

Service-Manual  
**Allied**  
**L460 – 4WD – Logstacker**



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This documentation is not subject to revision. We reserve the right to make modifications without prior notice.

# Introduction

Axles, transmissions, wheel gears and non drive wheels from Kessler & Co. GmbH & Co.KG (hereinafter referred to as KESSLER) are designed and manufactured in accordance with the state of the art and the recognised technical safety regulations.

This documentation describes the state of the art at the time the documentation was created. Although the documentation was created with great care KESSLER accepts no liability for any errors with respect to the depiction and description.

This documentation is not subject to revision service. We reserve the right to make modifications without prior notice.

Due to continuous developments and technical improvements of our products, the depictions in the following work steps may deviate or differ from the actual product / component. Drawings, graphics, pictures and photos are generally not true-to-scale.

This manual was developed for technicians who have been trained by KESSLER for the repair and servicing of KESSLER axles, transmissions, wheel gears and non drive wheels.

The manual must be stored where it is available to the technicians at all times.

The company will not be liable for damages and consequential costs resulting from improperly executed work by third parties. This also applies if spare parts other than those specified by KESSLER are used.

KESSLER offers customer service tools that make working on axles, transmissions, wheel gears and non drive wheels easier and safer.

# General information

Axles, transmissions, wheel gears and non drive wheels from KESSLER may be used only in technically flawless condition and as specified, in a safety- and hazard-conscious manner and in compliance with the manual. Defects, especially those that could impair safety, must be remedied immediately. It is likewise prohibited to use defective or improperly serviced, repaired or modified axles, transmissions and non drive wheels.

In addition to and having priority over the warning and safety information in this manual, the applicable national safety and environmental regulations also apply.

Maintenance, repairs or modifications may be performed only by trained specialists.  
The manual must be read prior to starting maintenance, repairs or modifications.  
In case of ambiguities and uncertainty, always consult KESSLER.

When performing maintenance and repairs, comply with the safety regulations and the statutory requirements for preventing injuries and damage to the product. Persons who perform these tasks are obligated to become familiar with and comply with these regulations. These persons are responsible for the occupational safety.

After conducting maintenance and repairs, the product must be inspected to ensure that it is functioning properly.  
In case of major repairs and overhauls it is recommended to send the entire components (axle, gear, wheel gear and non drive wheel) to KESSLER.



All maintenance instructions in the KESSLER manual must be complied with.



Assembly and disassembly must be carried out in a clean work area.  
Use special tools from KESSLER for the work.  
Before reinstalling used parts, they must be inspected for damage, undamaged contact surfaces and wear.  
It is especially important to ensure that no chips or other foreign objects remain in the axles, transmissions, wheel gears and non drive wheels.



To remove the components (axle, gear, wheel gear and non drive wheel) from the vehicle, read the instructions of the vehicle manufacturer. The following descriptions assume that the component has been removed and mounted on a mounting device for further processing.


## Safety

### Explanation of the warning information and symbols appearing in the Service Manual

 <b>DANGER</b>	
	<p><b>Highest danger level</b></p> <p>There is immediate danger of death or severe injury in case of failure to comply with this safety notice.</p> <ul style="list-style-type: none"> <li>➤ this arrow indicates the absolutely necessary measures for preventing the specific danger</li> </ul>

 <b>WARNING</b>	
	<p><b>Second highest danger level</b></p> <p>There is possible danger of death or severe injury in case of failure to comply with this safety notice.</p> <ul style="list-style-type: none"> <li>➤ this arrow indicates the absolutely necessary measures for preventing the specific danger</li> </ul>

 <b>CAUTION</b>	
	<p><b>Third highest danger level</b></p> <p>There is danger of minor injury or property damage in case of failure to comply with this safety notice.</p> <ul style="list-style-type: none"> <li>➤ this arrow indicates the absolutely necessary measures for preventing the specific danger</li> </ul>

<b>NOTICE</b>	
	<p>Failure to observe this will result in dangers to the machine and its functions.</p>







#### **Information**



Offers additional information to facilitate working.



## Special types of danger

 <b>DANGER</b>	
	<p>When working on brakes, make sure that releasing the braking force cannot result in unintentional movement of the machine.</p>

 <b>DANGER</b>	
	<p>When working on assemblies with spring actuator elements, such as: brakes and brake cylinders, whether service brake or parking brake. The assemblies are under spring tension.</p> <p>Improper opening can cause parts to suddenly be released and fly off.</p> <ul style="list-style-type: none"> <li>➤ In such cases, always comply with the safety, repair and maintenance instructions of the suppliers.</li> </ul>

 <b>DANGER</b>	
	<p>Special care is necessary when working on wet multiple disk brakes. They are under high spring tension.</p> <p>Improper installation and/or removal of the brake can cause parts to suddenly be released and fly off.</p> <ul style="list-style-type: none"> <li>➤ Do not pre-tension and release the tension on the springs by means of the brake housing screw connections!</li> <li>➤ Open the screw connection of this brake only using a suitable press or mounting device</li> <li>➤ Preferably, installation/removal should be carried out by KESSLER</li> </ul>

 <b>DANGER</b>	
	<p>Never remain directly in front of the wheel rim during deflation or inflation.</p> <p>The pressure inside the tyre could cause parts to suddenly be released and fly off.</p>

 <b>DANGER</b>	
	<p>When removing and mounting wheels on vehicles with clamped rims there is a danger that the tyre pressure can cause damaged parts of the rim to become released explosively when removing the clamped rim, which can cause severe or fatal injuries to the mechanic.</p> <ul style="list-style-type: none"> <li>➤ Completely deflate the tyre before performing any task</li> <li>➤ Never remain directly in front of the wheel rim during deflation or inflation of tyres</li> </ul>

**⚠ DANGER**

**Comply with tightening torque for wheel nuts.**

- Retighten wheel nuts after a short operating period!

**Basic safety information****⚠ WARNING**

**Comply with the safety signs on the axle.**

- They must be kept in legible condition at all times.

**⚠ WARNING**

**Only tools and equipment of the highest quality may be used; tools and equipment must be undamaged and electrical equipment must be approved for use in the respective country.**

- Never use improvised devices.
- Use only original tools from KESSLER.

**⚠ WARNING**

**Due to the unforeseeable dead weight of the single parts (e.g. wheel hub) or complete axles, transmissions, wheel gears or wheel ends it is possible that they can fall or tip over during assembly work.**

- Always use suitable, undamaged and tested cranes and load attachment gear for the respective load.
- Never work or stand under suspended loads
- Secure parts with a lashing strap and/or support
- Wear safety shoes

**⚠ WARNING**

**Movement / rotation of different parts can result in the danger of injury to limbs.**

- Never reach between moving parts with your hands



**⚠ WARNING**

**Welding repairs are permitted only in coordination with KESSLER!**

**⚠ WARNING**

**Work on an axle, a transmission, a wheel gear and a wheel end is allowed only if the temperature of the respective component permits.**

- Make sure that the oil has cooled before draining it
- Make sure that rotating parts have cooled before starting to remove them
- Wear fireproof gloves

**⚠ CAUTION**

During all machining work on metal parts, during which there is a danger of splinters (abrasive cutting, deburring, cleaning with compressed air, etc.), flying metal parts can cause eye injuries.

- Wear protective goggles

**⚠ CAUTION**

It is prohibited to wear loose clothing and long open hair when working on axles, transmissions, wheel gears and wheel ends! Oils and greases can cause allergic skin reactions.

- Wear suitable protective clothing

**NOTICE**

Always observe the technical data (brake connections, tightening torques of screws and wheel locking nuts, etc.). Compliance with these specifications is very important for the safety of other people.

- For information on connections: see installation drawing
- For information on tightening torques: see "Important Information"
- For information on the drive assembly: see "Drive assembly"
- For information on the hub assembly: see "Hub assembly"
- For information on the planetary gear drive: see "Planetary gear drive"
- For information on the brakes: see "Brakes"

# Table of contents

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<b>1</b>	Important remarks
<b>2</b>	Lubrication intervals and maintenance instructions
<b>3</b>	General instructions for correct assembly and disassembly Service tools
<b>4</b>	Assembly drive assembly
<b>5</b>	Assembly hub assembly
<b>6</b>	Assembly planetary gear drive
<b>7</b>	Assembly service brake
<b>8</b>	Assembly parking brake
<b>9</b>	Assembly of axle bracket



## Important remarks

### **Checking of screw connections, safety devices and corrosion**

For safety reasons, the vehicle operator must check and service all important screw connections and safety devices at regular intervals.

- Wheel nuts
- Nuts of axle mounting bolts
- Tightening screws on housing joints and steering components will break the Loctite bond, which means the screws have to be reinstalled!  
Secure screw connections and joints in accordance with specifications; in case of doubt, contact Kessler & Co. GmbH & Co.KG.
- Corrosion and cracks on support components (e.g. the axle spindle) are not permissible for reasons of operational safety and leaks.  
Supporting components with cracks must be replaced!
- Cracks on steering components are not permissible for reasons of operational safety.  
Steering components with cracks must be replaced!

### **Check of brakes**

- Inspect brake lining and brake drum / brake disc regularly as well as wear of brake system parts.
- Inspect the free movement of brake system rods.
- In case of signs of excessive heating, consult a brake specialist or the manufacturer.

## **Service instructions**

- Assembly and disassembly may be carried out only by trained specialists.
- Repair welding is permissible only after consulting Kessler & Co. GmbH & Co.KG!
- To remove the axle from the vehicle, read the instructions in the vehicle manufacture's manuals. The following descriptions assume that the axle has been removed and mounted on a jig for further processing.
- Always comply with the safety regulations for your country. There is no guarantee that they correspond to the instructions in this manual.

## Operation of creep gear, axle disconnection, inter axle diff-lock and cross diff-lock

### Operation of the creep gear

The operation of the creep gear in the transfer case may be necessary for 2 reasons:

- a) For low speed operation, normally on good ground. In this case the connection of further drive axles and especially the operation of cross axle differential locks must be prevented because of possible wind up and possible damage on the drive line parts.
- b) Operation of the creep gear in the transfer case because of loose of traction on difficult, slippery ground condition. Under these circumstances operation of lock should only be made step by step and only if really required:
  - If traction is not sufficient then connection of further drive axles, on further traction problems operation of inter axle differential lock.
  - If necessary as a next step operation of cross diff. lock.

### **! General comments !**

Operation of diff. locks may cause overloading of drive line parts. Special attention is necessary:

- Operation of diff. lock only in difficult ground condition (sand, gravel, mud).
- Diff. locks must only be operated shortly before the obstacle and must be disconnected immediately after.
- **Diff. lock should only be operated at stand still** and under no circumstances when wheels are spinning.
- No steering is allowed during operation of cross diff. lock. With operated interaxle diff. lock steering may be done under great caution.
- Operation of diff. lock only in the transport conditions of the machine or when the machine weight is not heavier. Diff. lock should not be operated during a built up condition with additional weights.
- Drive carefully: not jerky and not with full engine power.
- With operated diff. lock never drive longer distances or on normal, good driving condition

## **Control light**

- A control light in the drivers cabin must inform about the operation of inter axle and cross diff. lock separately. Further the control light should show with already the first lock operated, even if the other locks are not yet connected or already disconnected (electrical installation parallel).

## Instructions for ordering spare parts

### Warranty

Kessler & Co. GmbH & Co.KG provides a warranty only for the original delivered replacement parts. Please be aware that the use of other than original replacement parts can have a negative effect on the design properties of the axle, therefore making it unsafe.

Kessler & Co. GmbH & Co.KG will not be liable for any damages resulting from the use of other than original replacement parts and accessories. Please be aware that special production and delivery specifications exist for proprietary or third-party parts and that our replacement parts comply with the most recent standards as prescribed by law.

### Ordering

When ordering original Kessler replacement parts, please provide the following information:

1. Part number (no. on the installation drawing) → see identification plate
2. Serial → see identification plate
3. Vehicle manufacturer
4. Name of the spare part
5. Spare part number (drawing or DIN no.)
6. Quantity
7. Mode of dispatch

### Identification plate

- The position of the identification plate on the axle is mostly next to the drive assembly on the same side as the oil fill plug.
- Close to the identification plate, you will also find the axle serial number of the axle stamped into the axle housing.





## **Necessary to contact Kessler & Co. GmbH & Co.KG.**

- In case of questions, contact Kessler & Co. GmbH & Co.KG.
- In case of major repairs or overhaul, it is advisable to send the entire axle to Kessler & Co. GmbH & Co.KG.

# Disassembly resp. assembly of wheels on vehicles with clamp fixation rims

### **! Attention !**

Before any kind of operation, wheel change enclosed can be realized, the inflation pressure has to be released completely.

**NEVER** stay in front of the rim while tire deflation or tire inflation **(danger of life!)**

### **Assembly of wheels on vehicles with clamp fixation rims**

1. **Actuate the parking brake** and place the wheel chocks .
2. Release the wheel nuts partially when the wheel still contacts the ground.
3. Lift up the concerning axle with a suitable lifting jack. For safety reasons use suitable supports after lifting up.
4. Safe the wheel with a suitable hoist, detach the wheel.
5. Before assembling the wheel onto the hub clean the rim careful and check it for cracks and defects.
6. Check that the assigned tire type is used and that the tire is free of bulges and cracks.
7. Clean the wheel studs and wheel nuts.
8. Check that the assigned wheel nut type is used.
9. The seats of the wheel nuts and the threads must not be greased.
10. Before tightening the wheel nuts check that the wheels are well fitted at the contact surface of the hub.
11. Tighten the wheel nuts one by one reciprocity crosswise.
12. Tightening torque according to sheet 3.4.
13. Tire inflating ⇒ inflation pressure according to the vehicle manufacturer.

### **Important**

14. Retighten the wheel nuts 20 h of operation after assembling or to the recommendation of the vehicle manufacturer.



## General lubrication instructions

### Fill levels

- Are checked at the level control plugs.

### Oil change

1. Place the vehicle in a horizontal position.
2. Draining of the oil is to be accomplished only in warm condition. Clean all lubrication points before, opening them. Open the drain holes on the carrier assembly, on the wheel assemblies, and if present, on the interaxle differential and drop gear housing. On the hub assemblies, the drain plug should be turned downward.
3. Oil draining
4. Replacement of the oil draining plugs
5. Remove the oil filler plug as well as the oil level control plug on the carrier assembly, on the wheel assembly, and, if present, on the interaxle differential and drop gear housing. (See page 3 lubrication points).
6. Oil filling
7. Check the oil level at the oil level plug hole (Overflow control).  
Wait a few minutes.  
If the oil level falls,  
add oil  
until the level remains constant.
8. Clean the grease nipples before lubrication.

### Preservation of Kessler axles for an extended storage period

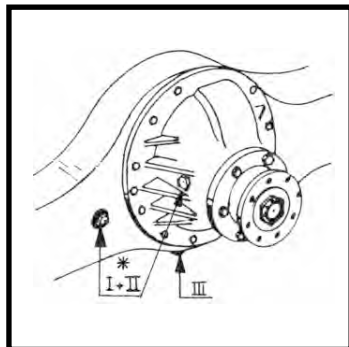
- Replace the breather with a screw plug with a sealant in order to avoid water intrusion and oil leakage.
- Fill axles completely up with oil, the same applies to wet disc brakes.
- Protect machined surfaces (for example: rim surface, steering cylinder, brake disc, ...) with additional anticorrosive.

### Before putting the axle into operation

- Drain storage oil. Fill the axle with suitable oil (see service manual Kessler & Co. GmbH & Co.KG) to the required oil level.
- Check sealing contact surfaces for corrosion. Check the seals immediately after start-up for leakage and renew them if leaking.
- Completely remove the anticorrosive machined surfaces (for example: rim surface, steering cylinder, brake disc, ...). The rim face must be cleaned from rust or grease in order to secure a correct friction tight with the rim and to prevent loosening of the rim.
- Check axle structure for corrosion, especially after several years of storage.

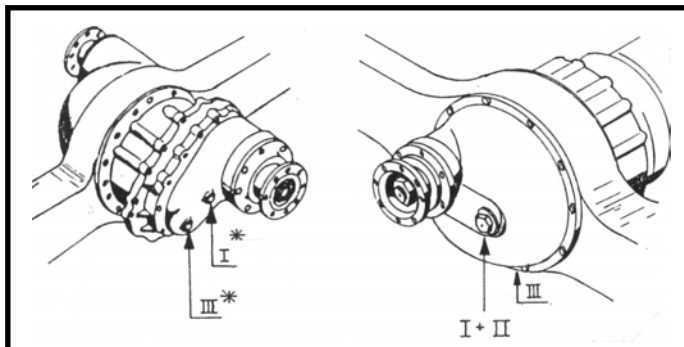
## Lubrication points

The binding lubrication points have to be taken from the according installation drawing of the axle



### Single drive assembly

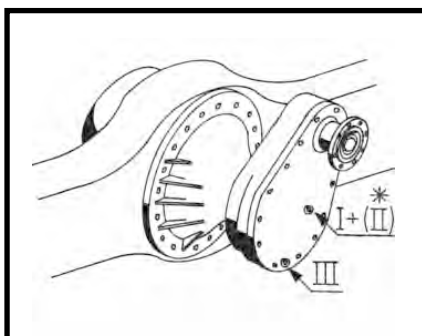
\*The position is dependent from the respective axle version.



### Drive assembly with throughdrive

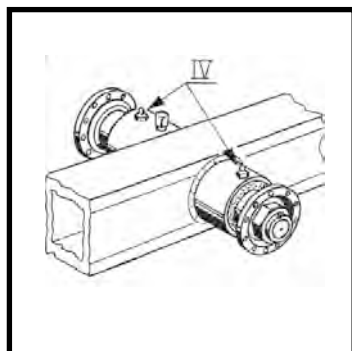
\*Version with interaxle differential.

Fill 1,5 liter oil at \*I for first - time filling and for refilling!



### Drop gear D51 / D108

\*II – only at version with separately oil space.



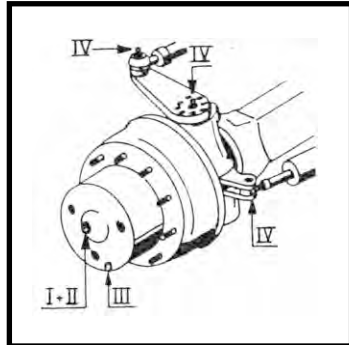
### Cardan shaft intermediate bearing

I = Oil fill plug  
II = Oil level control plug

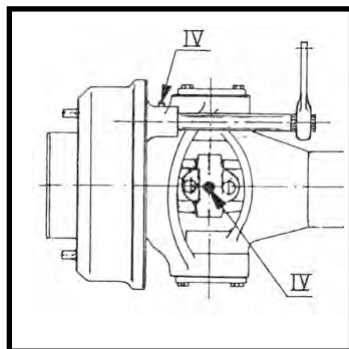
III = Oil drain plug  
IV = Grease nipple

## Lubrication points

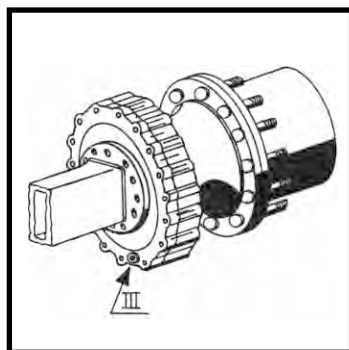
The binding lubrication points have to be taken from the according installation drawing of the axle



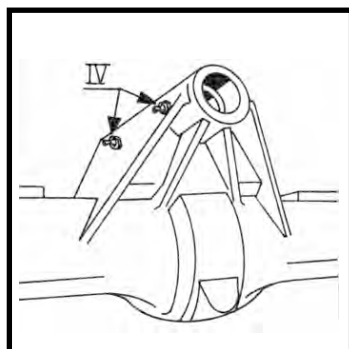
**Hub assembly with planetary gear drive**



**Lubrication points at universal joint  
and brake shaft.  
(If not maintenance – free)**



**Hub assembly with wet disc brake**



**Tumbler bearing**

I = Oil fill plug  
II = Oil level control plug

III = Oil drain plug  
IV = Grease nipple

## Lubricants and lubrication intervals

Lubrication point	Lubricant	Remarks	Lubrication intervals 1.)				
			after 100Bh 1000Km	every 500Bh 5000Km	every 1000Bh 10000Km	at least 1x per year	at least 1x in 2 years
Drive assembly	Hypoid – gear oil per MIL-L – 2105 B / API GL 5 Hypoid – gear oil in multi – range characteristic per MIL-L – 2105 C / D / API GL 5 SAE 90 or multi grade oils for normal external temperature SAE 75 W – 90; SAE 75 W – 85 for external temperature lower – 10°C SAE 140 or multi grade oils for external temperature over + 30°C	Oilchange	⊕		⊕	⊕	
Wheel hub planetary gear drive		Check oil level at control points monthly	⊕		⊕	⊕	
Interaxle differential			⊕		⊕	⊕	
Drop gear/ Gear boxes			⊕		⊕	⊕	
Wheel bearing oil lubricated			⊕		⊕	⊕	
Multi disk parking brake	Hydraulicoil ISO VG 32	Oilchange wet running	⊕		⊕	⊕	
Cardan shaft intermediate bearing	Fuchs Renolit LX-NHU 2	if provided for			⊕	⊕	
Steering knuckle bearing	Multi – use grease lithium saponified groove penetration per NLGI 2  f. e. Fuchs Renolit MP 150		⊕	⊕			
Steering knuckle bearing		maintenance reduced			⊕	⊕	
Universal joint		if provided for	⊕	⊕			
Track rod		if provided for	⊕	⊕			
Steering cylinder -ball head/ -spherical plain bearing		if provided for	⊕	⊕			
pinion bearing		if grease lubricated	⊕		⊕	⊕	
Brake shaft bearing		Attention! 2.)	⊕	⊕			
Brake shoe bearing		Attention! 2.)	Lightly greased at brake shoe new assembly				
Wheel bearing		if grease lubricated	Change grease at wheel hub disassembly				
Wet disc brake	see chapter -7-	external cooled oilchange	dependent on tank volume / cooling system / operation conditions				
		not external cooled oilchange	⊕		⊕	⊕	

(Bh = Hours of operation)

- 1.) Whichever occurs first.
- 2.) The bearing point is to be lightly lubricated only, to avoid the penetration of grease in the interior of the brake (use only hand operated grease gun and remove surplus grease!). Check regularly the brake shafts and if need correct the lubrication intervals (danger of overheating!)

## **Important – if a noise is produced on axles with self locking differentials**

- On the axles with self locking differentials, a noise is produced if normal oils are used.  
In case of abnormal noises and in case of a jerky roll off of the tyres, use gear oil EP with additives of the “Limited Slip” type conforming to **specification M 2C - 104 A**.



## **Recommendable hypoid gear oils corresponding MIL-L 2105 B/API GL 5    resp. MIL-L 2105 C/D/API GL 5**

ARAL - Gearoil Hyp 90

AVIA - Gearoil Hypoid 90 EP

BP - Multiuse - Gearoil EP SAE 90

ELF - Tranself Typ B 90 / Tranself Typ B 80 W - 90

ESSO - Gearoil GX - D 90

FINA - Pontonic MP SAE 85 W - 90

FUCHS - Renogear Hypoid 90

MOBIL - HD 90 - A

SHELL - Spirax MB 90 / HD 90

TEXACO - Multigear EP SAE 85 W / 90

AGIP - Rotra MP / Rotra MP DB

**On no account use “normal” gear oils!**

## General maintenance instructions

Check - and main- tenance points	Remarks	Maintenance intervals 1.)				
		after 50Bh 500Km	after 100Bh 1000Km	every 500Bh 5000Km	every 1000Bh 10000Km	at least 1x per year
Wheel bearing	Inspect, if necessary readjust wheel bearing		⊕			⊕
Wheel nuts	Check and tighten with a torque wrench (after tire change after 50km and 200km)	⊕	⊕	⊕		
Castle nuts/track rod Screws/drive flange Nuts/axle mounting bolts	Check and retighten (Verify the adjustment)	⊕	⊕	⊕		⊕
Brakes (see also chapter 7)	Check lining wear, if necessary readjust, control the proper operation of the brake shafts	⊕	monthly			
Wet disc brake	Check lining wear					⊕
Wet disc brake - spring load design	Check lining wear				⊕	
Steering - and trackrod lever	Check and retighten mounting bolts *)		⊕			⊕
Bolted connections (for example drive assembly)	Check from time to time			⊕		
Ring gear support bolt on drive assembly	Readjust (if necessary)					⊕
Seals	Check from time to time	monthly				
Differential lock	Check function and the auto- matic return in original position	monthly				

(Bh = Hours of operation)

\*) If the bolts are moving (Loctite brakes loose), the lever has to be mounted once more.

1.) Whichever occurs first.

- **General assembly /disassembly instructions**
  - **service tools**
-

## General instructions for correct assembly and disassembly

### **General instructions for disassembly**

- The disassembly occurs made inverted to the respective assembly instruction.
- Drain oil before removing, check for presence of metal particles.
- Mark the parts to each other before dismantle.
- Never use a hard object to separate tightly fitted assemblies. To remove bearings, drive flange and similar parts, use adequate pull-off tools.
- It is recommended that the special tools according 3.6 be used for disassembly.
- Before disassembly, the destruction of bearings and other components must check, if it is necessary to destroy it.
- Systematically replace used seals, O-rings and if needed bearings on disassembly.
- Replace or clean corroded parts.
- Do not place parts on dirty surface.

### **General instructions for assembly**

- Clean parts before reassembly.
- The cages of bearings rotating in oil must coat with oil at reassembly.
- During mounting of radial seal rings, pay attention that there is sufficient overlap to the housing bores. Pay attention for a plain alignment of the radial seal ring. The seal lips may never be encountered Loctite!
- Oil seal rings and particularly the anti-dust lip seals must fill with grease.
- The universal joint shafts and the axle shafts must forcibly mounted (they must slide).
- Seal ring treads on flanges, shafts and so on, must preserve with Castrol Rustilo DWX 32 before mounting.
- Refill oil after assembly!

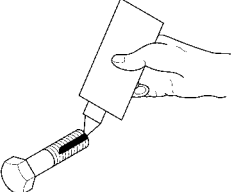
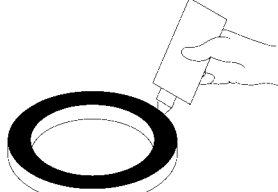
## Application of Loctite and operating supplies

### Application of Loctite and operating supplies

	Type	colour	Application
1. LOCTITE	243	blue	Lightly locked screws
	262	red	Middle locked screws
	270	green	Highly locked screws
	270	green	Increased coefficient of friction in contact surfaces
	510	orange	Surface gasket
	572	white	Special gasket
	638	light-green	Gluing with big width of slit
	5926 and 209 125	blue	Surface gasket
2. EPPL	33	grey	Surface gasket
3. DIRKO		grey	Elastic gasket

### Remarks for working up Loctite and operating supplies

- Threads and surfaces have to be cleaned and free from colour, oil and grease before applying Loctite. Loctite will harden under following conditions:
  - Exclusion of air
  - Metal contact
  - Increased temperature
- Pre - assembly and control tightening must do in a short time (5 to 10 min.)
- The time between gluing and mounting of the parts should be shorter than 1h.  
Exception: parts made from nonferrous metal have to be glued within one minute.
- Assembled parts must remain unloaded for at least 24 hours.
- Loctite quantity:

<b>At screws:</b>  <b>1 bead</b>	<b>At contact surfaces:</b>  <b>Pay attention for a sufficient Loctite application!</b>
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## Application of Loctite and operating supplies of hub assembly

Safety blocked parts	Joint	Loctite	Operating supplies
Spacer ring	Contact surface	572	-
Axle spindle	Screws	262	-
Axle spindle	Contact surface	270	-
Grommet	in planetary housing	270	-
Disc	in axle spindle	270	-
Adjusting screw with nut	in planetary housing	270	-
Support	Screw	262	-
Ring gear retainer	Screws	270	-
Pol wheel	Contact surface	638	-
Steering lever Track rod lever	Screws	262	-
Steering lever Track rod lever	Contact surface	270	-
Wheel hub cover	Thread	572	-
Radial seal rings Rubber casing	Contact surface	572	-
Radial seal rings Steel casing	Contact surface	270	-
Wheel safety nut → see chapter 5 → Adjustment of wheel bearings			

## Application of Loctite and operating supplies of differential and carrier assembly

Safety blocked parts	Joint	Loctite	Operating supplies
Drive flange	Nut surface	-	Epple 33 alternative Dirko grey
Diff-housing	Screws	262	-
Shifter cylinder (Diff-lock)	Contact surface	572	-
Diff.carrier (Through drive)	Contact surface	510	-
Drop gear housing	Contact surface	510	-
Diff.carrier	Contact surface	-	Epple 33 alternative Loctite 5926 and 209125
Through drive cover	Contact surface	510	-
Differential strap	Screws	262	-
Adjustment nut screw	Screw	270	-
Ring gear	Screws	262	-
Ring gear	Contact surface	270	-
Ring gear support	Cap	270	-
Ring gear support	Thread	-	Epple 33 alternative Dirko grey

## Tightening torques

### General instructions for tightening torques (Nm)

$\mu = 0,14$

All tightening torques are rated in Nm.

Tolerance of the tightening torques is  **$\pm 5\%$**

*(assuming a manually operated torque spanner is used)*

### Tightening torque of metric coarse-pitch thread

Thread	Screw	Nut	Screw	Nut	Screw	Nut
	8.8	8	10.9	10	12.9	12
M 4	3,0		4,4		5,1	
M 5	5,9		8,7		10	
M 6	10		15		18	
M 8	25		36		43	
M 10	49		72		84	
M 12	85		125		145	
M 14	135		200		235	
M 16	210		310		365	
M 18	300		430		500	
M 20	425		610		710	
M 22	580		830		970	
M 24	730		1050		1220	
M 27	1100		1550		1800	
M 30	1450		2100		2450	



# General instructions for correct assembly and disassembly

## Tightening torque of metric fine pitch thread

Thread	Screw	Nut	Screw	Nut	Screw	Nut
	8.8	8	10.9	10	12.9	12
M 8 x 1	27		39		46	
M 10 x 1	55		81		95	
M 10 x 1,25	52		76		90	
M 12 x 1,25	93		135		160	
M 12 x 1,5	89		130		155	
M 14 x 1,5	145		215		255	
M 16 x 1,5	225		330		390	
M 18 x 1,5	340		485		570	
M 20 x 1,5	475		680		790	
M 22 x 1,5	650		920		1050	

## Tightening torque for galvanized bolts and nuts!

Regard reduced tightening torque for galvanized bolts and nuts!

## Tightening torque for brake caliper dowel screws (greased !)

M 20 x 1,5	400 + 100
M 27 x 2	900 + 100

## Tightening torque of the nut for steering stop

300
-----

## Approximate value for the tightening torque for screw plug

Thread	Tightening torque (Approximate value)	Tightening torque (Screw plugs with O-Ring)
M14x1,5	ca. 45	45
M16x1,5	ca. 60	-
M22x1,5	ca. 100	100
M24x1,5	ca. 120	-
M30x1,5	ca. 160	-
M42x1,5	ca. 260	-
M45x1,5	ca. 280	-

## Units

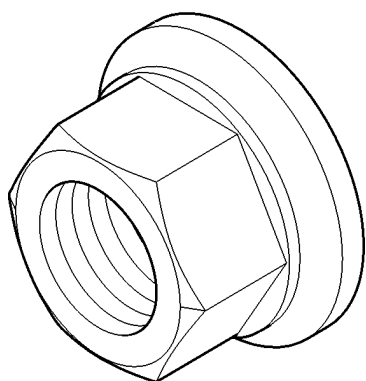
### Comparison table for units

25,40 mm	=	1 in (inch)
1 mm	=	0,0394 in (inch)
1 kg (kilogram)	=	2,205 lb (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 (1,02kp/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 Litre	=	0,264 Gallon (Imp.)
4,456 Litre	=	1 Gallon (Imp.)
1 Litre	=	0,220 Gallon (US)
3,785 Litre	=	1 Gallon (US)
1609,344 m	=	1Mile (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

### Names of the legal units

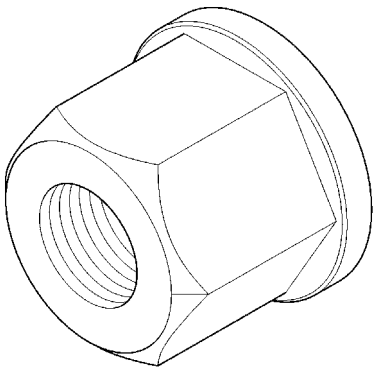
Term	Symbol	New	Old	Conversion	Comment
Torque	T	Nm (Newton meter)	kpm	1 kpm = 9,81 Nm	T (Nm) = F (N) x r (m)
Moment of force	M	Nm (Newton meter)	kpm	1 kpm = 9,81 Nm	M (Nm) = F (N) x r (m)
Pressure	pü	bar	atü	1,02 atü = 1,02 kp/cm <sup>2</sup> = 1 bar = 750 torr	

## Tightening torque wheel nut with thrust collar



Dimension	Tightening torque	
	Wheel nut with thrust collar – Phosphorous darkened -	Wheel nut with thrust collar – Galvanized -
M22x1,5	650 Nm	--

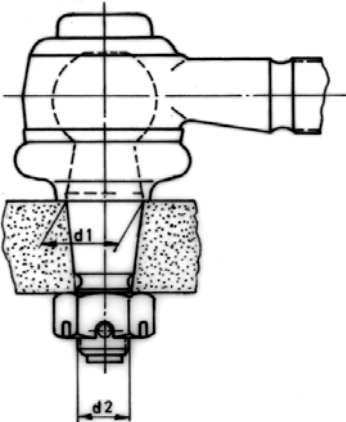
## Tightening torque collar nut



Dimension	Tightening torque	Tightening torque
	Collar nut – Phosphorous darkened -	Collar nut – Galvanized -
M30x3,5	1700 Nm	--

## Tightening torques for castle nuts and adjusting nuts

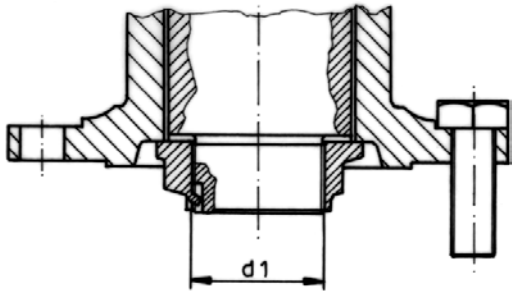
### Tightening torques for castle nuts on ball joints for track rods and ram cylinders

	Cone size d1 (mm)	Thread d2 (mm)	Torque (Nm)
	26	M 20 x 1,5	200 - 220
	30	M 24 x 1,5	280 - 300
	32	M 27 x 1,5	290 - 320
	38	M 30 x 1,5	340 - 360
	45	M 39 x 1,5	410 - 430

The tightening torques of the different thread dimensions of the joints are applicable for nuts of quality S6.

# General instructions for correct assembly and disassembly

**Tightening torque of the adjusting nut resp. slotted nut at flanges resp. gearwheels ect.**

	Thread d1 (mm)	Torque (Nm)
	M 24 x 1,5	360
	M 30 x 1,5	450
	M 36 x 1,5	540
	M 42 x 1,5	850
	M 45 x 1,5	850
	M 48 x 1,5	850
	M 52 x 1,5	950
	M 64 x 1,5	1050 - 1100

## Tools

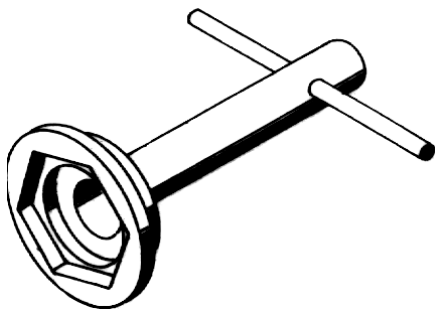
**When ordering maintenance tools, please provide**

- Part number (no. of installation drawing number)

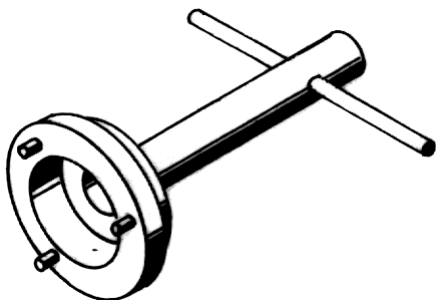
**and**

- Serial number → see identification plate

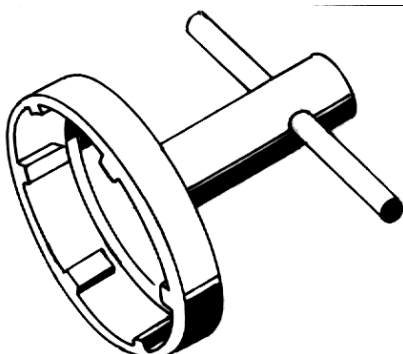
**(The illustrations are not binding for the design)**



Spanner for wheel safety nut



Spanner for wheel safety nut



Spanner for splined nut (hub assembly)

## Tools

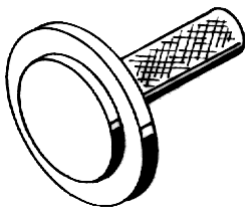
**When ordering maintenance tools, please provide**

- Part number (no. of installation drawing number)

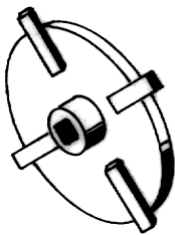
**and**

- Serial number → see identification plate

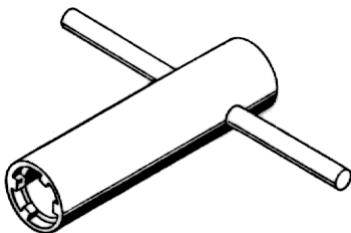
**(The illustrations are not binding for the design)**



Seal ring sleeve driver



Spanner for thread rings  
(Differential bearing)



Spanner for counter nut  
(Planetary gear drive)



Assembly cone for o – ring  
(Differential lock)



## Tools

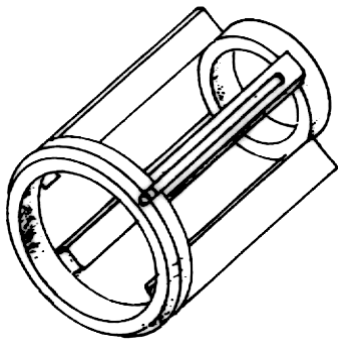
**When ordering maintenance tools, please provide**

- Part number (no. of installation drawing number)

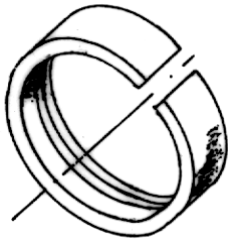
**and**

- Serial number → see identification plate

**(The illustrations are not binding for the design)**



Centering tool for discs



Installation tool for face seal



## **Adjustment of contact pattern of bevel gear teeth**



**NOTICE:** search for the production numbers of the drive pinion and the ring gear.

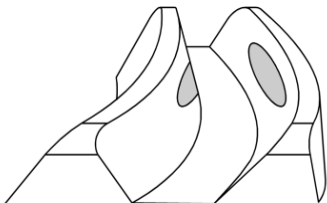
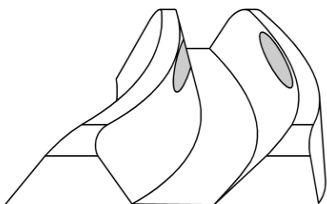
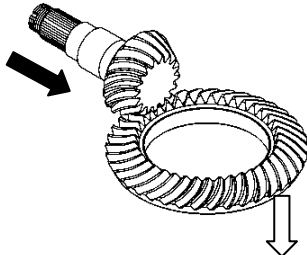
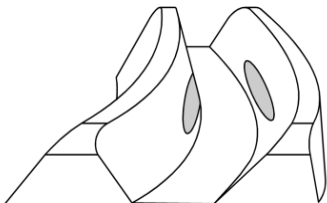
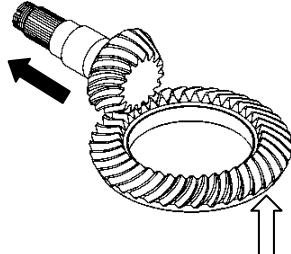
**It is only possible to achieve an optimal contact pattern, if:**

Version 1	Version 2
Production numbers <ul style="list-style-type: none"><li>• on drive pinion (marked on the end face)</li><li>• on ring gear (marked on the face of the ring gear)</li></ul>	<u>No</u> production numbers <ul style="list-style-type: none"><li>• on drive pinion</li><li>• on ring gear</li></ul>
➤ The production numbers of the drive pinion and ring gear <u>must</u> match – <b>only mount in pairs!</b>	➤ <u>indiscriminate</u> use of drive pinion and ring gear is possible – <b>no pairing necessary!</b>

## Checking the contact pattern of the gear teeth



1. Coat the teeth of the ring gear with spotting paste and then turn it several times until you can see pressure marks from the drive pinion on the coated teeth.
2. Check the contact pattern / pressure marks and compare them with the illustrations in the following table.
3. If necessary, make adjustments as shown in the table.

	Optimal contact pattern	
	Contact pattern too high.  Reduce drive pinion distance by correcting thickness of the adjustment disk. Adjust the backlash by moving the ring gear out.	
	Contact pattern too low.  Increase drive pinion distance by correcting thickness of the adjustment disk. Adjust the backlash by moving the ring gear in.	

## Securing of the striking nut



**NOTICE:** The brim of the striking nut has to be sheared only along the slot flank and the corner has to be bended on the slot ground.

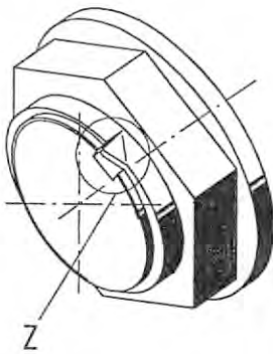


Figure 1

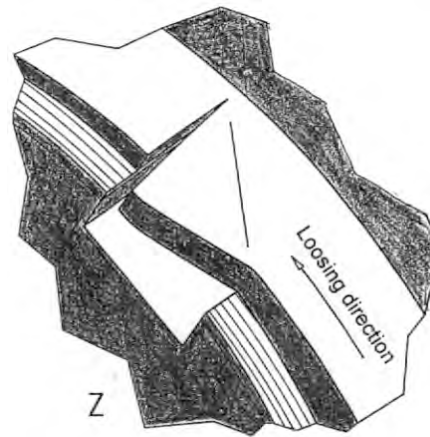


Figure 2

## Use of Loctite and other operating supplies

- Striking nut at drive flange
  - **In thread: assembly paste with MoS2 (exception: through drive pinion see enumeration 2)**
  - **Front side contact surface: sealing compound (Epple 33 or equivalent)**
- Striking nut at through drive nut
  - **On thread: Loctite 262**
- Striking nut at gear wheels, bearings and so on
  - **On thread: assembly paste with MoS2**

## Removing of the striking nut



**NOTICE:** Bend away the nose completely. Otherwise, the thread of the of the drive pinion will be damaged. Screw the nut off.



Figure 3



Figure 4



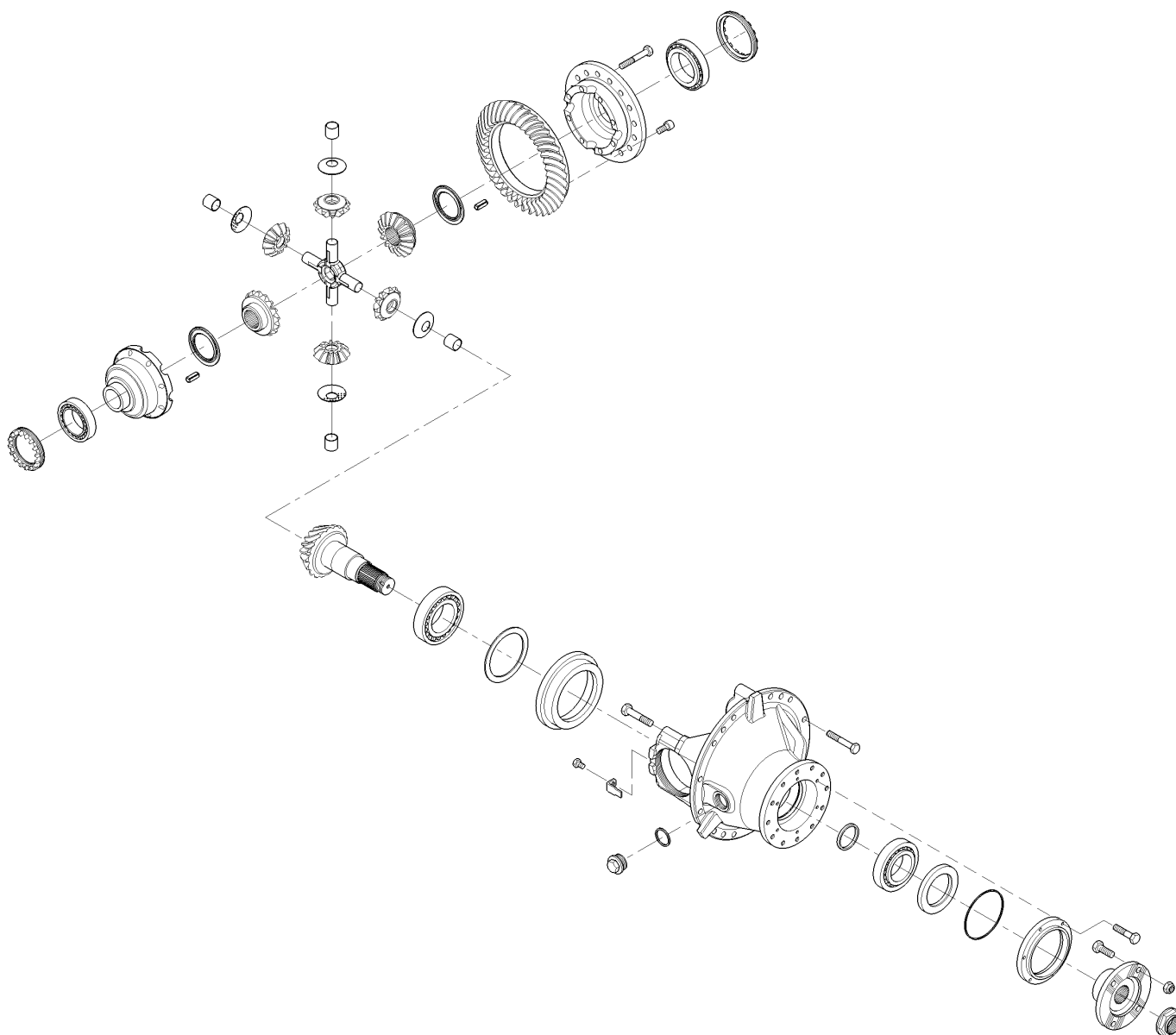
Figure 5

1. The secured striking nut.

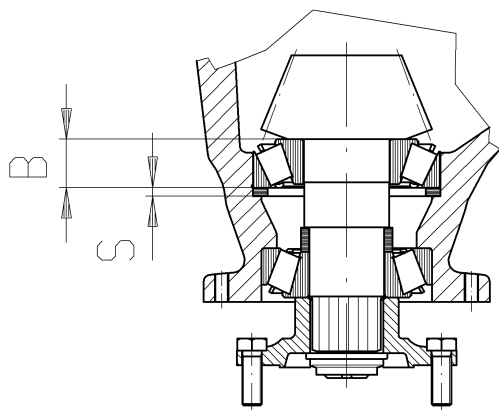
2. Applying an applicable flat chisel in the slot between drive pinion and securing and removing the securing of the striking nut.

3. The loosened striking nut.

## Differential and carrier assembly D 71



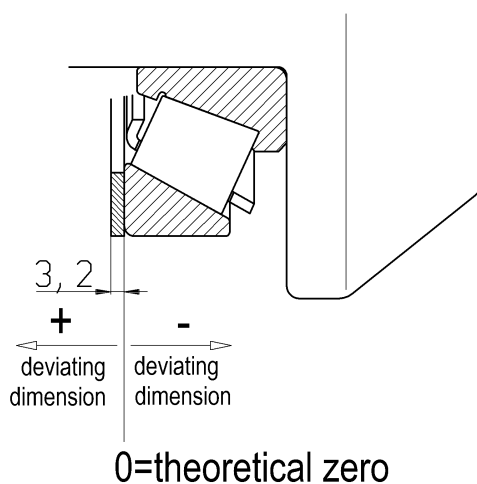
## Adjustment of drive pinion distance



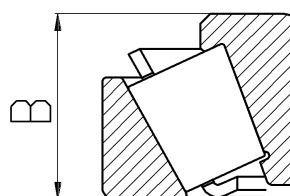
To obtain the proper tooth flank contact, adjust the axial position of the drive pinion with the thickness of the adjustment disc. The necessary thickness of the adjustment disc for first time assembly can be obtained by measurement (see calculation example).

Drive assembly	A 71
theoretical S	3,2
theoretical B	40

The final thickness of the adjustment disc can be fixed during the checking of gear meshing at the assembled drive assembly (see page „Checking the contact pattern of the gear teeth” – 4.0.1).

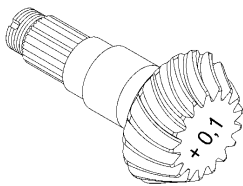
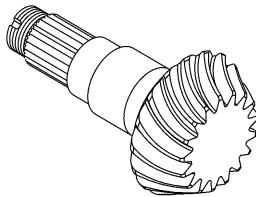


B = Measured width of the taper roller bearing.

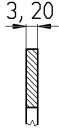
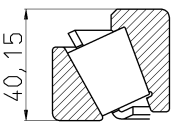

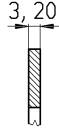
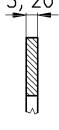
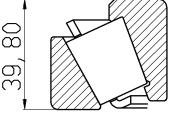

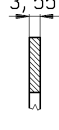
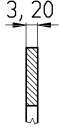
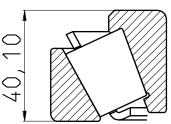
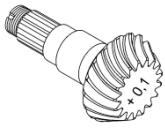
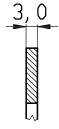




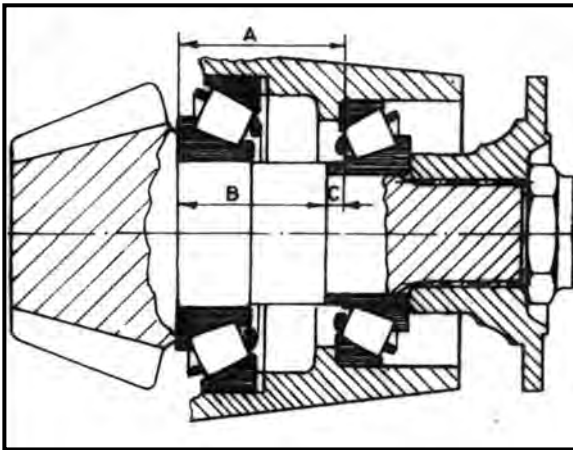
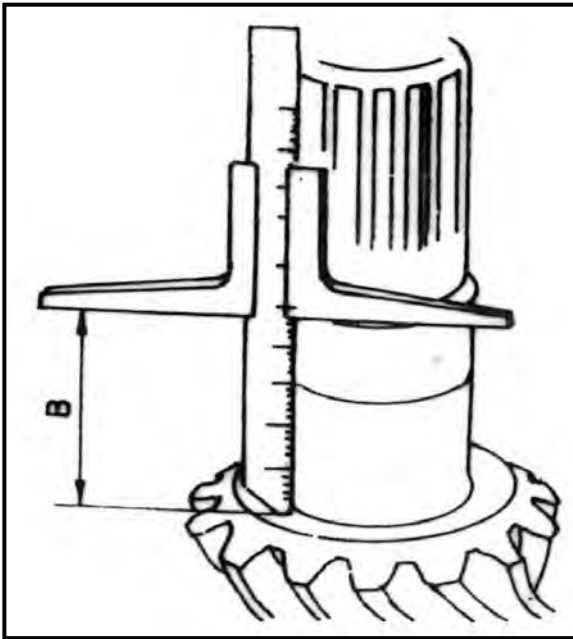
# Assembly of differential and carrier assembly A71

Version 1	Version 2
<p>Adjustment dimension – A</p> <p>Deviating dimension (defined during production) is marked on the locating face of the pinion. It indicates the deviation from the specified dimension.</p> <p>Example: Deviation +0,1</p> 	<p>Adjustment dimension – A</p> <p>Without inscription on the locating face of the pinion, the deviating from the specified dimension is 0.</p> <p>Example: Deviation 0</p> 

## Sample calculations (dimensions in mm):

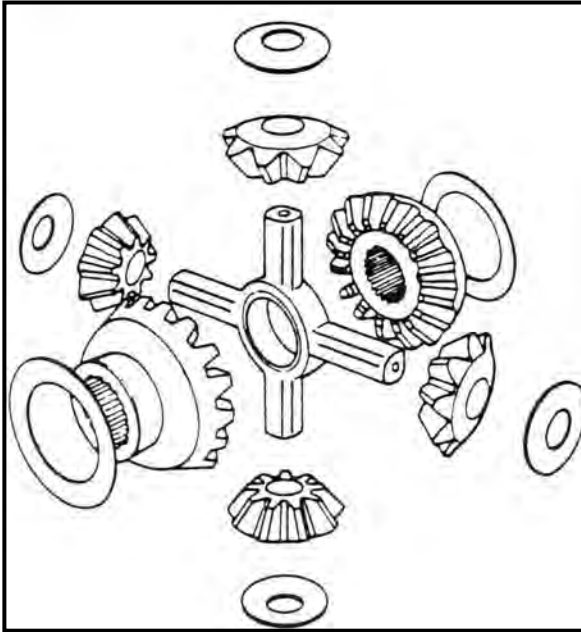
Theor. adjustment disk thickness	Measured bearing width	Tolerance at drive pinion	Calculation of the required adjustment disk thickness	Required adjustment disk thickness
		Version 1 	$\begin{matrix} \text{theor. disk thickness} & - & \text{deviation from bearing} & + & \text{deviation from pinion} & = & \text{required disk thickness} \end{matrix}$	
	deviation from the theoretical dimension +0,15	deviation from the theoretical dimension -0,15	$3,2 - 0,15 + 0,15 = 3,2$	
		Version 1 	$\begin{matrix} \text{theor. disk thickness} & + & \text{deviation from bearing} & + & \text{deviation from pinion} & = & \text{required disk thickness} \end{matrix}$	
	deviation from the theoretical dimension -0,20	deviation from the theoretical dimension -0,15	$3,2 + 0,20 + 0,15 = 3,55$	
		Version 1 	$\begin{matrix} \text{theor. disk thickness} & - & \text{deviation from bearing} & - & \text{deviation from pinion} & = & \text{required disk thickness} \end{matrix}$	
	deviation from the theoretical dimension +0,10	deviation from the theoretical dimension +0,10	$3,2 - 0,1 - 0,1 = 3,0$	

Fit corresponding disc and outer rings of the taper roller bearings.



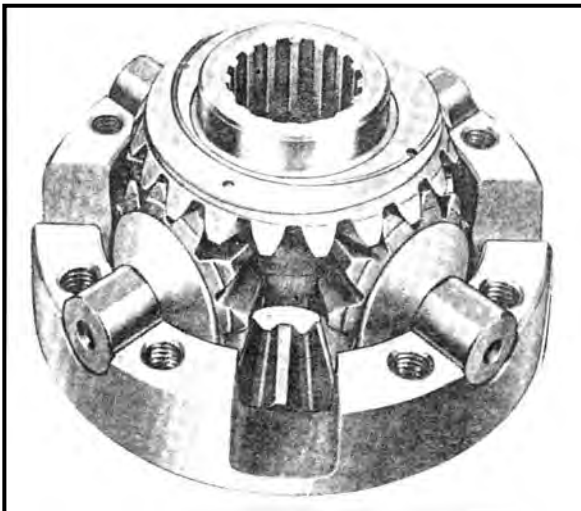
1. Insert the two outer rings of the taper roller bearings into the differential carrier.
2. Calculate the thickness C of the spacer ring.
  - a) Place the two inner rings of the taper roller bearings in their outer rings. Measure A.
  - b) Measure the dimension B of the drive pinion.
  - c) Thickness of the spacer ring  $C = A - B$ .
3. Heat the drive pinion side taper roller bearing to about 100°C and install it on the drive pinion shaft. (Drive on completely after it cools).
4. Install the spacer ring on the pinion shaft.
5. Install the drive pinion into the differential carrier. Heat the taper roller bearing inner ring at undersize to about 100°C and install it with a tube onto the drive pinion shaft.
6. Install the drive flange onto the drive pinion shaft. Tighten the safety nut according to sheet 3.5. For tightening fix the differential carrier and block the drive flange.

7. Measure the resistance of the bearings by using a torque wrench. If the measured value is not the prescribed 0,8 to 1,2 Nm, adjust the resistance by modification of the thickness of the spacer ring. After arriving at the adjustment of the bearing, back - off the safety nut and draw off the drive flange.
8. Install the radial seal ring with Loctite 572 applied into the cover. Fill the radial seal ring with bearing grease. Install the o - ring into the slot of the cover, fit the cover on the differential carrier and tighten the screws. Fit the carrier of the parking brake (if present) on the differential carrier and tighten the screws. Slip on the drive flange, screw on the safety nut with sealing compound between the contact surfaces. Tighten the safety nut according to sheet 3.5. Lock the nut by striking the nut brim into the slot of the pinion.

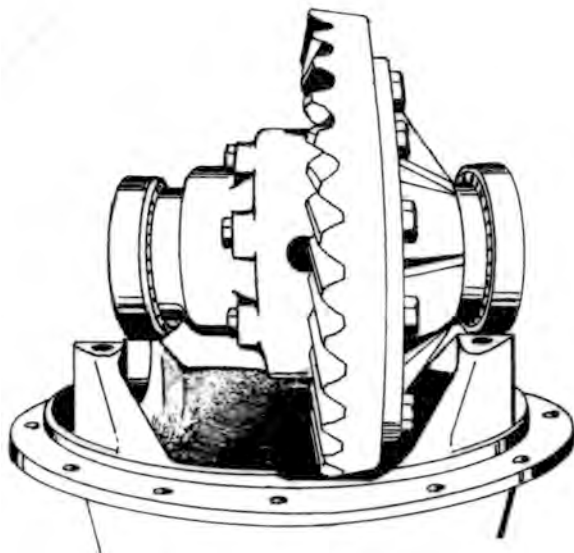


Before assembly all of the bevel gears and the thrust rings should be well oiled.

1. Place one differential side gear with the side gear thrust washer in the differential case.
2. Install the spider with differential gears and differential pinion thrust washers in the differential case.
3. Install the other differential side gear and side gear thrust washer. (At variants with Nospin differential install the Nospin diff. instead of the differential gears)
4. Install the other half of the differential case over the assembly and observe the alignment marks, tighten the differential case bolts. Secure with Loctite 262.
5. Check that all differential pinions can rotate easily.
6. Coat the contact surface of the ring gear with Loctite 270 and install the ring gear on the differential case by tapping lightly on the circumference. Tighten the ring gear bolts. Secure with Loctite 262.
7. Heat the two taper roller bearings to about 100°C and install them by using a sleeve.



## Dimension of backlash



Place the differential with the outer rings of the taper roller bearings on the differential carrier which is in a vertical position, with mounted drive pinion.

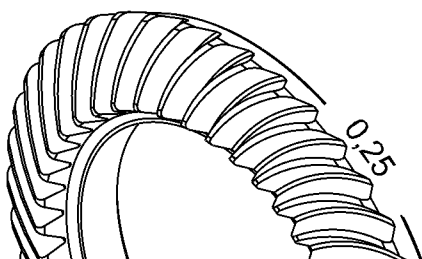
Mount the differential straps and align them with the thread rings.

During this operation be careful of the alignment marks on the differential straps with respect to the differential carrier. (Do not interchange the differential straps.)

## Backlash

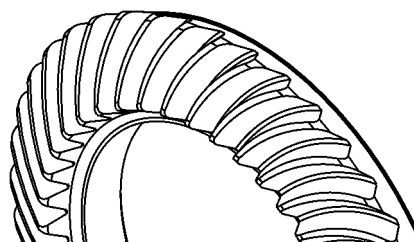
### Version 1

The smallest admissible value at the closest place is marked on the circumference of the ring gear.



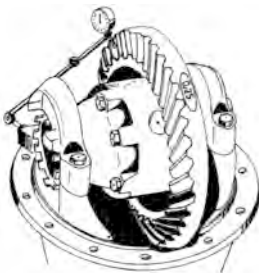
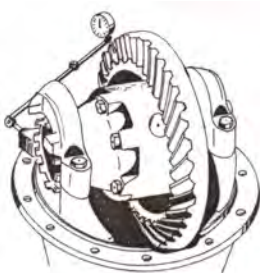

### Version 2

Is no value marked on the circumference of the ring gear, the backlash is depend on the ring gear diameter (see following table).



<i>Drive description</i>	<i>Ring gear diameter</i>	<i>Backlash</i>
Drive assembly 71	< 360	<b>0,35</b>

## Adjustment of backlash

Version 1	Version 2	
		<p>Tighten the differential strap bolts by hand. By a counter rotation of the two thread rings, move the differential until the backlash is correct.</p> <p>Therefore hold the drive pinion at the drive flange. Check the backlash by careful forwards and rearwards rotating the ring gear. Use a dial indicator.</p> <p>Measure the backlash during a few times turns of the ring gear and if need correct the backlash, because of the smallest admissible value at the closest place must not be fall short of.</p>
		<p>Adjust the backlash according to sheet "Adjustment of contact pattern of bevel gear teeth".</p> <p>Tighten screws of the differential straps and lock them with Loctite 262.</p> <p>Adjust the bearing roll resistance trough tightening of the thread rings. Set value: 2,0 to 3,0 Nm. Check the value with a torque wrench. If measuring at the drive pinion / drive flange, take the ratio of the bevel wheel set into account.</p> <p>Screw the lock plates for the thread rings and secure with Loctite 270, if need bend the lock plates.</p>



## **Adjustment of contact pattern of bevel gear teeth**



**NOTICE:** search for the production numbers of the drive pinion and the ring gear.

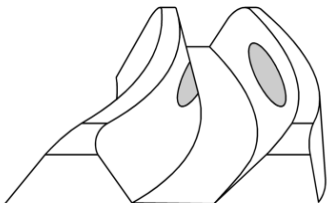
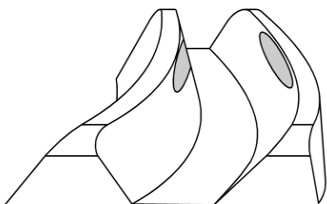
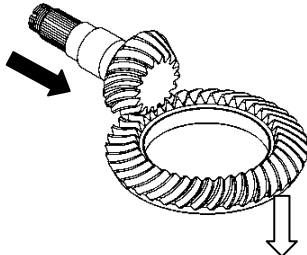
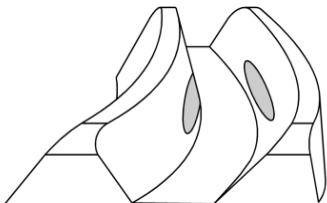
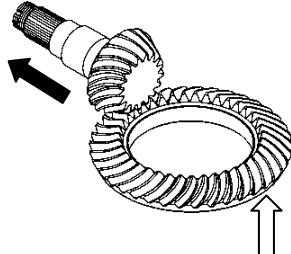
**It is only possible to achieve an optimal contact pattern, if:**

Version 1	Version 2
Production numbers <ul style="list-style-type: none"><li>• on drive pinion (marked on the end face)</li><li>• on ring gear (marked on the face of the ring gear)</li></ul>	<u>No</u> production numbers <ul style="list-style-type: none"><li>• on drive pinion</li><li>• on ring gear</li></ul>
➤ The production numbers of the drive pinion and ring gear <u>must</u> match – <b>only mount in pairs!</b>	➤ <u>indiscriminate</u> use of drive pinion and ring gear is possible – <b>no pairing necessary!</b>

## Checking the contact pattern of the gear teeth



1. Coat the teeth of the ring gear with spotting paste and then turn it several times until you can see pressure marks from the drive pinion on the coated teeth.
2. Check the contact pattern / pressure marks and compare them with the illustrations in the following table.
3. If necessary, make adjustments as shown in the table.

	Optimal contact pattern	
	Contact pattern too high.  Reduce drive pinion distance by correcting thickness of the adjustment disk. Adjust the backlash by moving the ring gear out.	
	Contact pattern too low.  Increase drive pinion distance by correcting thickness of the adjustment disk. Adjust the backlash by moving the ring gear in.	



## Securing of the striking nut



**NOTICE:** The brim of the striking nut has to be sheared only along the slot flank and the corner has to be bended on the slot ground.

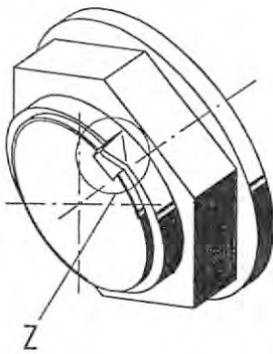


Figure 1

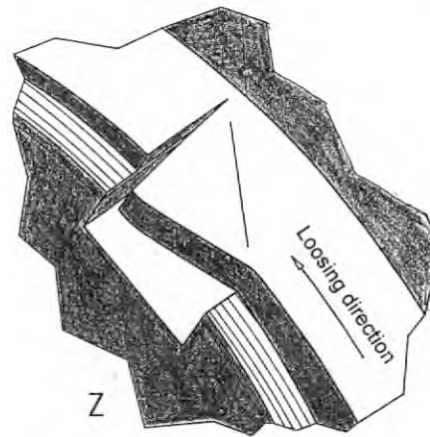


Figure 2

## Use of Loctite and other operating supplies

- Striking nut at drive flange
  - **In thread: assembly paste with MoS2 (exception: through drive pinion see enumeration 2)**
  - **Front side contact surface: sealing compound (Epple 33 or equivalent)**
  
- Striking nut at through drive nut
  - **On thread: Loctite 262**
  
- Striking nut at gear wheels, bearings and so on
  - **On thread: assembly paste with MoS2**

## Removing of the striking nut



**NOTICE:** Bend away the nose completely. Otherwise, the thread of the of the drive pinion will be damaged. Screw the nut off.



Figure 3

1. The secured striking nut.



Figure 4

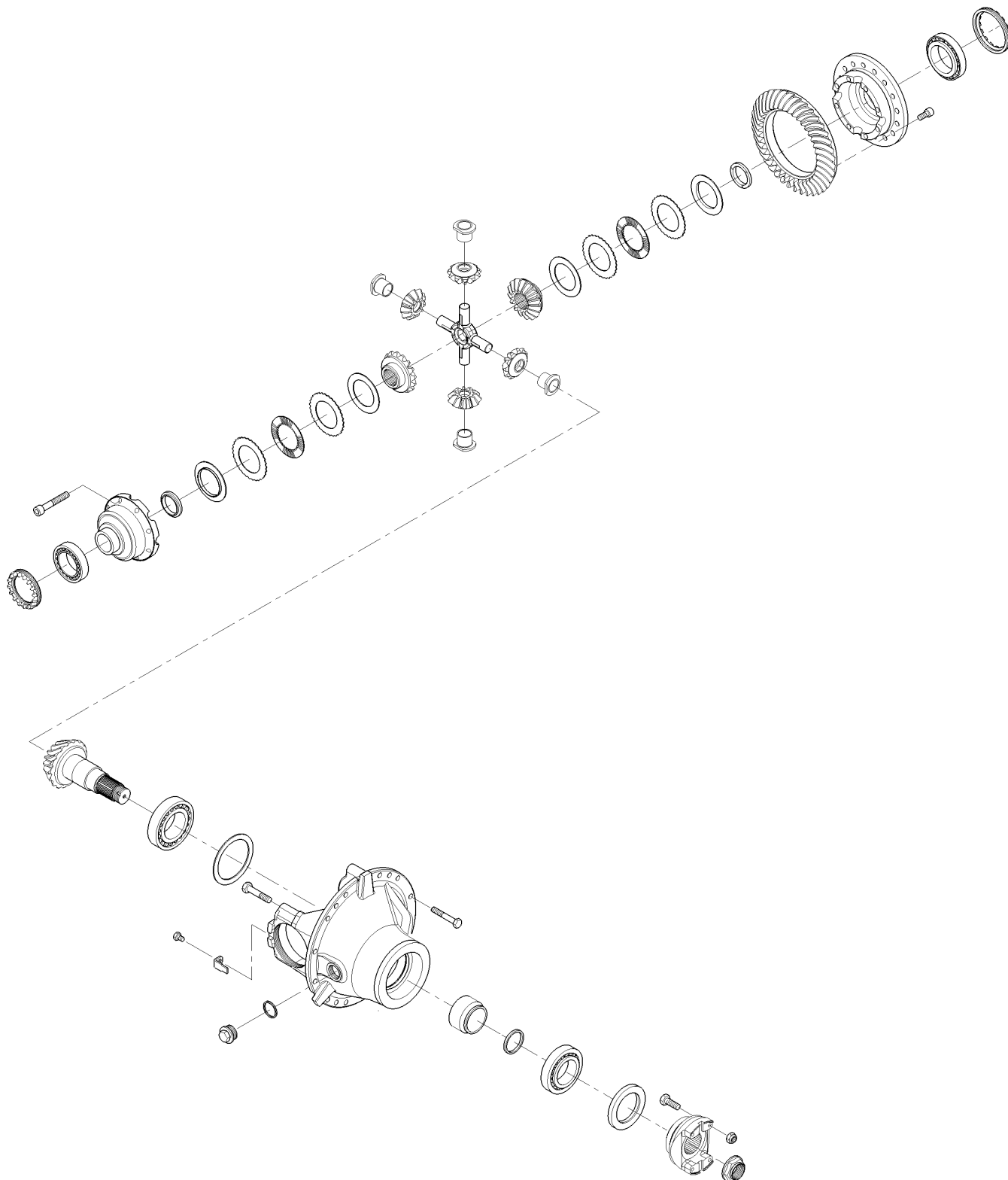
2. Applying an applicable flat chisel in the slot between drive pinion and securing and removing the securing of the striking nut.



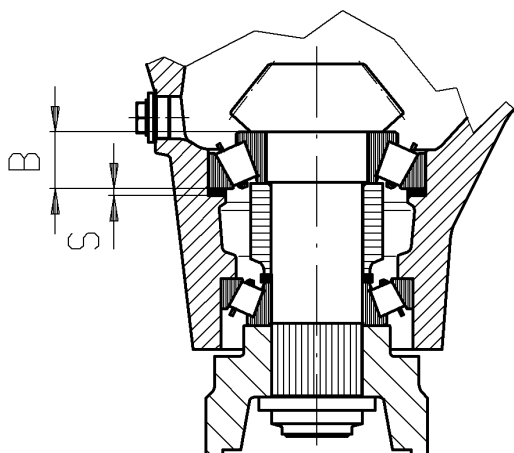
Figure 5

3. The loosened striking nut.

## Differential and carrier assembly D 91



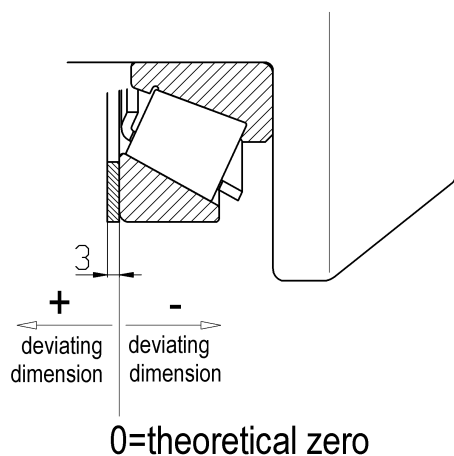
## Adjustment of drive pinion distance



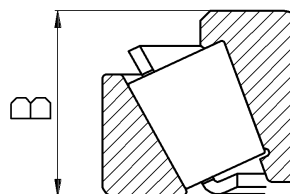
To obtain the proper tooth flank contact, adjust the axial position of the drive pinion with the thickness of the adjustment disc. The necessary thickness of the adjustment disc for first time assembly can be obtained by measurement (see calculation example).

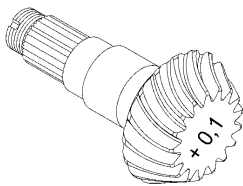
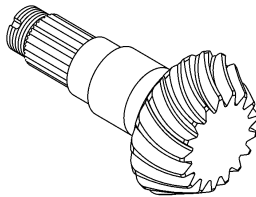
Drive assembly	A 91
theoretical S	3
theoretical B	56,5

The final thickness of the adjustment disc can be fixed during the checking of gear meshing at the assembled drive assembly (see page „Checking the contact pattern of the gear teeth” – 4.0.1).


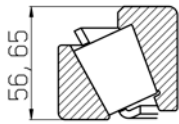
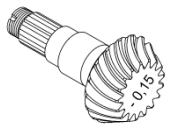


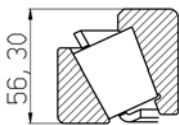
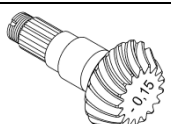


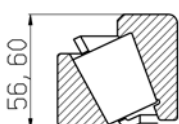
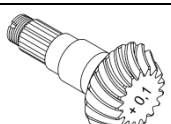



B = Measured width of the taper roller bearing.

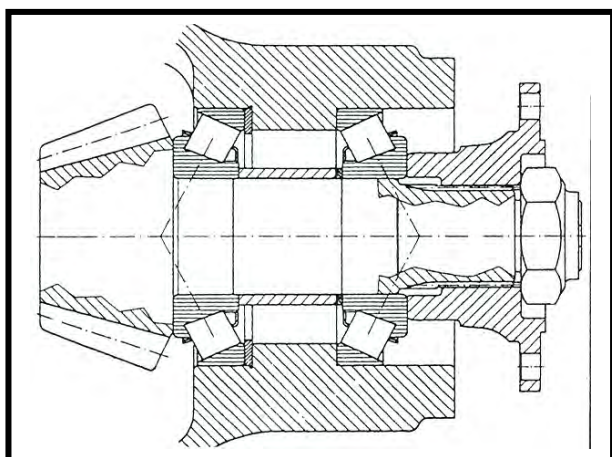
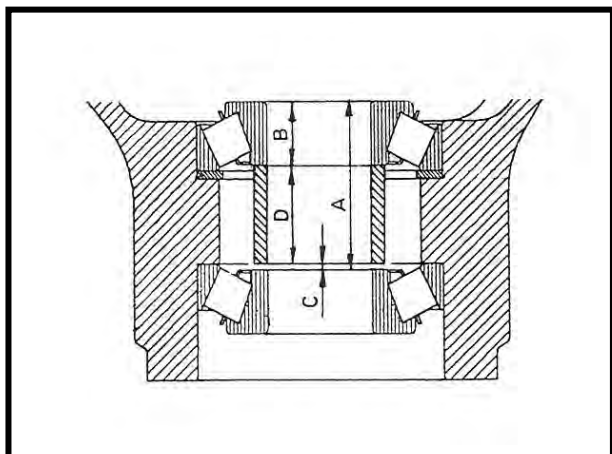


Version 1	Version 2
<p>Adjustment dimension – A</p> <p>Deviating dimension (defined during production) is marked on the locating face of the pinion. It indicates the deviation from the specified dimension.</p> <p>Example: Deviation +0,1</p> 	<p>Adjustment dimension – A</p> <p>Without inscription on the locating face of the pinion, the deviating from the specified dimension is 0.</p> <p>Example: Deviation 0</p> 

## Sample calculations (dimensions in mm):

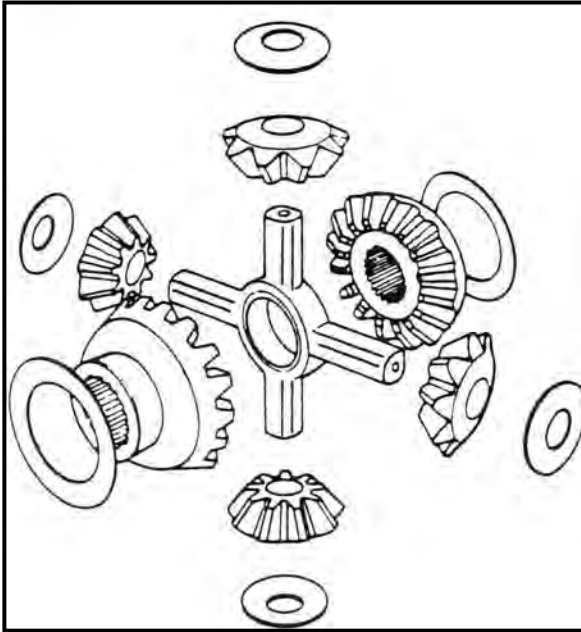
Theor. adjustment disk thickness	Measured bearing width	Tolerance at drive pinion	Calculation of the required adjustment disk thickness	Required adjustment disk thickness
		Version 1 	$\begin{matrix} \text{theor. disk thickness} & - & \text{deviation from bearing} & + & \text{deviation from pinion} & = & \text{required disk thickness} \end{matrix}$	
	deviation from the theoretical dimension +0,15	deviation from the theoretical dimension -0,15	$3,0 - 0,15 + 0,15 = 3,0$	
		Version 1 	$\begin{matrix} \text{theor. disk thickness} & + & \text{deviation from bearing} & + & \text{deviation from pinion} & = & \text{required disk thickness} \end{matrix}$	
	deviation from the theoretical dimension -0,20	deviation from the theoretical dimension -0,15	$3,0 + 0,20 + 0,15 = 3,35$	
		Version 1 	$\begin{matrix} \text{theor. disk thickness} & - & \text{deviation from bearing} & - & \text{deviation from pinion} & = & \text{required disk thickness} \end{matrix}$	
	deviation from the theoretical dimension +0,10	deviation from the theoretical dimension +0,10	$3,0 - 0,1 - 0,1 = 2,8$	

Fit corresponding disc and outer rings of the taper roller bearings.



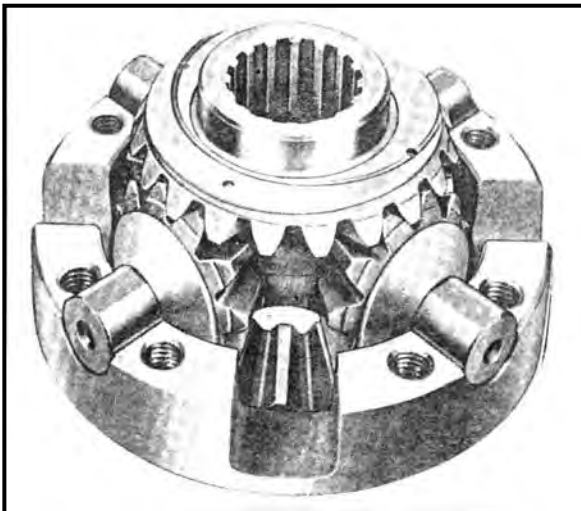
1. Insert the two outer rings of the taper roller bearings into the differential carrier.
2. Calculate the thickness C of the spacer disc.
  - a. Place the two inner rings of the taper roller bearings in their outer rings. Measure A.
  - b. Measure the dimension B of the roller bearing.
  - c. Measure the dimension D of the spacer bushing.
  - d. Thickness of the spacer disc  $C = A - B - D$ .
3. Heat the drive pinion side taper roller bearing to about 100°C and install it on the drive pinion shaft. (Drive on completely after it cools).
4. Install the spacer bushing and the spacer disc on the pinion shaft.
5. Install the drive pinion into the differential carrier. Heat the taper roller bearing inner ring at undersize to about 100°C and install it with a tube onto the drive pinion shaft.
6. Install the drive flange onto the drive pinion shaft. Tighten the safety nut according to sheet 3.5. For tightening fix the differential carrier and block the drive flange.

7. Measure the roll resistance of the bearings by using a torque wrench. If the measured value is not the prescribed 1,5 to 2,5 Nm, adjust the resistance by modification of the thickness of the spacer disc. After arriving at the adjustment of the bearing, back - off the safety nut and draw off the drive flange.
8. Install the radial seal ring with Loctite 572 applied. Fill the radial seal ring with bearing grease. Slip on the drive flange, screw on the safety nut with sealing compound between the contact surfaces. Tighten the safety nut according to sheet 3.5. Lock the nut by striking the nut brim into the slot of the pinion.

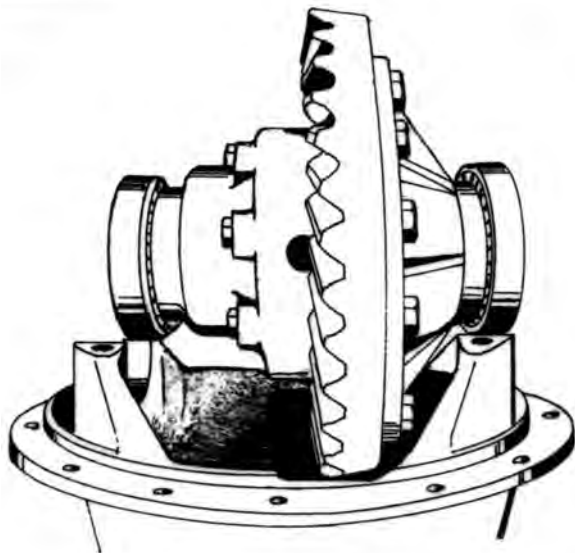


Before assembly all of the bevel gears and the thrust rings should be well oiled.

1. Place one differential side gear with the side gear thrust washer in the differential case.
2. Install the spider with differential gears and differential pinion thrust washers in the differential case.
3. Install the other differential side gear and side gear thrust washer. (At variants with Nospin differential install the Nospin diff. instead of the differential gears)
4. Install the other half of the differential case over the assembly and observe the alignment marks, tighten the differential case bolts. Secure with Loctite 262.
5. Check that all differential pinions can rotate easily.
6. Coat the contact surface of the ring gear with Loctite 270 and install the ring gear on the differential case by tapping lightly on the circumference. Tighten the ring gear bolts. Secure with Loctite 262.
7. Heat the two taper roller bearings to about 100°C and install them by using a sleeve.



## Dimension of backlash



Place the differential with the outer rings of the taper roller bearings on the differential carrier which is in a vertical position, with mounted drive pinion.

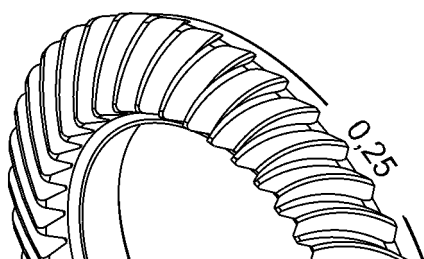
Mount the differential straps and align them with the thread rings.

During this operation be careful of the alignment marks on the differential straps with respect to the differential carrier. (Do not interchange the differential straps.)

## Backlash

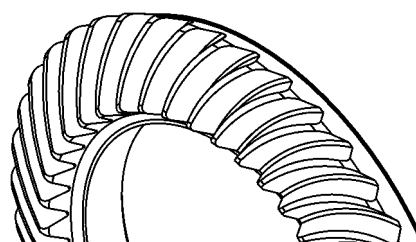
### Version 1

The smallest admissible value at the closest place is marked on the circumference of the ring gear.



### Version 2


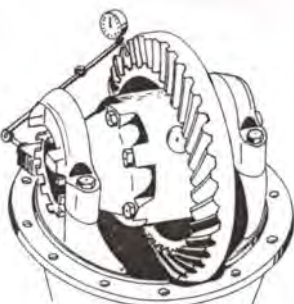

Is no value marked on the circumference of the ring gear, the backlash is depend on the ring gear diameter (see following table).



Drive description	Ring gear diameter	Backlash
Drive assembly 91	< 410	<b>0,40</b>



## Adjustment of backlash

Version 1	Version 2	
		<p>Tighten the differential strap bolts by hand. By a counter rotation of the two thread rings, move the differential until the backlash is correct.</p> <p>Therefore hold the drive pinion at the drive flange. Check the backlash by careful forwards and rearwards rotating the ring gear. Use a dial indicator.</p> <p>Measure the backlash during a few times turns of the ring gear and if need correct the backlash, because of the smallest admissible value at the closest place must not be fall short of.</p>
		<p>Adjust the backlash according to sheet "Adjustment of contact pattern of bevel gear teeth".</p> <p>Tighten screws of the differential straps and lock them with Loctite 262.</p> <p>Adjust the bearing roll resistance trough tightening of the thread rings. Set value: 2,0 to 3,0 Nm. Check the value with a torque wrench. If measuring at the drive pinion / drive flange, take the ratio of the bevel wheel set into account.</p> <p>Screw the lock plates for the thread rings and secure with Loctite 270, if need bend the lock plates.</p>

## Limited slip differential

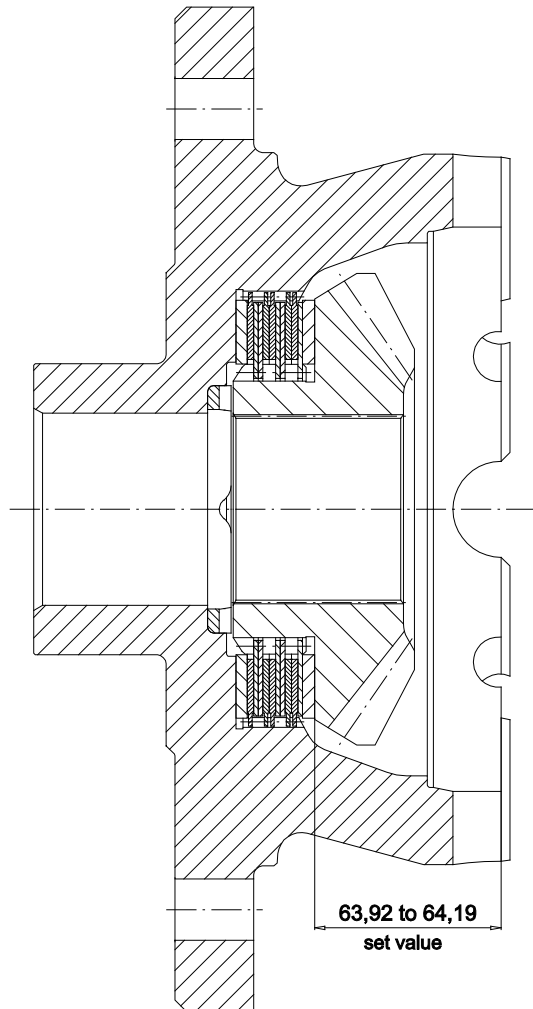


Figure 1

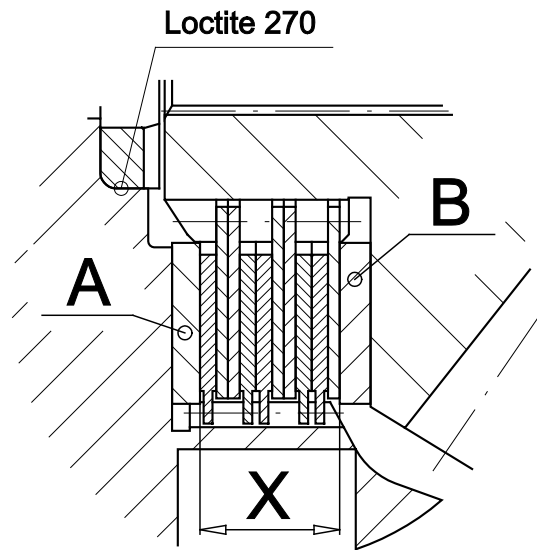


Figure 2

### Operating sequence

- measure dimension X of the disk set
- select the disks A and B according to the table „Disk selection based on the disk set dimension“
- insert the matching disks according to the arrangement in figure 2
- if it is necessary, the disks D109.2873.4P.5/4/3/2 can get ground to the required thickness or order the specific disks A and B according to the table “Disks and their thickness”
- check the set value (63,92 – 64,19 mm)

## Disk selection

Disk selection based on the disk set dimension:

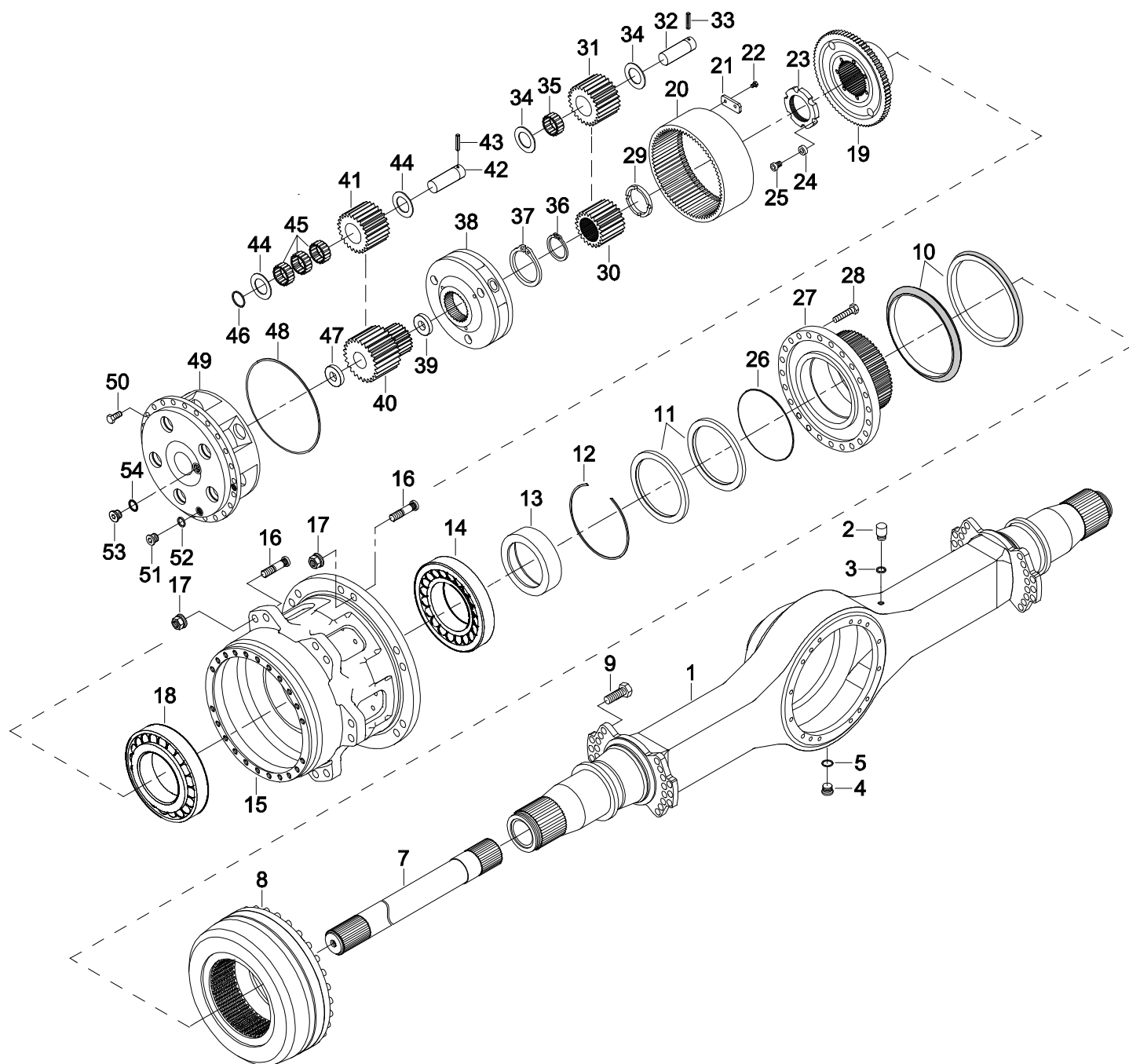
Disk set dimension X	Disk A	Disk B
18,45 to 18,55 mm	D109.2873.4P.5	D109.2873.4P.2
18,56 to 18,65 mm	D109.2873.4P.2	D109.2873.4P.2
18,66 to 18,75 mm	D109.2873.4P.5	D109.2873.4P.4
18,76 to 18,85 mm	D109.2873.4P.2	D109.2873.4P.4
18,86 to 18,95 mm	D109.2873.4P.5	D109.2873.4P.3
18,96 to 19,05 mm	D109.2873.4P.4	D109.2873.4P.4
19,06 to 19,15 mm	D109.2873.4P.6	D109.2873.4P.2
19,16 to 19,25 mm	D109.2873.4P.3	D109.2873.4P.4
19,26 to 19,35 mm	D109.2873.4P.6	D109.2873.4P.4
19,36 to 19,45 mm	D109.2873.4P.3	D109.2873.4P.3
19,46 to 19,55 mm	D109.2873.4P.6	D109.2873.4P.3

Disks and their thickness:

Disk	Thickness
D109.2873.4P.2	4,2 mm
D109.2873.4P.3	3,8 mm
D109.2873.4P.4	4,0 mm
D109.2873.4P.5	4,3 mm
D109.2873.4P.6	3,7 mm



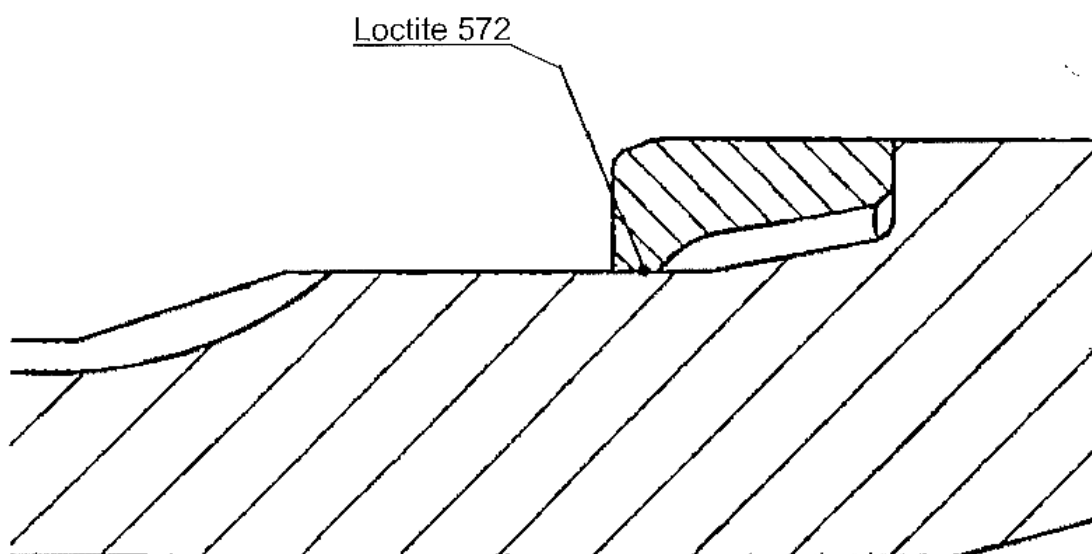
## Hub assembly drive axle



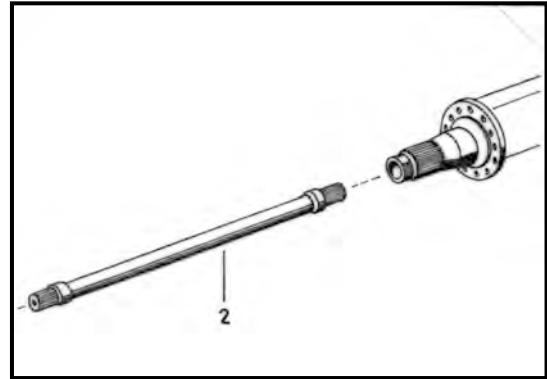
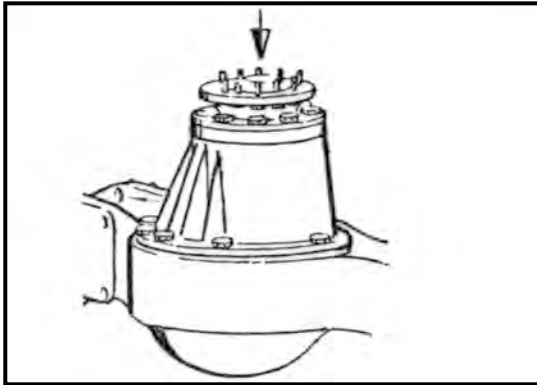
## Overview of parts

1	Axle housing	28	Hexagon screw
2	Breather	29	Thrust washer
3	Sealing ring	30	Sun gear
4	Screw plug	31	Planetary gear
5	Sealing ring	32	Planetary pin
6	--	33	Spring-type straight pin
7	Axle shaft	34	Disk
8	Wet multiple disk brake	35	Needle bearing
9	Hexagon screw	36	Circlip
10	Face seal	37	Circlip
11	Radial seal ring	38	Planetary carrier
12	Circlip	39	Thrust washer
13	Spacer ring	40	Sun gear
14	Tapered roller bearing	41	Planetary gear
15	Wheel hub	42	Planetary pin
16	Wheel stud	43	Spring-type straight pin
17	Wheel nut	44	Disk
18	Tapered roller bearing	45	Needle bearing
19	Ring gear carrier	46	O-ring
20	Ring gear	47	Thrust washer
21	Lock plate	48	O-ring
22	Hexagon screw	49	Planetary housing
23	Wheel bearing adjustment nut	50	Hexagon screw
24	Ring	51	Screw plug
25	Hexagon socket screw	52	Sealing ring
26	O-ring	53	Screw plug
27	Disk carrier	54	Sealing ring

Coat the seat of the spacer ring on the steering knuckle resp. axle spindle with Loctite 572. Heat the spacer ring to about 100°C and push it by gently striking onto the steering knuckle resp. axle spindle. (The steering knuckle resp. axle spindle must be free of corrosion). Oil the seal ring tread onto the spacer ring.



# Assembly of the differential and carrier assembly onto the axle housing



Coat the contact surface of the axle housing with Eppl 33 (at version through drive with Loctite 510), and mount the complete drive assembly. The axle housing being placed in a horizontal position, secure the screws with Loctite 262. Mount the pol wheel (if present) onto the axle shaft (see 5.1.7).

Engage the axle shaft into the axle housing.

The axle shaft should be able to be moved easily (by hand) in the tothing of the differential side gear.

At version with differential lock on the outside (D 71/ D 109) the differential lock must always be actuated when assemble or disassemble the axle shaft.

## **Direction:**

Actuating of the differential lock is necessary to prevent the sliding sleeve to drop out of the shifter fork into the axle housing when pulling out or sliding in the axle shaft. This would entail disassembly of the axle.



- Assembly of the spacer ring (if present) see sheet 5.1.6.
- Install the brake onto the axle spindle, be careful of the brake control position and bolt it.  
At version with disc brake install the brake carrier (if present), then mount the wheel hub with the brake disc, and after this operation install the brake.
- Prepare and mount the wheel hub see chapter 5.5.  
**Attention:** Hold the wheel hub with a hoist until the outer bearing with ring gear carrier is mounted.
- Assembly of the planetary gear drive see chapter 6.
- At version with drum brake mount the brake drum.
- Assembly of the ABS - sensor installation (if present) see 5.1.7.

**Attention:**

At version with ABS resp. ABS - preparation (the pol wheel is mounted onto the axle shaft) the thrust ring of the sun gear in the axle spindle must be dismounted for disassembly the axle shaft.

## Prepare carrier disc

## Prepare and mount wheel hub

### NOTICE



**At irregular assembly of the radial seal ring.**

The sealing of the oil chamber is not guaranteed.

- Observe the fitting position of the sealing lip from the radial seal ring!
- Do not damage the sealing lip.
- Use a special tool – seal ring sleeve driver.

### **Prepare Disc carrier**

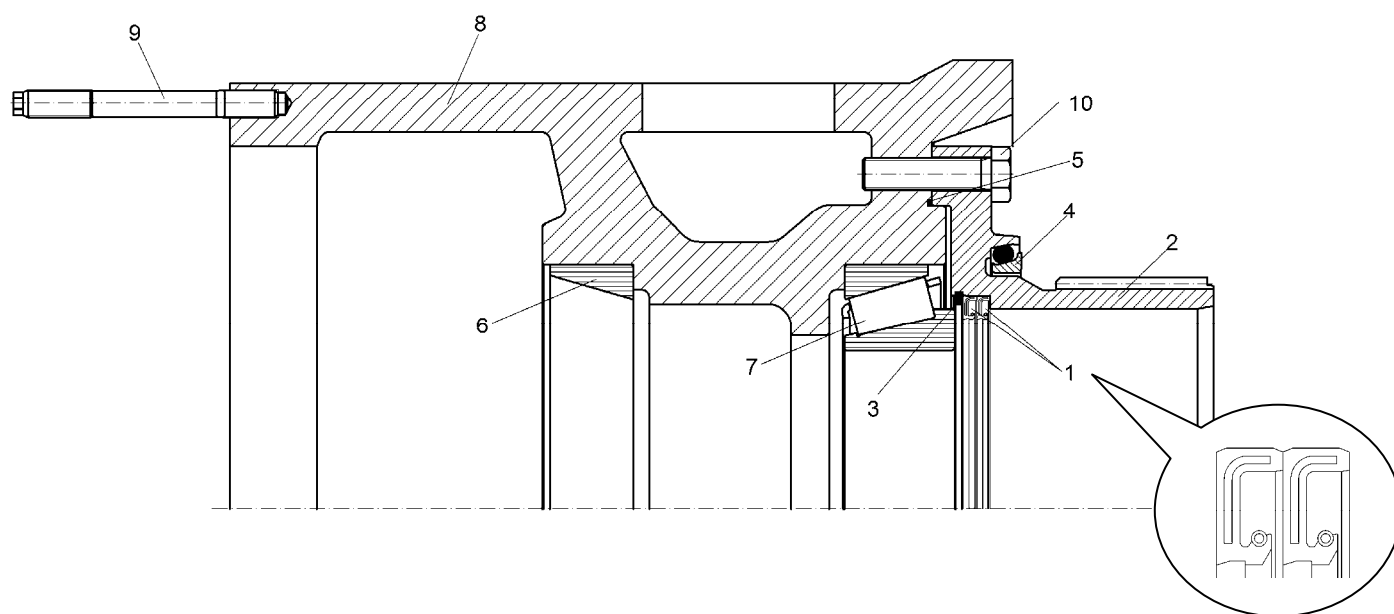
- Press the radial seal rings (1) with Loctite 572 (rubber cage) resp. Loctite 270 (steel cage) applied into the disc carrier (2).
- Install the circlip (3) into the slot of the disc carrier (2).
- Fill the radial seal rings (1) with bearing grease.
- Install the face seal (4) into the disc carrier (2) (see 5.8).
- Place the o - ring (5) into the slot of the wheel hub (8).

### **Prepare wheel hub**

- Press in outer rings of taper roller bearings (6+7), do not hammer them. Install inner ring of taper roller bearing (7).
- Place the pre - assembled disc carrier (2) onto the wheel hub (8) and bolt it with the screws (10), secure the screws (10) with Loctite 262.
- Screw the wheel studs (9) until they contact to the thread ground into the wheel hub (8), tightening torque about 100 Nm.

### **Mount wheel hub**

- Push the pre - assembled wheel hub (8) parallel onto the axle spindle resp. steering knuckle.
- **Important:** Be careful not to damage the seal rings (1).



## Tightening torque of the wheel safety nut

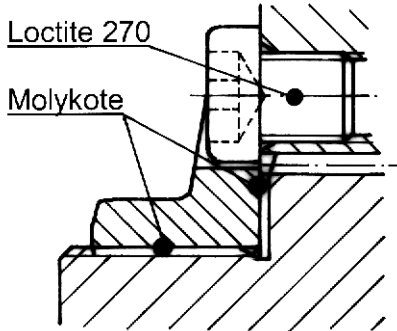
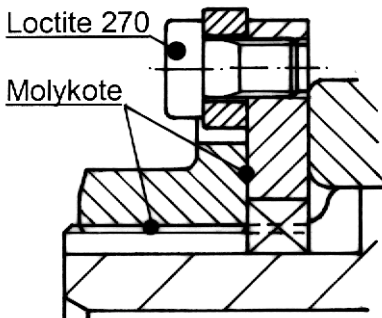
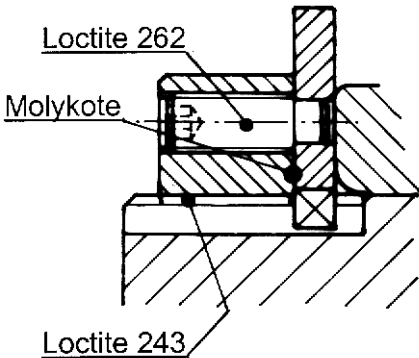
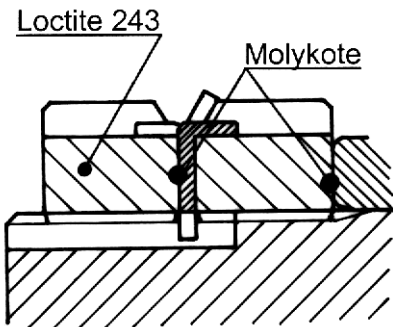
series	Nm
41	300
51	350
61	400
71/ 72	400
81/ 82	450
91	500
109	500
116	500
L101	500
L102	550
D/ LT 101/ 102	600-650
106	650-700
111	750
112	1000

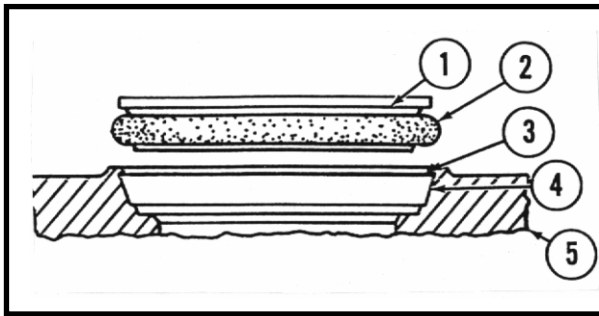
## Adjusting of wheel bearings

The temperature of the axle parts should be between 0 and + 20°C at the bearing adjustment.

Screw on the wheel safety nut (Loctite- resp. Molykote- using see page 5.7.2) and adjust and secure as following described:

Screw on the wheel safety nut and tighten it with a 1,5 - 2 times higher tightening torque than the finish tightening torque. During the tightening, turn the wheel hub a few times and knock it with a plastic hammer. Untighten the wheel safety nut (about 180° back rotation), then tighten the wheel safety nut to the tightening torque according to the table. At this tightening turn the wheel hub also a few times, if there is no possibility for securing, the wheel safety nut has to be turned back to next securing possibility.

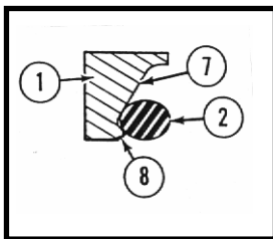
Designation	Version	Security/ Remarks
Shaft nut with cheese head screw		Cheese head screw & Loctite 270
Shaft nut with cheese head screw and bushing		Cheese head screw & Loctite 270
Shaft nut with set screw		Set screw & Loctite 243/ 262 Back off set screw ½ rotation after tightening
Shaft nut with counter nut		Security spline & counter nut & Loctite 243



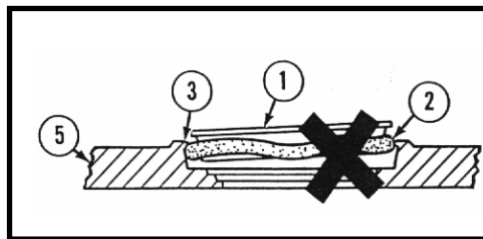
1. Seal ring
2. Rubber toric ring
3. Housing retaining lip
4. Housing ramp
5. Seal ring housing

Seal rings, torics, and housings must be clean and free of any oil film, dust, or other foreign matter. Use a solvent that evaporates quickly, leaves no residue, and is compatible with the rubber toric rings. The recommended solvent is Isopropanol. Ring and housings should be wiped with a solvent - soaked lint free cloth or paper towel.

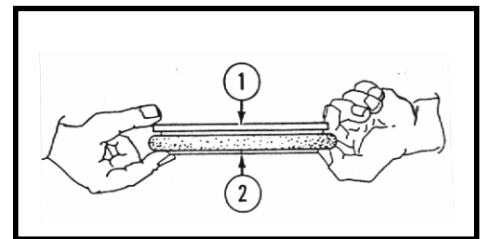
After all components have been wiped clean, the torics should be installed on the metal seal rings so that they rest in the radius on the tail of the metal ring. Insure that the torics are not twisted by inspecting the mold flash line on the outside diameter of the toric for true circumferential tracking around the seal. Twisted torics will cause nonuniform face load that can result in leakage of lubricant and pumping of debris past the toric. If a twist is apparent, it can be eliminated by gently pulling a section of the toric radially away from the metal seal ring and letting it “snap” back. Repeating this in several places around the ring will eliminate any twist in the toric ring.



Put the toric ring (2) on seal ring (1), at the bottom of the seal ring (1) and against the retaining lip (8).

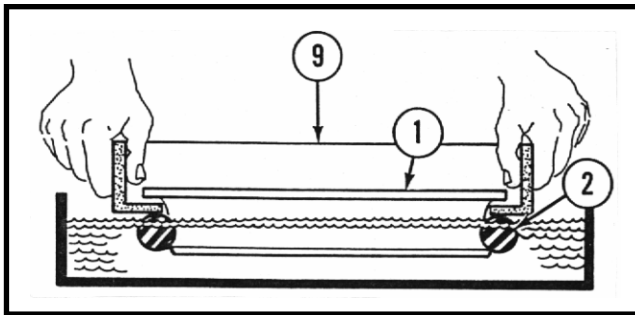


The toric ring (2) can twist if it is not wet all around during installation or if there are burrs or fins on the retaining lip (3) of the housing (5).

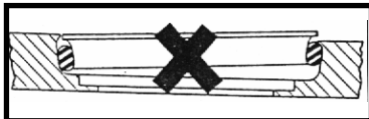


Eliminate toric twist by gently pulling a section of the toric (2) rapidly away from the seal ring (1) and letting it “snap” back.

Place the installation tool around the seal ring and dip the seal ring into a pan of Isopropanol solvent to lubricate the toric ring. It is essential to lubricate the toric with Isopropanol so that the toric will slip past the housing retaining lip and seal uniformly in the housing nose radius. Insufficient lubrication can cause poor seal performance due to nonuniform loading (twisted torics or cocked seals). Use of solvents other than Isopropanol can leave a residue on the toric or ramps and allow the toric to slide rather than roll in seat. This can also result in poor seal performance due to nonuniform loading.



Put the installation tool (9) onto the seal ring (1) with toric ring (2). Lower the rings into a container with Isopropanol until all surfaces of the toric (2) are wet.



Toric sliding on retainer ramp.

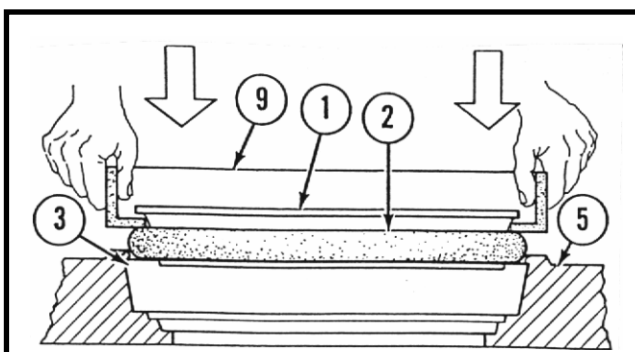


Toric caught on housing retainer lip.



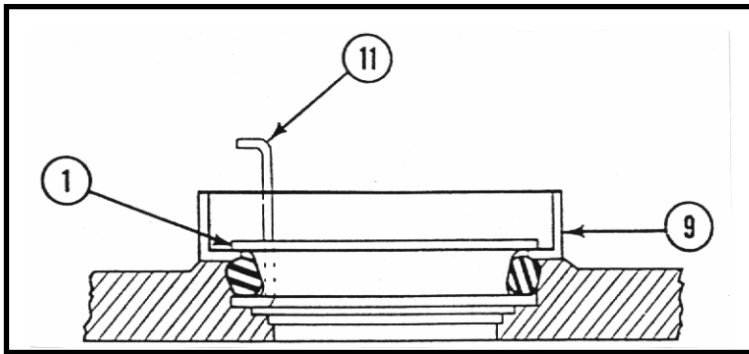
Toric sliding on seal ramp.

After dipping the seal assembly in the solvent, shake the excess solvent from the seal assembly and immediately “pop” the seal into the housing with a firm push of the installation tool. Remove the installation tool and check the seal stantout height at several places around the circumference of the ring to verify an accurate installation. If the seal does not meet the height specification, inspect the toric for twists or obvious bulges.

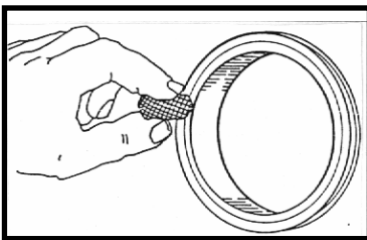


With all surfaces of the toric ring (2) wet with Isopropanol, use the installation tool (9) to position the seal ring (1) and the toric ring (2) squarely against the housing (5) as shown. Use sudden and even pressure to pop (push) the toric ring (2) under the retaining lip (3) of the housing (5).

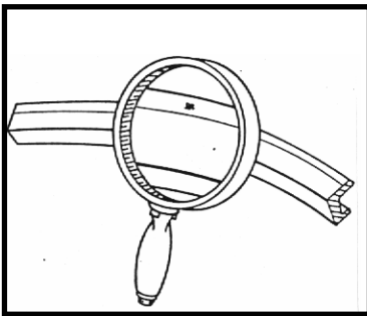
The seal can be adjusted by gently pushing the toric into position by hand or by using a fabricated adjustment hook.



If small adjustments are necessary, do not push directly on the seal ring (1); use the installation tool (9) to push down or the adjustment tool (11) to pull up.



A thin film of light oil should be applied to the seal faces prior to assembly. Use an applicator, a disposable tissue or a clean finger to distribute the oil evenly. Be careful not to get any oil on the rubber toric rings.



Be sure there is no visible debris on either of the seal faces - even a small piece of lint can hold the seal faces apart and cause leakage.

After successful installation, wait one minute for the Isopropanol to dry before assembling the two seal halves in the final loaded position. This delay is to allow any excess solvent to dry so that the torics roll, rather than slide, in the housing as the faceload is increased. If the torics slide, this can produce a nonuniform load that can result in poor seal performance.

## **Results of incorrect assembly :**

Point "A" and point "B" remain stationary.

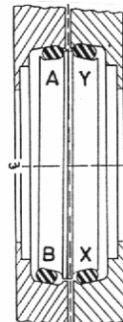
Points "X" and "Y" rotate 180°.

This causes high pressure at "A"/ "Y" and possible galling.

When rotated, points "B"/ "X" has low pressure and possible leakage.



Original assembled position



Rotated 180°

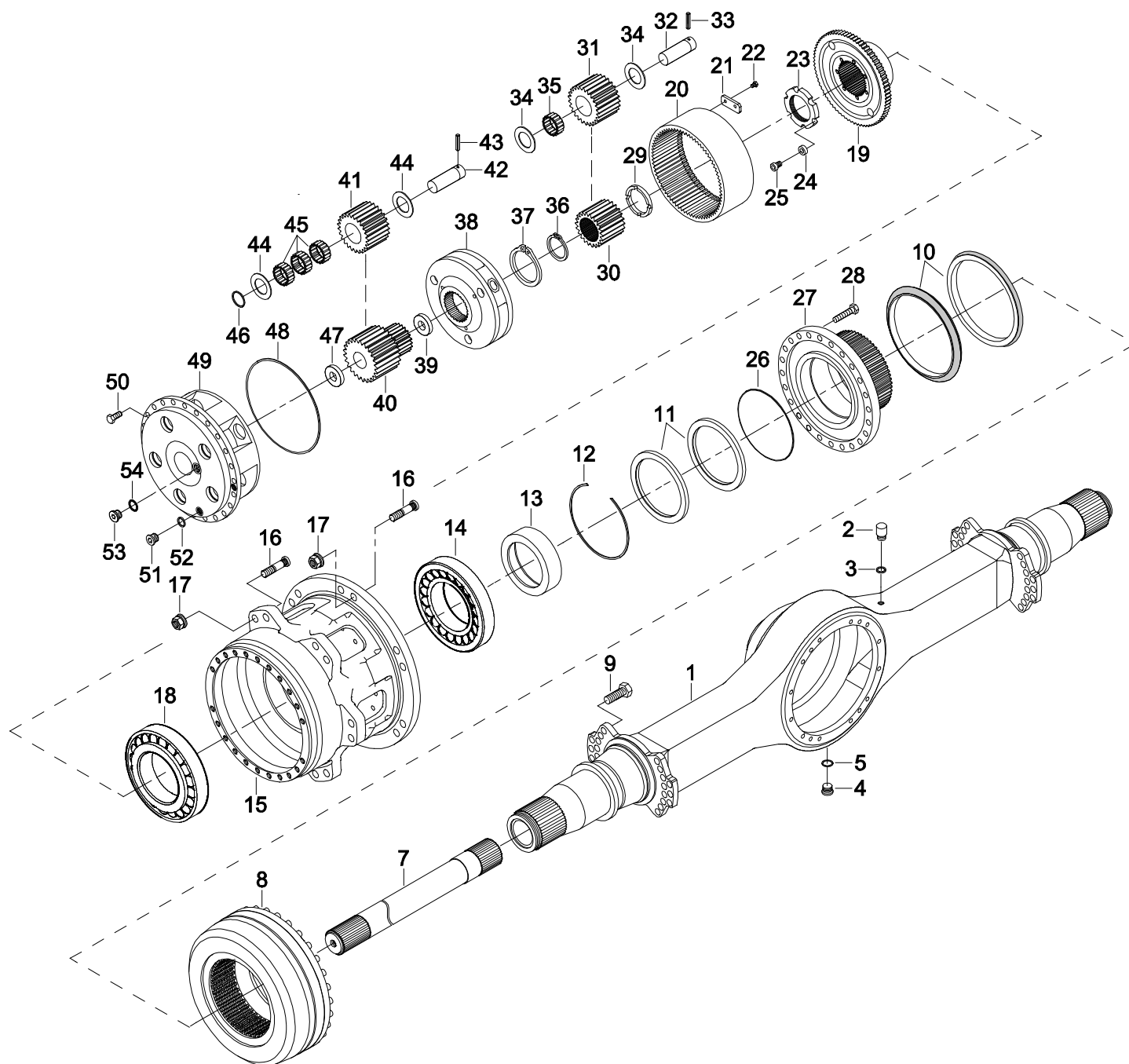


After the unit to be sealed is assembled, a post - assembly leakage test can be performed to insure the seal is properly installed. A vacuum check is recommended rather than a pressure check as vacuum checks are more sensitive. Many users find this an easy check to combine with a vacuum fill technique for the lubricant. It is recommended the compartment be filled to the correct level with lubricant and then rotated slowly several revolutions to seat the seals. A vacuum test will catch big seal damage such as broken seal rings or cut torics that may be caused in the last phases of assembly. The Duo - Cone seal is not designed to seal air, so some leakage can be expect using such a procedure.

Following these guidelines and recommendations should insure optimum performance from the Duo - Cone - seals.



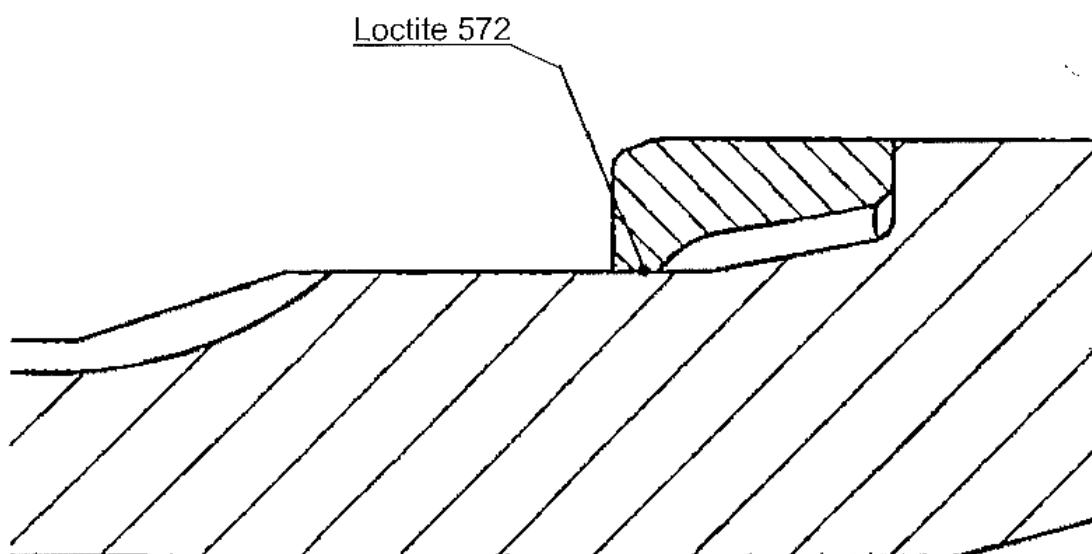
## Hub assembly drive axle



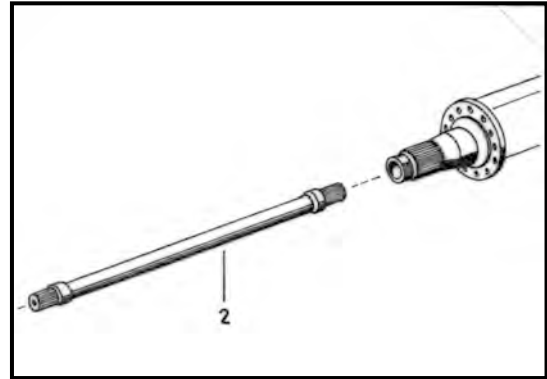
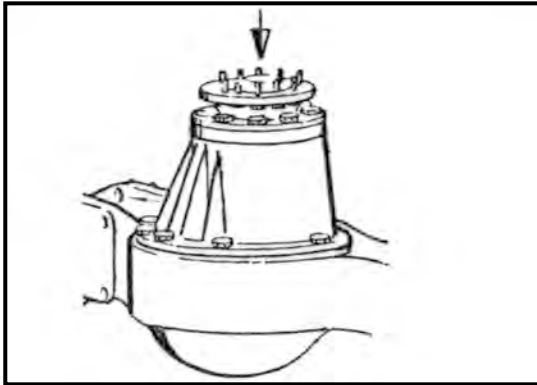
## Overview of parts

1	Axle housing	28	Hexagon screw
2	Breather	29	Thrust washer
3	Sealing ring	30	Sun gear
4	Screw plug	31	Planetary gear
5	Sealing ring	32	Planetary pin
6	--	33	Spring-type straight pin
7	Axle shaft	34	Disk
8	Wet multiple disk brake	35	Needle bearing
9	Hexagon screw	36	Circlip
10	Face seal	37	Circlip
11	Radial seal ring	38	Planetary carrier
12	Circlip	39	Thrust washer
13	Spacer ring	40	Sun gear
14	Tapered roller bearing	41	Planetary gear
15	Wheel hub	42	Planetary pin
16	Wheel stud	43	Spring-type straight pin
17	Wheel nut	44	Disk
18	Tapered roller bearing	45	Needle bearing
19	Ring gear carrier	46	O-ring
20	Ring gear	47	Thrust washer
21	Lock plate	48	O-ring
22	Hexagon screw	49	Planetary housing
23	Wheel bearing adjustment nut	50	Hexagon screw
24	Ring	51	Screw plug
25	Hexagon socket screw	52	Sealing ring
26	O-ring	53	Screw plug
27	Disk carrier	54	Sealing ring

Coat the seat of the spacer ring on the steering knuckle resp. axle spindle with Loctite 572. Heat the spacer ring to about 100°C and push it by gently striking onto the steering knuckle resp. axle spindle. (The steering knuckle resp. axle spindle must be free of corrosion). Oil the seal ring tread onto the spacer ring.



# Assembly of the differential and carrier assembly onto the axle housing



Coat the contact surface of the axle housing with Eppl 33 (at version through drive with Loctite 510), and mount the complete drive assembly. The axle housing being placed in a horizontal position, secure the screws with Loctite 262. Mount the pol wheel (if present) onto the axle shaft (see 5.1.7).

Engage the axle shaft into the axle housing.

The axle shaft should be able to be moved easily (by hand) in the tothing of the differential side gear.

At version with differential lock on the outside (D 71/ D 109) the differential lock must always be actuated when assemble or disassemble the axle shaft.

## **Direction:**

Actuating of the differential lock is necessary to prevent the sliding sleeve to drop out of the shifter fork into the axle housing when pulling out or sliding in the axle shaft. This would entail disassembly of the axle.

- Assembly of the spacer ring (if present) see sheet 5.1.6.
- Install the brake onto the axle spindle, be careful of the brake control position and bolt it.  
At version with disc brake install the brake carrier (if present), then mount the wheel hub with the brake disc, and after this operation install the brake.
- Prepare and mount the wheel hub see chapter 5.5.  
**Attention:** Hold the wheel hub with a hoist until the outer bearing with ring gear carrier is mounted.
- Assembly of the planetary gear drive see chapter 6.
- At version with drum brake mount the brake drum.
- Assembly of the ABS - sensor installation (if present) see 5.1.7.

**Attention:**

At version with ABS resp. ABS - preparation (the pol wheel is mounted onto the axle shaft) the thrust ring of the sun gear in the axle spindle must be dismounted for disassembly the axle shaft.

## Prepare and mount the wheel hub

### NOTICE



#### At irregular assembly of the radial seal ring.

The sealing of the oil chamber is not guaranteed.

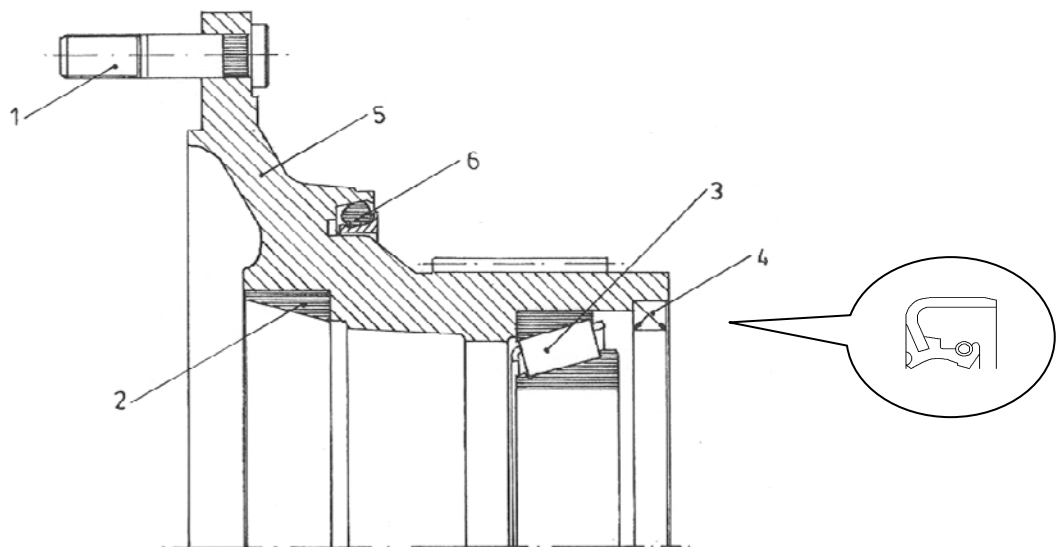
- Observe the fitting position of the sealing lip from the radial seal ring!
- Do not damage the sealing lip.
- Use a special tool – seal ring sleeve driver.

### Prepare wheel hub

- Install the wheel studs (1).
- Press in outer rings of taper roller bearings (2 + 3), do not hammer them.
- Install inner ring of taper roller bearing (3).
- Press the radial seal ring (4) with Loctite 572 (rubber cage) resp. Loctite 270 (steel cage) applied into the wheel hub (5).
- Fill the radial seal ring with bearing grease.
- Install the face seal (6) into the wheel hub (5) (see 5.8).

### Mount wheel hub

- Push the pre - assembled wheel hub (6) parallel onto the axle spindle resp. steering knuckle.
- **Important:** Be careful not to damage the radial seal ring (4).





## Tightening torque of the wheel safety nut

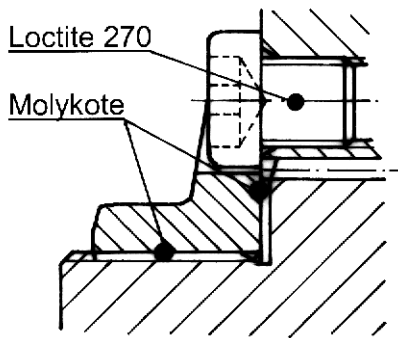
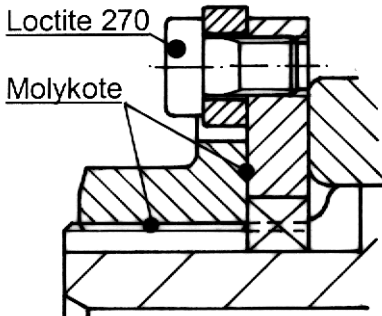
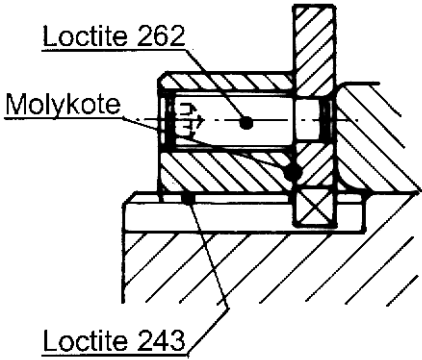
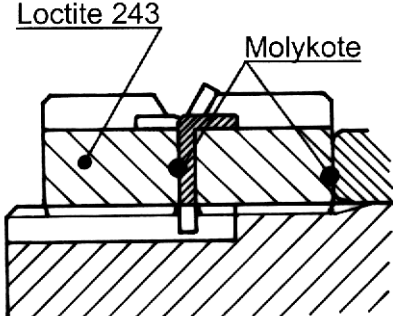
series	Nm
41	300
51	350
61	400
71/ 72	400
81/ 82	450
91	500
109	500
116	500
L101	500
L102	550
D/ LT 101/ 102	600-650
106	650-700
111	750
112	1000

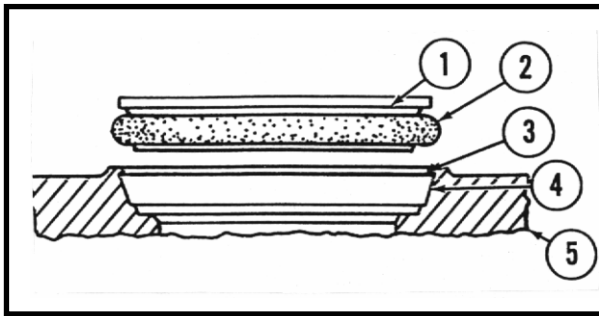
## Adjusting of wheel bearings

The temperature of the axle parts should be between 0 and + 20°C at the bearing adjustment.

Screw on the wheel safety nut (Loctite- resp. Molykote- using see page 5.7.2) and adjust and secure as following described:

Screw on the wheel safety nut and tighten it with a 1,5 - 2 times higher tightening torque than the finish tightening torque. During the tightening, turn the wheel hub a few times and knock it with a plastic hammer. Untighten the wheel safety nut (about 180° back rotation), then tighten the wheel safety nut to the tightening torque according to the table. At this tightening turn the wheel hub also a few times, if there is no possibility for securing, the wheel safety nut has to be turned back to next securing possibility.

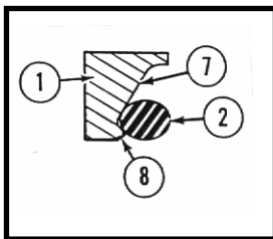
Designation	Version	Security/ Remarks
Shaft nut with cheese head screw		Cheese head screw & Loctite 270
Shaft nut with cheese head screw and bushing		Cheese head screw & Loctite 270
Shaft nut with set screw		Set screw & Loctite 243/ 262 Back off set screw ½ rotation after tightening
Shaft nut with counter nut		Security spline & counter nut & Loctite 243



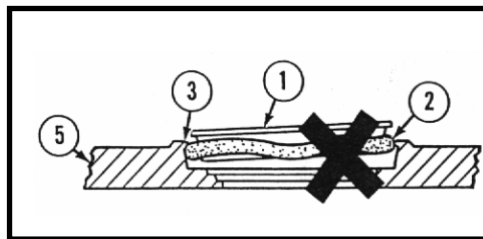
1. Seal ring
2. Rubber toric ring
3. Housing retaining lip
4. Housing ramp
5. Seal ring housing

Seal rings, torics, and housings must be clean and free of any oil film, dust, or other foreign matter. Use a solvent that evaporates quickly, leaves no residue, and is compatible with the rubber toric rings. The recommended solvent is Isopropanol. Ring and housings should be wiped with a solvent - soaked lint free cloth or paper towel.

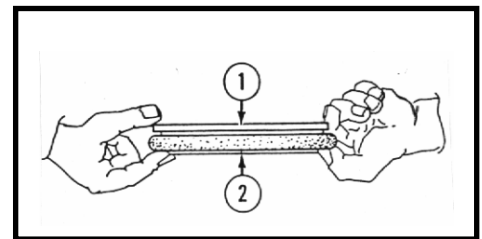
After all components have been wiped clean, the torics should be installed on the metal seal rings so that they rest in the radius on the tail of the metal ring. Insure that the torics are not twisted by inspecting the mold flash line on the outside diameter of the toric for true circumferential tracking around the seal. Twisted torics will cause nonuniform face load that can result in leakage of lubricant and pumping of debris past the toric. If a twist is apparent, it can be eliminated by gently pulling a section of the toric radially away from the metal seal ring and letting it “snap” back. Repeating this in several places around the ring will eliminate any twist in the toric ring.



Put the toric ring (2) on seal ring (1), at the bottom of the seal ring (7) and against the retaining lip (8).

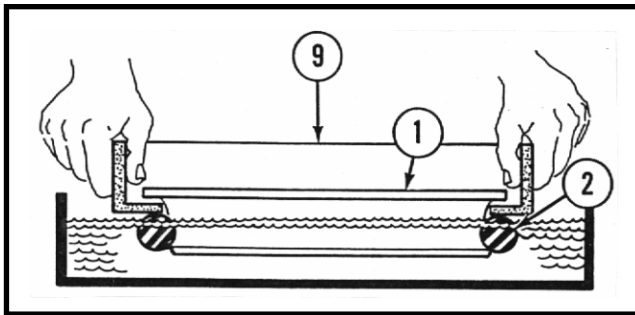


The toric ring (2) can twist if it is not wet all around during installation or if there are burrs or fins on the retaining lip (3) of the housing (5).

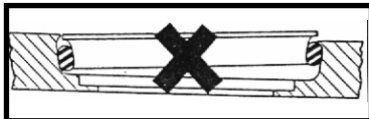


Eliminate toric twist by gently pulling a section of the toric (2) rapidly away from the seal ring (1) and letting it “snap” back.

Place the installation tool around the seal ring and dip the seal ring into a pan of Isopropanol solvent to lubricate the toric ring. It is essential to lubricate the toric with Isopropanol so that the toric will slip past the housing retaining lip and seal uniformly in the housing nose radius. Insufficient lubrication can cause poor seal performance due to nonuniform loading (twisted torics or cocked seals). Use of solvents other than Isopropanol can leave a residue on the toric or ramps and allow the toric to slide rather than roll in seat. This can also result in poor seal performance due to nonuniform loading.



Put the installation tool (9) onto the seal ring (1) with toric ring (2). Lower the rings into a container with Isopropanol until all surfaces of the toric (2) are wet.



Toric sliding on retainer ramp.

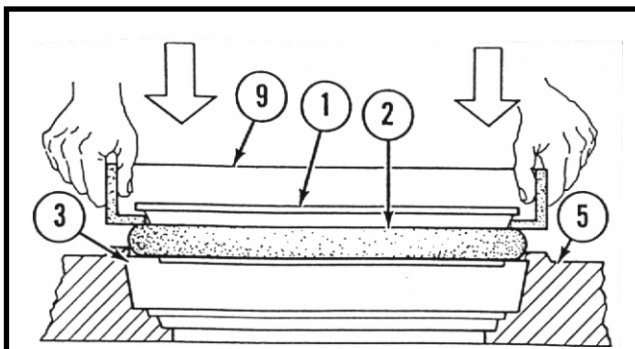


Toric caught on housing retainer lip.



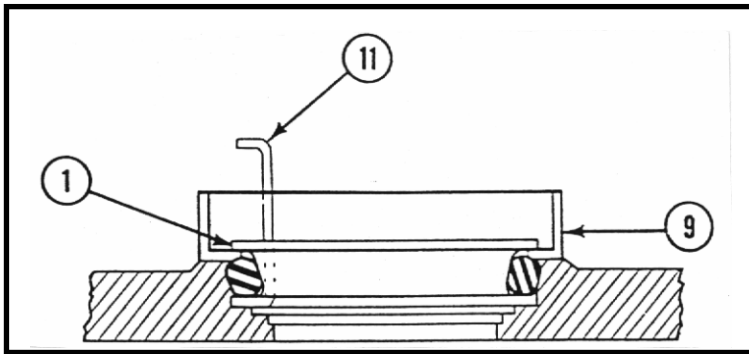
Toric sliding on seal ramp.

After dipping the seal assembly in the solvent, shake the excess solvent from the seal assembly and immediately “pop” the seal into the housing with a firm push of the installation tool. Remove the installation tool and check the seal stantout height at several places around the circumference of the ring to verify an accurate installation. If the seal does not meet the height specification, inspect the toric for twists or obvious bulges.

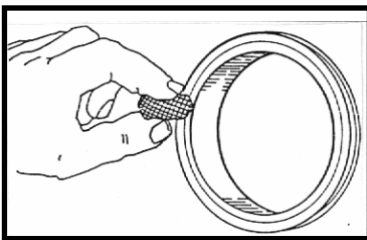


With all surfaces of the toric ring (2) wet with Isopropanol, use the installation tool (9) to position the seal ring (1) and the toric ring (2) squarely against the housing (5) as shown. Use sudden and even pressure to pop (push) the toric ring (2) under the retaining lip (3) of the housing (5).

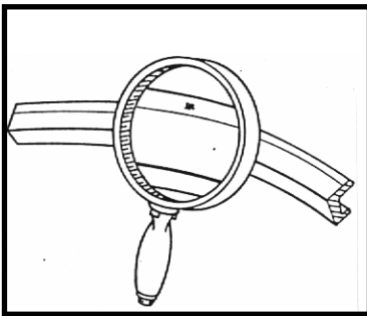
The seal can be adjusted by gently pushing the toric into position by hand or by using a fabricated adjustment hook.



If small adjustments are necessary, do not push directly on the seal ring (1); use the installation tool (9) to push down or the adjustment tool (11) to pull up.



A thin film of light oil should be applied to the seal faces prior to assembly. Use an applicator, a disposable tissue or a clean finger to distribute the oil evenly. Be careful not to get any oil on the rubber toric rings.



Be sure there is no visible debris on either of the seal faces - even a small piece of lint can hold the seal faces apart and cause leakage.

After successful installation, wait one minute for the Isopropanol to dry before assembling the two seal halves in the final loaded position. This delay is to allow any excess solvent to dry so that the torics roll, rather than slide, in the housing as the faceload is increased. If the torics slide, this can produce a nonuniform load that can result in poor seal performance.

## **Results of incorrect assembly :**

Point "A" and point "B" remain stationary.

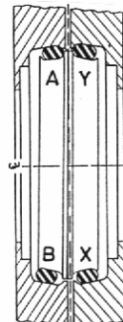
Points "X" and "Y" rotate 180°.

This causes high pressure at "A"/ "Y" and possible galling.

When rotated, points "B"/ "X" has low pressure and possible leakage.



Original assembled position

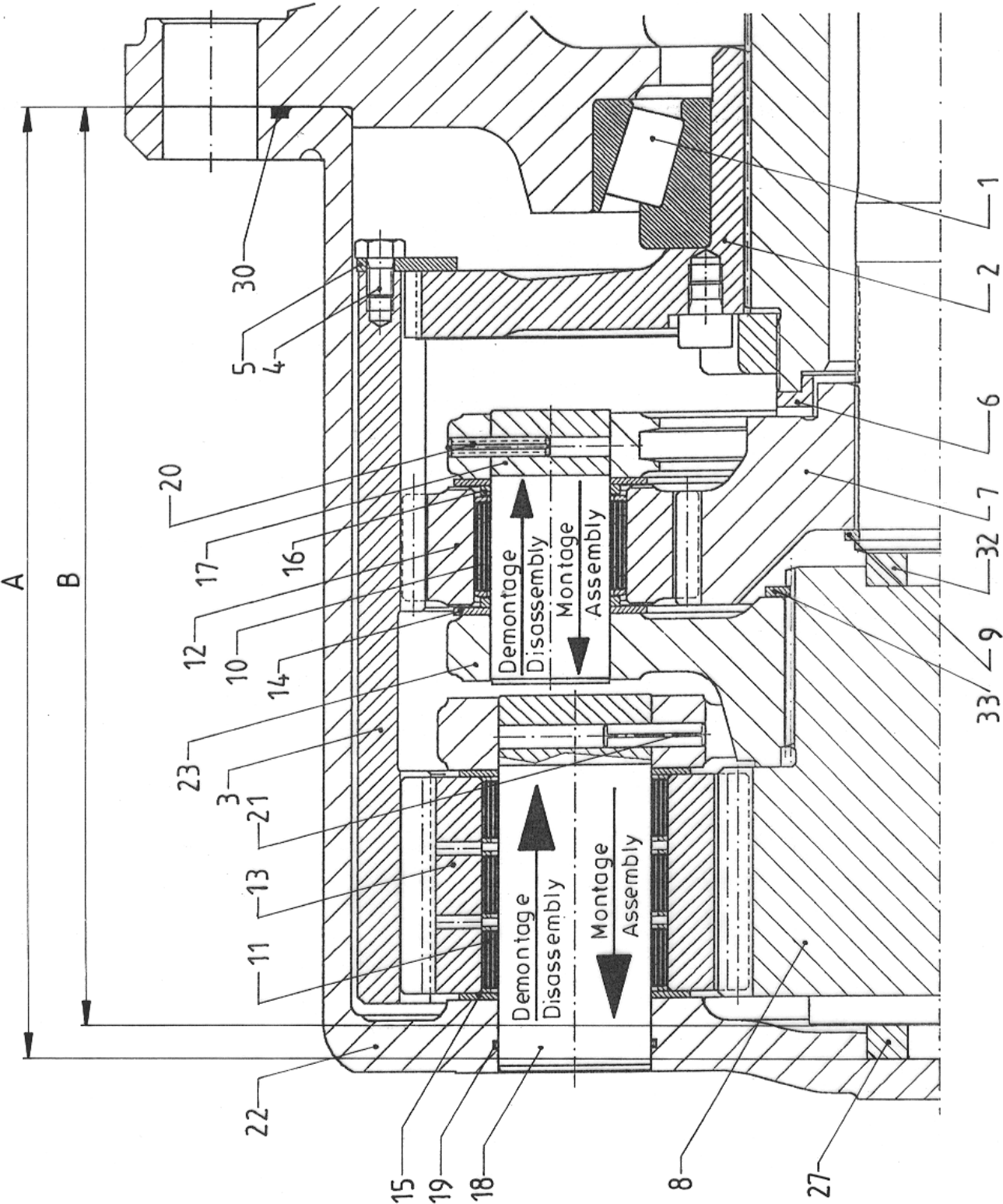


Rotated 180°

After the unit to be sealed is assembled, a post - assembly leakage test can be performed to insure the seal is properly installed. A vacuum check is recommended rather than a pressure check as vacuum checks are more sensitive. Many users find this an easy check to combine with a vacuum fill technique for the lubricant. It is recommended the compartment be filled to the correct level with lubricant and then rotated slowly several revolutions to seat the seals. A vacuum test will catch big seal damage such as broken seal rings or cut torics that may be caused in the last phases of assembly. The Duo - Cone seal is not designed to seal air, so some leakage can be expect using such a procedure.

Following these guidelines and recommendations should insure optimum performance from the Duo - Cone - seals.



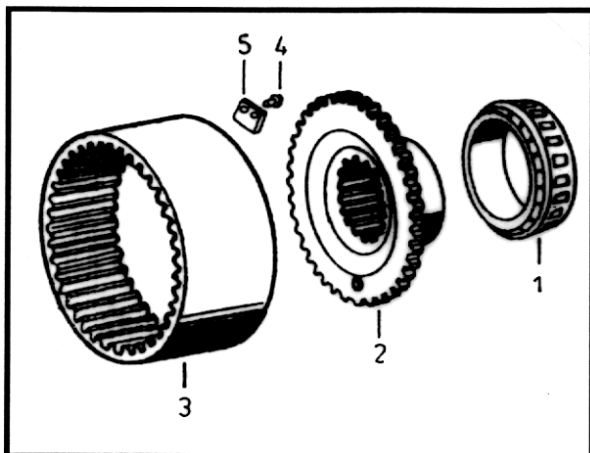




# Assembly of the ring gear and ring gear carrier

## Assembly of the sun gear

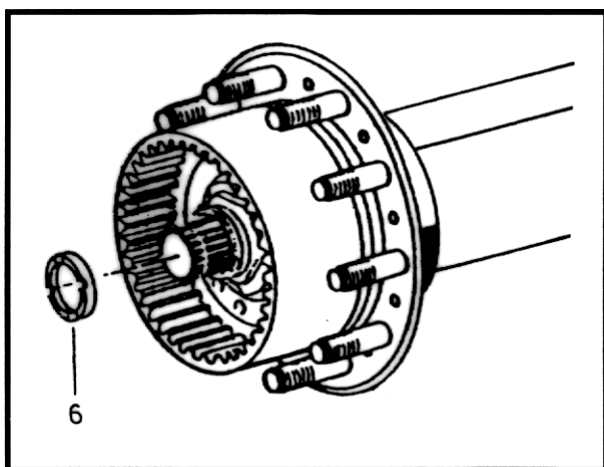
### Prepare the ring gear and the ring gear carrier



Heat the taper roller bearing inner ring with cage (1) to about 100°C and install it onto the ring gear carrier (2). Place the ring gear (3) onto the ring gear carrier. Bolt the retainer (5) with the screws (4), secure the screws with Loctite 270. At PL417/510 the ring gear has to be mounted after installation of the fast planetary gear stage, reverse the ring gear has to be disassembled before disassembly of the fast planetary gear stage.

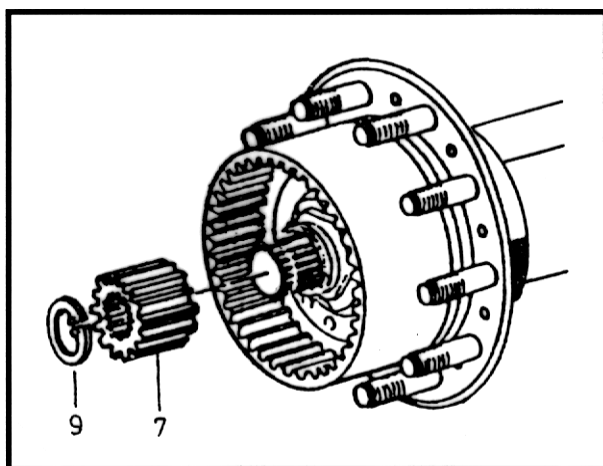
### Assembly of the ring gear carrier

Install the ring gear carrier (2) with ring gear (3) into the wheel hub resp. onto the steering knuckle resp. axle spindle. The oil compensating hole in the ring gear carrier must be on the bottom. Subsequent adjust wheel bearings (see chapter 5.7).



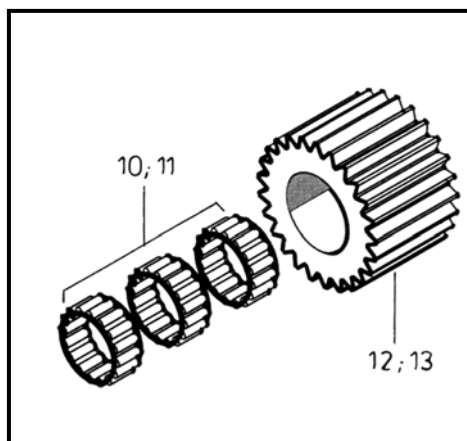
### Assembly of the thrust ring

Press the thrust ring (6) into the steering knuckle resp. axle spindle. Secure with Loctite 270.



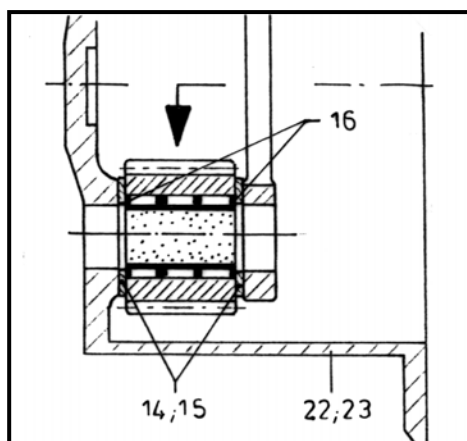
### Assembly of the sun gear

Slip the sun gear (7) onto the universal joint resp. axle shaft, install the circlip (9) and push the universal joint resp. axle shaft towards the inside until the circlip contacts to the sun gear and the sun gear contacts to the thrust ring.

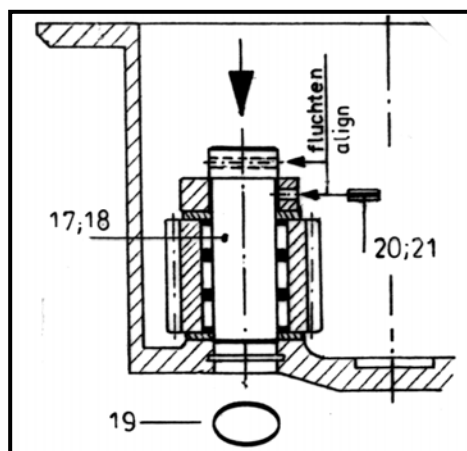


## Prepare planetary gear:

Install the needle bearing (10 resp. 11) into the planetary gear (12 resp. 13).



Insert the preassembled planetary gears (12 resp. 13) with needle bearings (10 resp. 11), rings (16) (if present) and thrust discs (14 resp. 15) into the planetary housing (22 resp. 23) (planetary housing in horizontal position).



Place o - ring (19) into the slot of the planetary housing (22). Because of the difference of diameter of 0,1 mm press the planetary pin (17 resp. 18) in direction of arrow. Be sure, that the bore hole of the locking pin in the planetary pin and planetary housing are aligned. After inserting, secure the planetary pin with the locking pin (20 resp. 21).

### Assembly of the planetary housing (23)

Press the thrust disk (32) into the sun gear (8), secure with Loctite 270.

Press the sun gear (8) into the planetary housing (23), secure with Loctite 270.

Install the circlip (33) into the slot of the sun gear. Insert the preassembled planetary housing (23) into the hub assembly (fix on the sun gear (7) and in the ring gear (3)).

### Adjustment of the axial clearance

The axial clearance between sun gear (8) and thrust disc (27) in the planetary housing (22) must be 0,6 - 0,9 mm.

Measure distances:

Dimension A =

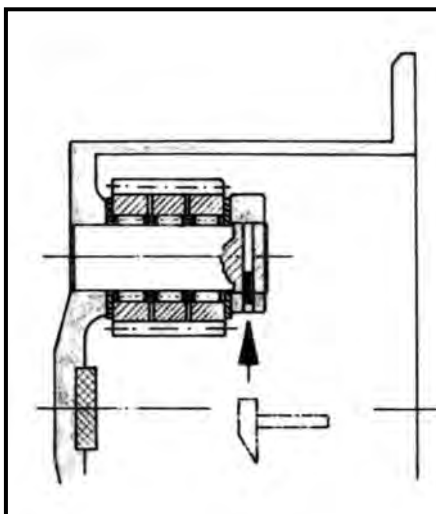
Dimension B =

Required disc thickness = A - B - axial clearance (0,6 - 0,9 mm)

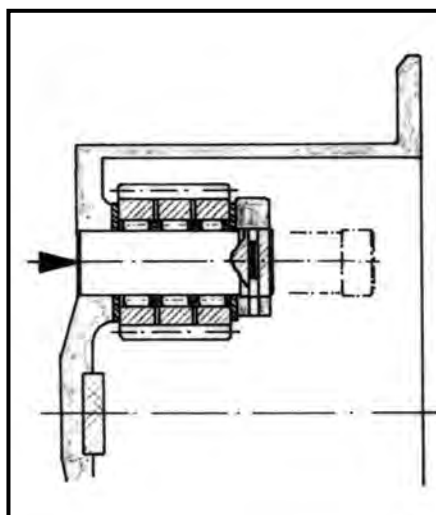
Mount the correctly dimensioned thrust disc (if necessary, make final correction on a lathe) into the planetary housing. Secure with Loctite 270.

### Assembly of the planetary housing (22)

Place o - ring (30) into the slot of the planetary housing. Install the preassembled planetary housing (22) and bolt it.



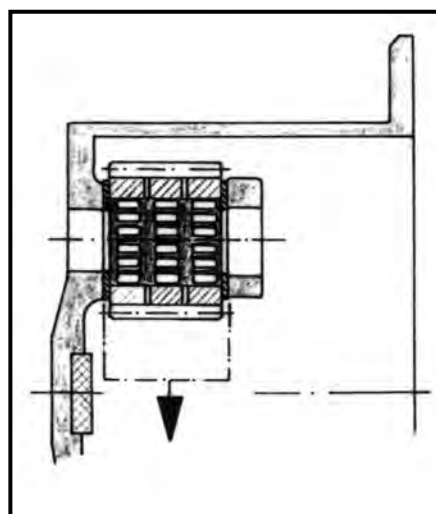
Knock the locking pin (20 resp. 21) completely to the inner side of the planetary pin.



Press the planetary pin in direction of arrow out of the planetary housing.

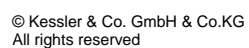
**Attention:**

Because of the difference of diameter of 0,1 mm do not press the planetary pin against the direction of arrow out of the planetary housing, to prevent damaging the bore.



Remove the planetary gears with the thrust discs and needle bearings.

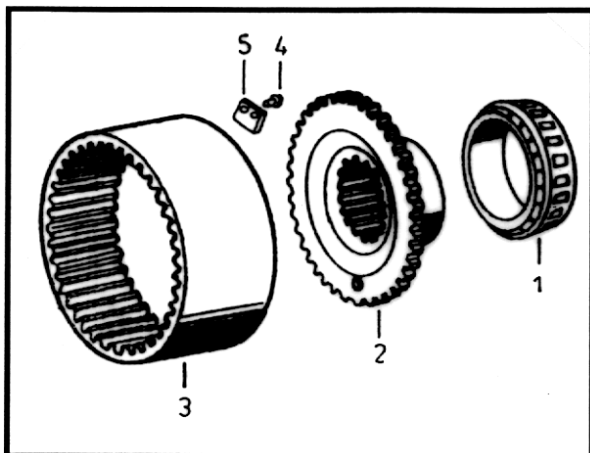


Section 6  
6.4

# Assembly of the ring gear and ring gear carrier

## Assembly of the sun gear

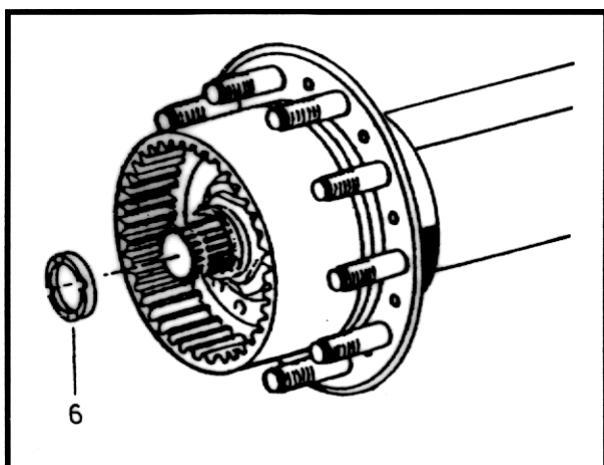
### Prepare the ring gear and the ring gear carrier



Heat the taper roller bearing inner ring with cage (1) to about 100°C and install it onto the ring gear carrier (2). Place the ring gear (3) onto the ring gear carrier. Bolt the retainer (5) with the screws (4), secure the screws with Loctite 270. At PL417/510 the ring gear has to be mounted after installation of the fast planetary gear stage, reverse the ring gear has to be disassembled before disassembly of the fast planetary gear stage.

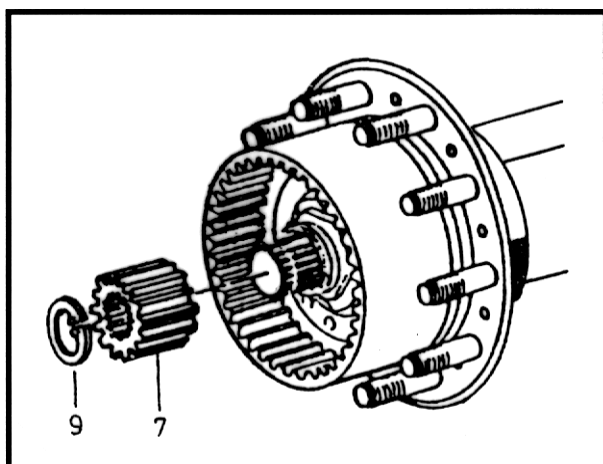
### Assembly of the ring gear carrier

Install the ring gear carrier (2) with ring gear (3) into the wheel hub resp. onto the steering knuckle resp. axle spindle. The oil compensating hole in the ring gear carrier must be on the bottom. Subsequent adjust wheel bearings (see chapter 5.7).



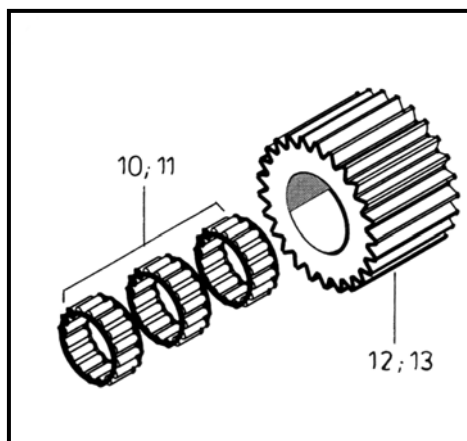
### Assembly of the thrust ring

Press the thrust ring (6) into the steering knuckle resp. axle spindle. Secure with Loctite 270.



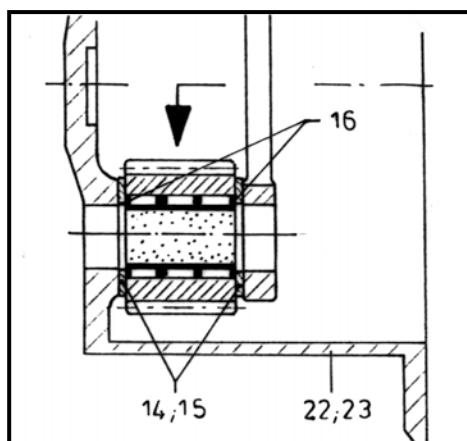
### Assembly of the sun gear

Slip the sun gear (7) onto the universal joint resp. axle shaft, install the circlip (9) and push the universal joint resp. axle shaft towards the inside until the circlip contacts to the sun gear and the sun gear contacts to the thrust ring.

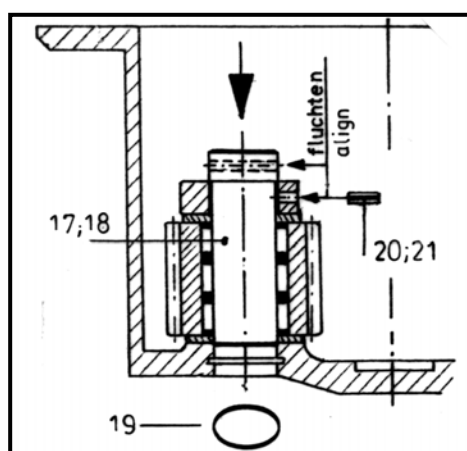


## Prepare planetary gear:

Install the needle bearing (10 resp. 11) into the planetary gear (12 resp. 13).



Insert the preassembled planetary gears (12 resp. 13) with needle bearings (10 resp. 11), rings (16) (if present) and thrust discs (14 resp. 15) into the planetary housing (22 resp. 23) (planetary housing in horizontal position).



Place o - ring (19) into the slot of the planetary housing (22). Because of the difference of diameter of 0,1 mm press the planetary pin (17 resp. 18) in direction of arrow. Be sure, that the bore hole of the locking pin in the planetary pin and planetary housing are aligned. After inserting, secure the planetary pin with the locking pin (20 resp. 21).



### Assembly of the planetary housing (23)

Press the thrust disc (32) into the sun gear (8), secure with Loctite 270.

Press the sun gear (8) into the planetary housing (23), secure with Loctite 270.

Install the circlip (33) into the slot of the sun gear. Insert the preassembled planetary housing (23) into the hub assembly (fix on the sun gear (7) and in the ring gear (3)).

### Adjustment of the axial clearance

The axial clearance between sun gear (8) and thrust disc (27) in the planetary housing (22) must be 0,6 - 0,9 mm.

Measure distances:

Dimension A =

Dimension B =

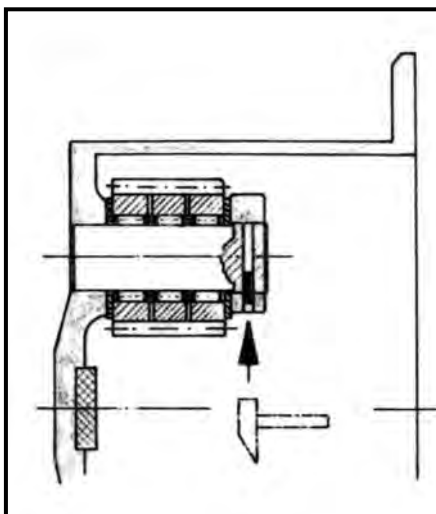
Required disk thickness =

A - B - axial clearance (0,6 - 0,9 mm)

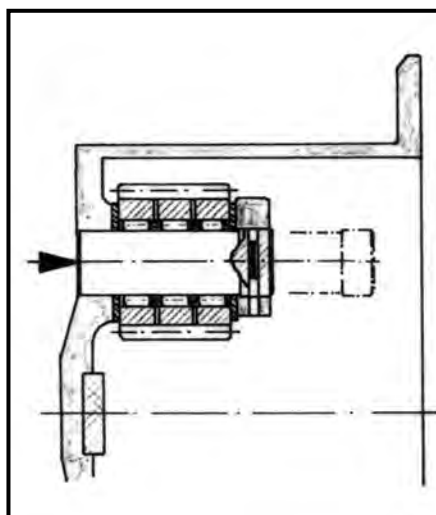
Mount the correctly dimensioned thrust disc (if necessary make final correction on a lathe) into the planetary housing. Secure with Loctite 270.

### Assembly of the planetary housing (22)

Place o - ring (30) into the slot of the planetary housing. Install the preassembled planetary housing (22) and bolt it, secure the screws with Loctite 262.



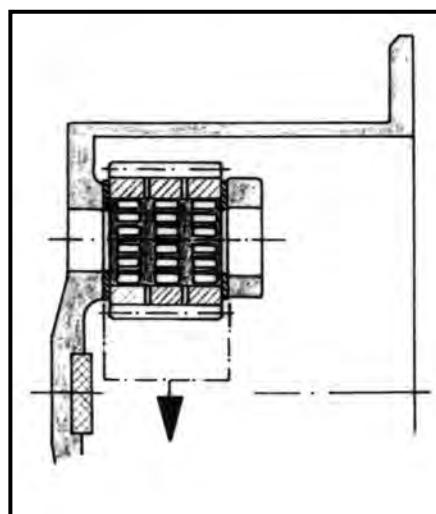
Knock the locking pin (20 resp. 21) completely to the inner side of the planetary pin.



Press the planetary pin in direction of arrow out of the planetary housing.

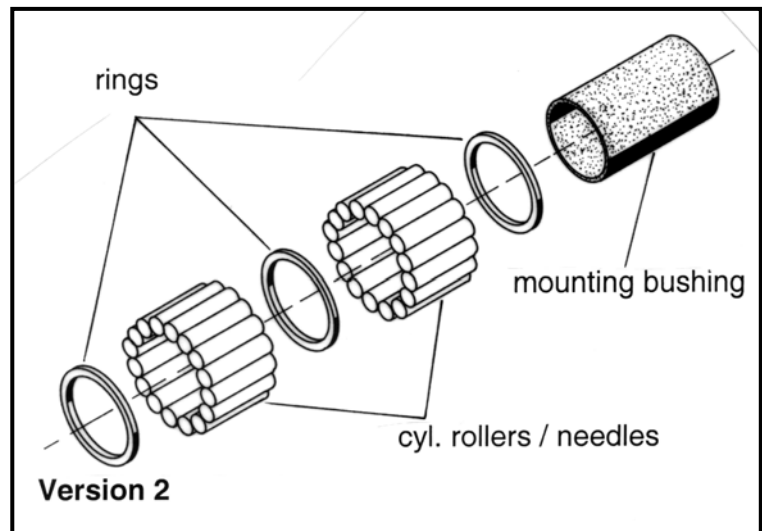
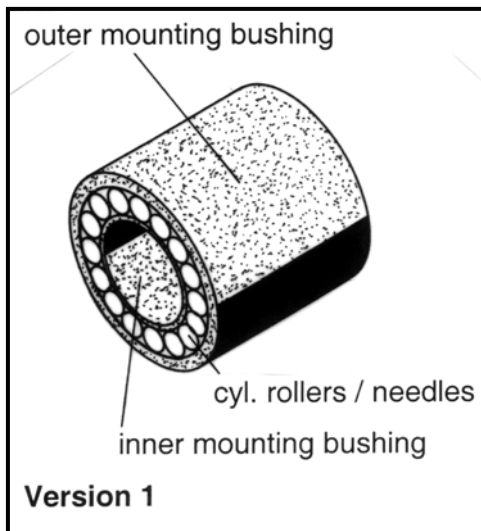
**Attention:**

Because of the difference of diameter of 0,1 mm do not press the planetary pin against the direction of arrow out of the planetary housing, to prevent damaging the bore.



Remove the planetary gears with the thrust discs and needle bearings.

# Assembly/ disassembly of cageless needle bearing (planetary gear bearing)



## Assembly:

**Version 1:** Install the needle bearing with mounting bushings into the planetary gear, thereby the outer mounting bushing will be stripping.  
Insert the planetary gear with thrust discs into the planetary housing.  
Press in the planetary pin, thereby the inner mounting bushing will remove.

**Version 2:** Place one thrust disc on the work bench, place on the planetary gear and insert the mounting bushing.  
Insert the cylindrical rollers/ needles alternately with the rings (according to the design).  
Insert the planetary gear with thrust discs into the planetary housing.  
Press in the planetary pin, thereby the mounting bushing will remove.

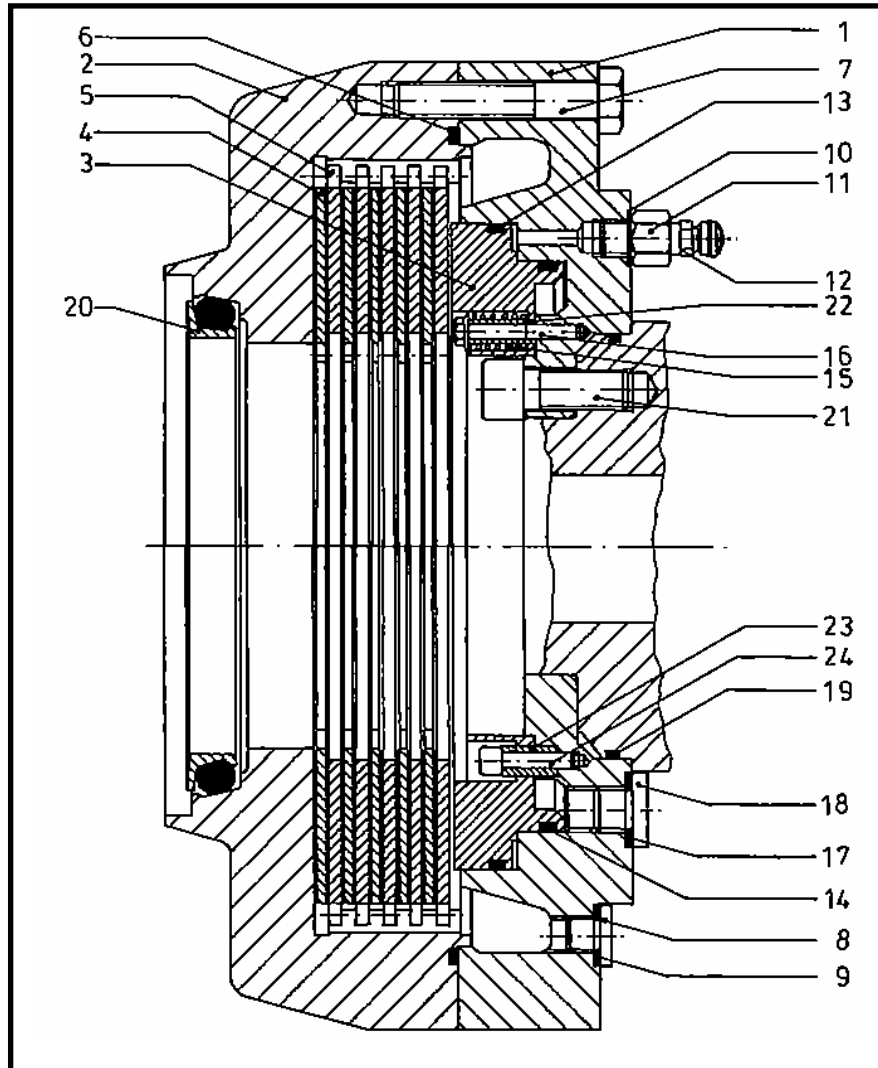
**Hint:** Note the passage "Assembly of the planetary gear"!

## Disassembly:

At the disassembly of the planetary pin the cageless needle bearing will fall asunder, if not a mounting bushing will be pushing inwards at planetary pin removing.

**Hint:** Note the passage "Disassembly of the planetary gear"!



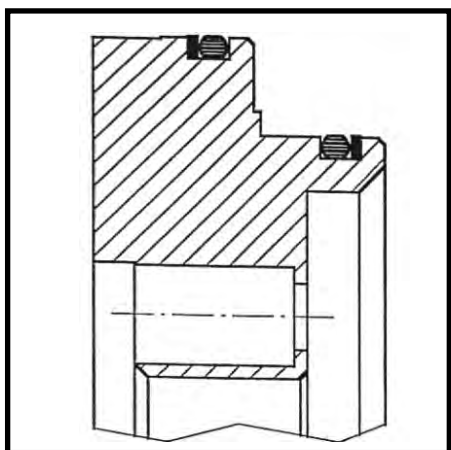


- |                      |                  |
|----------------------|------------------|
| 1. Brake carrier     | 13. Sealing ring |
| 2. Brake housing     | 14. Sealing ring |
| 3. Piston            | 15. Spring       |
| 4. Inner disc        | 16. Screw        |
| 5. Outer disc        | 17. Seal ring    |
| 6. O – ring          | 18. Screw plug   |
| 7. Screw             | 19. O - ring     |
| 8. Screw plug        | 20. Face seal    |
| 9. Seal ring         | 21. Screw        |
| 10. Seal ring        | 22. Tube         |
| 11. Connection peace | 23. Bushing      |
| 12. Breather         | 24. Screw        |

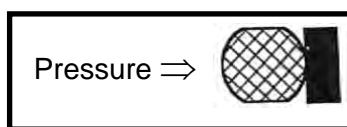
## Assembly of the piston seals

Place piston with the larger diameter downwards. Note succession of the sealing parts at fitting.  
Install o - rings free of torsion and loops.

### Assembly of o - ring and supporting ring

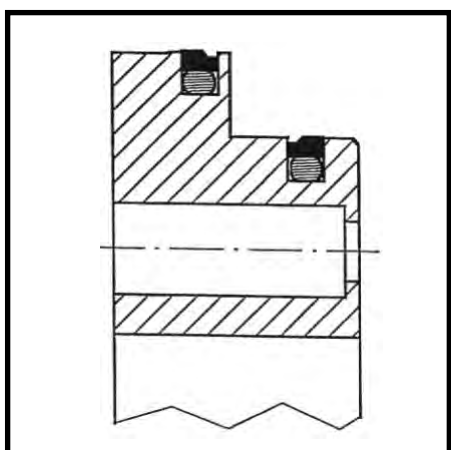


1. large supporting ring
2. large o - ring
3. small o - ring
4. small supporting ring

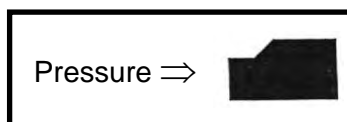


Install the supporting rings to the averting side of pressure!

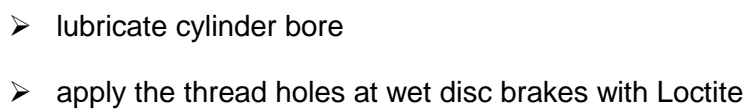
### Assembly of the Omegat seal kit



1. large o - ring
2. small o - ring
3. large supporting ring
4. small supporting ring



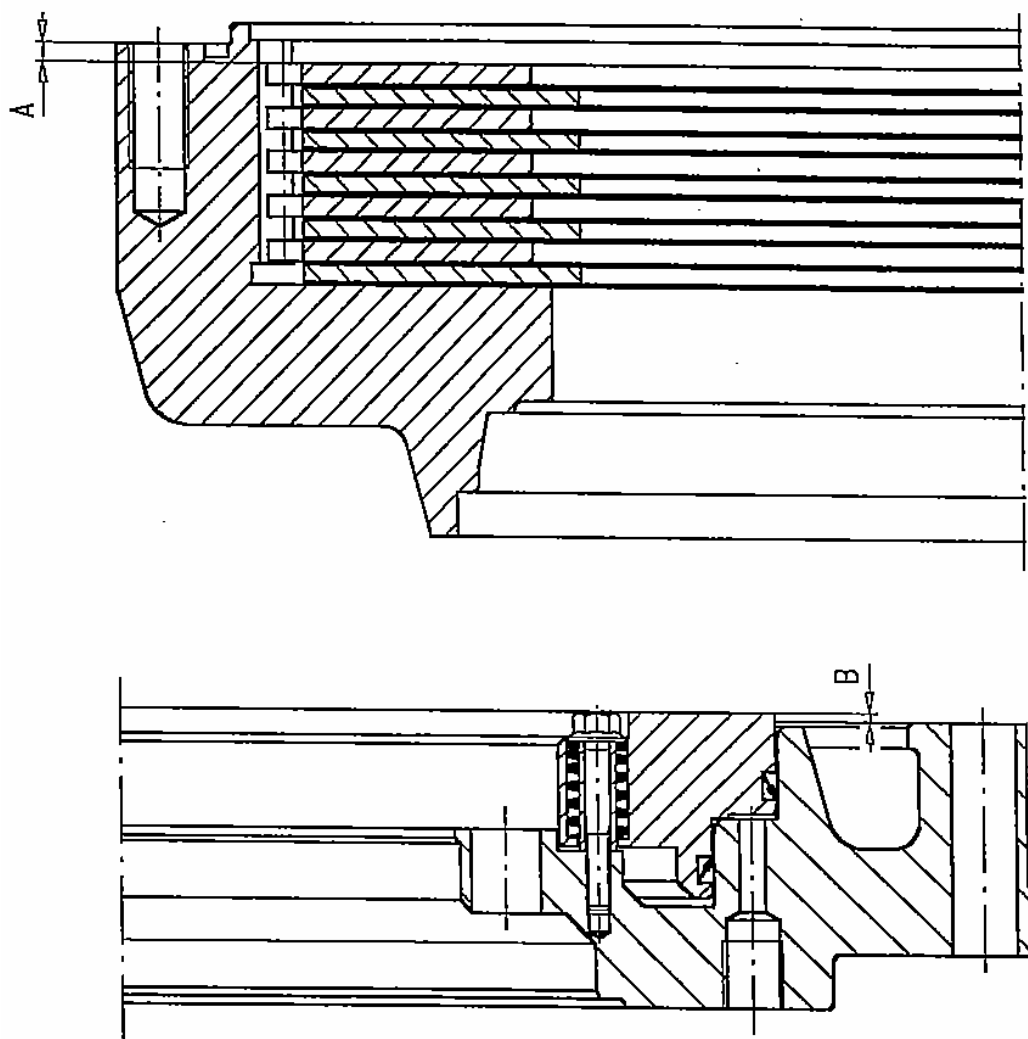
Install the PTFE - profile rings with small diameter to pressure side!



- install and screw the bushing (if present)
- place the piston onto the brake carrier (do not cant it!)

- if necessary adjust the piston with easy hammer taps to the thread holes
- install first the springs, then the tubes in the bore holes of the piston
- screw in the hexagon head screws with flange

# Prepare housing and check the air gap



Lay discs into the housing.

## Check the air gap:

Air gap = measure A - measure B (measured without pressure)

Rated size about 0,5 mm smaller than the air gap pressurized (see table).

Install o - ring (brake housing/ brake carrier) free of torsion and loops.



## Air gap and wear dimension

brake type	air gap sL new (pressurized) (mm)	wear dimension (mm)
3270	$1,5 \pm 0,7$	1,5
3340	$2,4 \pm 0,6$	1,5
3340-1	$1,8 + 0,5/ - 0,1$	1,5
4340	$2,5 \pm 0,9$	2,0
5340	$2,4 \pm 0,9$	2,5
6340	$2,8 \pm 0,6$	3,0
3460	$2,5 + 0,7/ - 0,1$	1,5
4460	$2,5 + 0,7/ - 0,1$	2,0
4460-1	$2,25 + 1/ - 0,1$	2,0
5460	$3,0 + 0,5/ - 0,1$	2,5
6460	$3,0 + 0,5/ - 0,1$	3,0
7460	$3,0 + 0,5/ - 0,1$	3,5
8460	$3,3 + 0,5/ - 0,1$	4,0
10460	$4,0 + 0,5/ - 0,1$	5,0
5550	$3,0 + 0,5/ - 0,1$	2,5
8550	$3,5 + 0,5/ - 0,1$	4,0
4650-1	$3,5 + 0,5/ - 0,1$	2,0
6650-1	$4,0 + 0,5/ - 0,1$	3,0

Place the brake carrier onto the brake housing and bolt it. Mount breather with connection piece and seal ring, screw plugs with seal rings.

Check brake hydraulik system for leaks (see tightness checking instruction).

Install o - ring (Brake carrier/ axle spindle resp. steering knuckle) free of torsion and loops.

### **Check the air gap (pressurized):**

Measure through the check hole the distance from brake carrier to the piston end face, while non actuated brake, actuate the brake and repeat the measure operation - the difference of the measured distances gives the air gap sL (pressurized), rated size sL see table.

Measure through the check hole the distance from brake carrier to the piston end face, while actuating the brake and knock the measured value with marking punches into the brake carrier.

Install the complete brake on the axle (coat the contact surface with Loctite 270).

Mount face seal see chapter 5.8.

### **Alignment of the discs**

Wet disc brake dimension X270 and X340:

The alignment of the discs has to be made at mounting of the wheel hub by itself.

Wet disc brake dimension X460 and X650:

The alignment of the discs has to be made by a mounting device (see chapter 3.6). Clamp the discs by actuating the brake (hydraulic or air pressure).

# Tightness checking instruction for brake hydraulic system and cooling oil room

## Check brake hydraulic system for leaks

Before conducting the test, bleed the brake hydraulic system.

The pressure drop after applying 120 bar for a period of 15 minutes must not exceed 2% (leaving 117,5 bar).

**Test medium:** Motor oil SAE 10 W corresponding to MIL - L 2104.

## Check cooling oil room for leaks

### Brake with external cooling:

After assembly of the wheel hub with the face seal and adjusting of the wheel bearings check the tightness of the cooling oil room.

Install an air pressure gauge with shutoff valve.

Beload the hub assembly with 1,5 bar pressure air.

Turn the hub assembly several times.

The pressure drop after a period of 10 minutes must not exceed 0,1 bar.

### Brake without external cooling:

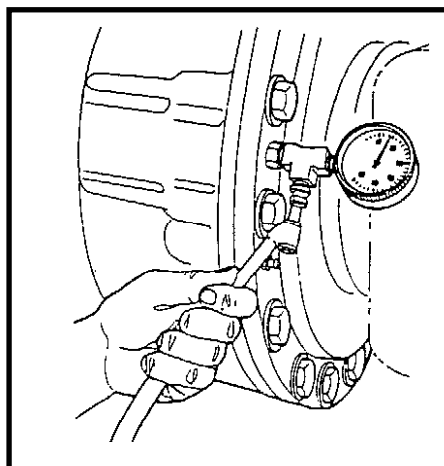
After assembly of the planetary gear drive check the tightness of the cooling oil room.

Install an air pressure gauge with shutoff valve.

Beload the hub assembly with 0,5 bar pressure air.

Turn the hub assembly several times.

The pressure drop after a period of 15 minutes must not exceed 0,1 bar.



## Permissible oil for brake with external cooling

### Actuation fluid:

**Do not use brake fluid at any time!**

**Use a mineral oil base hydraulic oil type fluid only!**

- 1) Motoroil            API SE/ CD  
                             MIL - L - 46152C/ MIL - L - 2104 C o. D
- 2) ATF C - 3 or Dexron ®
- 3) Hydraulicoil HLP DIN 51524 Teil 2

### Viscosity:

For moderate climate            ISO VG 22 - 32

For extremely cold climate       ISO VG 15

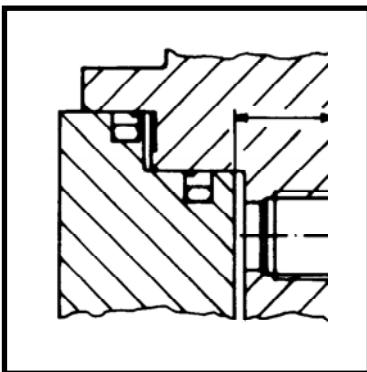
For extremely warm climate      ISO VG 46

**Cooling fluid:**    like actuation fluid.

**Important:** It is necessary to use oils with LS - additives (Limited Slip), according to the recommendation of the oil supplier.

For example: 3 - 6% Lubrizol LZ 6117/ LZ 9990 A or LZ 6279

### Check measure:



It is measured through the check hole, while actuating the brake.

The check measure, new, is marked in the housing below the hole.

Is the measured dimension bigger than the marked dimension and max. wear dimension, unconditional consult Kessler & Co.

After working at the brake, bleed the brake hydraulic system and check for tightness!



## Safety notes:

### WARNING!

Before commencing work on the parking brake, ensure that no unintended machine movement can happen when the braking effect is removed.

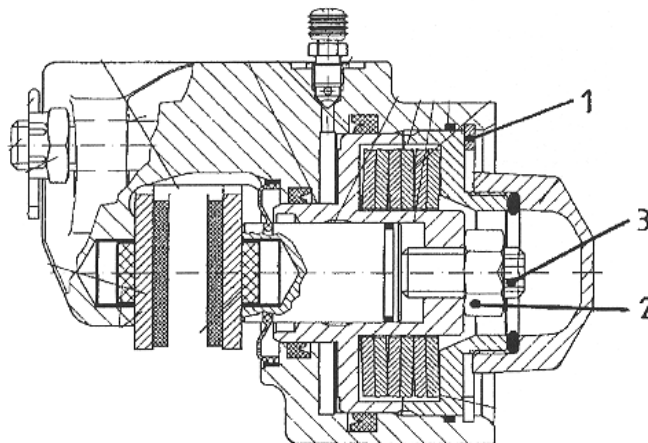
**- Danger to life! -**

### DANGER!

The parking brake is under spring tension. Parts could become loose and fly out suddenly if improper brake opening.

**- Danger to life! -**

Therefore release the lock nut (2) and turn the adjusting screw (3) counter – clockwise until the spring set is released before disassembly of the circlip (1)!



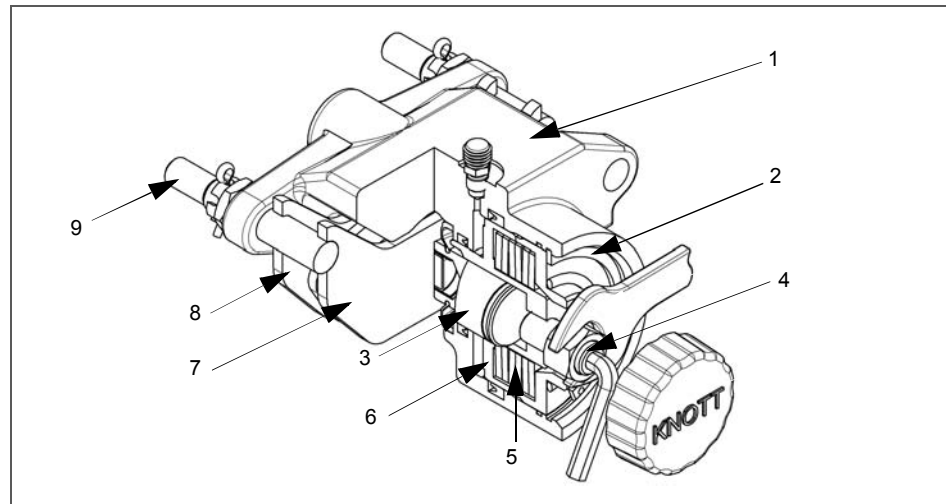
Nonbinding sketch

### 1. Construction and funktion

Bild 1-1:

**Parts of the brake**

- 1 housing
- 2 pressure ring
- 3 thrust bolt
- 4 adjusting screw
- 5 bank of cup springs
- 6 piston
- 7 lining pad
- 8 lining pad
- 9 gliding bolt



The two identical brake pads and slide freely on the guide bolt, which is fastened in the housing. The guide bolts are guided in an additional brake anchor plate which in turn is screwed onto the vehicle, i.e. its axle.

On actuation, the brake generates a clamping force at the brake lining pads, which cause a tangential force/braking moment to be generated at the brake disk, the extent of which depends on the coefficients of friction generated by the linings.

The clamping force is generated by the bank of cup springs, during which the piston is moved together with the adjusting screw, the thrust bolt and the brake pad towards the brake disk.

When the brake pad comes into contact with the brake disk, the reaction force shifts the housing onto the guide bolts until the brake pad) is also pressed against the brake disk.

The brake is released by complete pre-tensioning of the bank of cup springs. During this process, through application of the necessary release pressure after overcoming the cup spring force, the piston must move back until it comes to rest against the pressure ring.

The clamping force diminishes with wear of the brake lining and brake disk. The brake must be adjusted at the latest at the times indicated by the adjusting specification below.

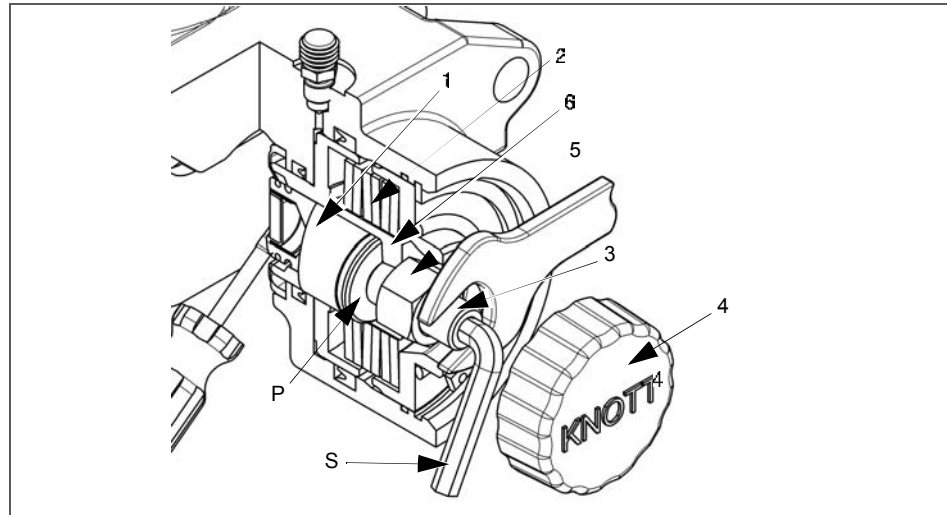
## 2. Mounting and basic setting regulations

Basic brake setting is required after mounting new brake lining plates or brake disks, as well as during all repair stages and in the event of insufficient braking performance.

**Bild 2-1:**

**Adjusting and assembly possibilities**

- 1 thrust bolt
- 2 bank of cup springs
- 3 adjusting screw
- 4 screw cap
- 5 lock nut
- 6 piston
- P even surface
- S socket wrench



**Note:**

All mounting and basic setting work must be carried out on the brake when cold.

### 2.1. Mounting the brake

1. Stand the vehicle on an even surface and secure against rolling away.
2. Release the screw cap.
3. Release the lock nut (size 24 or 30) and turn the adjusting screw anticlockwise using a size 8 or 10 socket wrench until the pressure bolt comes to rest against the even surface of the piston. In this status, the brake can be mounted onto the brake disk and fastened.
4. Mount the pressure connection again.

Apply the necessary release pressure to the brake until the bank of cup springs is completely pre-tensioned

Following carry out the below described basic setting regulation.



## 2.2. Basic setting regulation

1. Turn the adjusting screw manually clockwise until both brake pads make contact with the brake disk. Then it is not longer possible to turn the adjusting screw without exerting a major amount of force.
2. Turn the adjusting screw anticlockwise in order to set the following rated clearances:

type	adjusting screw	clearance (mm)		turns
FSG90	M16 (SW 8)	min.	0,5	1/4
		clearance	1,0	1/2
		max.	1,5	3/4
FSG110	M20 (SW 10)	min.	1,0	2/5
		clearance	2,0	4/5
		max.	3,0	1 1/5

3. Hold the adjusting screw in position with a hexagonal socket wrench and lock with lock nut.
4. Mount the screw cap and tighten as far as possible manually.
5. Stellen Sie den Druckanschluß gemäß der Vorschrift der Achs- bzw. Getriebehersteller her. Mount the pressure connection in accordance with the instructions of the axle / gear manufacturer.

For bleeding the piston chamber use the socket spanner size 13 for the bleeding valve.

## 2.3. Adjusting regulations

During this adjusting process, the parking brake must be released, i.e. the bank of cup springs must be completely pre-tensioned.

1. Stand the vehicle on an even surface and secure against rolling away.
2. Release the parking brake by using the required release pressure.
3. Release the screw cap and unscrew.
4. Release the lock nut (size 24 or 30) and turn the adjusting screw with socket wrench size 8 or 10 manually clockwise until the two brake pads make contact with the brake disk.
5. Turn the adjusting screw anti-clockwise and set the clearance specified in the above table.
6. Hold the adjusting screw in position with the hexagonal socket wrench and lock with the lock nut.
7. Mount the screw cap and tighten as far as possible manually.

Actuate the brake valve several times and check the braking efficiency of the parking brake on a slope.

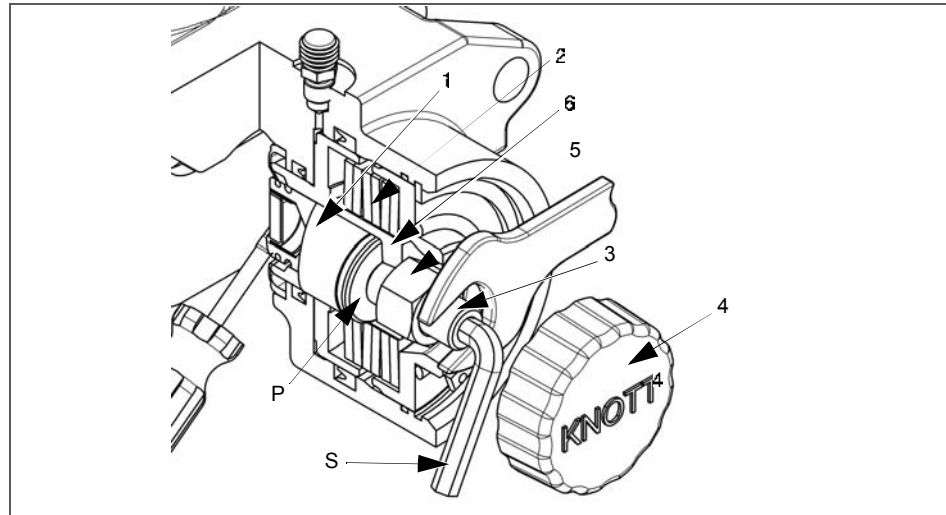
### 3. Emergency release of the parking brake

After the failure of the pressure release the parking brake by using following manual procedure:

Bild 3-1:

**Adjusting and assembly possibilities**

- 1 thrust bolt
- 2 bank of cup springs
- 3 adjusting screw
- 4 screw cap
- 5 lock nut
- 6 piston
- P even surface
- S socket wrench



1. The vehicle has to be secured against rolling away.
2. Release the screw cap and unscrew.
3. Release the lock nut (size 24 or 30) and turn the adjusting screw with socket wrench size 8 or 10 manually counter-clockwise until the brake disc is free.



**Caution!**

**For the emergency release is an actuation torque of 40 Nm respectively 70 Nm required .**

4. Mount the lock nut and the screw cap and tighten both as far as possible manually. (Protection against dirt



**Caution!**

**Now, the vehicle do not have any brake function. The vehicle must be secured against moving away with proper means. Before putting the vehicle into operation again, the brake has to be adjusted again. Res. „Assembly and basic setting regulations“.**

## 4. Maintenance and repair work

### 4.1. Maintenance and exchange of brake pads

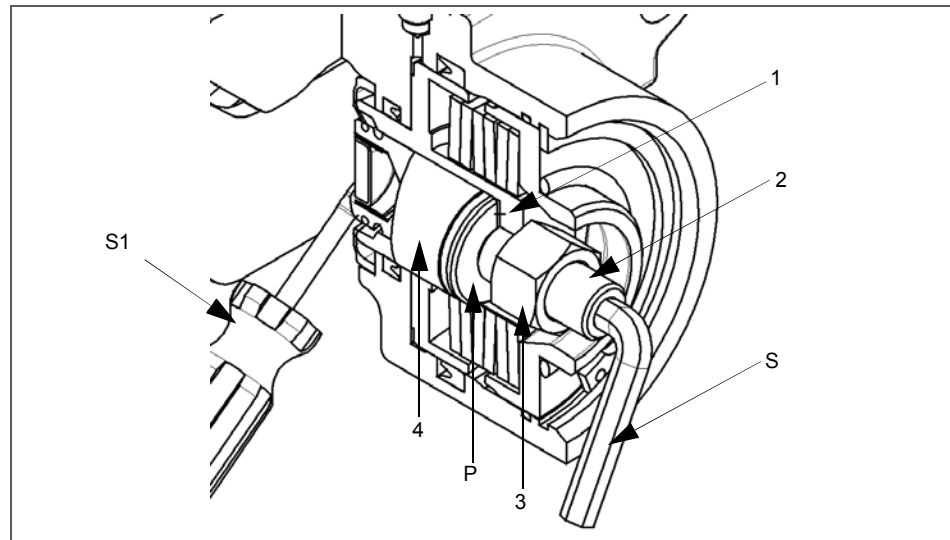
The brake pads themselves are maintenance free. All that is required here is a check for damaged parts, as well as inspection to ensure that the brake disk remains easy running.

The thickness of the brake lining must be subjected to a visual inspection at regular intervals, which depend on vehicle usage, but every six months at the latest. In the event of a minimal residual lining thickness, these intervals must be reduced accordingly in order to avoid major damage to the brake or disk:

- FSG 90:  
min. residual thickness 1,0 mm per lining pad (6 mm carrier plate thickness).
- FSG 100:  
min. residual thickness 2.0 mm per lining pad (8 mm carrier plate thickness).

**Bild 4-1:**  
**Extending the lining pads**

- 1 piston
- 2 adjusting screw
- 3 lock nut
- 4 thrust bolt
- S socket wrench
- S1 screwdriver
- P inside of the piston



**Note:**

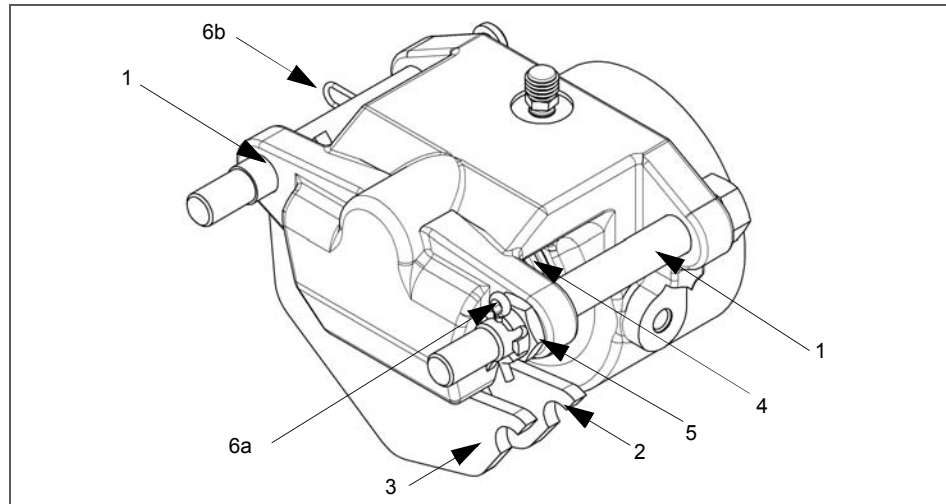
Only Knott original spare lining plates may be used. If any other spare parts are used, no warranty claims will be accepted either for the brakes or their functional characteristics

1. Stand the vehicle on an even surface and secure against rolling away.
2. Release the parking brake by applying the required release pressure
3. Release the screw cap and unscrew.
4. Release the lock nut (size 24 or 30) and turn the adjusting screw with socket wrench size 8 or 10 manually clockwise until it lies flush with the inside of the piston.
5. Press back the thrust bolt using a suitable screwdriver until it has contact with the piston.

Bild 4-2:

#### Exchanging the lining pads

- 1 guide bolt
- 2 lining pad
- 3 lining pad
- 4 permanent magnet
- 5 castellated nut
- 6a safety splint
- 6b safety clip



6. Depending on the free space available, release one of the two guide bolts, removing the safety splint, unscrewing the castellated nut and pulling the guide bolt out of the brake anchor plate. Now, the brake lining pads can be removed tangentially to the brake disk.



#### Note:

In the event of minimal clearance, i.e. it is not possible for space reasons to exchange the brake lining plate in accordance with these instructions, the brake must be removed completely. To do this, pull both guide bolts out of the brake anchor plate.



#### Caution!

**Check the pressure hose. If the pressure hose is too short, it must be unscrewed to remove the brake. Before the pressure hose can be released the brake must be emergency released.**

- 7. Exchange the brake pads and insert the guide bolts into the brake anchor plate. If you have removed the complete brake you have to mount the brake on both guide bolts again, now.
- 8. Check both permanent magnets if they still have sufficient magnetic force to hold the brake lining plates. Should this not be the case, the permanent magnets must also be changed by using a suitable screw driver.
- 9. Secure the guide bolt with the castellated nut and the safety splint resp. safety clip.



#### Note:

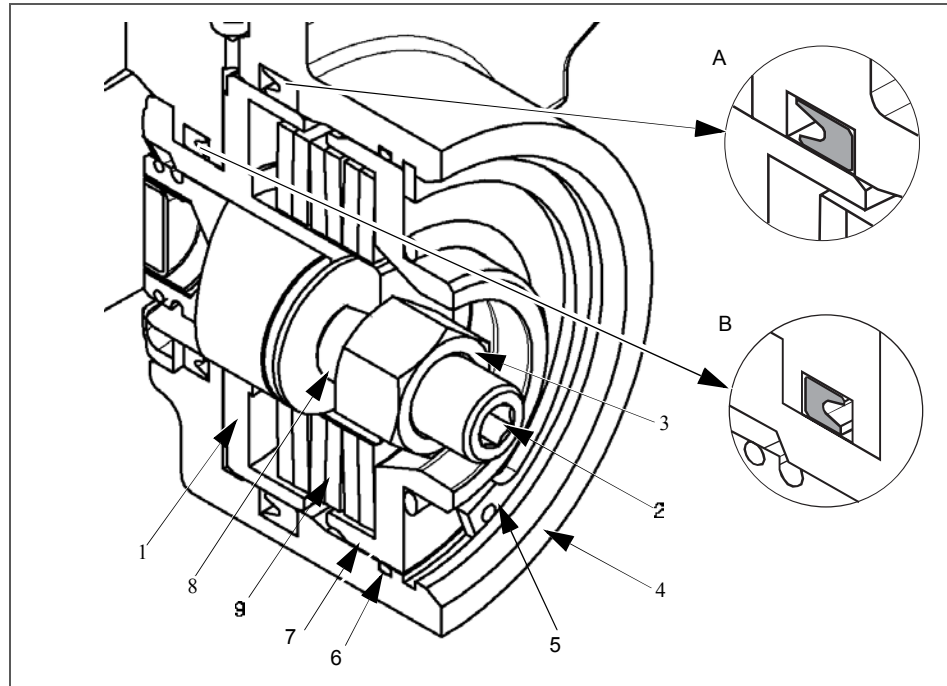
After mounting new brake lining plates or their repair, the brake must be correctly set in accordance with the instructions „Adjusting regulations“.

#### 4.2. Changing the seal

Bild 4-3:

**Change of the seals**

- 1 piston
- 2 adjusting screw
- 3 lock nut
- 4 housing
- 5 circlip
- 6 seal
- 7 guide bolt
- 8 thrust bolt
- 9 bank of cup spring
- A detail of the seal
- B detail of the seal



Faulty seals must be exchanged in accordance with the instructions below:

1. Stand the vehicle on an even surface and secure against rolling away.
2. Release the parking brake by applying the necessary release pressure.
3. Release the screw cap and unscrew.
4. Release the lock nut (size 24 or 30) and turn the adjusting screw with socket wrench size 8 or 10 manually counter clockwise until the adjuster screw is flush with the inner side of the piston.
5. Push back the thrust bolt until it has contact with the piston. Following actuate the hand brake valve. (no pressure must be in the piston chamber). The bank of cup springs is now completely depressurized.
6. Unscrew the pressure hose and remove the brake.
7. Release the circlip and remove the pressure ring of the housing.
8. Release the bank of cup springs and the piston.



**Caution!**

**Pay attention to the mounting direction of the seal rings, otherwise leaks can occur.**

**Use for mounting the new seal rings a suitable mounting needle with rounded edge. Be careful,**

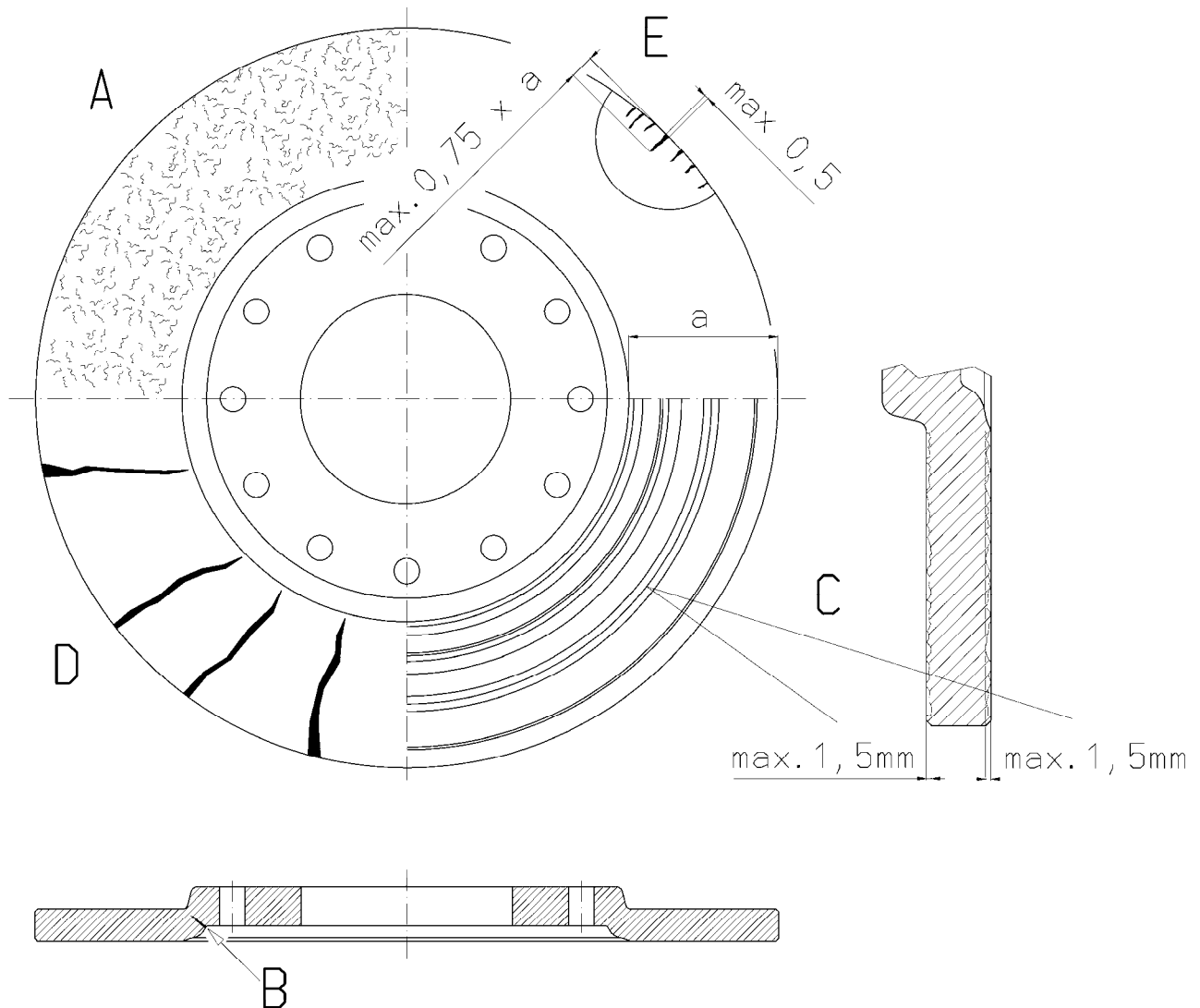
9. Change all seals and mount the parts of the brake in other way round order.  
By mounting the piston, the sliding and sealing surfaces must be greased lightly using lubricating grease to DIN 51825.  
The dust protection cap is fitted with a vulcanized-in steel ring which is used to press it through the locating hole. For exchanging, "lever out" the ring using a suitable tool. The new dust protection cap must be pressed in with the aid of a suitable mounting ring and screw clamps or a lever press.

Mount the brake in accordance with the above procedure into the vehicle / at the axle.

#### 4.3. General

Any discovered defects or damage to parts not listed here must naturally be repaired or replaced using original parts.

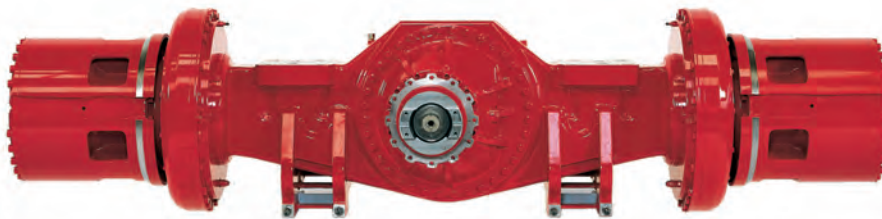
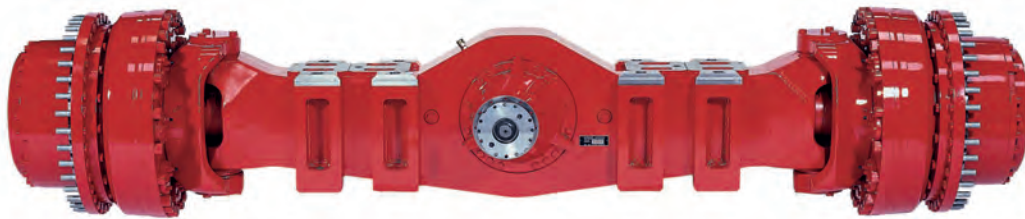
For any other information not contained in these instructions or for more detailed instructions, please contact the vehicle or brake manufacturer



- |          |   |                              |
|----------|---|------------------------------|
| <b>A</b> | Network –like formation of cracks                 | admissible                   |
| <b>B</b> | Radial shaped crack                               | <b><u>not</u></b> admissible |
| <b>C</b> | Uneven brake surface characteristics below 1,5 mm | admissible                   |
| <b>D</b> | Continuous cracks                                 | <b><u>not</u></b> admissible |
| <b>E</b> | Radial cracks max. 0,5 mm (width)                 | admissible                   |

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