

Assembly and Maintenance  
**BPR-Rico (USA)**  
**P-300 (82.10622)**



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## Preface

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Axles, gearboxes, transmissions, drive assemblies, wheel gears, and wheel ends produced by Kessler & Co. GmbH & Co.KG (hereinafter referred to as KESSLER) are designed and produced according to the current state of the art and generally recognized safety regulations.

The following assembly instructions describe the state of the art at the time when the documentation was written. It was written to the best of the author's knowledge, KESSLER accepts no liability, however, for possible errors regarding illustrations and descriptions.

It is directly related to the corresponding installation drawing of KESSLER, which is available to the vehicle manufacturer. All technical data which has been agreed upon by the axle manufacturer and the vehicle manufacturer, and which must be observed, is specified on the installation drawing.

This documentation is not subject to revision. Subject to change without notice.

Due to the constant further development and technical improvements of our products, the illustrations may differ in the following work steps or vary from the actual product/components. Drawings, graphics, and photos are often not true to scale.

Claims for damage and consequential costs due to work carried out unprofessionally or improperly by third parties are ruled out.

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## Table of contents

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|          |   |           |
|----------|---|-----------|
| <b>1</b> | <b>Safety</b> .....   | <b>1</b>  |
| 1.1      | Structure of warning notices .....  | 1         |
| 1.2      | Explanation of the usual warning notices and symbols .....  | 1         |
| 1.3      | Basic safety instructions .....   | 2         |
| <b>2</b> | <b>Intended use</b> .....   | <b>4</b>  |
| <b>3</b> | <b>Technical data</b> .....   | <b>5</b>  |
| <b>4</b> | <b>Transport</b> .....  | <b>6</b>  |
| <b>5</b> | <b>Installation</b> .....   | <b>7</b>  |
| 5.1      | Modes of fastening and transport means .....  | 8         |
| 5.2      | Measures during installation .....  | 8         |
| 5.3      | Installing drive shaft .....  | 8         |
| <b>6</b> | <b>Startup</b> .....  | <b>9</b>  |
| 6.1      | Painting .....  | 9         |
| 6.2      | Lines .....   | 9         |
| 6.3      | Filling oil .....   | 9         |
| 6.4      | Brakes .....  | 10        |
| 6.4.1    | Wet multiple disk brake .....   | 11        |
| 6.4.2    | Bleeding the wet multiple disk brake .....  | 12        |
| 6.4.3    | Running-in instructions .....   | 12        |
| 6.5      | Rim .....   | 13        |
| 6.5.1    | Rim attachment .....  | 13        |
| 6.6      | Drive flange .....  | 13        |
| 6.7      | Bleeding a KESSLER-product .....  | 13        |
| <b>7</b> | <b>Checklist for the installation and startup of a KESSLER product</b> .....                              | <b>14</b> |
| <b>8</b> | <b>Operation</b> .....  | <b>16</b> |
| <b>9</b> | <b>Maintenance</b> .....  | <b>17</b> |
| 9.1      | Lubricants and lubrication intervals .....  | 17        |
| 9.2      | Oils .....  | 18        |
| 9.2.1    | Recommended types of hypoid gear oil .....  | 18        |
| 9.2.2    | Approved oils for brake with external cooling .....   | 19        |
| 9.3      | Oil change .....  | 20        |
| 9.3.1    | Oil drain .....   | 21        |
| 9.3.2    | Oil filling and filling level .....   | 23        |
| 9.4      | Checking the screwed connections, safeguards, formation of corrosion and on load-bearing components ..... | 25        |

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|           |  |           |
|-----------|--|-----------|
| 9.5       | Maintenance intervals .....  | 26        |
| 9.6       | Checking gaskets.....  | 27        |
| 9.7       | Controlling of breather.....   | 27        |
| 9.8       | Wheel bearing adjustment.....  | 28        |
| 9.9       | Wet multiple disk brake regulations .....  | 31        |
| 9.10      | Lining wear measurement of wet multiple disk brakes.....                             | 32        |
| <b>10</b> | <b>Ordering spare parts.....</b>   | <b>33</b> |
| 10.1      | Guarantee .....  | 33        |
| 10.2      | Required specifications for ordering spare parts.....                                | 33        |
| 10.3      | Type plate .....   | 33        |
| 10.4      | Necessary consultation with KESSLER .....  | 34        |
| <b>11</b> | <b>Storage .....</b>   | <b>35</b> |
| 11.1      | Standard conservation .....  | 35        |
| 11.2      | Conditions for storage with standard conservation.....                               | 35        |
| 11.3      | Measures for longer storage periods .....  | 35        |
| 11.4      | Measures before startup after storage.....   | 36        |
| 11.5      | Responsibility during storage .....  | 36        |
| <b>12</b> | <b>Disposal.....</b>   | <b>37</b> |
| <b>13</b> | <b>Important information .....</b>   | <b>38</b> |
| 13.1      | Auxiliary materials: Adhesives, sealing compounds, grease, and assembly pastes ..... | 38        |
| 13.1.1    | Use of auxiliary materials.....  | 38        |
| 13.1.2    | Handling auxiliary materials .....   | 39        |
| 13.2      | Tightening torques .....   | 40        |
| 13.2.1    | Tightening torque wheel nut.....   | 40        |
| 13.2.2    | Tightening torques for standard metric threads.....                                  | 41        |
| 13.2.3    | Tightening torques for metric fine threads.....                                      | 42        |
| 13.2.4    | Tightening torques for galvanized screws and nuts .....                              | 42        |
| 13.2.5    | Tightening torque for screw plugs .....  | 43        |
| 13.3      | Units.....   | 44        |

# 1 Safety

## 1.1 Structure of warning notices



### SIGNAL WORD

Type and source of the danger

Consequences if ignored

➤ Measure

## 1.2 Explanation of the usual warning notices and symbols

|                  |   |
|------------------|---|
| <b>⚠ DANGER</b>  |   |
|                  | <p><b>Indicates a direct danger.</b></p> <p>If not avoided, death or serious injury will result.</p>                        |
| <b>⚠ WARNING</b> |   |
|                  | <p><b>Indicates a possibly dangerous situation.</b></p> <p>If not avoided, death or serious injury may possibly result.</p> |
| <b>⚠ CAUTION</b> |   |
|                  | <p><b>Indicates a possibly dangerous situation.</b></p> <p>If not avoided, injury may possibly result.</p>                  |
| <b>NOTICE</b>    |   |
|                  | <p>Indicates situations where material damage can occur.</p>  |
|                  | <p><b>NOTE</b></p> <p>Indicates important information, application tips, and useful notes for proper working practices.</p> |



General warning sign that draws attention to potential dangers.



Warning against danger of burns or cut injuries. Protective gloves must be worn.

## 1.3 Basic safety instructions

The following safety instructions must be read and observed before work is started on KESSLER products.

### Product safety

Axles, gearboxes, drive assemblies, wheel gears, and wheel ends produced by KESSLER (referred to as KESSLER products in the following) are developed, designed and manufactured according to German and European technical regulations.

Work on Kessler products may only be carried out in compliance with the technical rules and safety regulations valid at the operating site.

- Valid health, work, and fire-protection regulations
- Laws, directives, and safety regulations

### Organizational and personnel matters

**Fundamental principles:** axles, gearboxes, drive assemblies, wheel gears, and wheel ends produced by KESSLER may only be put into operation in a technically fault-free condition, when used as intended and being mindful of safety and danger while observing the instructions. Remove defects immediately, especially those which might adversely affect safety. The operation of defective and improperly maintained, repaired or retrofitted axles, gearboxes, drive assemblies, wheel gears and wheel ends is not permitted under any circumstances! Carry out all activities in a responsible and safety-oriented manner. Furthermore, all markings and labels on axles, gearboxes, wheel gears, and wheel ends of KESSLER must be legible.

**Scope of validity:** The documentation is valid for all persons who work on KESSLER products. Before work is carried out on the vehicle, the documentation must be read completely and closely observed. If there are questions or something cannot be understood, KESSLER must be consulted.

The documentation should be stored near the KESSLER products and be accessible for the personnel at any time. The documentation is part of the KESSLER products and must be available in its entirety during the entire service life.

**Competences:** Work on KESSLER products may only be carried out by trained technicians such as motor vehicle mechanics or persons with comparable vocational training.

Work on the electrical sector may only be carried out by trained technicians such as an electrician, electronics technician or persons with comparable vocational training (=qualified electrician).

### Product-specific dangers

**Transport, installation, maintenance, repair, and conversion work:** Activities between or on moving subassemblies must be avoided as there is a danger of crushing or shearing.

The unpredictable own weight of KESSLER products or individual parts can cause them to fall or tip over unexpectedly.

- Employ only suitable, undamaged, and approved cranes and slinging means for the load in question.
- Do not stand under suspended loads.
- Secure parts with tension belts and/or suitable supports.
- Wear safety shoes.

All maintenance specifications in KESSLER's documentation must be observed.

All work must be carried out at a clean workplace.

The instructions in this documentation assume that the KESSLER product has been disassembled and is fixed onto a device for further processing. Read the vehicle manufacturer's instructions on how to dismantle the KESSLER products from the vehicle.

Work on a KESSLER product may only be carried out when permissible by the temperature of the respective component.

- Make sure that oil has cooled down before draining it.
- Make sure that rotating parts have cooled down before starting disassembly.
- Wear fire-proof gloves.

**Brake:** When working on the brake it must be ensured that no unintended machine movement can occur when the brake mechanism is disengaged.

The brake is a safety component of the first order; improper work on it may cause the brake to fail.

**Rim and tire:** Never stand directly in front of the rim when air is released or during inflation. Parts may suddenly come loose and be ejected due to the inner pressure of the tire.

The air needs to be released completely from the tire beforehand when disassembling versions with clamped rim fixation. Be sure to observe the tightening torques and maintenance of the wheel nuts and clamps.

**Lubricants and auxiliary materials:** Be sure to observe the manufacturer's safety data sheets when handling lubricants and auxiliary materials (e.g. oils and greases).

Oils and greases can trigger allergic reactions on skin. For this reason, appropriate protective clothing must be worn.

Loose-fitting clothing and long loose hair is prohibited when working on KESSLER products!

When metal parts are being machined where there is a risk of shattering (grinding, deburring, cleaning with compressed air, etc.), bits of metal may be flung out that can injure the eyes. For this reason, safety goggles must always be worn.

KESSLER offers customer service tools that make working on axles, gearboxes, wheel gears, and wheel ends easier and safer.

Repair welding is only permitted after consultation with KESSLER!

Before reassembling used parts, they must be checked for damage, fault-free contact surfaces and wear. In particular, check that there are no chips or other foreign bodies in the axles, gearboxes, wheel gears, and wheel ends.

After carrying out maintenance and repair work, check that the product functions properly.



## **2 Intended use**

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KESLER axles, wheel gears, wheel ends, drive assemblies or gearboxes may only be installed and operated in vehicles for which they have been designed. KESLER products may not be operated when they have been dismantled.

### **3 Technical data**

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All technical data is specified on the corresponding installation drawing and questionnaire of KESSLER and is available to the vehicle manufacturer. The installation drawing provides information on the following points:

- Installation dimensions
- Direction of travel
- Location of the connections
- Permitted operating pressures, etc.

## 4 Transport

### WARNING



**Own weight / gravity of axles, gearboxes, transmissions, wheel gears, or wheel ends is not observed or underestimated.**

Risk of injury

- Use only hoisting devices and slinging means with sufficient lifting capacity.
- Employ suitable, undamaged, and approved cranes for the load in question.
- Do not stand under suspended loads.

- A KESSLER product is generally prepared by KESSLER, securely placed on a transport frame for transport.
- The shipping company has to secure the shipment onto the vehicle.
- Each KESSLER product should be transported in such a manner as to avoid any damage.
- Keep the weight of the KESSLER product to be transported in mind; refer to the valid transport papers.
- Secure top-heavy KESSLER products on the industrial truck so that it does not tip over.
- Always fasten and secure the KESSLER product at a minimum of two points.

## 5 Installation

### WARNING



**Falling, slipping, tipping of axles, gearboxes, transmissions, wheel gears, or wheel ends during installation**

Risk of injury

- Securing components with tension belts and/or supports
- Employ only suitable, undamaged, and approved cranes and slinging means for the load in question.

### CAUTION



**Sharp-edged parts**

Danger of cut injuries

- Wear protective gloves.

## **5.1 Modes of fastening and transport means**

---

- A KESSLER product is generally securely placed on a transport frame for shipment. To lift and move a KESSLER product, a traverse is needed as well as hoisting devices and slinging means with sufficient lifting capacity.
- Fasteners for the installation of the KESSLER product may only be attached to steelwork components that have the appropriate capacity for the load. If you have any questions, please contact KESSLER.
- A gearbox may only be loaded at the support or attachment points provided. Under no circumstances use control cylinders, pipes or similar parts for suspension.
- Drive assembly may only be loaded at the support or attachment points provided or the housing of the drive assembly must be secured with a round sling with sufficient capacity. Under no circumstances use control cylinders or similar parts for suspension
- The KESSLER product always has to be fastened and secured at a minimum of two points.
- Releasing the hoisting devices and slinging means is only permitted once the KESSLER product has been sufficiently attached to the vehicle.

## **5.2 Measures during installation**

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- The vehicle manufacturer must make sure that there is sufficient means for raising and supporting the KESSLER product during installation.
- The vehicle manufacturer must make sure that no persons are present in the danger zone during the lifting.
- The vehicle manufacturer must make sure that the KESSLER product cannot move uncontrolled during/after the installation.
- Wear work gloves during the installation.
- Use suitable tools during the installation.

## **5.3 Installing drive shaft**

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- When installing drive shafts, the phasing (Z- or W-alignment) allowed for and the specified deflection angles must be maintained.

## 6 Startup

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### 6.1 Painting

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- When painting the KESSLER product, the radial seal rings must be protected from paint.

### 6.2 Lines

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- Connect lines only when they are not pressurized.

### 6.3 Filling oil


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- KESSLER products are generally shipped without oil; they therefore need to be filled with oil.
- Always check the oil filling before startup, even if a KESSLER product was delivered with an oil filling as ordered.
- Make sure the correct oil quality is used for filling, [see "Oils" on page 18.](#)
- Check the oil level, [see "Oil change" on page 20.](#)
- Take separate oil spaces and pre-filling into account, e.g. at drop gear, through drive assembly, oil cooler or at gear boxes assembled onto axles.

#### Oil quality for wet multiple disk brake with external cooling

- Make sure the correct oil quality is used for filling, [see "Approved oils for brake with external cooling" on page 19.](#)

## 6.4 Brakes

| <b>⚠ DANGER</b>   |  |
|---|--|
|  | <p><b>Brake failure due to ignoring of regulations during startup.</b></p> <p>Serious injury</p> <ul style="list-style-type: none"><li>➤ When working on the brakes, make sure that no unintended vehicle movement can occur when the brake mechanism is disengaged.</li><li>➤ The vehicle manufacturer has to carry out a documented brake test before releasing the vehicle.</li></ul> |

- Use specified actuation medium, see installation drawing as well as the brake manufacturer's instructions.
- Observe the permissible maximum actuation pressures according to the installation drawing, brake calculation, brake specification sheets or the brake manufacturer's instructions.
- Check that the position of the brake connections is correct according to the installation drawing.
- Bleed the actuation space / piston space of the brakes, see respective instructions of the brake manufacturer.
- Check the proper function of the brakes.
- On combination operational and parking brakes, an overload of brake components needs to be prevented during joint actuation of the operational and parking brake by installing a suitable protection valve.
- The vehicle manufacturer must observe the running-in instructions of the brake manufacturer and KESSLER.
- The vehicle manufacturer has to carry out a documented brake test before final startup of the vehicle.

### 6.4.1 Wet multiple disk brake

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#### Brake cooling

- Observe the position of the connections, in particular the cooling oil connections, see installation drawing / ["Technical data" on page 5](#).
- External cooling of the wet multiple disk brake is necessary. A model without cooling is only permissible with the express approval of KESSLER.
- Approved oils for cooling (attention: observe LS additives) see KESSLER company standard WN85601 and WN85602.
- The amount of cooling oil needs to be specified according to vehicle usage. Representative test drives with the vehicle are necessary to verify sufficient cooling.
- The cooling oil pressure at the cooling oil outlet must not exceed 1 bar. Pressures up to 5 bar are permissible at the cooling oil inlet however.
- The cooling oil temperature at the cooling oil outlet must not exceed 100°C. The cooling oil temperature at the cooling oil inlet must therefore not exceed 70°C.
- The cooling oil circuit should be designed with a tank that allows for a dewatering of the oil. Water in the oil can cause the brake linings to come loose!


#### Brake actuation


- Observe the respective brake specifications sheet WN 63.... according to the technical specification field on the installation drawing / ["Technical data" on page 5](#).
- Approved oils for actuation; see KESSLER company standard WN85601 and WN85602. Use only mineral oils!
- Check the permissible maximum residual pressure in non-actuated condition according to brake specifications sheet!
- Constant pressure at the brake actuation is not permissible!

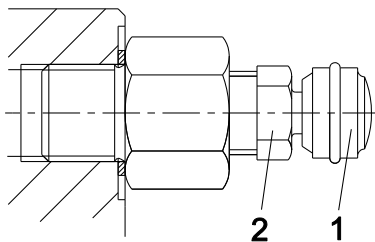


### 6.4.2 Bleeding the wet multiple disk brake

The brake system needs to be bled before starting up the vehicle.

| <b>⚠ WARNING</b>  |   |
|---|---|
|  | <p><b>When work is being performed on the brake, its braking effect is disabled.</b></p> <p>Rolling away of the vehicle</p> <ul style="list-style-type: none"> <li>➤ Make sure that no machine movements can take place.</li> </ul> |

| <b>⚠ CAUTION</b>  |  |
|---|--|
|  | <p><b>Oil and bleeder valve are pressurized.</b></p> <p>Injury due to parts being ejected</p> <ul style="list-style-type: none"> <li>➤ Only trained technicians may bleed the brakes.</li> </ul> |



1. Make sure that no machine movements can take place.
2. Pressurize the brake.
  - The brake closes.
3. Remove the protection cap (1) of the bleeder valve (2).
4. Slide the hose onto the bleeder valve.
5. Open the bleeder valve slowly by no more than 1/4 of a rotation.
  - Oil-air mixture escapes through the hose.
6. Once only oil seeps out, close the bleeder valve again properly.
7. Pull off the hose.
8. Place the protection cap (1) onto the bleeder valve (2).

### 6.4.3 Running-in instructions

#### Running-in instructions for wet multiple disk brakes:

- When starting up the vehicle, drive carefully to bring the brakes to the operational temperature.
- Drive carefully to get used to the brake effect.

## 6.5 Rim

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- Check permissible rim offset according to the installation drawing / ["Technical data" on page 5](#).
- Contact surface for rim and fastening parts of the rim have to be level, clean and free of grease.
- Check the clearance between rim and tire to the neighboring axle parts.
- On steerable axles, check the clearance, in particular at full steering angle.

### 6.5.1 Rim attachment

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#### Wheel nuts

- Use correct types of wheel nuts and tighten with controlled tightening torques in accordance with specifications on ["Tightening torque wheel nut" on page 40](#).
- Check the wheel nuts after a few operating hours and retighten. See ["Maintenance intervals" on page 26](#)

## 6.6 Drive flange

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- Contact surfaces have to be clean and free of grease.
- Observe the reduced tightening torque for galvanized screws, [see "Tightening torques" on page 40](#)

## 6.7 Bleeding a KESSLER-product

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At oil filled KESSLER-products breather are usually delivered separately.

- Mount breather, screw in the breather and tighten it hand-tight .
- Check breather for correct function.
- Check if the breather is free of damage, paint and dirt.
- A leaky breather must be replaced.

## 7 Checklist for the installation and startup of a KESSLER product

| For safety instructions and required work/tasks, refer to the chapter Installation and startup.   | Completed  |  | Remarks |
|---|--|--|---------|
|   | yes  | no   |         |
| <b>Items to be checked:</b>   |  |  |         |
| <b>Installing a KESSLER product after a longer storage period</b> <ul style="list-style-type: none"> <li>Special measures observed before startup after storage?</li> </ul>   | <input type="checkbox"/>   | <input type="checkbox"/>   |         |
| <b>Moving KESSLER product</b> <ul style="list-style-type: none"> <li>Capacity of the hoisting device and the slinging means sufficient for the KESSLER product?</li> <li>Is the KESSLER product to be moved secured at two steelwork components (suitable for the load)?</li> </ul>   | <input type="checkbox"/><br><input type="checkbox"/>   | <input type="checkbox"/><br><input type="checkbox"/>   |         |
| <b>Installation position</b> <ul style="list-style-type: none"> <li>Driving direction and installation angle observed?</li> </ul>   | <input type="checkbox"/>   | <input type="checkbox"/>   |         |
| <b>Lines</b> <ul style="list-style-type: none"> <li>All lines connected?</li> </ul>   | <input type="checkbox"/>   | <input type="checkbox"/>   |         |
| <b>Rim</b> <ul style="list-style-type: none"> <li>Permissible rim offset checked according to the installation drawing?</li> <li>Clearance between rim and neighboring axle parts checked?</li> </ul>   | <input type="checkbox"/><br><input type="checkbox"/>   | <input type="checkbox"/><br><input type="checkbox"/>   |         |
| <b>Rim attachment</b> <ul style="list-style-type: none"> <li>Is the contact surface for rim and fastening parts of the rim to be level, clean and free of grease?</li> <li>Correct fastening parts used?</li> <li>Fastening parts tightened with the correct tightening torque?</li> <li>Retighten the fastening parts regularly after short running interval!</li> </ul> | <input type="checkbox"/><br><input type="checkbox"/><br><input type="checkbox"/><br><input type="checkbox"/> | <input type="checkbox"/><br><input type="checkbox"/><br><input type="checkbox"/><br><input type="checkbox"/> |         |
| <b>Tires</b> <ul style="list-style-type: none"> <li>Clearance between tires and neighboring axle parts checked?</li> <li>Tire pressure correct according to vehicle manufacturer's specifications?</li> </ul>   | <input type="checkbox"/><br><input type="checkbox"/>   | <input type="checkbox"/><br><input type="checkbox"/>   |         |
| <b>Inlet direction of rotation / driving direction correct?</b>   | <input type="checkbox"/>   | <input type="checkbox"/>   |         |
| <b>Radial seal rings</b> <ul style="list-style-type: none"> <li>Radial seal rings free of paint?</li> </ul>   | <input type="checkbox"/>   | <input type="checkbox"/>   |         |

| For safety instructions and required work/tasks, refer to the chapter Installation and startup.  | Completed |    |         |
|--|-----------|----|---------|
| Items to be checked:   | yes       | no | Remarks |
| <p><b>Oil filling</b></p> <ul style="list-style-type: none"> <li>• Oil quality used correct? <input type="checkbox"/></li> <li>• KESSLER product filled to correct oil level? <input type="checkbox"/></li> <li>• Separate oil spaces (drop gear and through drive assemblies, ...) filled? <input type="checkbox"/></li> <li>• Recheck oil level short time after startup! <input type="checkbox"/></li> </ul>  |           |    |         |
| <p><b>Brakes</b></p> <ul style="list-style-type: none"> <li>• Actuation medium correct? <input type="checkbox"/></li> <li>• Actuation pressure checked? <input type="checkbox"/></li> <li>• Max. permissible residual pressure checked? <input type="checkbox"/></li> <li>• Brake properly connected? <input type="checkbox"/></li> <li>• Cooling oil medium of the brake correct? <input type="checkbox"/></li> <li>• Actuation space, piston space of the brake bled? <input type="checkbox"/></li> <li>• Function tested? <input type="checkbox"/></li> <li>• Running-in instructions observed? <input type="checkbox"/></li> <li>• Brake test carried out? <input type="checkbox"/></li> </ul> |           |    |         |
| <p><b>Drive flange</b></p> <ul style="list-style-type: none"> <li>• Contact surfaces clean and free of grease? <input type="checkbox"/></li> <li>• Screw connections tightened with the correct tightening torque? <input type="checkbox"/></li> </ul>   |           |    |         |
| <p><b>Drive shaft</b></p> <ul style="list-style-type: none"> <li>• Phasing and deflection angles correct? <input type="checkbox"/></li> </ul>  |           |    |         |
| <p><b>Breather</b></p> <ul style="list-style-type: none"> <li>• Breather mounted and checked? <input type="checkbox"/></li> </ul>  |           |    |         |

## 8 Operation

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The technical specifications such as the permissible axle load must be observed at all times when KESSLER products are operated.

Refer to the installation drawing / ["Technical data" on page 5](#).

## 9 Maintenance

### 9.1 Lubricants and lubrication intervals

| Lube point   | Ambient-temperature when axle is used | Lubricant   | Remarks   | before start-up      | Lubrication intervals<br>(The value that is reached first is always valid.) |  |                       |
|--|---------------------------------------|---|---|----------------------|---|--|-----------------------|
|  |                                       |   |   |                      | after 100 hours of operation<br>1000 km                                     | every 1000 hours of operation<br>10,000 km | at least 1 x per year |
| Differential and carrier assembly<br>Wheel hub - planetary gears<br>Interaxle differential<br>Drop gear assembly / Gearbox<br>Wheel bearing oil-lubricated |                                       | Hypoid gear oil acc. to MIL-L2105 B/API GL5<br>Hypoid gear oil in multi-gradecharacteristic acc. to MIL-L2105 C/D/API GL5 | Oil change<br>monthly oil level-check by overflow-measurement | check the oilfilling | +   | +  | +                     |
|  | from -10°C to +30°C                   | SAE 90 or Multi-grade oils  |   |                      |   |  |                       |
|  | permanently less than -10°C           | SAE 75 W - 90 or SAE 75 W - 85  |   |                      |   |  |                       |
|  | permanently over +30°C                | SAE 140 or Multi-grade oils   |   |                      |   |  |                       |
| Wet multiple disk brake  |                                       | see <a href="#">"Approved oils for brake with external cooling" on page 19</a>  | with external cooling:<br>Oil change                          |                      | depends on tank volume / cooling system / application                       |  |                       |

## 9.2 Oils

### 9.2.1 Recommended types of hypoid gear oil




For KESSLER axles, gear oil types with the specification MIL-L 2105 B/API GL 5 or MIL-L 2105 C/D/API GL 5 have to be used!

- ADDINOL - gear oil GH 85 W 90
- AGIP - Rotra MP / Rotra MP DB
- ARAL - gear oil Hyp 90
- AVIA - gear oil Hypoid 90 EP
- BP - multipurpose gear oil EP SAE 90
- ELF - Tranself type B 90 / Tranself type B 80 W - 90
- ESSO - gear oil GX - D 90
- FINA - Pontonic MP SAE 85 W - 90
- FUCHS - Renogear Hypoid 90
- MOBIL - HD 90 - A
- SHELL - Spirax S3 AM / S3 AD / S5 ATE / S4 AX
- TEXACO - Multigear EP SAE 85 W / 90

## 9.2.2 Approved oils for brake with external cooling

### Actuation fluid:

| NOTICE  |  |
|---|--|
|  | Use only mineral oil as actuation fluid. Brake fluids are not permitted! |


### Selection of mineral oils:

- Motor oil
  - API SE / CD
  - MIL – L 46152C / MIL – L 2104 C or D
- AFT C - 3 or Dexron<sup>®</sup>
- Hydraulic oil HLP DIN 51524 part 2

### Viscosity class depending on ambient temperature:

- for temperate climate: ISO VG 22 – 32
- for extremely cold climate: ISO VG 15
- for extremely warm climate: ISO VG 46

### Cooling fluid:

| NOTICE  |  |
|---|--|
|  | <p>Only oils with LS additives that are approved by the vehicle manufacturer according to the KESSLER WN 85601 may be used.</p> <p>➤ e.g. 3 - 6% Lubrizol LZ 9990 A or LZ 6279</p> |

The cooling fluid can also be used as actuation fluid.



### 9.3 Oil change

---

**During changing the oil, always follow the stated measures:**

- Place vehicle in horizontal position and jack it up if possible so that complete draining of oil is possible and clean oil can be filled to the correct level.
- Make sure that oil has cooled down before draining it.
- Always replace gaskets of the screw plugs with new gaskets. The gaskets are mostly copper rings.
- Pay attention to the specific notes.
- The precise position of the lube point can deviate from the illustration. The relevant lube point can be found on the KESSLER product on hand.
- Pay attention to the given activity sequence.

## 9.3.1 Oil drain

**⚠ CAUTION****Hot oil**

Burn hazard

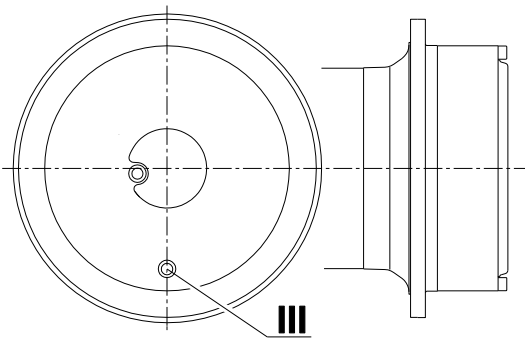
- Make sure that oil has cooled down before draining it.
- Wear protective goggles and protective gloves.

**Differential and carrier assembly, axle housing and hub assembly have a total oil space.**

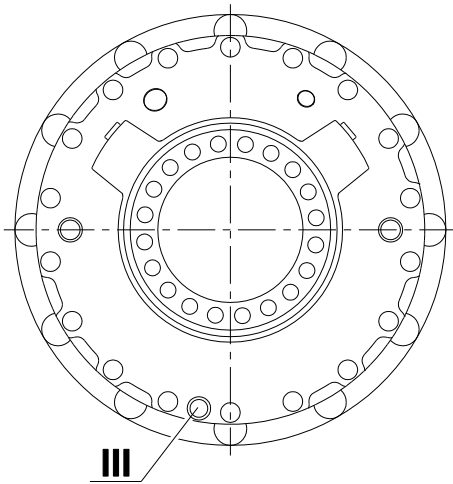
Oil drain has to take place at the complete axle.

**Wet multiple disk brake**

Drain the extra oil.

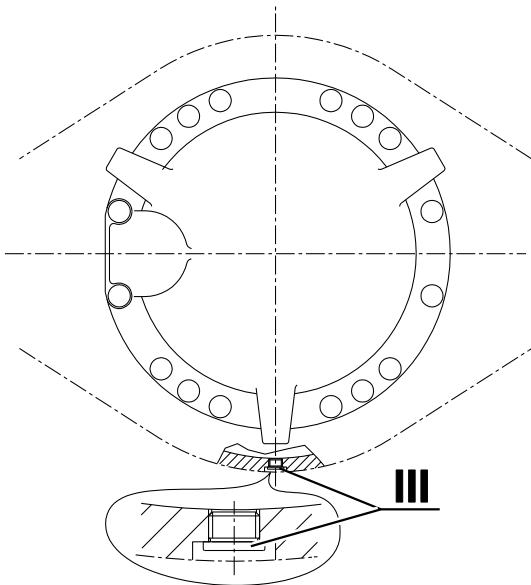
**III = oil drain point****Oil drain, hub assembly:**

1. Clean drainage point and oil drain plug.
2. Rotate the hub assembly until the oil drain plug is at the bottom position (6 o'clock position).
3. Open the oil drain plug and allow oil to drain.
  - Collect the oil in a suitable container.
  - Dispose of the oil in an environmentally friendly manner.
4. Clean borehole and oil drain plug.
5. Screw oil drain plug back in.
  - Tightening torque: [see " Tightening torque for screw plugs" on page 43](#)



#### Oil drain, wet multiple disk brake:

1. Clean drainage point and oil drain plug.
2. Open the oil drain plug and allow oil to drain.
  - Collect the oil in a suitable container.
  - Dispose of the oil in an environmentally friendly manner.
3. Clean borehole and oil drain plug.
4. Screw oil drain plug back in.
  - Tightening torque: [see " Tightening torque for screw plugs" on page 43](#)



#### Oil drain, differential and carrier assembly/axle housing:

1. Clean drainage point and oil drain plug.
2. Open the oil drain plug and allow oil to drain.
  - Collect the oil in a suitable container.
  - Dispose of the oil in an environmentally friendly manner.
3. Clean borehole and oil drain plug.
4. Screw oil drain plug back in.
  - Tightening torque: [see " Tightening torque for screw plugs" on page 43](#)

### 9.3.2 Oil filling and filling level



The axle has a total oil space.

All oil drain plugs have to be closed before filling with oil.

The whole axle is filled with oil from the hub assembly and differential and carrier assembly / axle housing together.

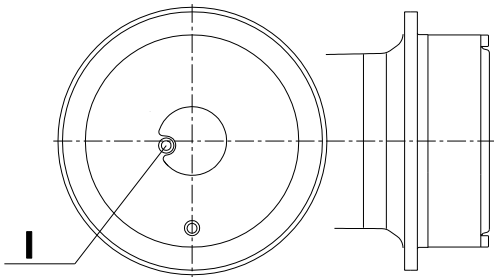
The oil level for the whole axle is specified at the component (differential and carrier assembly / axle housing).

The oil level of the whole axle needs to be checked at the differential and carrier assembly / axle housing.

I = oil filling point

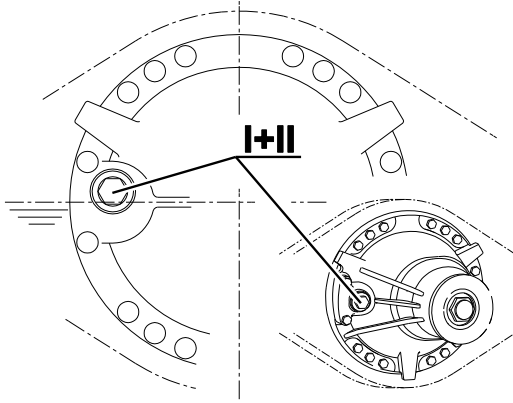
II = oil level inspection point

≡ = oil level



#### Oil filling and oil level on hub assembly:

1. Clean filling point and oil filling plug.
2. Turn both hub assemblies into position.
  - The oil drain plug has to be down.
3. Open the oil filling plug.
4. Fill both hub assemblies with clean oil until the oil level reaches the filling bore.
  - Oil in accordance with the specified lubricants. [see "Lubricants and lubrication intervals" on page 17](#)
5. After a few minutes, check the oil level again at the oil level inspection plug for differential and carrier assembly / axle housing.
  - If necessary, refill oil at both hub assemblies.
6. Clean borehole and oil filling plug.
7. Screw oil filling plug back in.
  - Tightening torque: [see " Tightening torque for screw plugs" on page 43](#)

**Oil filling and oil level on differential and carrier assembly/axle housing:**

1. Clean filling point and oil filling plug.
2. Open oil filling plug.
3. Fill axle and differential and carrier assembly with clean oil until the oil level reaches the filling bore (= inspection bore).
  - Overflow check
  - Oil in accordance with the specified lubricants. See "[Lubricants and lubrication intervals](#)" on page 17.
4. After a few minutes, check the oil level again at the filling bores.
  - Keep filling the axle until the oil level remains constant.
5. Clean borehole and oil filling plug.
6. Screw oil filling plug back in.
  - Tightening torque: see "[Tightening torque for screw plugs](#)" on page 43



Recheck the oil level of the KESSLER product after driving the first time.

## 9.4 Checking the screwed connections, safeguards, formation of corrosion and on load-bearing components

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- **Screws at housing connections, steering assembly parts, and brake parts:** If the screws can be retightened, the Loctite connection breaks. Remounting is necessary then! Secure screwed connections and join connections according to specifications, in case of any doubt, please consult KESSLER.
- **Corrosion and cracks** on load-bearing components (e.g. axle spindle) are not permissible for reasons of operational reliability and sealing.  
Replace any load-bearing components with cracks!
- **Cracks on steering assembly parts** are not permissible for reasons of operational reliability.  
Replace any steering assembly components with cracks!

## 9.5 Maintenance intervals

For safety reasons, the vehicle operator has to inspect and service all important screwed connections and safeguards at regular intervals.

| Inspection and maintenance points | Remarks   | Maintenance intervals                              |  |   |  |                             |
|-----------------------------------|---|--|--|---|--|-----------------------------|
|                                   |   | (The value that is reached first is always valid.) |  |   |  |                             |
|                                   |   | after<br>10<br>hours of<br>operation<br><br>500 km | after<br>100<br>hours of<br>operation<br><br>1000 km | every<br>500 hours<br>of-<br>operation<br><br>5000 km | every<br>1000<br>hours of -<br>operation<br><br>10000 km | at least<br>1 x per<br>year |
| Wheel bearing                     | Check and readjust  |  | +  |   |  | +                           |
| Wheel nuts                        | Check and retighten with torque wrench<br><br>(following a tire change, after about 50 km and about 200 km) | +  | +  | +   |  |                             |
| Nuts / Axle bracket screws        | Inspection and check for firm fit, if necessary retighten   | +  | +  | +   |  | +                           |
| Screwed connections               | Check   |  |  | +   |  |                             |
| Gaskets                           | Check sealing points for leaks  | monthly  |  |   |  |                             |
| Screws / Drive flange             | Inspection and check for firm fit, if necessary retighten   | +  | +  | +   |  | +                           |
| Wet multiple disk brake           | Check the lining wear   |  |  |   |  | +                           |

### 9.6 Checking gaskets

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- Check sealing points for leaks. If this is not ensured see Repair instructions.

### 9.7 Controlling of breather

---

- Kessler does not stipulate exact intervals for the maintenance of the breather.
- The function of the breather must always be guaranteed.
- The breather must be free of damage, paint and dirt.
- A leaky breather must be replaced.



## 9.8 Wheel bearing adjustment

### ⚠ DANGER



#### Faulty mounting and incorrect securing of the wheel bearing adjustment nut

The wheel along with the complete hub assembly comes off of the axle.

- In any case, tighten and secure the wheel bearing adjustment nut as described!

### ⚠ CAUTION



#### When loosening the threaded connection, the planetary gear can tip over uncontrolled due to its own weight and fall down.

Danger of being crushed

- Secure the planetary gear against falling with suitable lashing gear during disassembly.

#### The wheel bearing is checked by retightening the wheel bearing adjustment nut.

- On oil-filled hub assemblies the oil must be drained off.
- On hub assemblies with drum brake the brake drum must be disassembled/mounted if necessary. See supplier's requirements.
- On hub assemblies with planetary gears, the planetary gear and, if necessary, the sun gear are disassembled/mounted.
- On hub assemblies without planetary gears, these steps are omitted. Only the cover is disassembled/mounted.
- The steps loosening / checking / retightening / securing the wheel bearing adjustment nut always remain the same, regardless of the axle type.

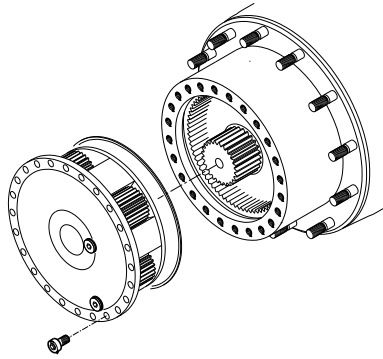


#### Wrench for wheel bearing adjustment nut

- Three additional bolts can be used, if necessary.

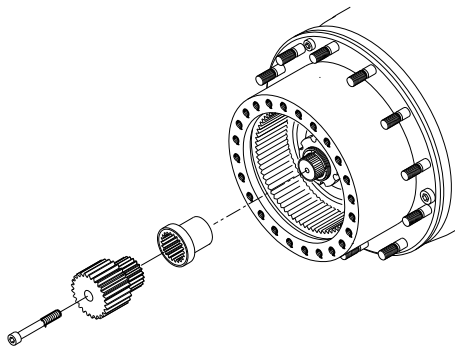


Order number: 031.105.1-2



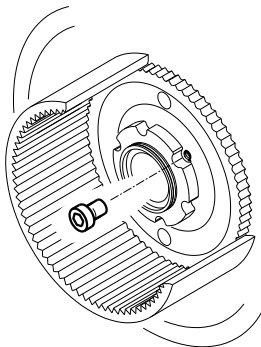
**Disassembly of planetary gear:**

1. Drain the oil.
  - See "Oil change" on page 20.
2. Loosen and remove mounting screws.
3. Carefully pull off planetary pot/cover.



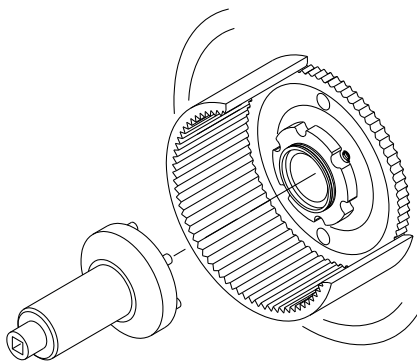
**Disassembly of sun gear:**

4. Loosen screw connection.
5. Pull off the sun gear.
6. Pull off the bushing.



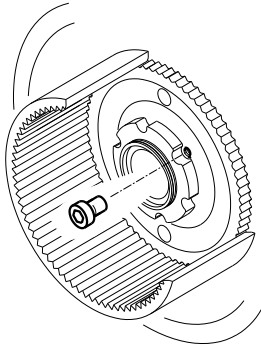
**Loosening the wheel bearing adjustment nut:**

7. Loosen the securing screw of the wheel bearing adjustment nut, clean it and deposit safely.



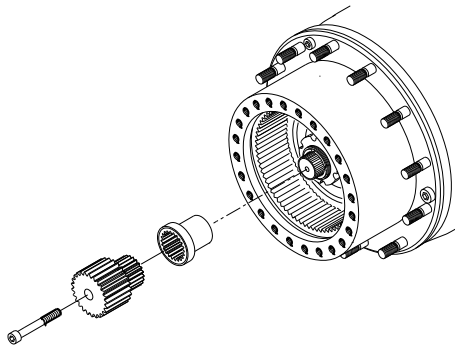
**Checking/Retightening the wheel bearing adjustment nut:**

8. Put the customer service tool on the wheel bearing adjustment nut and tighten to the specified tightening torque.
  - Customer service tool: Wrench for wheel bearing adjustment nut (see above)
  - Tightening torque for used bearings: 450 Nm
  - Rotate the wheel hub several times while tightening.
  - If it is not possible to secure at this position, the wheel bearing adjustment nut needs to be turned forward to the next possible position for securing.



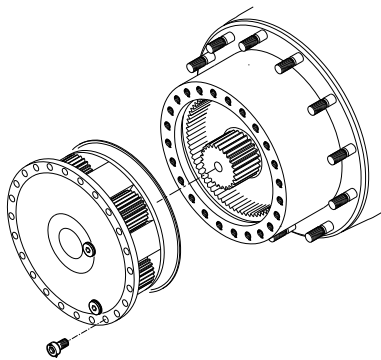
#### Securing the wheel bearing adjustment nut:

9. Secure the wheel bearing adjustment nut with a screw.
  - Hexagon socket screw
  - Screw securing: Loctite 270
  - Tightening torque: 72 Nm



#### Assembly of sun gear:

10. Slide bushing onto axle shaft/universal joint.
  - Lifting of the axle shaft/universal joint facilitates the sliding.
11. Slide sun gear into bushing and screw with axle shaft/universal joint.
  - Loctite 262
  - Tightening torque: 210 Nm
12. Slide the axle shaft/universal joint to the inside until sun gear contacts the bushing and bushing contacts the thrust ring.
13. Rotate the hub assembly until one of the oil compensating holes of the ring gear carrier is at the bottom position!



#### Assembly of planetary gear:

14. Insert O-ring into planetary housing.
  - Sealing of the contact surface between planetary housing and wheel hub
  - Multi-purpose grease prevents the O-ring from falling out during assembly.
15. Slide prepared planetary gear into the ring gear and onto the sun gear.
16. Align the boreholes with each other and screw planetary housing to wheel hub.
  - The oil drain plug has to be at the bottom!
  - Tightening torque: see ["Tightening torques for standard metric threads" on page 41](#)
17. Top up with oil.
  - See ["Oil change" on page 20.](#)

## 9.9 Wet multiple disk brake regulations

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### General:

- Vehicles that are approved for public roads must comply with the ordinances, standards, and regulations of the respective countries. Brake components need to be checked at regular intervals and, if necessary, be repaired or replaced. The regulations of the brake manufacturer must be observed for this.
- Vehicles that are not authorized need to be inspected by an expert in accordance with the respective accident prevention regulations at least once a year.
- If there are indications of thermal overload, consult a brake specialist or the manufacturer.



### Replacing the brake lining:

- Worn, burned, or glazed lining disks need to be replaced.
- If this is not observed, the general operating license of the vehicle will be void. Any claims for possible damage will not be acknowledged as well.

### Running-in instructions for wet multiple disk brakes:

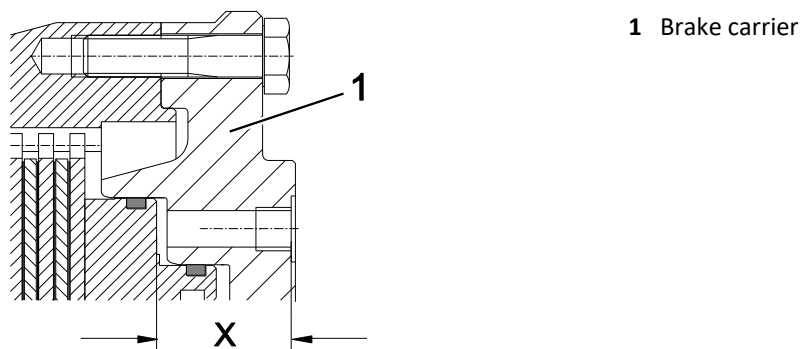
- When starting up the vehicle, drive carefully to bring the brakes to the operational temperature.
- Drive carefully to get used to the brake effect.

## 9.10 Lining wear measurement of wet multiple disk brakes

| <b>⚠ WARNING</b>  |   |
|---|---|
|  | <p><b>When work is being performed on the brake, its braking effect is disabled.</b></p> <p>Rolling away of the vehicle</p> <ul style="list-style-type: none"> <li>➤ Make sure that no machine movements can take place.</li> </ul> |
| <b>⚠ CAUTION</b>  |   |
|  | <p><b>Hot brakes and hot cooling oil</b></p> <p>Burns</p> <ul style="list-style-type: none"> <li>➤ The amount of wear rate may be measured only when the vehicle is cold.</li> </ul>  |

Checking the wear rate by comparing the imprinted value (= measurement with new disks) and the value to be measured (= measurement with used brake).

The reference dimension (= measurement with new disks) is imprinted below the wear inspection hole.



1. Disconnect the supply and return lines of the cooling oil from the brake.
2. Drain the oil from the brake. [see "Oil change" on page 20](#)
3. Measure dimension X through the wear inspection hole when the brake is actuated.
  - **Important:** Measurement needs to be taken from the countersink.
4. Make a note of dimension X.
5. Calculate the difference between the imprinted value with the measured value.
  - If the difference lies within the permissible tolerance, the brake can continue to be used.
  - If the difference is greater than the permissible wear rate, consult KESSLER.
6. Check the cooling oil level in the vehicle.



For Wet multiple disk brake (NLB) 3340, the maximum permissible wear rate is 1.5 mm.

## 10 Ordering spare parts

### 10.1 Guarantee

KESSLER provides a warranty only for the supplied original spare parts.

Please note that use of spare parts that are not original may negatively modify the specified design characteristics of the axles, gearboxes, transmissions, drive assemblies, wheel gears, and wheel ends and thus adversely affect the safety.

KESSLER accepts no liability for damage caused by use of non-original spare parts and accessories. Please note that special manufacturing and supply specifications exist for proprietary and third-party parts and that we always offer spare parts according to the latest statutory standards.

### 10.2 Required specifications for ordering spare parts

The following specifications are needed for ordering KESSLER spare parts:

- Part number (no. of the installation drawing) >>see type plate
- Serial number >>see type plate
- Manufacturer of the vehicle
- Name of the spare part
- Spare part number (drawing or DIN no.)
- Quantity
- Shipping mode

### 10.3 Type plate

The type plate is usually located near the differential and carrier assembly on the side of the oil filling plug.

The axle serial number is imprinted additionally on the axle housing next to the type plate.



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## 10.4 Necessary consultation with KESSLER

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- If there are any questions, please contact KESSLER.
- In the event of major repairs or overhauls, it would be appropriate to send the entire KESSLER product to KESSLER.
- If there are necessary repairs, repair instructions can be requested from KESSLER.

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## 11 Storage

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### 11.1 Standard conservation

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Standard conservation of the delivered KESSLER products is sufficient for:

- 18 months - with dry storage in closed rooms
- 12 months - with storage without water ingress
- 3 months - with storage in the open air (breather has to be closed)

### 11.2 Conditions for storage with standard conservation

---

Inadmissible and necessary conditions for storage of KESSLER products with standard conservation:

- Open air storage is not permissible in harbor areas (salt water)!
- If the packaging is damaged, renew the packaging!

### 11.3 Measures for longer storage periods

---

The following measures are necessary for longer storage periods:

- Oil leaks and water ingress are not permissible; the breather needs to be replaced by a screw plug with sealant.
- Fill units and multiple disk brake with oil.
- Filling volume: 80% of the axle housing volume / hub assembly volume / brake volume / drive assembly volume / gearbox volume.
- Oils to be used:
  - Make sure the correct oil quality is used for filling, ["Oils" on page 18.](#)
  - **Attention:** Do not overfill due to build-up of pressure during temperature fluctuations.
- Apply additional corrosion protection onto uncoated surfaces (for example: rim unit, steering cylinders, brake disks, drive flange, ...).



## 11.4 Measures before startup after storage

---

The following measures need to be taken prior to startup of the KESSLER product:

- Remove storage oil and fill KESSLER product with suitable oil to correct oil level.  
[Refer to "Oil change" on page 20.](#)
- Check running surfaces of the sealing rings for corrosion. Check sealing points for leaks immediately after startup. If this is not ensured, replace the sealing rings as well.
- Remove corrosion protection completely from uncoated surfaces at startup (e.g. rim unit, steering cylinder, brake disks, drive flanges, ...). Possible surface corrosion on the brake contact surface of the brake disks is a normal und harmless phenomenon. Surface corrosion on the brake disks will be removed automatically by the first brake operations during vehicle commissioning.
- The rim unit needs to be clean and grease-free so that frictional adhesion to the rim is ensured and loosening of rims is avoided.
- Check load-bearing components for corrosion, in particular if stored over several years.

## 11.5 Responsibility during storage

---

- The operator has the responsibility for proper storage of KESSLER products and, if applicable, additional necessary corrosion protection measures.

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## 12 Disposal

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**KESSLER products consist of various materials that can be reused after disposal and must be disposed of separately. The following steps have to be taken.**

- Put the vehicle out of operation before starting disassembly.
- Secure the steering assembly parts so that movements are no longer possible.
- Depressurize pressure connections.
- Drain and remove all operating fluids (coolants, lubricants) and dispose of properly.  
[See "Oil change" on page 20.](#)
- Attach KESSLER product to a suitable hoisting device and disassemble from vehicle.
- Dismantle KESSLER product into individual subassemblies and components.  
**NOTICE!** Dismantling of spring applied subassemblies (e.g. brakes) is not permitted. For this process, the respective safety regulations of the manufacturer must be observed.
- Separate individual parts according to type of material and dispose of according to national and local ordinances as well as valid regulations for the protection of the environment.

## 13 Important information

### 13.1 Auxiliary materials: Adhesives, sealing compounds, grease, and assembly pastes



If a screw is used covering with a securing (for example: Precote covering), more Loctite must not apply.

#### 13.1.1 Use of auxiliary materials

| Type                                    | Application  | Product    | Type               | Color                      |
|---|--|------------|--------------------|----------------------------|
| Adhesive                                | Screw securing light   | LOCTITE    | 243                | Blue                       |
| Adhesive                                | Screw securing medium  | LOCTITE    | 262                | Red                        |
| Adhesive                                | Screw securing very tight  | LOCTITE    | 270                | Green                      |
| Adhesive                                | Friction increase in joint faces                                   | LOCTITE    | 270                | Green                      |
| Adhesive                                | Bonding  | LOCTITE    | 480                | black                      |
| Adhesive                                | Surface sealing  | LOCTITE    | 510                | Orange                     |
| Adhesive                                | Special sealing  | LOCTITE    | 572                | White                      |
| Adhesive                                | Sealing with wide gap  | LOCTITE    | 638                | Light green                |
| Adhesive                                | Surface sealing  | LOCTITE    | 5926 or<br>209 125 | Blue                       |
| Sealing compound                        | Elastic sealing  | Dirko      | Grey               | Gray                       |
| Assembly paste with MoS <sub>2</sub>    | Prevents stick-slip  | LIQUI MOLY | LM 48              | Gray                       |
| Multi-purpose grease                    | Adhesive lubricant   | FUCHS      | RENOLIT AS         | Yellow transparent         |
| Multi-purpose grease lithium soap-based | Bearing lubrication - worked penetration in accordance with NLGI 2 | FUCHS      | RENOLIT MP150      | Yellow transparent         |
| Special grease                          | Gear-shifting  | Klüber     | Mircolube GL261    | yellow, almost transparent |
| Assembly-Gel                            | Elastomer components   | Klüber     | S06-100            | transparent                |

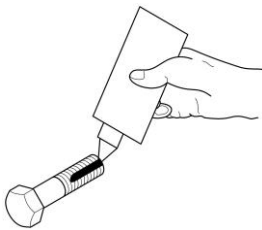
### 13.1.2 Handling auxiliary materials

#### Handling of Loctite 243 / 262 / 270 / 510 / 572 / 638

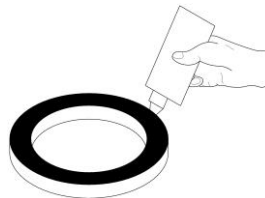
- The surfaces or screws and threaded boreholes to be cemented need to be free of paint, grease, and oil (washed).
- The Loctite adhesives applied cure under the following conditions:
  - Absence of air
  - Metal contact
  - Warmth
- Only a short time may pass between pre-assembly and controlled tightening (5 - 10 minutes).
- Parts prepared with Loctite intended for cementing can be exposed to air for up to 1 hour.  
**Exception:** Parts made of nonferrous metal may rest for no more than one minute.
- Allow loaded connections to cure for at least 24 hours.

**Loctite amount:**

**For screws: 1 bead**



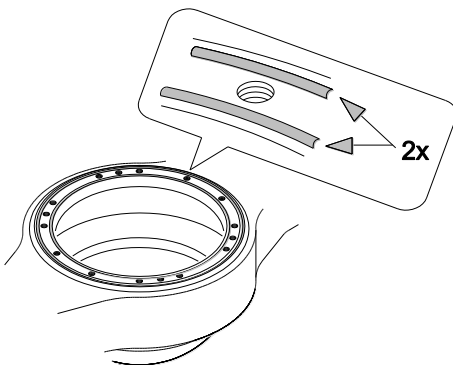
**sealing surface: ensure sufficient coating**



#### Handling of Loctite 5926

- The surfaces or screws and threaded boreholes to be cemented need to be free of paint, grease, and oil (washed).
- The Loctite adhesives applied cure under the following conditions:
  - moisture curing begins immediately after the product is exposed to the atmosphere
- Parts to be assembled should be mated within a few minutes after the product is dispensed.

**Loctite amount:**



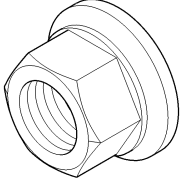
**on sealing surface: 2 beads**

## 13.2 Tightening torques

Friction:  $\mu = 0.14$

The tolerance of the tightening torques is  $\pm 5\%$   
(provided that a manual torque wrench is used).

### 13.2.1 Tightening torque wheel nut

| Wheel nut with flat washer  | Size       | - Phosphor blackened - |
|---|------------|------------------------|
|  | M 20 x 1,5 | 470 Nm                 |
|   | M 22 x 1.5 | 650 Nm                 |

**13.2.2 Tightening torques for standard metric threads**

| Thread size | Screw   | Nut | Screw   | Nut | Screw   | Nut |
|-------------|---------|-----|---------|-----|---------|-----|
|             | 8.8     | 8   | 10.9    | 10  | 12.9    | 12  |
| M 4         | 3.0 Nm  |     | 4.4 Nm  |     | 5.1 Nm  |     |
| M 5         | 5.9 Nm  |     | 8.7 Nm  |     | 10 Nm   |     |
| M 6         | 10 Nm   |     | 15 Nm   |     | 18 Nm   |     |
| M 8         | 25 Nm   |     | 36 Nm   |     | 43 Nm   |     |
| M 10        | 49 Nm   |     | 72 Nm   |     | 84 Nm   |     |
| M 12        | 85 Nm   |     | 125 Nm  |     | 145 Nm  |     |
| M 14        | 135 Nm  |     | 200 Nm  |     | 235 Nm  |     |
| M 16        | 210 Nm  |     | 310 Nm  |     | 365 Nm  |     |
| M 18        | 300 Nm  |     | 430 Nm  |     | 500 Nm  |     |
| M 20        | 425 Nm  |     | 610 Nm  |     | 710 Nm  |     |
| M 22        | 580 Nm  |     | 830 Nm  |     | 970 Nm  |     |
| M 24        | 730 Nm  |     | 1050 Nm |     | 1220 Nm |     |
| M 27        | 1100 Nm |     | 1550 Nm |     | 1800 Nm |     |
| M 30        | 1450 Nm |     | 2100 Nm |     | 2450 Nm |     |

**13.2.3 Tightening torques for metric fine threads**

| Thread size | Screw  | Nut | Screw  | Nut | Screw   | Nut |
|-------------|--------|-----|--------|-----|---------|-----|
|             | 8.8    | 8   | 10.9   | 10  | 12.9    | 12  |
| M 8 x 1     | 27 Nm  |     | 39 Nm  |     | 46 Nm   |     |
| M 10 x 1    | 55 Nm  |     | 81 Nm  |     | 95 Nm   |     |
| M 10 x 1.25 | 52 Nm  |     | 76 Nm  |     | 90 Nm   |     |
| M 12 x 1.25 | 93 Nm  |     | 135 Nm |     | 160 Nm  |     |
| M 12 x 1.5  | 89 Nm  |     | 130 Nm |     | 155 Nm  |     |
| M 14 x 1.5  | 145 Nm |     | 215 Nm |     | 255 Nm  |     |
| M 16 x 1.5  | 225 Nm |     | 330 Nm |     | 390 Nm  |     |
| M 18 x 1.5  | 340 Nm |     | 485 Nm |     | 570 Nm  |     |
| M 20 x 1.5  | 475 Nm |     | 680 Nm |     | 790 Nm  |     |
| M 22 x 1.5  | 650 Nm |     | 920 Nm |     | 1050 Nm |     |

**13.2.4 Tightening torques for galvanized screws and nuts**

Observe the reduced tightening torques for galvanized screws and nuts!

**13.2.5 Tightening torque for screw plugs**

| Screw plugs with metric thread |   |  |  |
|--------------------------------|---|--|--|
| Thread size                    | Tightening torque (reference values for screw plugs with copper ring) | Tightening torque (reference values for screw plugs with ED seal)<br>ED is equal to elastomer seal | Tightening torque (reference values for screw plugs with O-ring) |
| M 14 x 1,5                     | approx. 45 Nm (33 lbf x ft)   |  | 45 Nm (33 lbf x ft)  |
| M 16 x 1,5                     | approx. 60 Nm (44 lbf x ft)   | 50 Nm (37 lbf x ft)  | --   |
| M 22 x 1,5                     | approx. 100 Nm (74 lbf x ft)  | 90 Nm (66 lbf x ft)  | 100 Nm (74 lbf x ft)   |
| M 24 x 1,5                     | approx. 120 Nm (89 lbf x ft)  |  | --   |
| M 30 x 1,5                     | approx. 160 Nm (118 lbf x ft)   |  | --   |
| M 36 x 1,5                     | approx. 210 Nm (155 lbf x ft)   |  | --   |
| M 42 x 1,5                     | approx. 260 Nm (192 lbf x ft)   |  | --   |
| M 45 x 1,5                     | approx. 280 Nm (207 lbf x ft)   |  | --   |

| Screw plugs with inch thread |   |  |  |
|------------------------------|---|--|--|
| Thread size                  | Tightening torque (reference values for screw plugs with copper ring) | Tightening torque (reference values for screw plugs with ED seal)<br>ED is equal to elastomer seal | Tightening torque (reference values for screw plugs with O-ring) |
| 9/16-18 UN(F)                | --  | --   | 34 Nm (25 lbf x ft)  |
| 1 1/16-12 UN                 | --  | --   | 140 Nm (102 lbf x ft)  |
| G 1/2                        | --  | 80 Nm (58 lbf x ft)  | --   |
| G 3/4                        |   | 140 Nm (102 lbf x ft)  | --   |



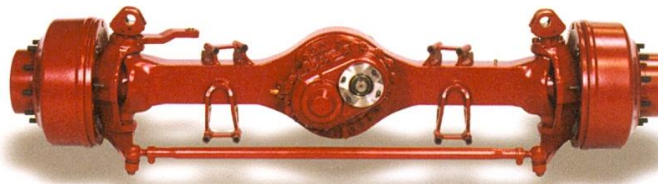
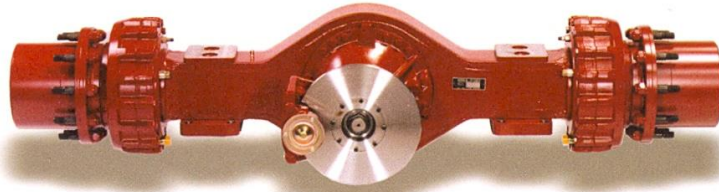
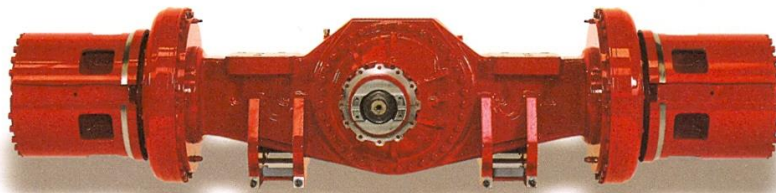
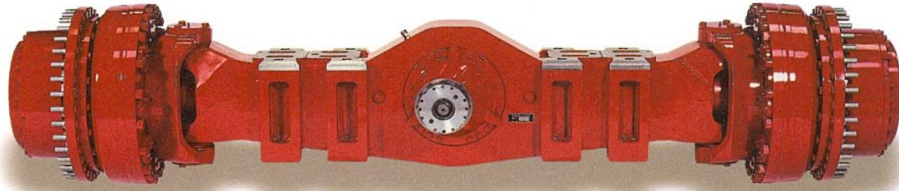
### 13.3 Units

#### Conversion table

|                                       |   |   |
|---------------------------------------|---|---|
| 25.40 mm                              | = | 1 in. (inch)  |
| 1 mm                                  | = | 0.0394 in. (inch)   |
| 1 kg (kilogram)                       | = | 2.205 lbs (pounds)  |
| 9.81 Nm (1 kpm)                       | = | 7.233 lbf x ft (pound force foot)                           |
| 1.356 Nm (0.138 kpm)                  | = | 1 lbf x ft (pound force foot)                               |
| 1 bar (1.02 kp/cm <sup>2</sup> )      | = | 14.5 psi (pound force per square inch lbf/in <sup>2</sup> ) |
| 0.070 bar (0.071 kp/cm <sup>2</sup> ) | = | 1 psi (lbf/in <sup>2</sup> )                                |
| 1 liter                               | = | 0.264 gallon (imp.)   |
| 4.456 liters                          | = | 1 gallon (imp.)   |
| 1 liter                               | = | 0.220 gallon (US)   |
| 3.785 liters                          | = | 1 gallon (US)   |
| 1609.344 m                            | = | 1 mile (land mile)  |
| 0°C (Celsius)                         | = | +32°F (Fahrenheit)  |
| 1°C (Celsius)                         | = | +33,8°F (Fahrenheit)  |
| 0°C (Celsius)                         | = | 273.15 Kelvin   |
| 1°C (Celsius)                         | = | 274.15 Kelvin   |

#### Description of the legal units

| Term             | Symbol | New               | Old         | Conversion                                     | Remarks                |
|------------------|--------|-------------------|-------------|--|------------------------|
| Moment of torque | T      | Nm (Newton meter) | kpm         | 1 kpm = 9.81 Nm                                | T (Nm) = F (N) x r (m) |
| Moment of force  | M      | Nm (Newton meter) | kpm         | 1 kpm = 9.81 Nm                                | M (Nm) = F (N) x r (m) |
| Pressure         | p      | bar               | atm (gauge) | 1.02 atm =<br>1.02 kp/cm = 1 bar<br>= 750 torr | ---                    |



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