| 7/16 - 14 UNC | 21.1 | 56.2 | 70.2 |
| 5/8 - 11 UNC | 64.4 | 172 | 215 |
| 3/4 - 10 UNC | 115 | 308 | 385 |
| 7/8 - 9 UNC | 187 | 498 | 622 |
| 1 1/8 - 7 UNC | 397 | 1060 | 1324 |

Tab. 13

Tightening torque M_A in ft-lbs with incremental tightening

| Mounting bolt dimensions | Step 1 30% | Step 2 80% | Step 3 100% |
|--------------------------|--|---------------|----------------|
| | Tightening torque M_A in ft-lbs Strength class 10.9 | | |
| M6 | 2.50 | 6.80 | 8.50 |
| M8 | 6.20 | 16.5 | 20.7 |
| M10 | 12.3 | 33.0 | 41.2 |
| M12 | 21.6 | 57.6 | 72.0 |
| M16 | 54.3 | 145 | 181 |
| M20 | 107 | 284 | 355 |
| M24 | 184 | 490 | 612 |
| M30 | 368 | 980 | 1225 |

Tab. 14

Tightening torque M_A in ft-lbs with incremental tightening

| Mounting bolt dimensions | Step 1 30% | Step 2 80% | Step 3 100% |
|--------------------------|---|---------------|----------------|
| | Tightening torque M_A in ft-lbs Strength class SAE Grade 8 | | |
| 1/4 - 20 UNC | 2.60 | 6.90 | 8.60 |
| 5/16 - 18 UNC | 5.40 | 14.4 | 18.0 |
| 3/8 - 16 UNC | 9.70 | 25.8 | 32.3 |
| 7/16 - 14 UNC | 15.6 | 41.6 | 52.0 |
| 5/8 - 11 UNC | 47.7 | 127 | 159 |
| 3/4 - 10 UNC | 85.5 | 228 | 285 |
| 7/8 - 9 UNC | 138 | 369 | 461 |
| 1 1/8 - 7 UNC | 294 | 785 | 981 |

Tab. 15

5.3.4 Determining the tilting clearance

Tilting clearance increases as raceway system wear increases. To determine the increase in tilting clearance a basic measurement must be executed in installed status and prior to first-time operation. This is the only way to determine changes.

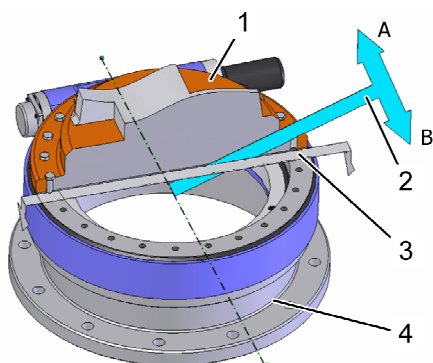


Fig. 23: Determine tilting clearance

- 1 Upper mounting structure
- 2 Tilting direction
- 3 Main load-carrying zone
- 4 Lower mounting structure

Installation and commissioning

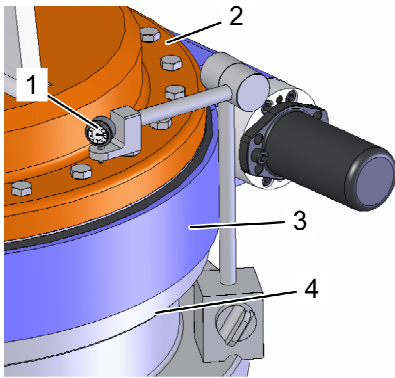


Fig. 24: Measurement setup

- 1 Dial gauge
- 2 Upper mounting structure
- 3 Slew Drive
- 4 Lower mounting structure

Procedure:

Tilting clearance measurement

1. Switch off the system and safeguard it from being turned on again.
 2. Permanently mark the measuring point in the main load direction on the housing and on the bearing ring.
 3. Attach the dial gauge as shown in Fig. 24.
 4. Apply defined tilt torque, at least 50% of max. operating load, in direction "A".
 5. Set dial gauge to zero.
 6. Apply defined tilt torque, at least 50% of max. operating load, in direction "B".
- ↪ The displayed measured value m_1 corresponds to the existing tilting clearance and serves as the base value that will be used for comparison in later inspections.
7. Log and document all measured values.
 - All inspections at a later point in time must be executed on the same measuring point, with the same loads, at the same relative position of the bearing rings, and in the same sequence.
 - At pure axial or radial load check the tilting clearance by applying an additional tilting load.

5.3.5 Determining the circumferential backlash

Tooth wear causes increased circumferential backlash. Consequently it is necessary to check circumferential backlash in accordance with the maintenance intervals (⇒ section 6.3 "Maintenance schedule").

IMPORTANT

Do not exceed the specified values for the circumferential backlash angle of the worm shaft (⇒ Tab. 18). Exceeding the specified values may result in failure of the slew drive and damage to the connecting components.

1. Switch off the system and safeguard it from being restarted.
2. Determine the measuring point in the main load-carrying zone, both on the housing as well as on the worm gear or on the toothed ring and permanently mark these points.

3. Remove the drive with the goal of ensuring that the worm shaft can be freely and easily moved by hand.
 - If using a front-end brake (flanged-mounted between motor and slew drive):
 - Remove front-end brake and motor (⇒ Operating manual for the front-end brake and motor).
 - If using a brake that is bolted to the slew drive opposite side of the motor:
 - Vent brake (⇒ Operating manual for the brake).
 - If using a permanent brake (series WD-L):
 - Remove brake (⇒ Operating manual for the permanent brake)
 4. Determine the circumferential backlash angle of the worm shaft in the area in which the worm gear is meshed the majority of the time.
 - ↪ The determined measured value serves as the comparison value for subsequent checks.
- Limit values, see section 6.4.3 "Checking the circumferential backlash".
 - Log and document the measured values.
 - All measurements at a later point in time must be performed on the same measuring point.

5.4 Function test

The slew drive must rotate uniformly. Deviations in the mounting structure as well as the influence of exterior loads can significantly affect the friction torque.

1. Turn the mounted slew drive several complete revolutions.
2. Check whether the slew drive turns uniformly and without jerking.
3. Perform additional test runs under full load.
4. After the function test, check the tightening torque of the mounting bolts.

6 Maintenance

- i** Follow the instructions provided in the operating manuals for the drive motors (hydraulic or electric), as well as the instructions provided for the optional potentiometer or permanent brake.

6.1 Safety

⚠ DANGER

Prior to starting work switch off all energy supplies and safeguard them from being switched on again. When performing maintenance tasks there is danger of the energy supply being switched on without authorization. This poses a life-threatening hazard for persons in the danger zone.

⚠ WARNING

Prior to starting work ensure that there is adequate free space for installation. Ensure order and cleanliness at the installation location! Parts and tools that are lying loose or on top of each other are accident hazards! If components have been removed, ensure that they are properly re-installed, that all fastening elements are re-installed, and that all threaded connections are tightened with the specified torque. Improper maintenance may cause serious injury or property damage.

Personnel

- Only qualified, specialized personnel shall perform maintenance and inspection work.
- Only qualified electricians should perform work on the electrical equipment.

Personal protective equipment

Wear the following personal protective equipment for all maintenance work:

- Protective work clothing
- Protective gloves
- Safety footwear

Environmental protection

Comply with the following instructions for environmental protection when performing maintenance work:

- At all lubricating points where lubricant is applied by hand, remove escaping, used, or excess grease, and dispose of it in accordance with applicable local regulations.
- Collect hydraulic fluids and oils in suitable containers and dispose of these substances in accordance with applicable local regulations.

6.2 Cleaning

IMPORTANT

Use cold solvent (e.g. white spirit, diesel oil, Kaltryl KEV) that does not corrode the sealing material. Ensure that the cleaning agent does not get into the slew drive. Do not use a high-pressure cleaner to clean the slew drive. Unsuitable trichloroethylene-based or perchloroethylene-based cleaning agents, or other extremely aggressive cleaners damage the seal and may cause bearing damage.

Wear the following additional protective equipment for cleaning work:

**Face protection**

to protect the eyes and face from solvents.

**Chemical-resistant protective gloves**

to protect hands from aggressive substances. Check protective gloves for leaks prior to use. Clean the gloves before pulling them off, store them in a well-ventilated location.

- When using cleaning agents, ensure adequate ventilation.
- Remove old grease, dust, and fouling with lint-free cloths.

6.3 Maintenance schedule

Maintenance tasks are described in the sections below that are required for optimal and trouble-free operation.

If increased wear is detected during regular inspections, then reduce the required maintenance intervals according to the actual indications of wear.

If you have questions concerning maintenance tasks and intervals, please contact our customer service (⇒ page 2).

Maintenance

| Interval | Maintenance task | To be executed by |
|---|---|-------------------|
| weekly | Check seal | Specialist |
| after 100 operating hours | Tighten bolts | Specialist |
| | Check tilting clearance | Specialist |
| after every additional 700 operating hours or at least every 6 months | Tighten bolts <ul style="list-style-type: none"> Reduce the inspection interval if there is heavy wear or continuous operation. | Specialist |
| | Check tilting clearance <ul style="list-style-type: none"> Reduce the inspection interval to 200 operating hours if the detected increase in tilting clearance is approximately 75% of the permissible tilting clearance increase. After further increase reduce the interval between inspections to 50 - 100 hours. | Specialist |
| | Check circumferential backlash <ul style="list-style-type: none"> Reduce the inspection interval to 200 operating hours if the detected increase in circumferential backlash is approximately 75% of the permissible circumferential backlash increase. After further increase reduce the interval between inspections to 50 - 100 hours. | Specialist |

Tab. 16

Lubrication

General re-lubrication of slew drives:

- After each cleaning
- Before and after longer periods of standstill, e.g. for cranes and construction machines during the winter months.

IMPORTANT

The main cause for slewing ring failure is inadequate lubrication. The lubrication intervals essentially depend on existing working and environmental conditions, as well as the version of the slew drive. Precise lubrication intervals can only be determined by tests under normal operating conditions.

If comparable results are not available, the following table can be used as a guide value:

| Work conditions | Lubricating interval | To be executed by |
|---|---|-------------------|
| Dry and clean workshop hall (rotary tables, robots, etc.) | Approx. every 300 operating hours, at least every 6 months | Specialist |
| Severe conditions on open terrain (cranes, excavators, etc.) | Approx. every 100 to 200 operating hours, at least every 4 months | Specialist |
| Aggressive climatic conditions, (ocean, desert, arctic climate, extremely polluted environment, ≥ 70 operating hours per week) | Every 50 operating hours, at least every 2 months | Specialist |
| Extreme conditions (tunnel boring machines, steel works, wind turbines) | Continuous lubrication (through central lubrication or grease cups) | Specialist |

Tab. 17

The specified values are valid for the following conditions:

- Operating temperature on the slew drive < 70° C (158° F).
- Circumferential speed < 0.5 m/s (1.64 ft/sec) for SP slew drives.
- Output speed < 5 rpm for WD slew drives.
- Low to moderate load.

i Comply with the instructions in the operating manual provided by the manufacturer, for lubrication of optional intermediate gear units, brakes, and motors.
If necessary re-lubricate permanent brakes. For this only use the special grease SHELL RETINAX HDX2.

6.4 Maintenance tasks

6.4.1 Inspecting the mounting bolts

IMPORTANT

To compensate for settling, the bolts must be retightened with the prescribed tightening torque. Retightening must be executed without exerting additional external stress on the bolted union.

1 Detached bolt

Execution only by a specialist.

- Special tools required:
 - Torque wrench
 - Hydraulic clamping fixture
- Replace loose and detached bolts or nuts and washers with new bolts, nuts and washers.
- Use the same bolt size and bolt quality.

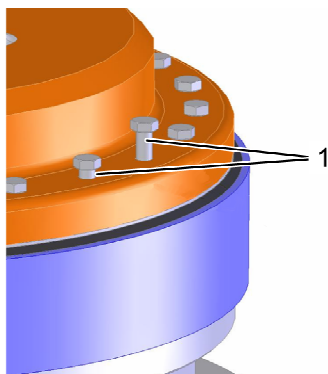


Fig. 25: Inspecting the mounting bolts

i If a hydraulic clamping fixture was used to tighten the bolts, then a hydraulic clamping fixture must also be used to check the bolt pretension. Always use the same tightening procedure as specified for installation of the slew drive when checking the bolted union.

6.4.2 Checking the tilting clearance

Wear in the raceway system results in an increase in tilting clearance. Consequently it is necessary to check the tilting clearance in accordance with the maintenance intervals (⇒ section 6.3 "Maintenance schedule").

CAUTION! If the maximum permissible tilting clearance increase is reached, then the system must be brought to a standstill and the slew drive must be replaced immediately, as safe operation can no longer be ensured.

Checking the tilting clearance increase d_k directly on the slew drive

The measured value m_1 determined at installation serves as the base value (\Rightarrow section 5.3.4 "Determination of tilting clearance").

- Determine the value m_x as described in the section 5.3.4 "Determining the tilting clearance".
- Subtract the base value m_1 from the value m_x determined in the inspection measurement:

$$d_k = m_x - m_1 \leq d_{k,perm}$$

$$d_{k,perm} = 0.45 \text{ mm}$$

$$d_{k,perm} = 0.0177 \text{ in}$$

Checking the tilting clearance increase d_k but not directly on the slew drive

Proportionally convert the tilting clearance increase each time a measurement is taken (after the installation measurement) and compare with $d_{k,perm}$.

6.4.3 Checking the circumferential backlash**⚠ CAUTION**

Tooth wear causes increased circumferential backlash. When the maximum permissible circumferential backlash is reached, then the system must be brought to a standstill and the slew drive must be replaced immediately, as safe operation can no longer be ensured.

1. Determine the circumferential backlash in accordance with 5.3.5 "Determining the circumferential backlash".
2. Compare the determined value with the permissible values of the table.
 - See the type plate for the module specification.
 - For a module that is between the specified values, use the value for the smaller module.

Circumferential backlash angle limit values

| Module of the tothing | Limit of circumferential backlash angle | Module of the tothing | Limit of circumferential backlash angle |
|-----------------------|---|-----------------------|---|
| 3 | 34° | 6 | 28° |
| 4 | 32° | 6/2 convolution | 14° |
| 4/2 convolution | 16° | 7 | 28° |
| 4,5 | 31° | 7/2 convolution | 14° |
| 5 | 30° | 8 | 27° |
| 5/2 convolution | 15° | 8/2 convolution | 13.5° |

Tab. 18

6.4.4 Lubricating the slew drive




IMPORTANT

Regularly lubricate the slew drives to prolong their service life and ensure safe operation.

IMPORTANT

Always use the lubricants specified in the order drawing. If using other lubricants pay attention to the relative mixability of the substances. The standard lubricants used are "r.tecc Norplex LKP2" from Rhenus, or the grease "Optimol Longtime PD0" from Castrol. If in doubt, or if there is no specification on the drawing, consult with our customer service (⇒ page 2). Using the wrong lubricant may cause damage to the slew drives and reduce the service life. In this case, any warranty shall be excluded. Comply with the instructions provided by the lubricant manufacturer!

If possible use a central lubrication system to lubricate the raceway system. In this regard ensure that the hoses are filled with grease at commissioning and that the storage tanks are regularly topped up with grease.

-  An automatic re-lubricating system significantly facilitates re-lubrication for the raceway system and the toothing. Functional safety as well as wear behavior are improved.
-  Comply with the instructions in the operating manual provided by the respective manufacturer for lubrication of optional intermediate gear units, brakes, and motors.
-  If it is evident that moisture has penetrated into the slew drive, or has been absorbed by the grease, you must re-lubricate more intensively.

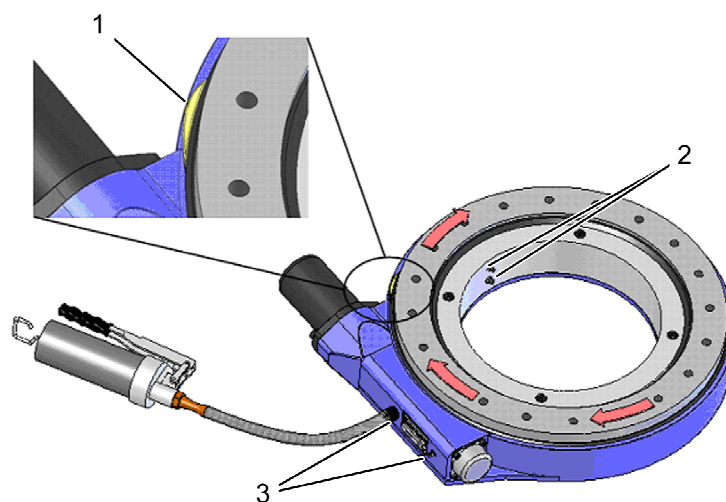


Fig. 26: Lubricating the slew drive

- 1 Fresh lubricant
- 2 Lubricating nipple, bearing ring
- 3 Lubricating ring housing

1. In succession, press grease into all lubricating nipples while simultaneously turning the slew drive all the way through, until a continuous collar of grease forms under at least one seal.
2. Ensure that old lubricant can escape without obstruction.

6.4.5 Inspecting the seals

IMPORTANT

Damaged seals must be replaced immediately. If there is corrosion damage or functional impairment as a consequence of damaged seals not being replaced at the proper time, any warranty shall be excluded. Penetrating moisture may quickly cause corrosion in the bearing ring and impairs safe operation. Note that the factory-installed seal only offers protection against dust and splashing water.

If damage is detected on a seal, contact the customer service organization without delay (⇒ page 2).

6.5 Measures after successful maintenance

Execute the following steps after concluding maintenance work and before switching the system on:

1. Check all previously loosened bolted unions for firm seat.
2. Ensure that all previously removed protective devices and covers have been properly installed.
3. Ensure that all tools, materials, and other equipment have/has been removed from the work area.
4. Clean the work area and remove any substances that may have escaped, such as liquids, processing material, or similar items.
5. Ensure that all system safety devices are again functioning properly!

7 Dismantling

At the end of the component's service life the component must be dismantled and disposed of in an environmentally responsible manner.

7.1 Safety

⚠ DANGER

Prior to starting work switch off all energy supplies and safeguard them from being switched on again. When performing maintenance tasks there is a danger of the energy supply being switched on without authorization. This poses a life-threatening hazard for persons in the danger zone.

⚠ WARNING

Prior to starting work ensure that there is adequate free space. Handle open, sharp-edged components carefully. Ensure order and cleanliness at the workstation! Parts and tools that are lying loose or on top of each other are accident hazards! Dismantle components properly. Pay attention to the high dead weight of some of the components. Use hoist equipment if necessary. Secure the components so that they do not fall down or fall over. There is an injury hazard if the device is not dismantled properly. Consult with the manufacturer if there are questions.

⚠ WARNING

Never position yourself under a suspended load! Swinging or falling parts may cause injury or life-threatening danger.

⚠ WARNING

Carefully supervise the lifting processes and transport. Only use the transport methods described here. A life-threatening crushing hazard exists if the components fall.

IMPORTANT

Proceed with caution when transporting objects! Comply with instruction symbols on the packages and only use the prescribed attachment points. Improper transport may cause significant damage.

IMPORTANT

Avoid impact when transporting! Improper transport may cause significant damage.

Personnel

- Only trained, specialized personnel should perform dismantling work.

Dismantling

7.2 Dismantling

Prior to dismantling:

- Switch off the system and safeguard it from being turned on again.
- Physically disconnect all energy supplies to the system, discharge stored residual energy.
- Remove fuels and auxiliary materials, as well as residual processing materials and dispose of these items in an environmentally responsible manner.

Then clean subassemblies and components properly and dismantle them, taking applicable local occupational safety and environmental protection guidelines into consideration.

1. Unscrew the fastening elements of the toothed bearing ring.
2. Remove the mounting structure.
3. Unscrew the mounting elements of the housing.
4. Remove the slew drive.

7.3 Disposal

IMPORTANT

Electrical scrap and electronic components, lubricants and other auxiliary materials are subject to treatment as special waste, and should only be disposed of by approved specialist companies! Improper disposal may cause environmental damage.

If a return or disposal agreement has not been concluded, then recycle dismantled components:

- Scrap metals.
- Recycle plastic elements.
- Sort and dispose of the remaining components in accordance with material condition

Local municipal authorities or specialized disposal companies provide information on environmentally responsible disposal.

8 Technical data – Type plate



The type plate is on the housing and contains the following information:

- Manufacturer
- Drawing no./type
- Identification code consisting of:
Order number, year of manufacture and consecutive number
- Module
- Web address

Fig. 27: Type plate

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