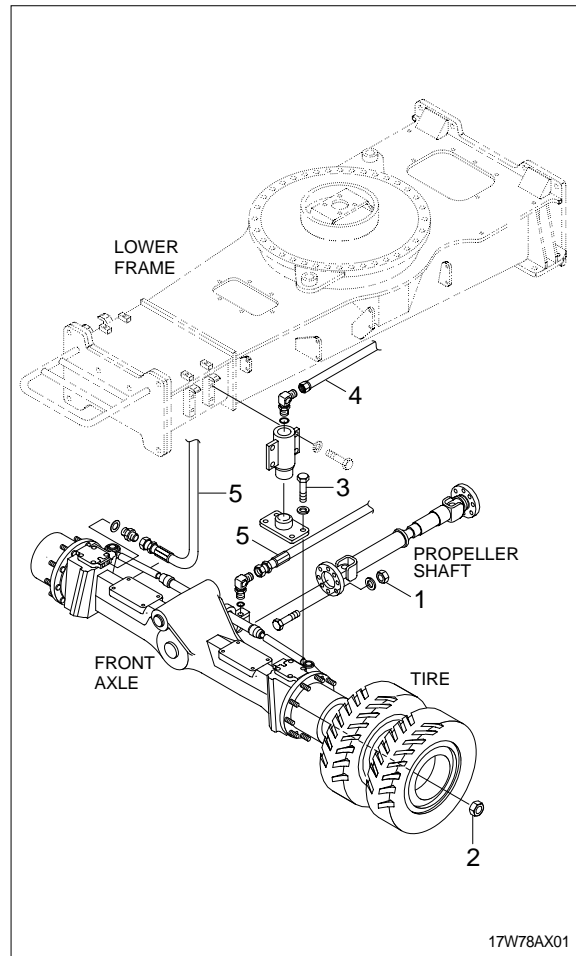


GROUP 9 FRONT AXLE

1. REMOVAL FRONT AXLE

- 1) Propeller shaft mounting nut(1, M10)
 - Tightening torque : $5.9 \pm 0.6 \text{ kgf} \cdot \text{m}$
($42.7 \pm 4.3 \text{ lbf} \cdot \text{ft}$)
- 2) Wheel nut(2, M20)
 - Tightening torque : $60 \begin{smallmatrix} +0 \\ -5 \end{smallmatrix} \text{ kgf} \cdot \text{m}$
($434 \begin{smallmatrix} +0 \\ -36 \end{smallmatrix} \text{ lbf} \cdot \text{ft}$)
- 3) Oscillating cylinder supporting mounting bolt(3, M16)
 - Tightening torque : $29.6 \pm 3.2 \text{ kgf} \cdot \text{m}$
($214 \pm 23.1 \text{ lbf} \cdot \text{ft}$)
- 4) Pipe assy(4)
- 5) Hose assy(5)
- 6) Front axle weight : 500kg(1110lb)



2. GENERAL INSTRUCTIONS

1) GENERAL WORKING INSTRUCTIONS

- (1) This manual has been developed for the skilled serviceman, trained by the ZF-Passau.
- (2) During all operations, pay attention to cleanliness and skilled working.
Therefore, axle removed from the machine, must be cleaned prior to open them.
- (3) We assume that the special tools, specified by ZF, will be used.
The special tools are available from ZF-Passau.
- (4) After the disassembly, all components must be cleansed, especially corners, cavities and recesses of housing and covers.
- (5) The old sealing compound must be carefully removed.
- (6) Check lubricating holes, grooves and pipes for free passage. They must be free of residues, foreign material or protective compounds.
- (7) The latter refers especially to new parts.
- (8) Parts which have been inevitably damaged in a disassembly operation, must be generally replaced by new ones, e.g. rotary seal rings, O-rings, U-section rings, cap boots, protective caps etc..
- (9) Components such as roller bearings, thrust washers, synchronizing parts etc. which are subject to normal wear in automotive operation, must be checked by the skilled Serviceman.
He will decide if the parts can be reused.
- (10) For the heating of bearings etc., hot plates, rod heaters or heating furnaces must be used.
- (11) Never heat parts directly with the flame. An auxiliary solution would be to immerse the bearing in a vessel filled with oil, which is then heated with the flame.
In this way, damage to the bearings could be avoided.
- (12) Ball bearings, covers, flanges and parts like that must be heated to about 90 to 100°C.
- (13) Hot-mounted parts must be reset after cooling in order to assure a proper contact.
- (14) Before pressing shafts, bearings etc. in position, both parts must be lubricated.
- (15) During to reassembly, all specified adjustment values, testing specifications and tightening torque must be respected.
- (16) After the repair, units are filled up with oil.
- (17) After the oil filling, the oil level plugs and oil drain plugs must be tightened to the specified tightening torque.

2) IMPORTANT INSTRUCTIONS CONCERNING THE LABOUR SAFETY

- (1) In principle, repairers are themselves responsible for the labour safety.
- (2) The observance of all valid safety regulations and legal rules is a precondition to prevent damage to individuals and products during the maintenance and repair operations.
- (3) Before starting the work, the repairers have to make themselves familiar with these regulations.
- (4) The proper repair of these products requires especially trained personnel.
- (5) The repairer himself is obliged to provide for the training.

3) LUBRICANT SPECIFICATIONS

- (1) Gear oils with limited - slip additives.
- (2) API GL-5
- (3) MIL-L-2105D(SAE 85W-90, 85W-140 with LS-Additive)

4) BRAKE LINING WEARING TEST

(1) General

The brake lining wearing test gives a limited information about the overall condition of the brake plate pack - without disassembly of the planetary carrier, resp. of the plates.

The wearing test has to be carried out in case of the following criteria :

- In the course of the oil change intervals(min. once a year)
- Braking noises
- Reduced braking power
- Change of deceleration, of the brake fluid level as well as of the brake pressure
- In case of a general change of the brake performance.

Carry out the wearing test on both final drive sides.

- Permitted piston stroke max. : 5.2mm
- Piston stroke in new condition of the plate pack : 3.1-3.5mm

(2) Carry out the wearing test

Turn the planetary carrier until screw plug A(M16 x 1.5) is in the upper position(12 o'clock position).

Now, remove the screw plug.

Apply the brake(required brake pressure min. 40bar).

Screw measuring screw(M16 x 1.5) in until contact is obtained and tighten it with a torque of $1\text{kg} \cdot \text{m}$.

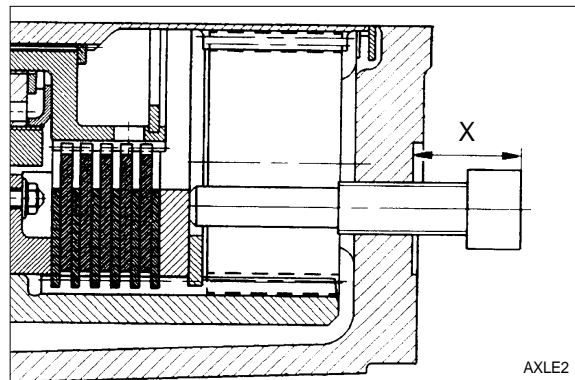
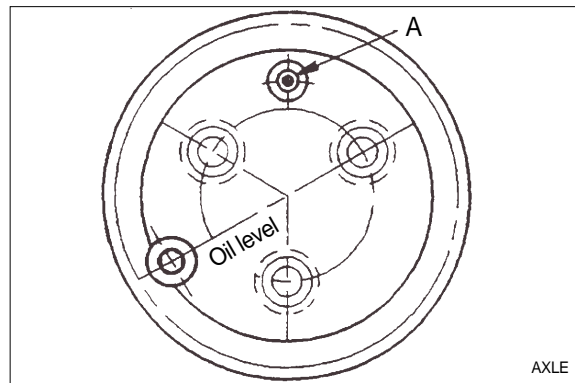
Determine dimension X according to the figure on the right.

Release the brake and equalize the plate clearance by resetting the measuring screw.

Torque limit $1\text{kg} \cdot \text{m}$.

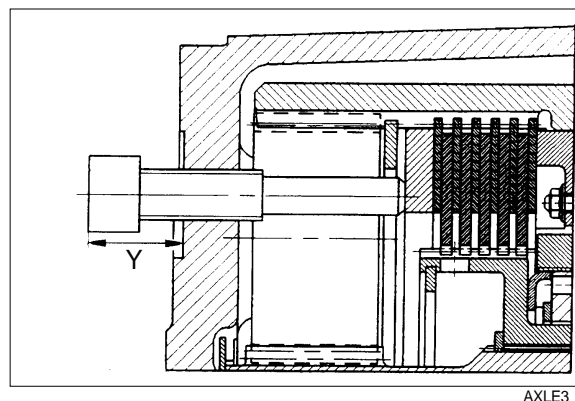
Determine dimension Y according to the figure on the right.

The difference of the two dimensions (X-Y) corresponds to the piston stroke (actual state).



(3) Result

If the max. permitted piston stroke(5.0mm) is exceeded, the lining plates must be renewed on both final drive sides.



3. FINAL DRIVE DISASSEMBLY AND ASSEMBLY

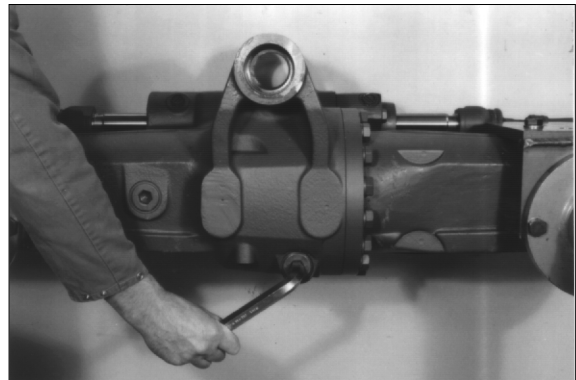
1) DISASSEMBLY

The illustration on the right shows the complete axle on the assembly car.



17W78FA001

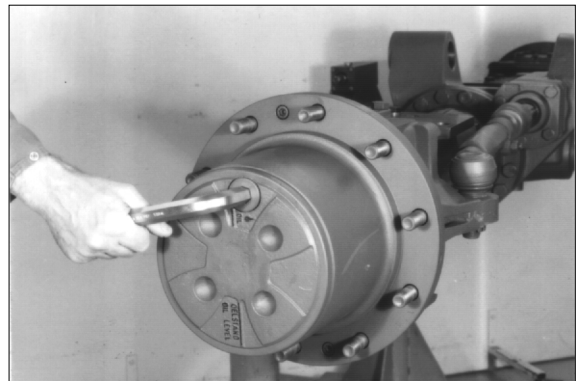
Drain oil from the axle housing.



17W78FA002

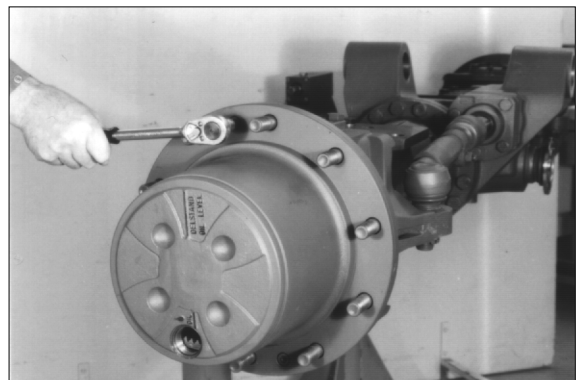
(1) Planetary carrier

Screw out the screw plug carefully.
Swivel planetary carrier through 180° and drain oil.
Pay attention to the position of the screw plug -12 o'clock position-during the opening.



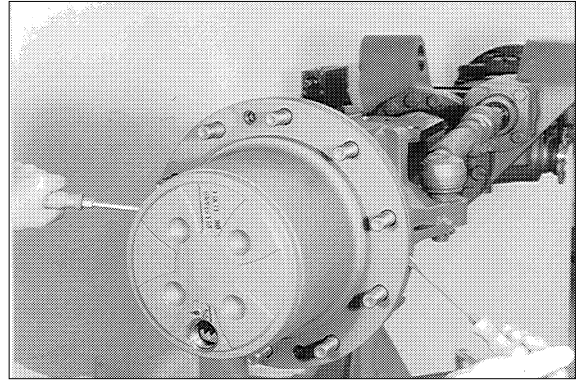
17W78FA003

Loosen the two socket head screws.



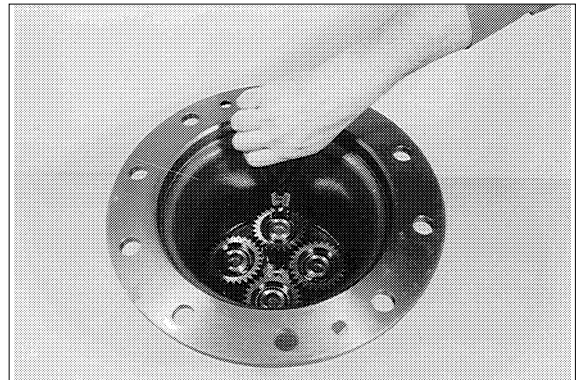
17W78FA004

Separate planetary carrier from the hub.



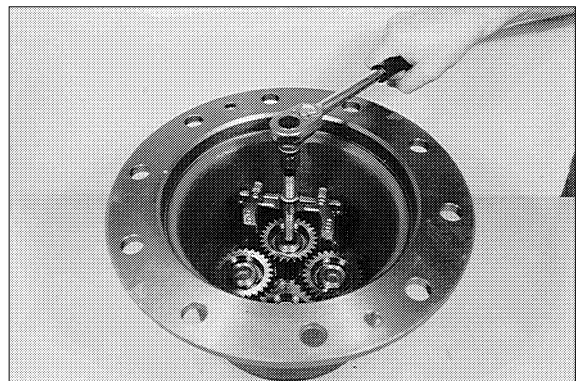
17W78FA005

Squeeze out circlip.



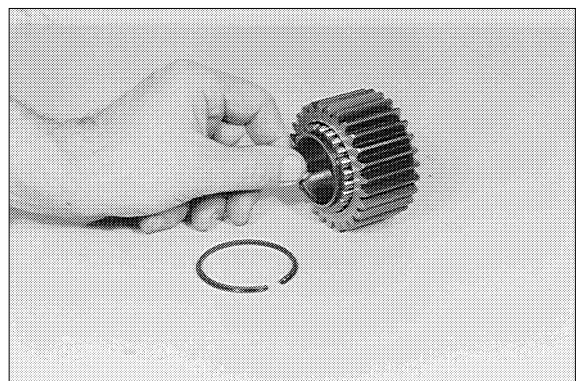
17W78FA006

Pull off planetary gears.
If required, remove the thrust washer (for
the sun gear shaft).



17W78FA007

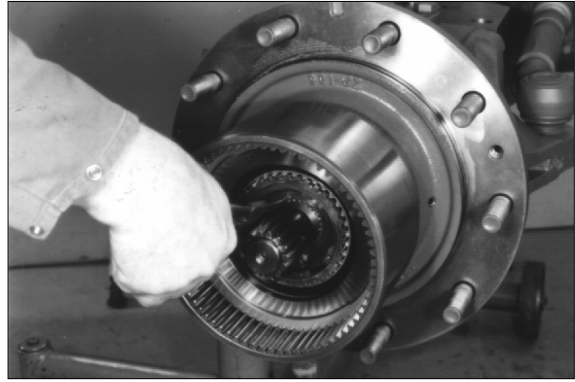
Squeeze out the angle rings and pull the
complete bearing inner race out of the
planetary gear.
Pay attention to the released rollers.



17W78FA008

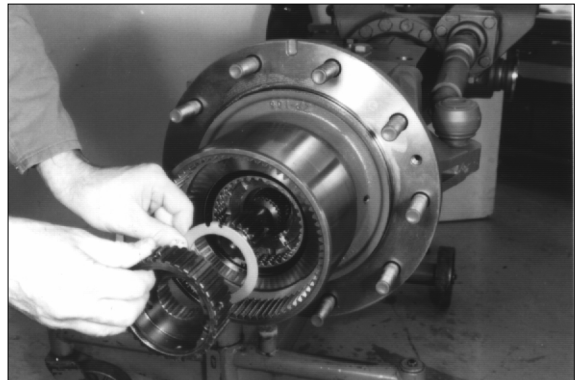
(2) Internal gear

Squeeze out circlip.



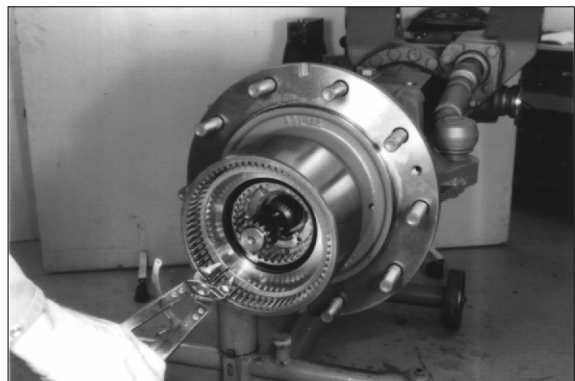
17W78FA009

Remove the plate carrier and the thrust washer installed behind it.



17W78FA010

Squeeze out circlip.



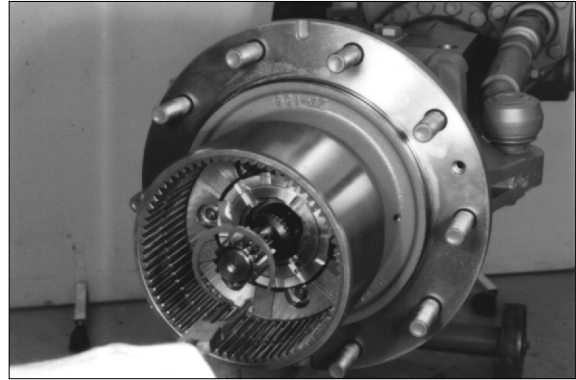
17W78FA011

Take backing plate and plate pack out of the internal gear.



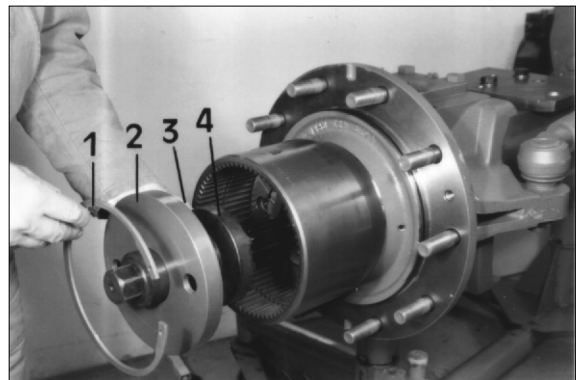
17W78FA012

Squeeze out circlip(slotted nut).



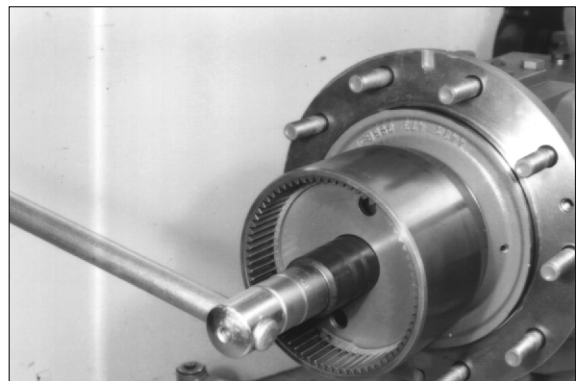
17W78FA013

Assemble spacing ring(3) and centering disk(2) upon hook spanner(4), position and fix them by means of circlip(1). Pay attention to the exact engagement of the circlip.



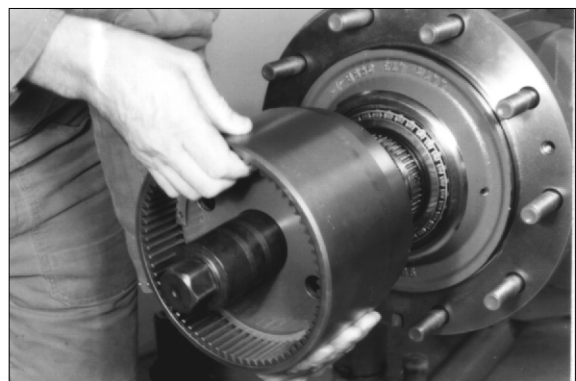
17W78FA014

Loosen slotted nut.



17W78FA015

Screw off slotted nut and separate complete internal gear from hub carrier.



17W78FA016

Remove hook spanner.
Lift slotted nut, angle ring and O-ring out of the internal gear.



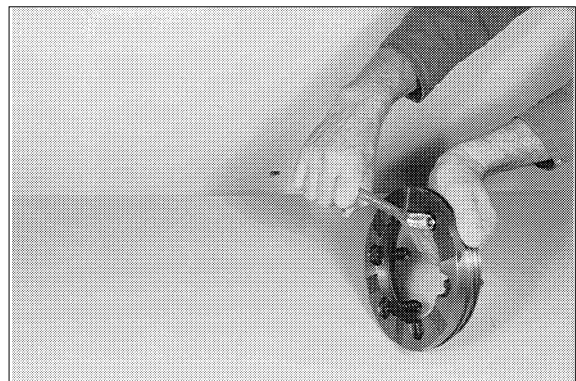
17W78FA017

Tap piston loose and drive it out of the internal gear.
Grooved rings and back up rings will be damaged in course of the piston removal.
Use new grooved rings and back up rings.



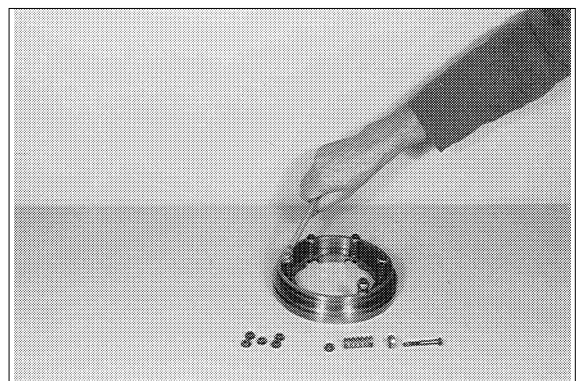
17W78FA018

Loosen lock nuts.



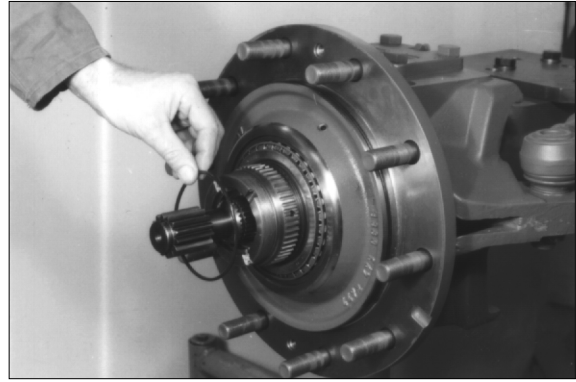
17W78FA019

Loosen all hex head screws, resp. socket head screws.
Remove compression springs, spring cages and the released supporting disk.



17W78FA020

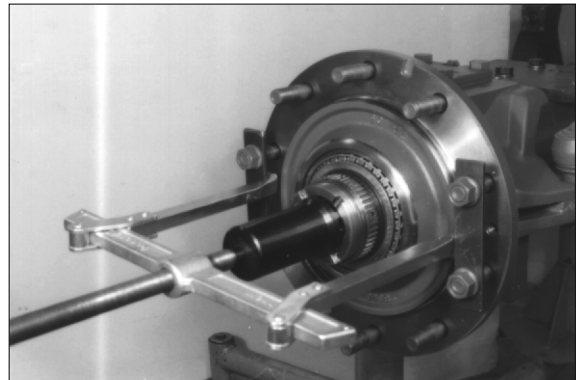
Remove O-ring.



17W78FA021

(3) Hub

Pull hub from steering knuckle hull.
Pay attention to the released bearing
inner race and the spacing ring.
Take O-ring out of the hub.



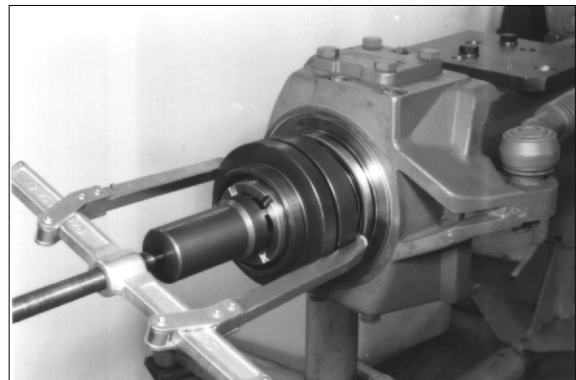
17W78FA022

Pry out sealing ring and remove the
bearing inner race.
If necessary, drive the two bearing outer
races out of the hub.
If the bearing inner race remains on the
neck of the steering knuckle hull, this one
must be disassembled as described as
figure().



17W78FA023

Pull bearing inner race from the neck of
the steering knuckle hull and pry off shaft
seal.

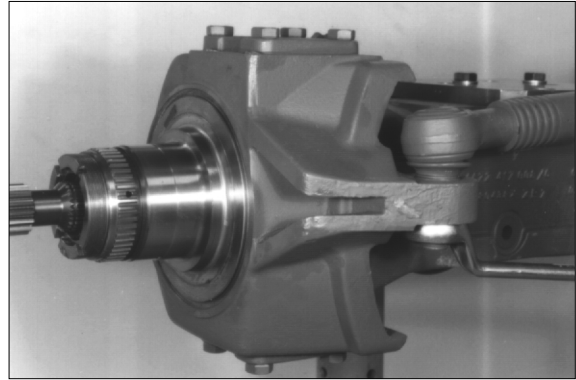


17W78FA024

(4) Steering knuckle hull

Remove cotter pin.

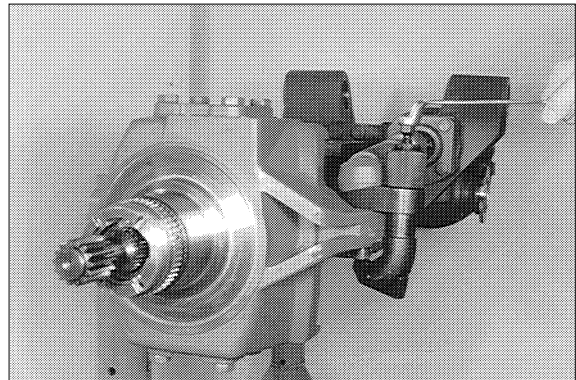
Loosen castle nut for some threads only.



17W78FA025

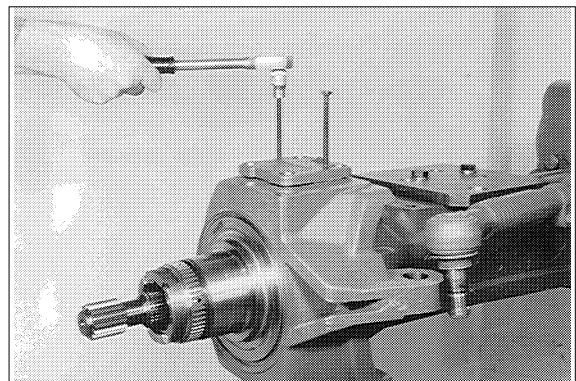
Loosen tie rod from the steering knuckle hull, using ejection tool.

Now, screw off castle nut and unhook tie rod.



17W78FA026

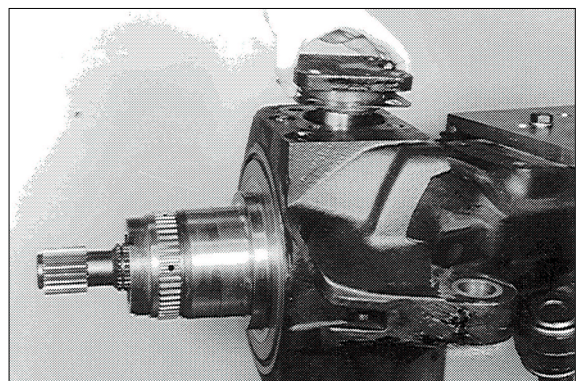
Loosen hex head screws and screw back-off screws in.



17W78FA027

Remove the two bearing pins.

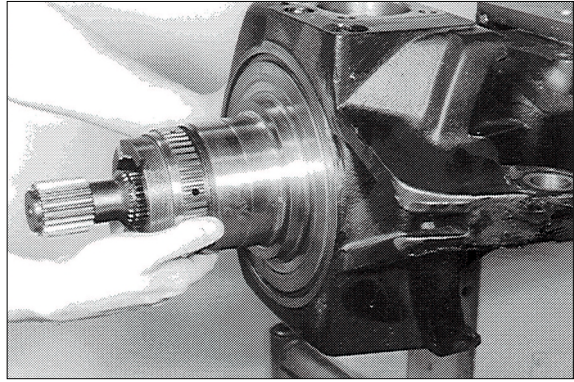
Pay attention to the released shim on the upper bearing pin.



17W78FA028

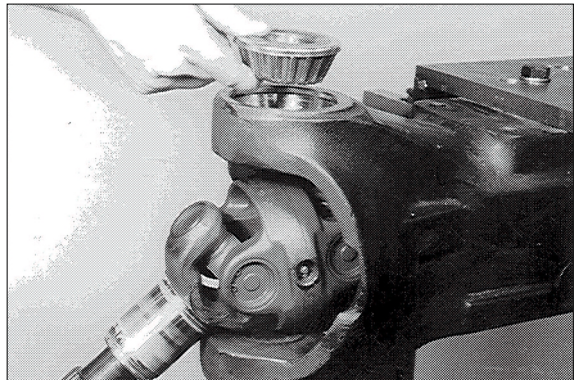
Separate the steering knuckle hull carefully from the axle housing-sun gear shaft could damage the shaft seal.

Pay attention to the released double-joint shaft, the sealing cap, the bearing inner race (Possibly with loose cylindrical rollers).



17W78FA029

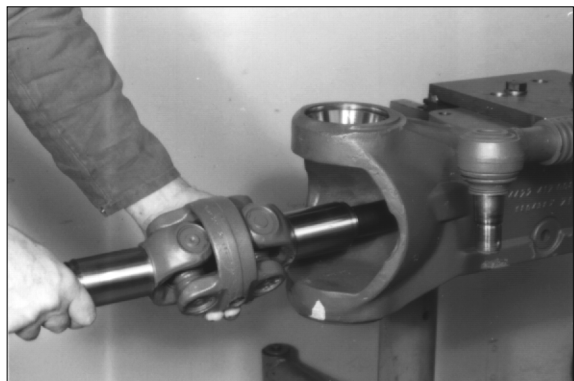
Remove sealing caps and bearing inner races.



17W78FA030

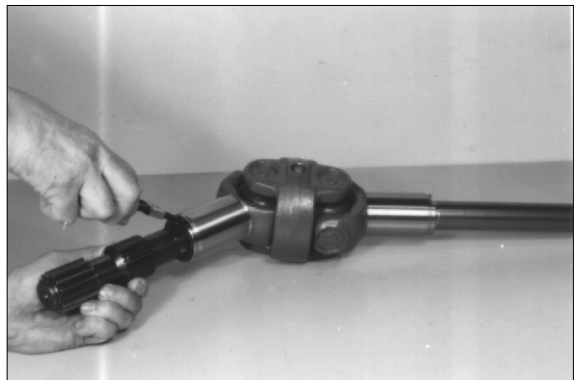
(5) Double-joint shaft

Take the double-joint shaft out of the axle housing.



17W78FA031

Expand circlip and pull sun-gear shaft out of the double-joint shaft.



17W78FA032

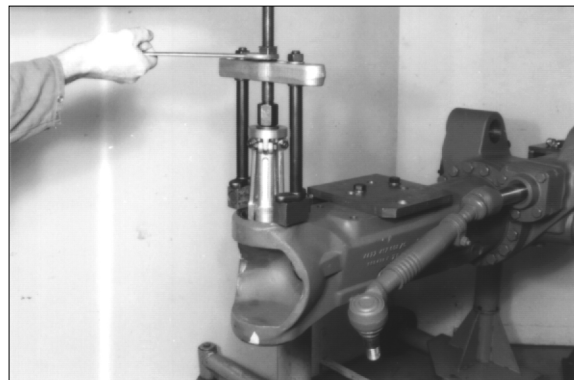
Expand circlip and remove stub shaft.



17W78FA033

(6) Axle housing

Pull bearing outer race out of the steering knuckle bores.



17W78FA034

Pull the shaft seal and the sleeve installed behind it out of the bore.



17W78FA035

In the case of versions - with traversing steering knuckle bore - drive the cover, if necessary, out of the steering knuckle bore.



17W78FA036

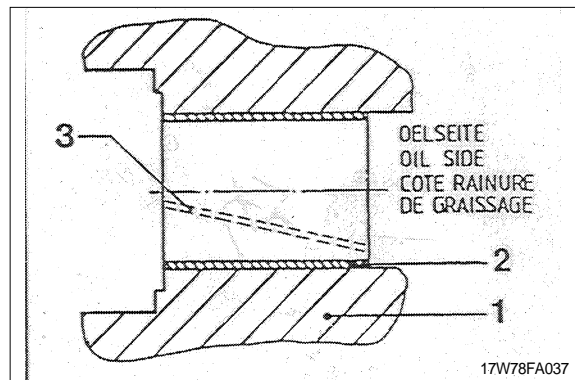
2) REASSEMBLY

(1) Axle housing and double-joint shaft

Reference Draft

(Sectional position vertical)

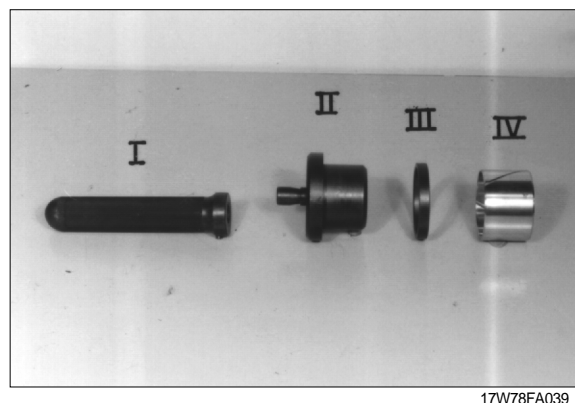
- 1 Axle housing
- 2 Sleeve
- 3 Lubricating groove



Drive in the sleeve - inner lubricating groove(3) showing downward towards the axle center - until it is flush(see also Draft).

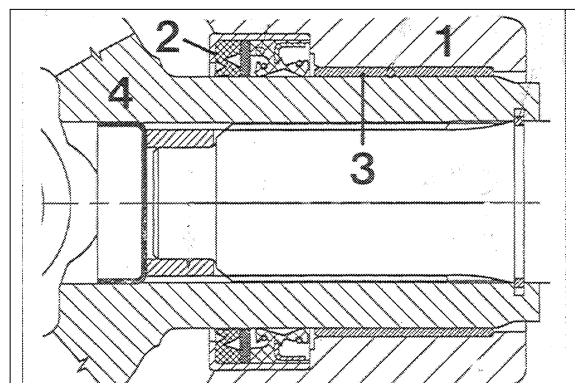


- 1 Handle
- 2 Driver
- 3 Ring
- 4 Sleeve



Reference Draft

- 1 Axle housing
- 2 Shaft seal
- 3 Sleeve
- 4 Double-joint shaft



Cover shaft seal on the outer diameter with loctite(Type-No. 574) and insert it until contact is obtained.

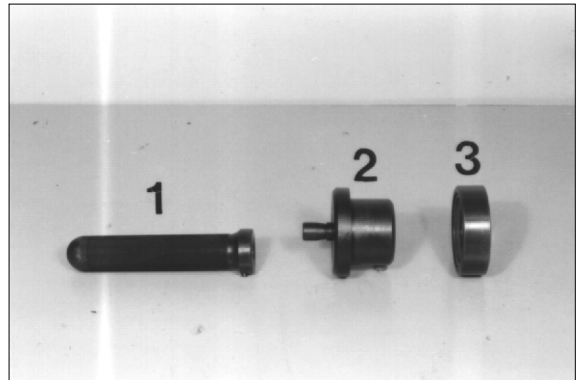
Pay attention to the installation position. Sealing lip must face the oil chamber(see Draft).

Grease shaft seal in the zone of the dust lip and sealing lip.



17W78FA041

- 1 Handle
- 2 Driver
- 3 Shaft seal



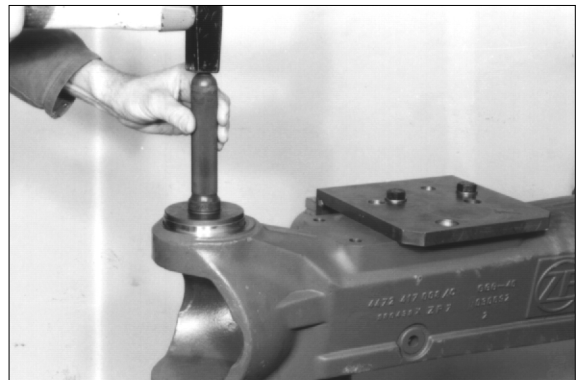
17W78FA042

If necessary, according to the version, insert the cover in the steering knuckle bore until contact is obtained.



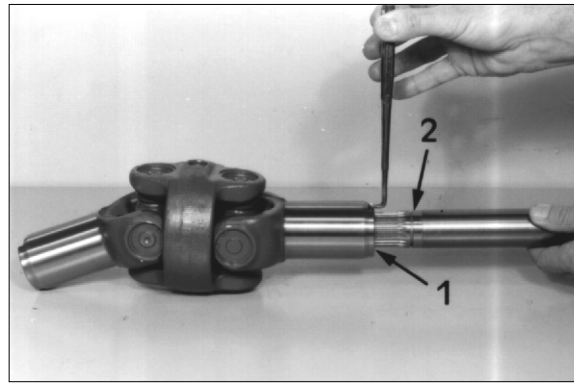
17W78FA043

Place undercooled bearing outer races against shoulder until contact is obtained.



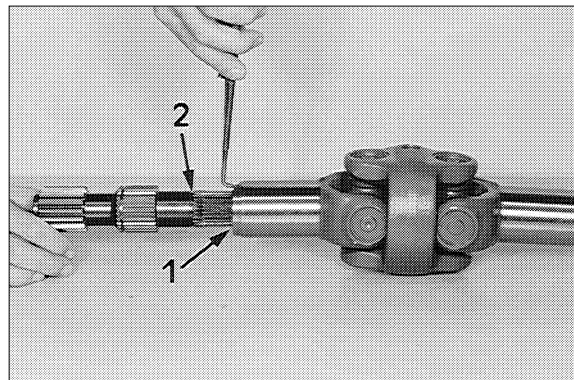
17W78FA044

Insert circlip(Arrow 1), assemble stub shaft into the double-joint until the circlip engages in the annular groove(2).



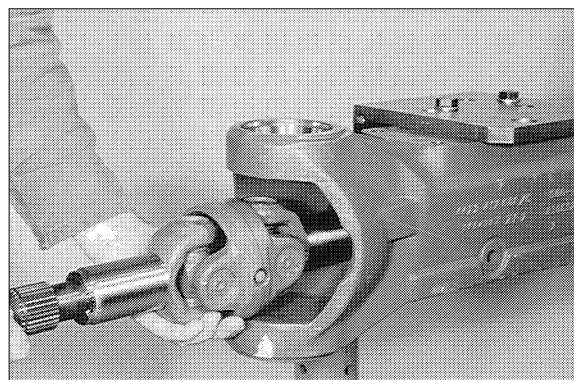
17W78FA045

Insert circlip(Arrow 1).
Assemble the sun-gear shaft until the circlip engages in the annular groove (Arrow 2).



17W78FA046

Introduce the complete double-joint shaft into the axle housing until the stub shaft splines are received in the differential.
Pay attention to the sealing elements.



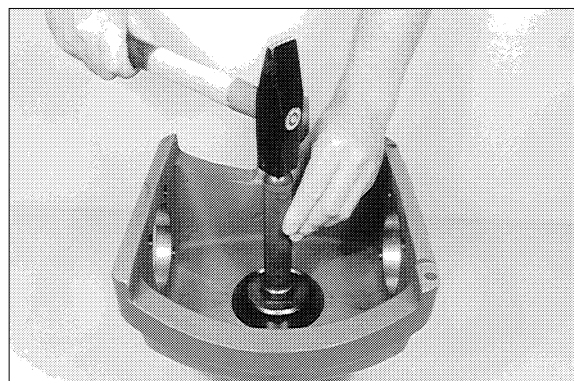
17W78FA047

(2) Steering knuckle hull

Drive the sleeve in until it is flush(see also Draft).

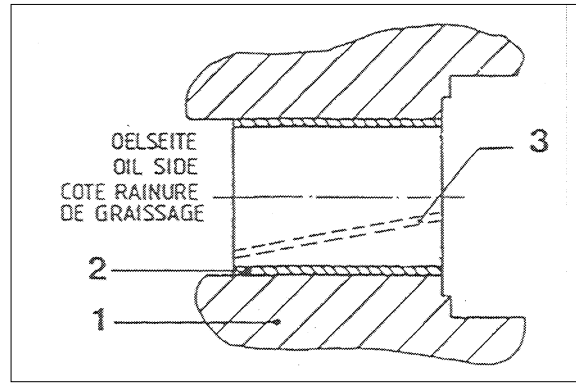
Pay attention to the installation position of the sleeve.

The inner lubricating groove(3) must show, in the installed steering knuckle hull, downward and towards the oil chamber.



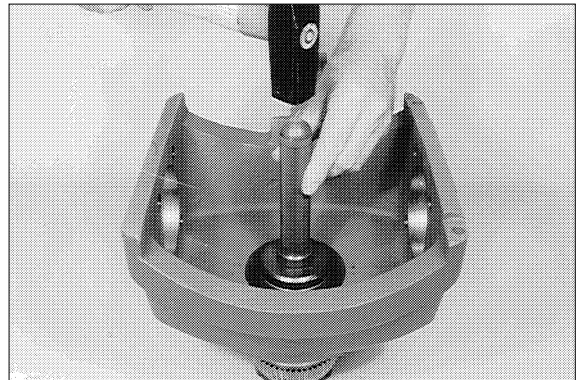
17W78FA048

- Reference Draft
 (Sectional position vertical)
 1 Steering knuckle hull
 2 Liner
 3 Lubricating groove



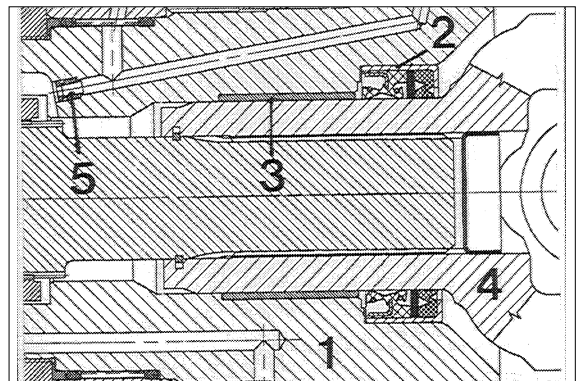
17W78FA049

Cover shaft seal on the outer diameter with loctite(Type-No. 574) and install it until contact is obtained.
 Pay attention to the installation position, see Draft .
 Grease the shaft seal in the zone of the dust lip and sealing lip.



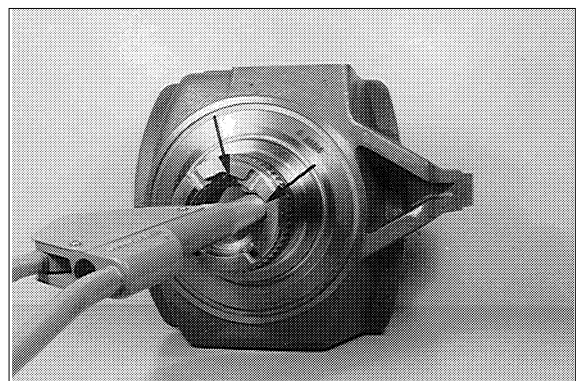
17W78FA050

- Reference Draft
 1 Steering knuckle hull
 2 Shaft seal
 3 Sleeve
 4 Double-joint shaft
 5 Screw plug



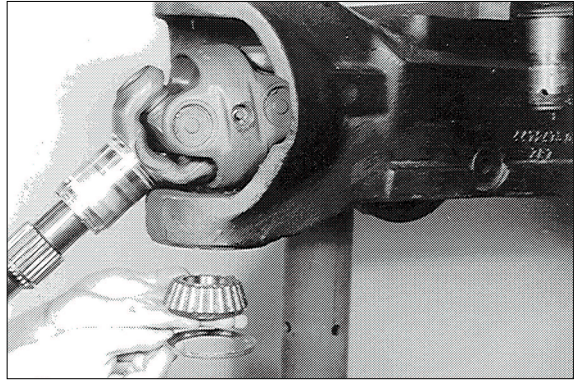
17W78FA051

Close the two bores(see Arrows) in the steering knuckle hull by means of screw plugs(5), (see also Draft).



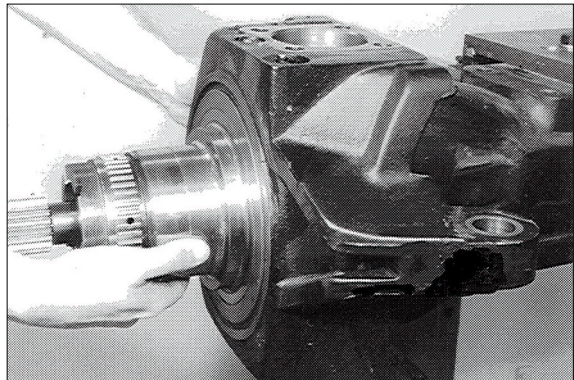
17W78FA052

Make bearing inner races adhere with grease in the steering knuckle bore and install the sealing caps subsequently. According to the version, a bearing inner race without roller cage(with loose rollers) may be installed. This bearing inner race must be always installed into the lower steering knuckle bore.



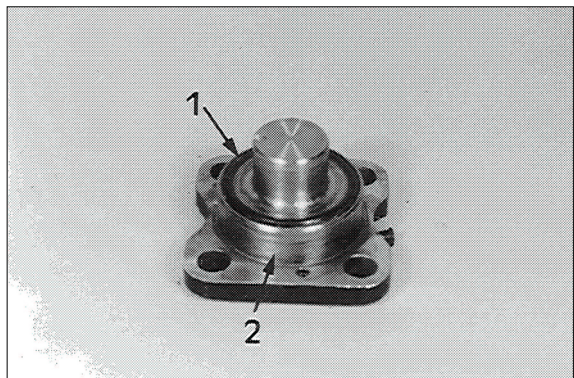
17W78FA053

Position the steering knuckle hull on the axle housing.



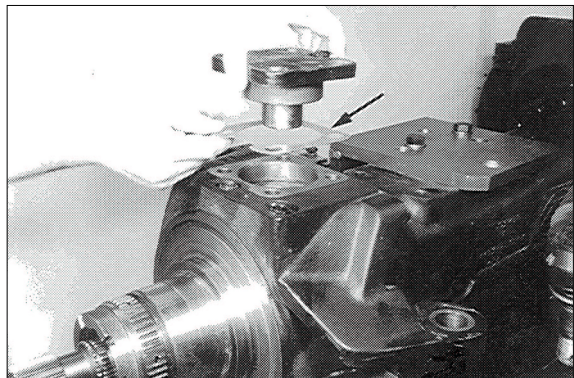
17W78FA054

Grease the O-ring and insert it in the annular groove of the bearing pin(1). Cover the collar of the bearing pin(2) with anti-corrosive agent.



17W78FA055

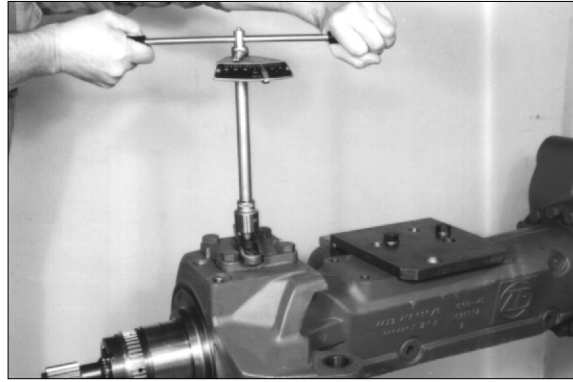
Fix the steering knuckle hull by means of bearing pins. Install the shim(Arrow) on the upper bearing pin. Pay attention to the installation position of the bearing pins. Grease nipple must face the axle center.



17W78FA056

(3) Check rolling resistance of the steering knuckle bearing (aim at the upper value)

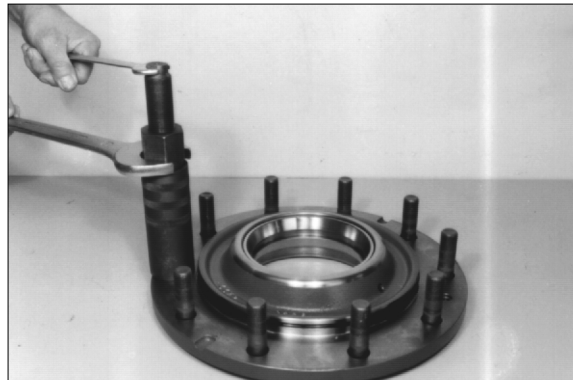
Bearing rolling moment : 4.1-5.1kg · m
(29.7-36.9 lb · ft)



17W78FA057

(4) Hub-wheel bearing

Pull in wheel studs.



17W78FA058

Insert the two undercooled bearing outer races in the hub and place them against shoulder.

Do not support the hub on the wheel studs.



17W78FA059

(5) Mount hub

Insert heated bearing inner race.

Pay attention to the different bearing inner ring sizes.

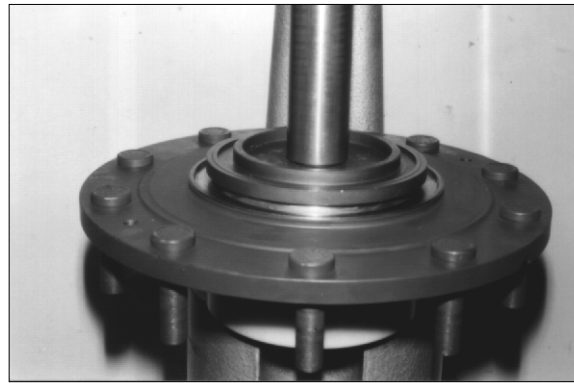
To avoid an excessive cooling down of the bearing inner race, the reassembly of the shaft seal, resp. the assembling of the hub must be carried out immediately after the insertion of the bearing inner race.



17W78FA060

Cover shaft seal on the outer diameter with loctite(Type-No. 574) and install it (see Draft).

Wet shaft seal in the zone of the inner diameter, immediately prior to the reassembly of the hub(Figure) with spirit.

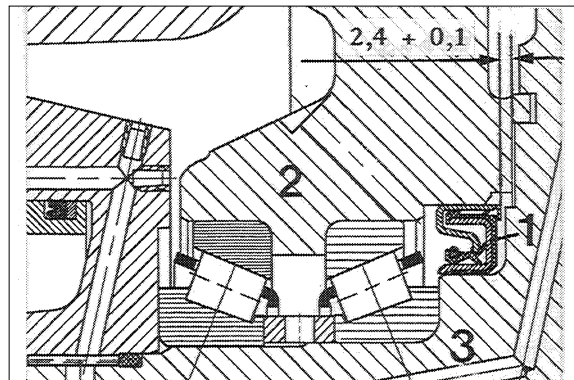


17W78FA061

By using the prescribed driver, the exact installation depth is obtained(see Draft on the right).

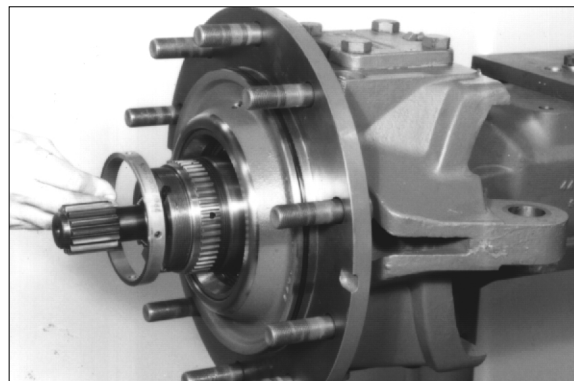
Reference Draft

- 1 Shaft seal
- 2 Hub
- 3 Steering knuckle hull



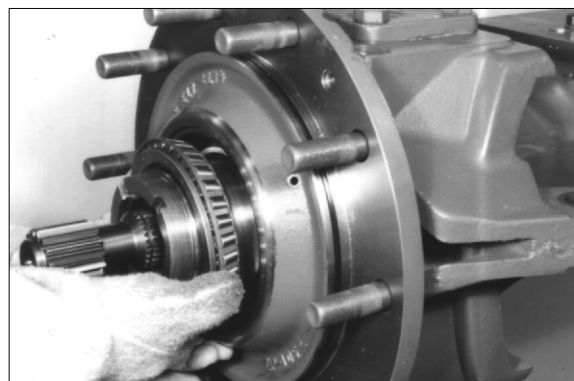
17W78FA062

Assemble pre-assembled hub and determined spacing ring (e.g. $s = 14.50$ mm).



17W78FA063

Fix the hub by means of the heated bearing inner race.



17W78FA064

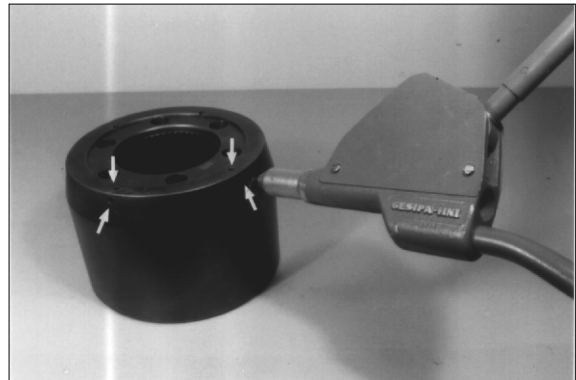
(6) Internal gear

One-piece internal gear :

Piston reset / socket head screws

For the following reassembly, the use of the assembly help is recommended.

Close bores(see Arrows) by means of screw plugs.

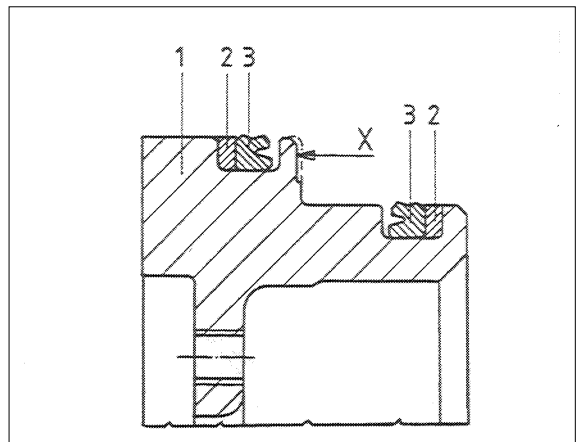


17W78FA065

Heat the two back-up rings in an oil bath and insert them in the piston recesses. Install grooved rings. Pay attention to the installation position, see draft on the right.

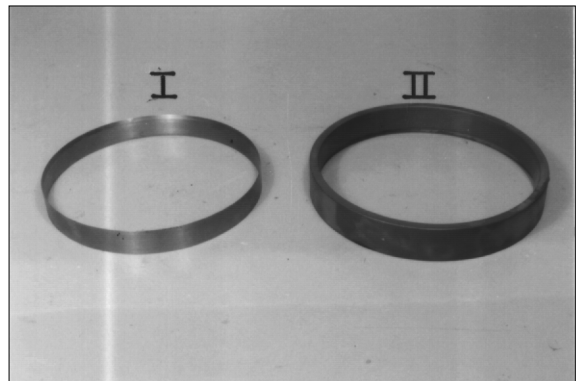
Reference Draft

- 1 Piston
- 2 Back-up rings
- 3 Grooved rings
- X Pressure chamber



17W78FA066

The illustrated assembly help facilitates, resp. assures a correct reassembly of the prescribed piston.

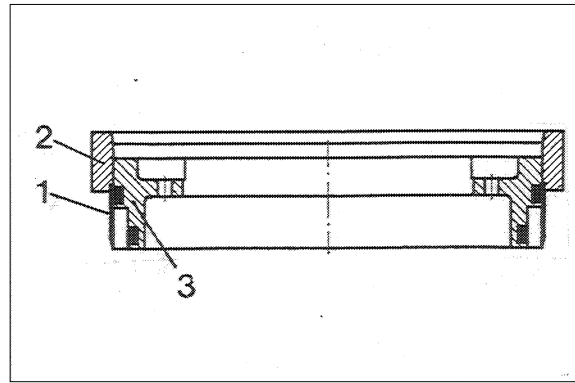


17W78FA067

After the cooling down, oil the back-up ring and the grooved ring(use W-10 oils).

Reference Draft

- 1 Assembly help / part I
- 2 Assembly help / part II
- 3 Piston



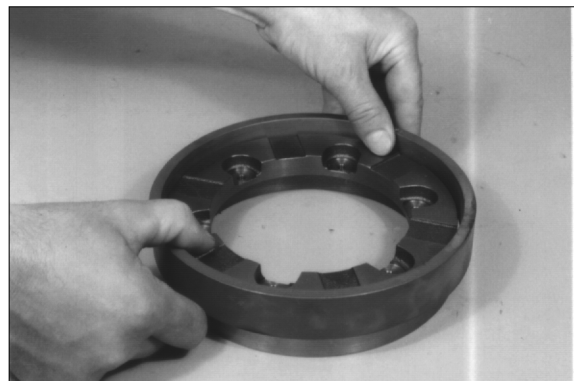
17W78FA068

Insert piston(3) in the assembly help / part II.



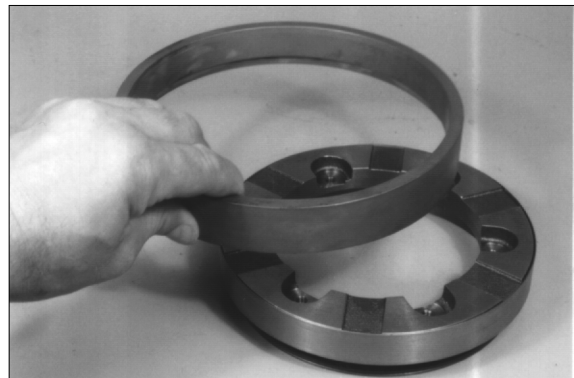
17W78FA069

⑥ Place assembly help / part II upon part I and press piston through.



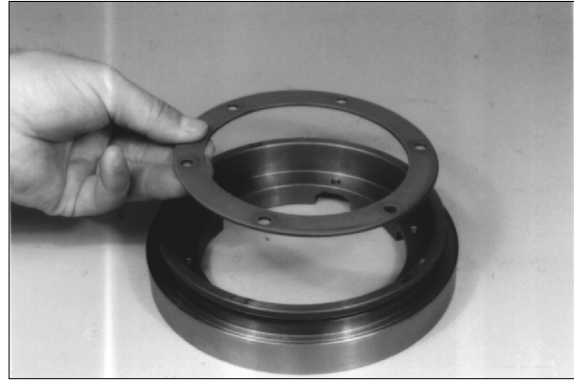
17W78FA070

Take off assembly help / part II.



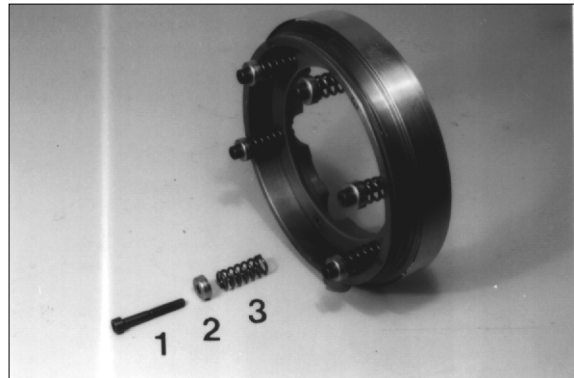
17W78FA071

Insert the supporting disk into the piston.



17W78FA072

Assemble spring cage(2) and compression spring(3) upon the socket head screws(1), and screw them into the piston.



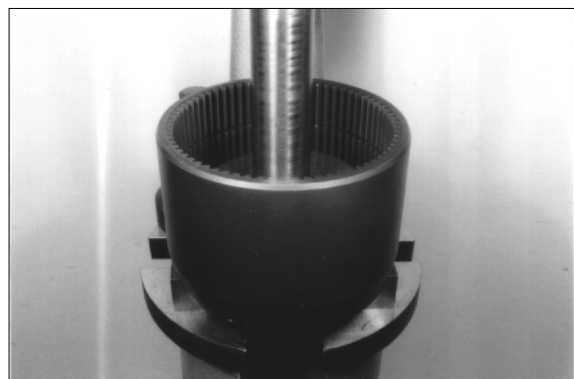
17W78FA073

Assemble the assembly help / part I (with the inserted piston) in the internal gear. Pay attention to the radial installation position of the piston.



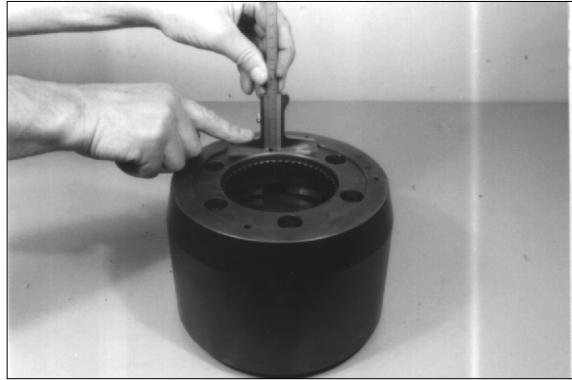
17W78FA074

Press piston carefully against shoulder. Now, take the assembly help / part I out of the internal gear. To avoid the shearing off, resp. tipping of the grooved rings, install the piston with utmost care (by means of a hand press).



17W78FA075

Adjust dimension "X" = 3.75 - 4.25mm,
bearing contact / internal gear to the
screw head - see draft .
Pay attention to the exact piston contact
in the internal gear.

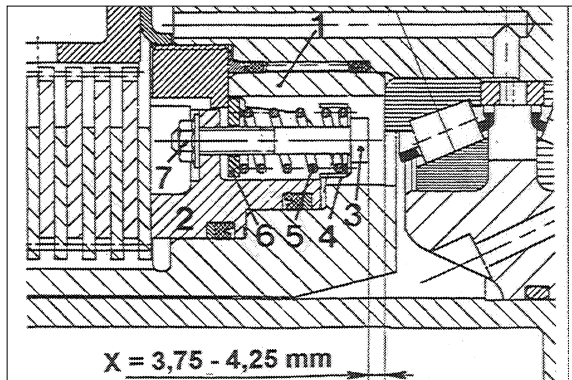


17W78FA076

Reference Draft

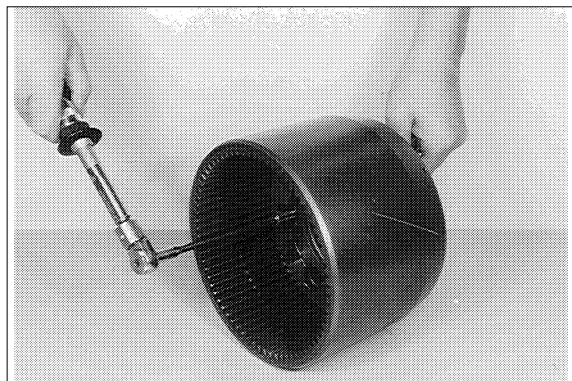
Dimension "X" = 3.75 - 4.25mm.

- 1 Internal gear
- 2 Piston
- 3 Socket head screw
- 4 Spring cage
- 5 Compression spring
- 6 Supporting disk
- 7 Lock nut



17W78FA077

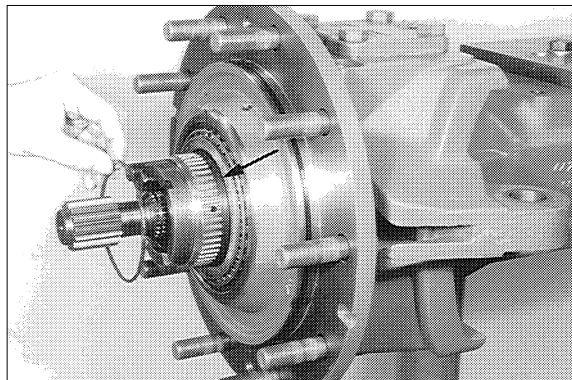
Check socket head screws by means of
lock nut.
Tightening torque : 1.1kg · m (8.0 lb · ft)
Secure lock nut additionally with loctite
(Type-No. 242).



17W78FA078

Mount Internal gear on the steering knuckle hull

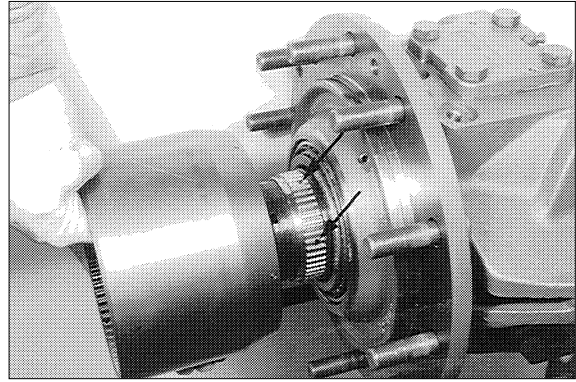
Oil O-ring and insert it in the annular
groove of the steering knuckle hull
(Arrow).



17W78FA079

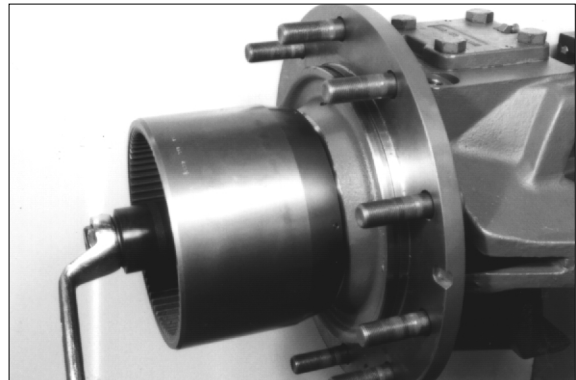
Assemble internal gear.

Pay attention to the exact overlapping of the oil supply holes(see Arrows) of the steering knuckle hull, resp. internal gear splines.



17W78FA080

Place internal gear by means of slotted nut over the O-ring until contact on the bearing inner race is obtained. Now, remove slotted nut again.

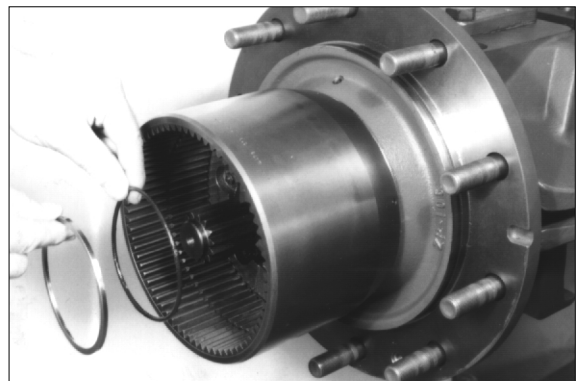


17W78FA081

Insert O-ring evenly in the gap of the steering knuckle hull and the internal gear.

Install subsequently angle ring and pull it by means of slotted nut against shoulder. Cover O-ring and angle ring amply with grease.

Pay attention to the installation position (see Draft).

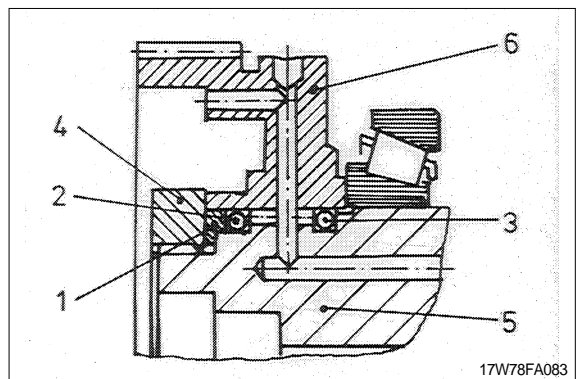


17W78FA082

Unscrew slotted nut again and check O-ring(if damaged), resp. angle ring seat.

Reference Draft

- 1 Angle ring
- 2 O-ring
- 3 O-ring
- 4 Slotted nut
- 5 Steering knuckle hull
- 6 Internal gear



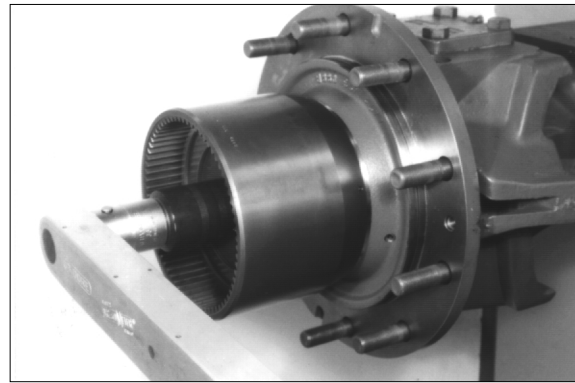
17W78FA083

Cover threads of slotted nut with lubricant (Type Molykote M11) and tighten slotted nut finally.

Tightening torque : $158^{+51} \text{kg} \cdot \text{m}$
($1143^{+369} \text{lb} \cdot \text{ft}$)

Aim at the conformity of slotted nut / Pocket of the steering knuckle hull, starting with the lower tightening torque $158 \text{kg} \cdot \text{m}$.

During the tightening, make several full revolutions of the hub in both senses.



17W78FA084

-) Fix slotted nut by means of circlip (tongue).

The tolerance range of the tightening torque has been selected in such a way that a matching position of the recesses of slotted nut and steering knuckle hull (Arrow 1) can be obtained.

Pay attention to the installation position of the circlip.

The tongue (Arrow 2) must be positioned in one of the upper recesses (Arrow 1).



17W78FA085

(7) Multi-disk drive

Adjust piston travel

Piston travel = 3.0 - 4.0mm

We know from experience that the required piston travel is obtained by installing 5 outer plates of the thickness $s = 2.50 \text{mm}$ and 1 outer plate of $s = 2.00 \text{mm}$.

However, in case of exceptions, a correction may become necessary. Therefore, a measuring of the piston travel (**Example B**) must be absolutely carried out.

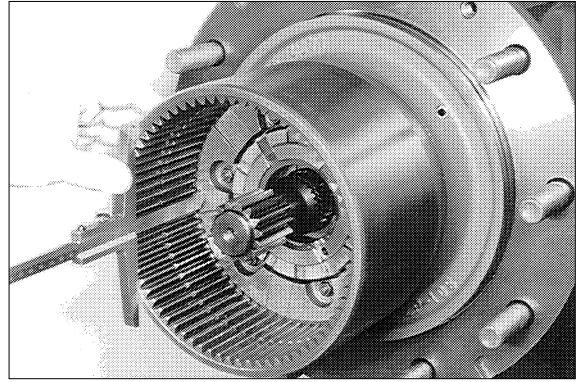
In case of deviations from the prescribed piston travel, correct by means of corresponding outer plate(s).

The correct performance of the multi-disk brake is assured.

Determine dimension I from the end face / internal gear to the plane surface / piston.

Dimension I e.g. : 89.70mm

Pay attention to a correct piston contact in the internal gear.



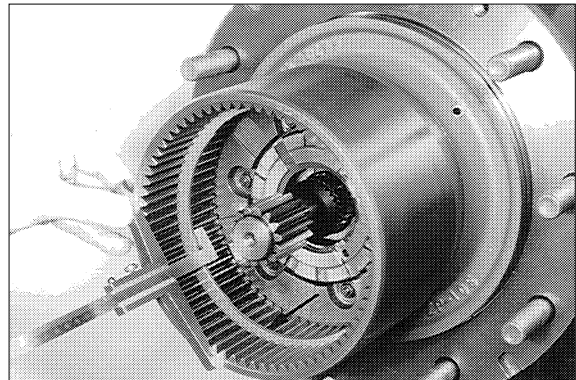
17W78FA086

Engine circlip and place it on the outer face of the recess(direction of Arrow) against shoulder.

Measure dimension II from the end face/ internal gear to the inner surface of the circlip.

Dimension II e.g. : 45.40mm

Now, remove circlip again.



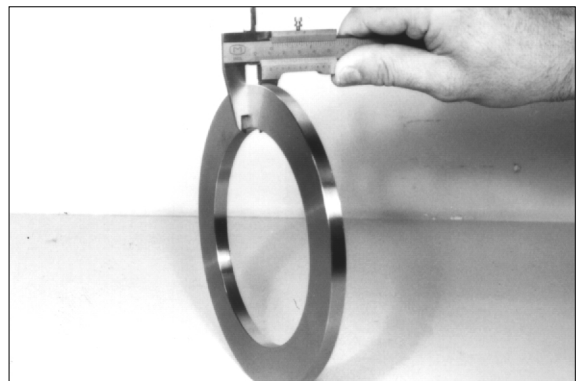
17W78FA087

Determine dimension III (Thickness of the backing plate).

Dimension III e.g. 9.00mm

Example A

Dimension I	89.70mm
Dimension II	- 45.40mm
Difference	= 44.30mm
Dimension III	- 9.00mm
Gives Dimension X	35.30mm

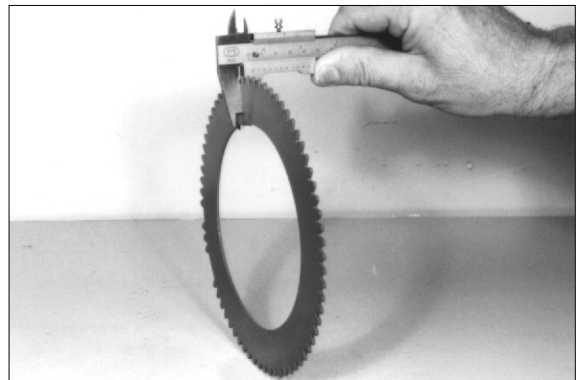


17W78FA088

Determine total height of the plate pack.

The plate thickness has to be measured on the single plate-not on the total plate pack.

The undulation of the outer plate may not affect the measuring result.



17W78FA089

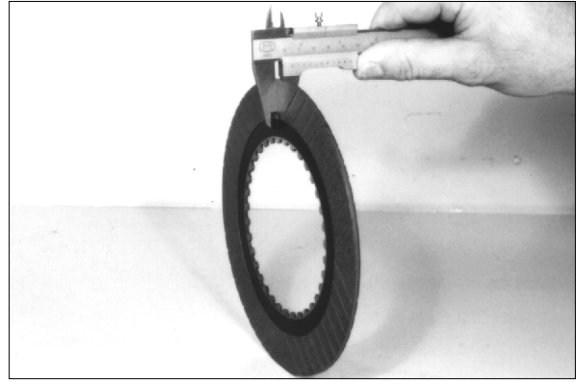
The inner plates have a constant thickness of $s = 3.50\text{mm}$.

5 Outer plates $s = 2.50\text{mm}$ = 12.50mm

1 Outer plate $s = 2.00\text{mm}$ = 2.00mm

5 Inner plates $s = 3.50\text{mm}$ = 17.50mm

Gives the total height = Dimension Y = 32.00mm



17W78FA090

Example B

Dimension X 35.30mm

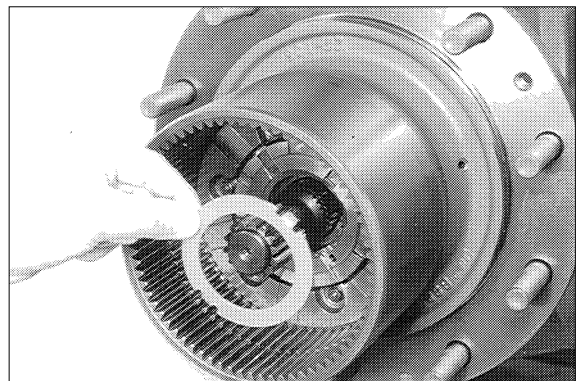
Dimension Y - 32.00mm

Difference = Piston travel = 3.30mm

If the required piston travel is not obtained, correct by means of corresponding outer plate(s)

($s = 2.00\text{mm}$, $s = 2.50\text{mm}$, $s = 3.00\text{mm}$).

Make thrust washer (with the two tongues in the free groove / steering knuckle hull) adhere with grease.



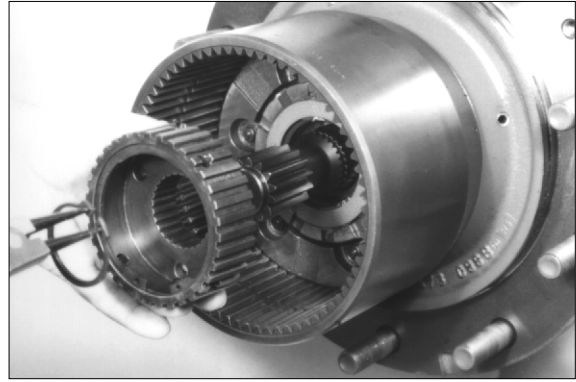
17W78FA091

Engage circlip in the plate carrier.



17W78FA092

Assemble the plate carrier upon the sun-gear shaft and fix it by means of circlip.
Now, place the sun-gear shaft along with the plate carrier against shoulder(thrust washer).



17W78FA093

Plate arrangement

To assure a correct plate arrangement, the undulated outer plater are marked by suppression of several teeth.

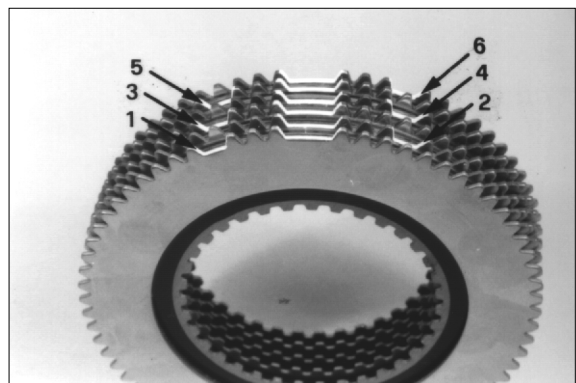
Figure show the correct arrangement of the outer plates.

Great tooth spaces(2 teeth missing) must be central in line.

Small tooth space (1 tooth missing, see Arrows) lies alternating to the left(outer plate 1, 3 and 5), resp. to the right (outer plate 2, 4, resp. 6).

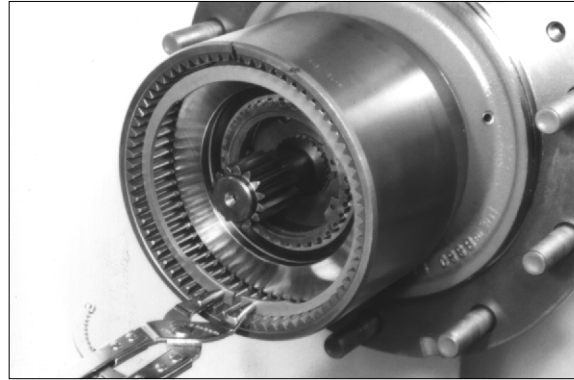
Between two outer plates, there must be always one coated (inner) plate installed.

Plate arrangement 5 Coated plates.



17W78FA094

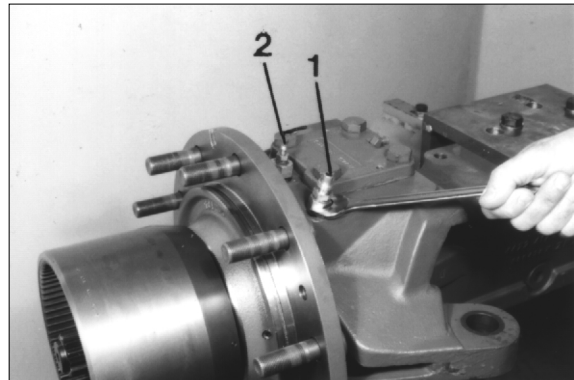
Install the plate pack according to the prescribed arrangement and fix it by means of backing plate and circlip.
If outer plates of different thickness are assembled, install the thinner plates externally in the pack.



17W78FA095

Check tightness of the brake hydraulic system

Install pressure port(1) and breather(2)
(use new sealing rings).



17W78FA096

Bleed and test the brake system.
Before starting the test, actuate the brake hydraulic system several times(10 times at least), and bleed it at the same time.

High-pressure test :

Build up a test pressure of $p = 120$ bar.
Close the shut-off valve.
During a test duration of 5 minutes, a pressure drop of max. 2% ($p = 117$ bar) is permitted.



17W78FA097

Low -pressure test :

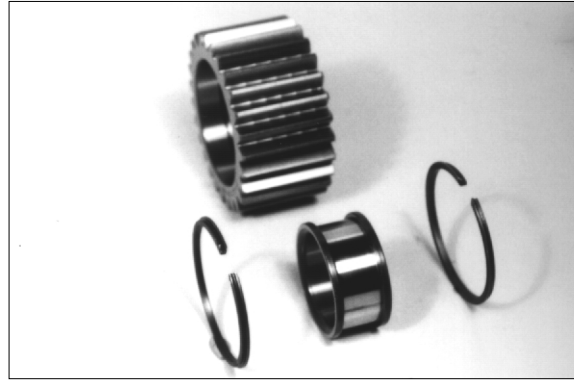
Reduce the test pressure to $p = 5$ bar.
During a test duration of 5 minutes, no pressure drop may occur.

Test media :

Motor Oils SAE 10-W, corresponds to MIL-L2104 C, MIL-L 45 152, API-CC, CD, SC, SD, SE, AFT-Oils Type A-Suffic A Dexron of II D.

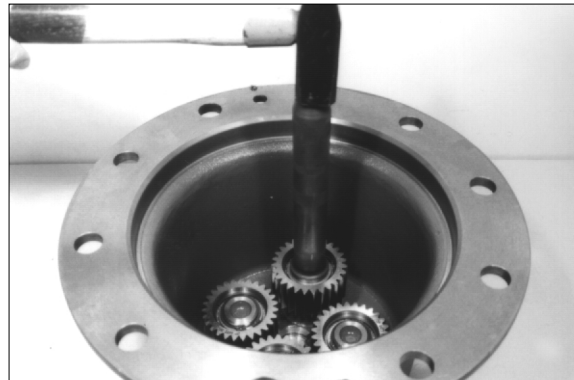
(8) Planetary gears

Install components, as illustrated in the figure on the right, into the planetary gear. Make cylindrical rollers adhere with grease on the bearing inner race. Offset side (small diameter) of the angle rings is always facing the outside.



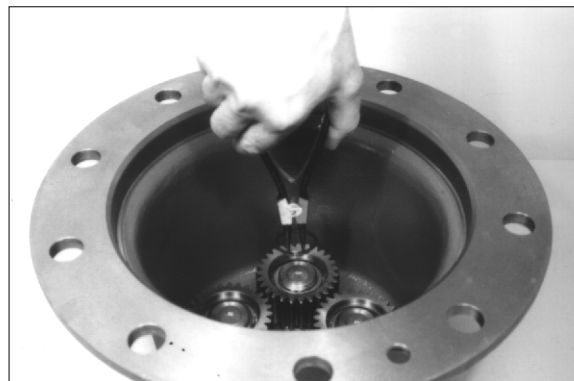
17W78FA098

Heat the bearing inner race of the pre-assembled planetary gear and place it against shoulder. Large radius on the bearing inner race is facing the planetary carrier (downward).



17W78FA099

Fix planetary gears by means of circlips.



17W78FA100

Adjust end play of the Sun-gear shaft 0.3-0.6mm (Figure -)

Determine dimension I from the flange-mounted surface / planetary carrier to the locating face / thrust washer. Dimension I e.g. : 199.10mm

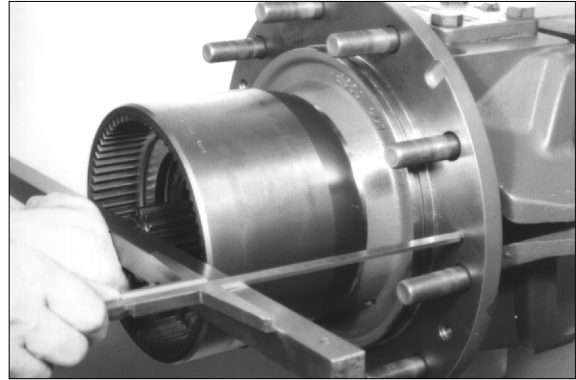


17W78FA101

Slide sun-gear shaft, resp. plate carrier in until contact is obtained.

Measure dimension II from the end face / sun-gear shaft to the flange-mounted surface / hub

Dimension II e.g. : 196.60mm



17W78FA102

Example

Dimension I 199.10mm

Dimension II -199.60mm

Difference = 2.50mm

Required end play e.g. - 0.50mm

Difference = Thickness of
thrust washer e.g. $s = 2.00\text{mm}$

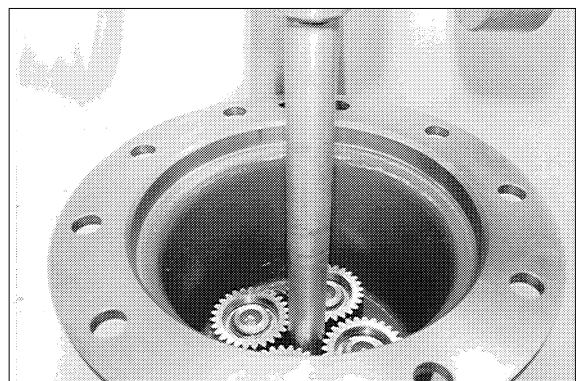
Insert thrust washer in the planetary carrier.

If the thrust washer has only one phosphatized surface, it must be installed with this surface facing the sun-gear shaft.



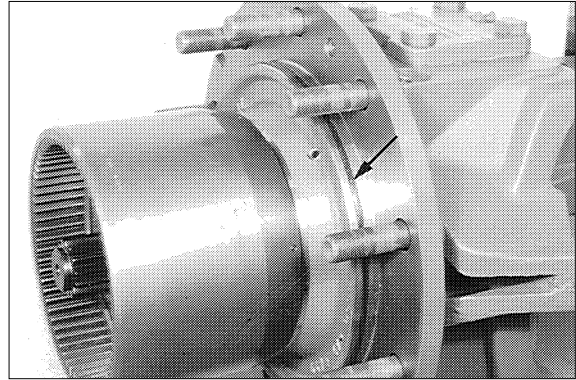
17W78FA103

According to the version - press in thrust washer - resp. in case of an unfavorable tolerance disposition, caulk(4 points).



17W78FA104

Grease the O-ring and insert it in the annular groove of the hub.



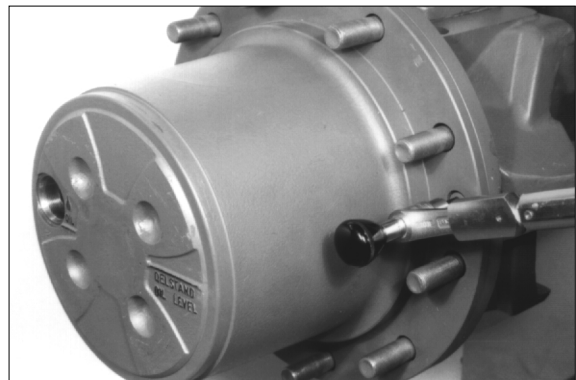
17W78FA105

Assemble the planetary carrier and fasten it by means of socket head screws.

Tightening torque :

M10 / 8.8 - 3.3kg · m (23.9 lb · ft)

M12 / 8.8 - 5.6kg · m (40.5 lb · ft)



17W78FA106

Employ new O-ring for the screw plug and screw it in.

Before the axle is put into service, pay attention to the lubrication and maintenance instructions, page 204.



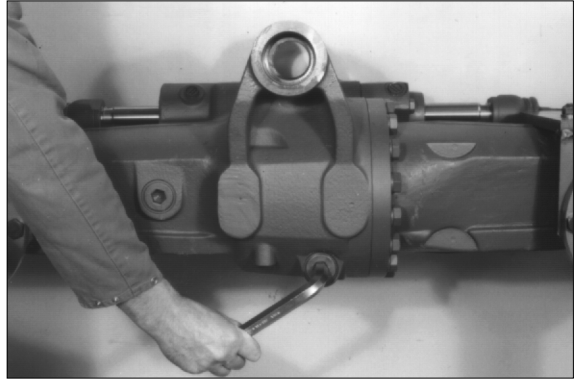
17W78FA107

4. DRIVE UNIT / DIFFERENTIAL DISASSEMBLY AND ASSEMBLY

1) DISASSEMBLY

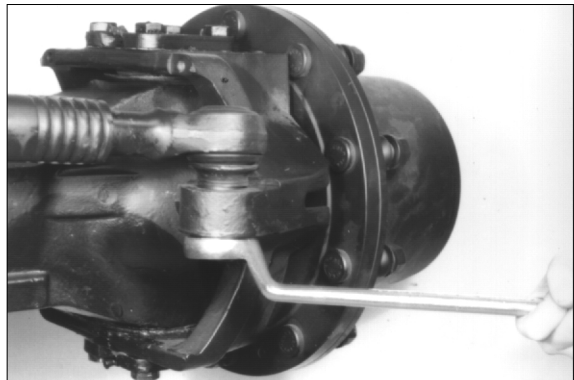
(1) Differential

Drain oil from the axle housing.



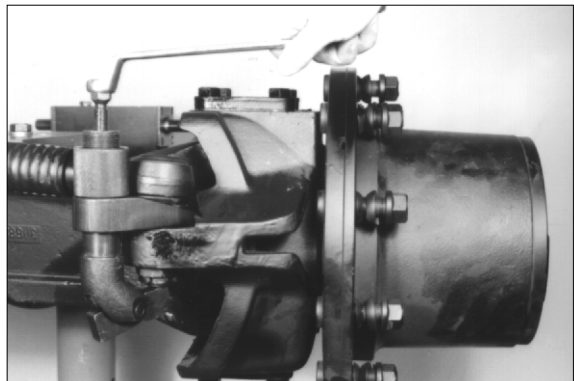
17W78FA108

Remove cotter pin, loosen castle nut for some threads.



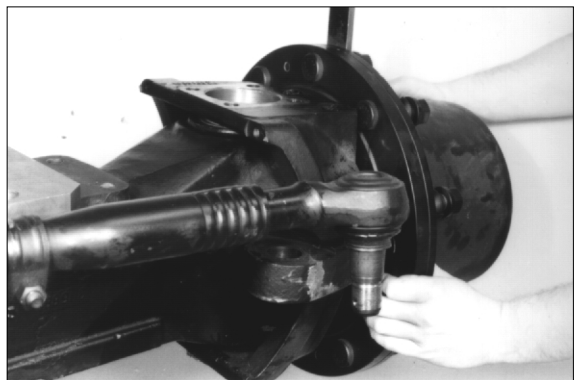
17W78FA109

Loosen tie rod by means of ejection tool. Now, screw off castle nut and unhook tie rod.



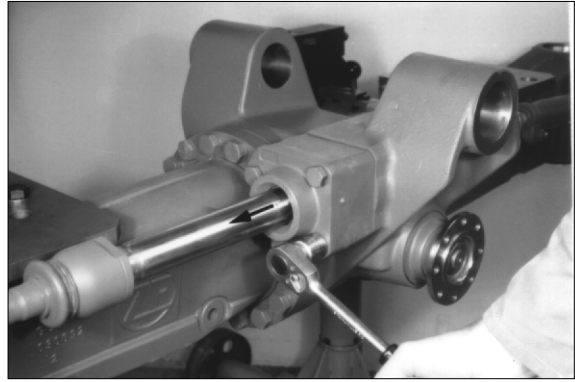
17W78FA110

Remove bearing pin and separate the two final drives from the axle housing. Pay attention, on the upper bearing pin, to the released shim.



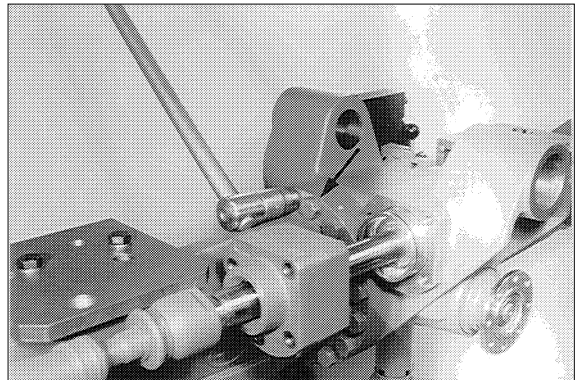
17W78FA111

Loosen hex head screws of the guide.
Displace guide on the piston rod(see
Arrows).



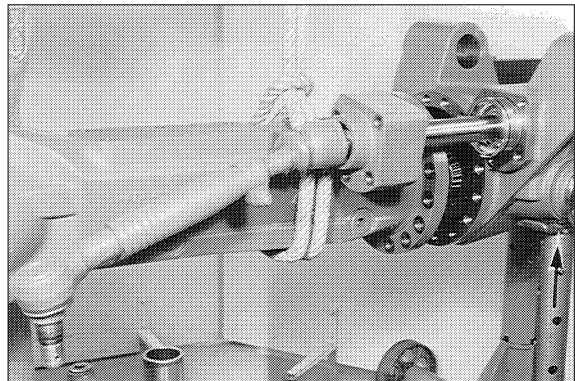
17W78FA112

Loosen hex head screws and reamed
bolt(see Arrow).
If a ground anchoring of the assembly car
is not possible, the axle housing part I
must be secured by means of a support
(see Figure -Arrow).



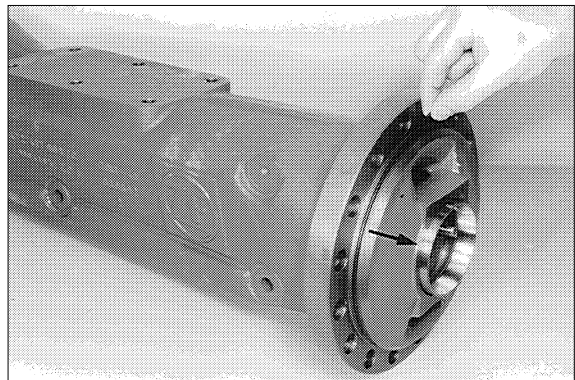
17W78FA113

Separate axle housing part II from part I.



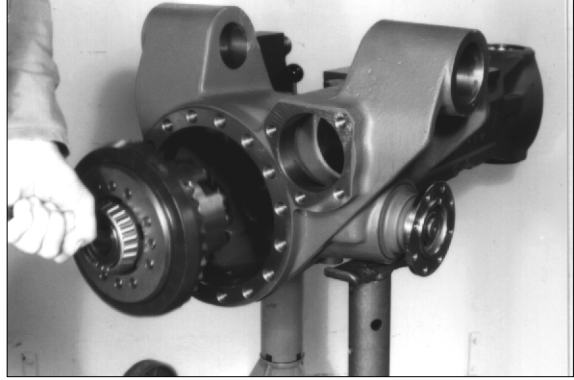
17W78FA114

Remove O-ring and drive the bearing
outer race(see Arrow) out of the axle
housing bore.
Pay attention to the released shim.



17W78FA115

Lift the complete differential case out of the axle housing.



17W78FA116

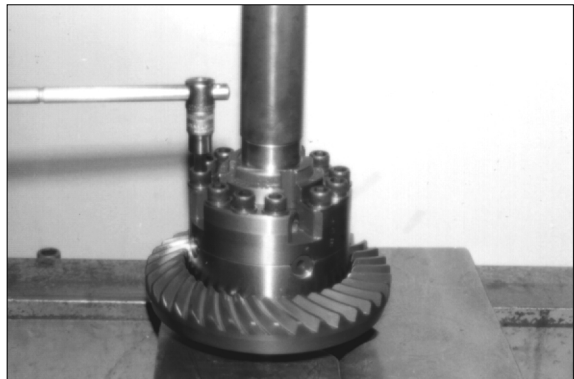
(2) Differential

Pull off the two tapered roller bearings.



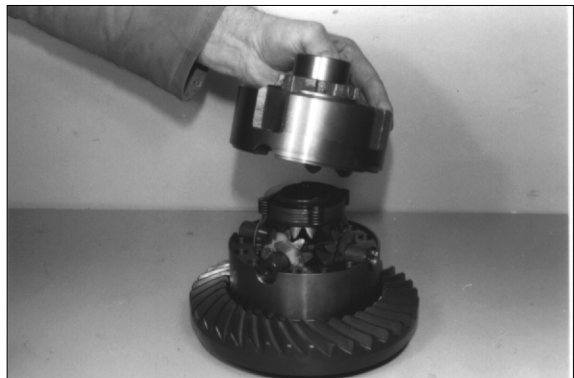
17W78FA117

Loosen socket head screws.



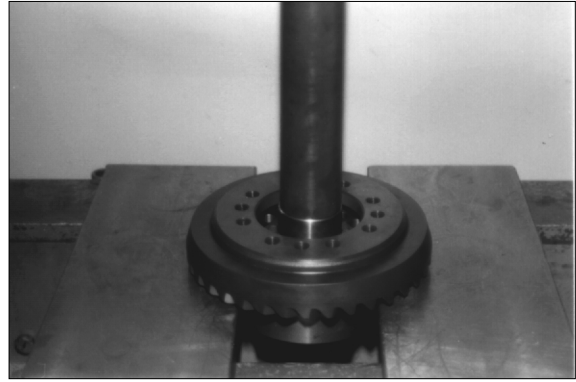
17W78FA118

Take off differential case half / part II and remove the released components.



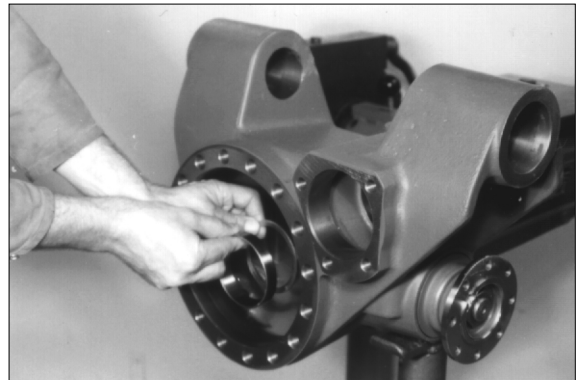
17W78FA119

Press crown wheel from differential case half part I.



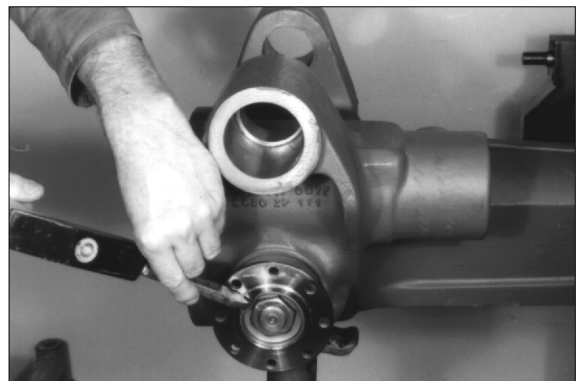
17W78FA120

Remove bearing outer race from axle housing / part I.
Pay attention to the released shim.



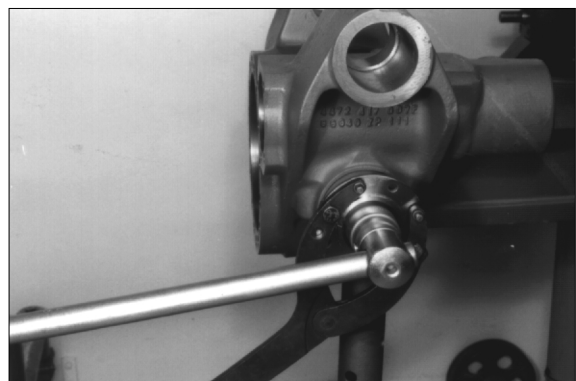
17W78FA121

(3) Remove drive pinion
Remove lock plate.



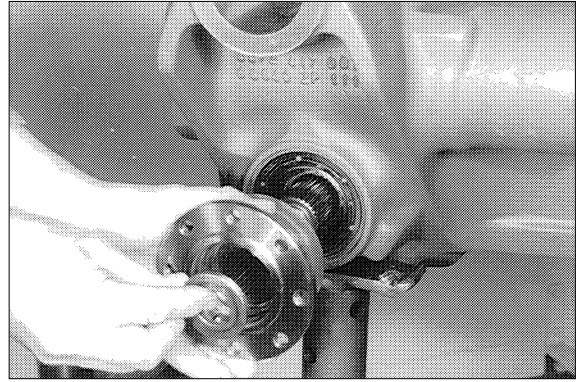
17W78FA122

Loosen hex nut.



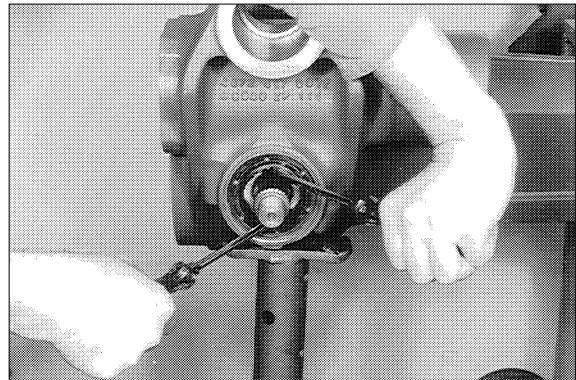
17W78FA123

Pull off disk and drive flange.



17W78FA124

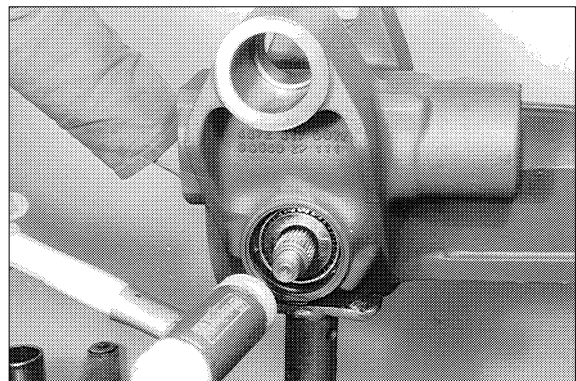
Pry out shaft seal.



17W78FA125

Remove drive pinion.

If the pinion bearing should not be renewed, pay attention that during the driving out of the drive pinion, the outer bearing inner race is always held against shoulder to avoid this damage of the bearing.



17W78FA126

Remove spacing ring.



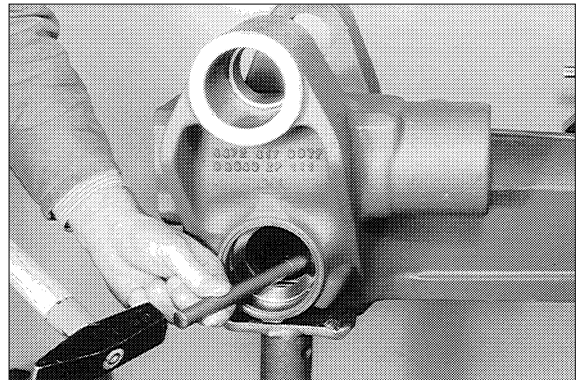
17W78FA127

Pull bearing inner race from drive pinion.



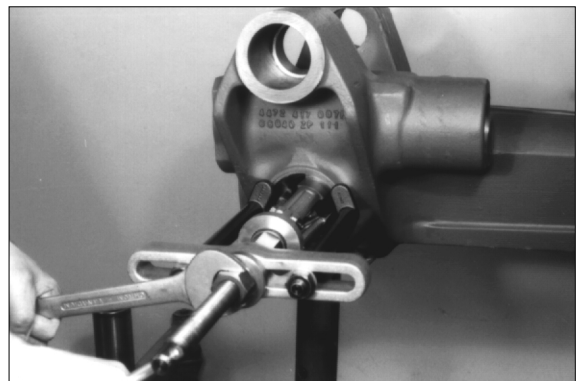
17W78FA128

Drive the bearing outer race out of the inner bearing bore.
Pay attention to the released spacing washer.



17W78FA129

Pull the bearing outer race out of the outer bearing bore.



17W78FA130

2) Reassembly

If a complete crown wheel set is installed, pay attention to the same mating numbers of drive pinion and crown wheel.

If crown wheel or drive pinion are damaged, the two parts must be renewed as a set.

(1) Determine thickness of shim - to obtain a correct contact pattern

The following measuring operations have to be carried out with utmost precision.

Inexact measurements bring along a faulty contact pattern and require another disassembly and reassembly of the drive pinion.

Determination of shim thickness "with" given dimension I (on the axle housing / part I)

Read dimension I from the axle housing / part I.

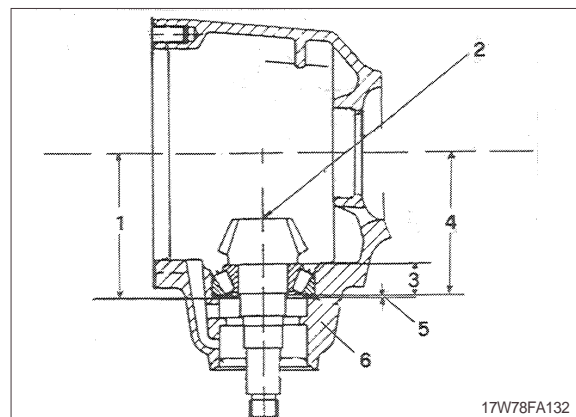
Dimension I e.g. : 145.05mm



17W78FA131

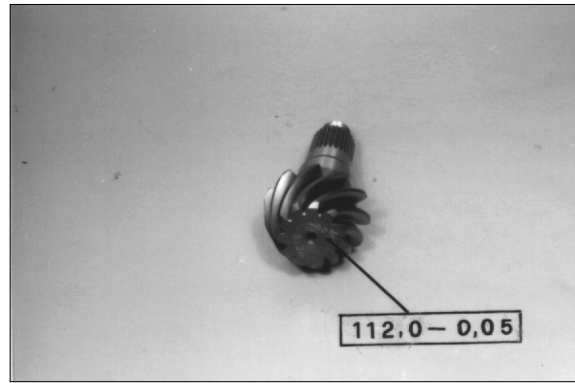
Reference Draft

- 1 Dimension I
- 2 Dimension II (Pinion dimension)
- 3 Dimension III (Bearing width)
- 4 Dimension X
- 5 Shim
- 6 Axle housing



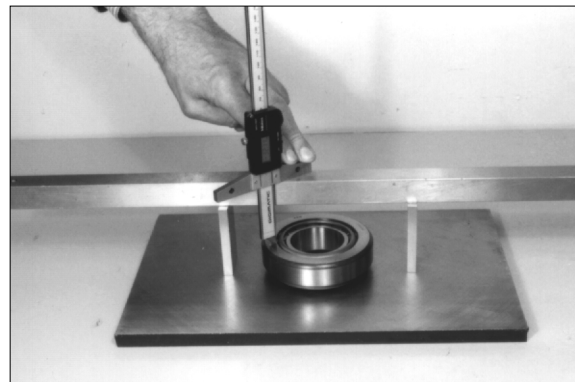
17W78FA132

Read dimension (Pinion dimension).
 Dimension II e.g. $(112.0_{-0.5}) = 111.95\text{mm}$



17W78FA133

Determine dimension III (Bearing width).
 Dimension III e.g. : 32.05mm



17W78FA134

Example A

Dimension II	111.95mm
Dimension III	<u>+ 32.05mm</u>
Gives Dimension "X"	<u>144.00mm</u>

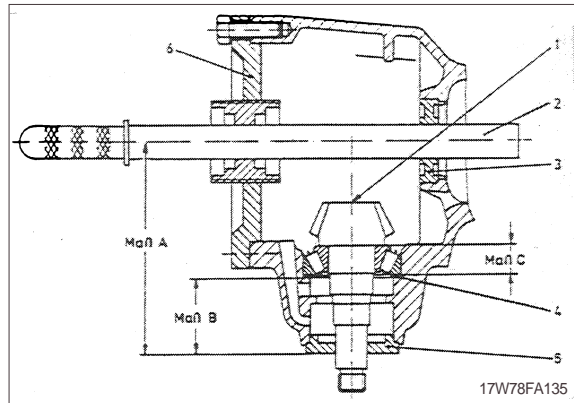
Example B

Dimension I	145.05mm
Dimension II	<u>- 144.00mm</u>
Difference = Thickness of shims =	<u>1.05mm</u>

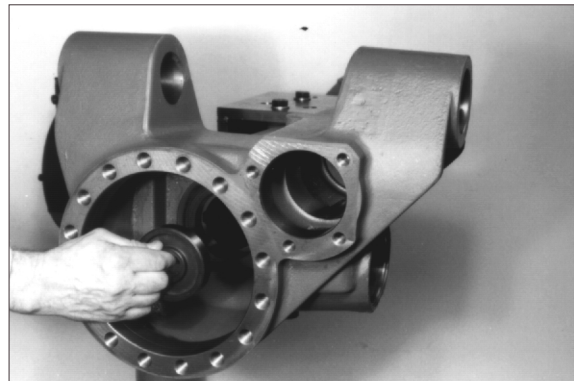
**Determination of shim thickness
"without" definition of dimension ,
(on the axle housing / part I)**

Reference Draft

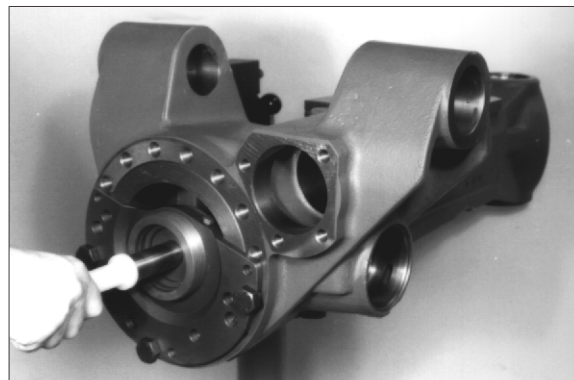
- 1 Pinion dimension and mating number
- 2 Measuring shaft
- 3 Adjusting piece
- 4 Shim
- 5 Gauge ring
- 6 Measuring cover, centering ring



Insert adjusting piece(3) in the bore of axle housing / part I (Differential bearings).



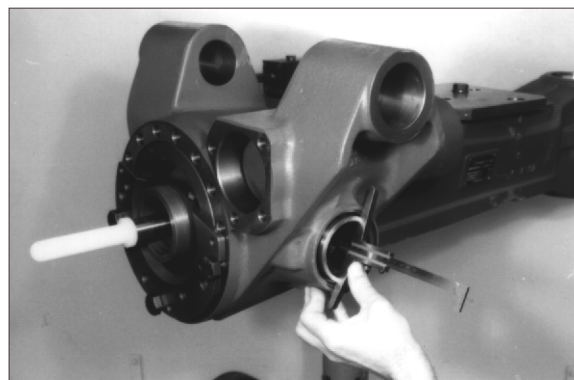
Push centering ring upon measuring cover(6), place it against shoulder and fasten it by means of hex head screws. introduce measuring shaft(2) into the bore of the adjusting piece(3) until the location is obtained.



Position gauge ring(5) on the locating face of the outer bearing inner race against shoulder.

Determine dimension A from the plane surface of the gauge ring(5) to the center/measuring shaft(2) (see Draft).

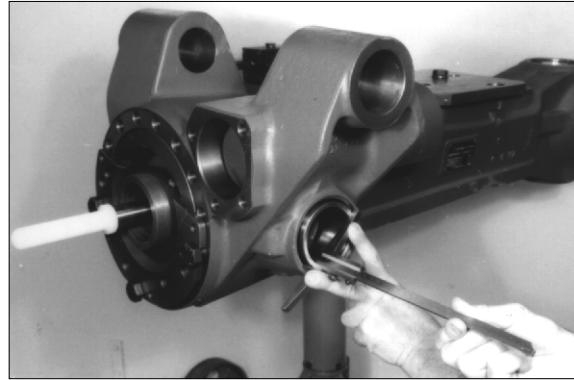
Determined dimension e.g.	208.85mm
1/2 Ømeasuring shaft	+15.00mm
Gives dimension "A" e.g.	<u>223.85mm</u>



Measure dimension B from the plane surface / gauge ring(5) to the locating face of the inner bearing outer race(see Draft).

Dimension B e.g. : 78.80mm

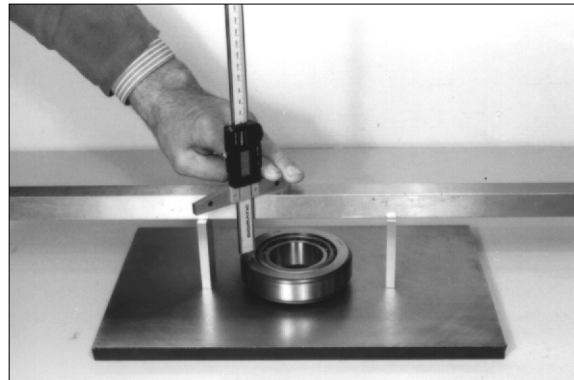
Now, remove measuring device.



17W78FA139

Determine dimension C (Bearing width).

Dimension C e.g. : 32.05mm

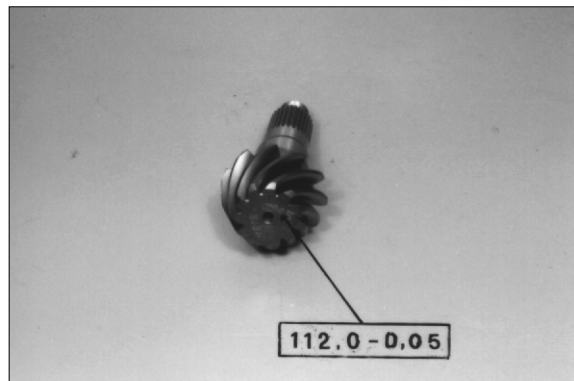


17W78FA140

Read pinion dimension(1).

Pinion dimension e.g.

$(112.0_{-0.5}) = 111.95\text{mm}$



17W78FA141

Example

Dimension A 223.85mm

Dimension B + Dimension C

$(78.80 + 32.05) \quad - 110,85\text{mm}$

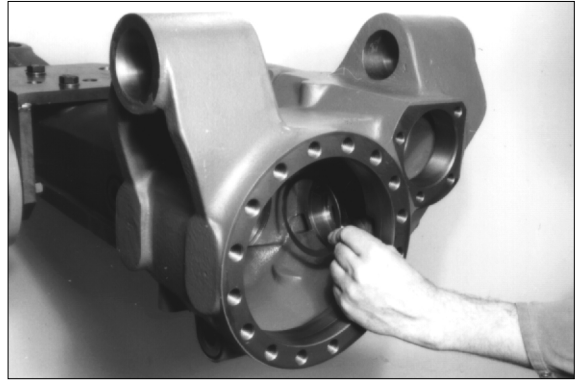
Gives 113.00mm

Pinion dimension $- 111.95\text{mm}$

Difference = Shim thickness $s = 1.05\text{mm}$

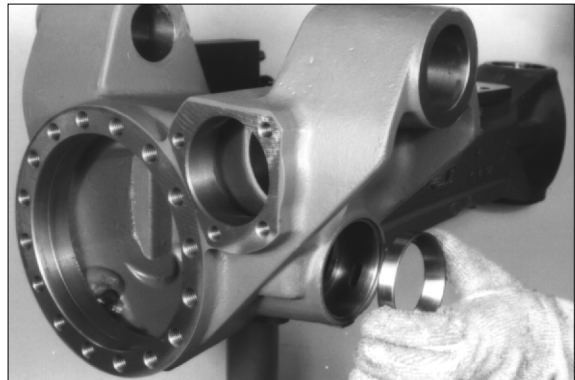
(2) Install drive pinion

Insert determined shim e.g. $s = 1.05\text{mm}$.



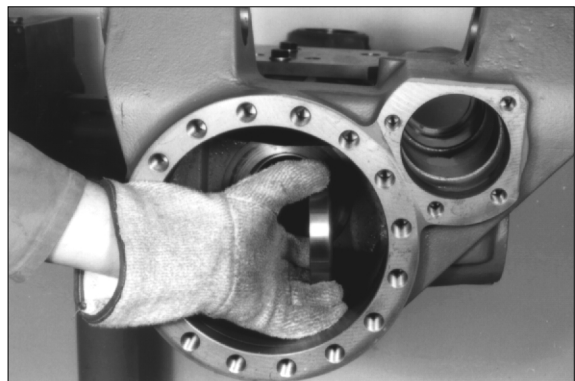
17W78FA142

Undercool and insert outer bearing outer race.



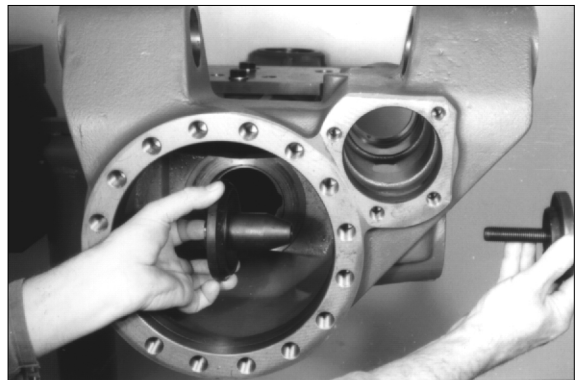
17W78FA143

Undercool and insert inner bearing outer race.



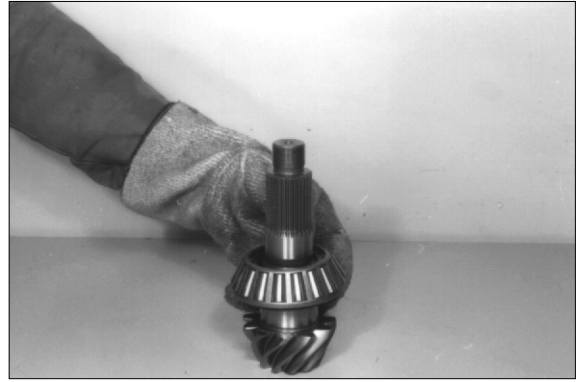
17W78FA144

Position the two bearing outer races against shoulder, using special device.



17W78FA145

Heat tapered roller bearing and replace it firmly against shoulder.
Reset the bearing after the cooling down.



17W78FA146

Adjust rolling moment of the drive pinion bearing 0.1-0.2kg · m(0.7-1.4 lb · ft)

Assemble gauge ring.
Shape and description of the gauge ring, see Draft .

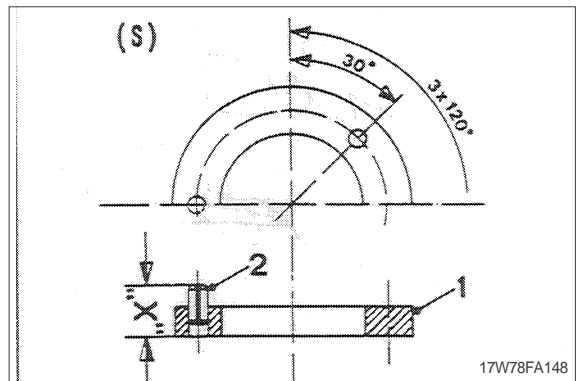


17W78FA147

Reference Draft

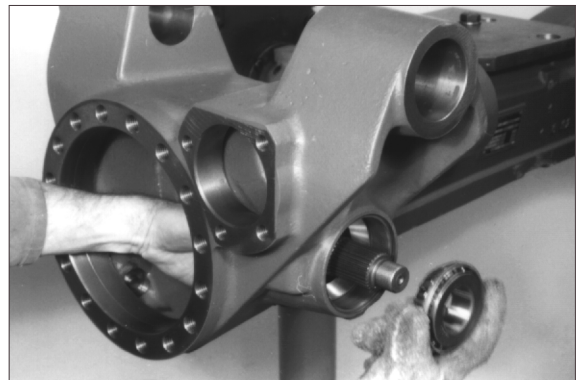
- 1 Gauge ring
- 2 Roll pins(3EA)

Dimension "X" = Thickness of the spacing ring.



17W78FA148

Insert pre-assembled drive pinion and assemble the heated bearing inner race until contact is obtained.

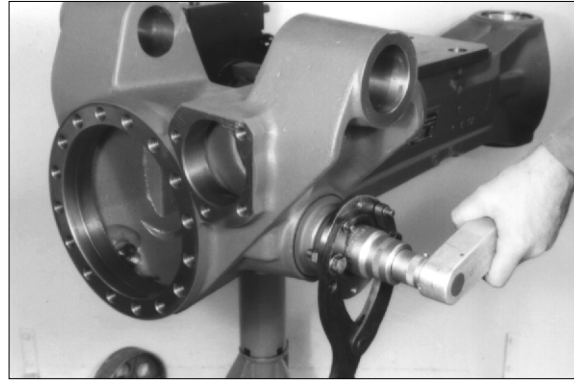


17W78FA149

Install drive flange.

Assemble the disk and tighten the hex nut until the required rolling moment of $0.1-0.2 \text{ kg} \cdot \text{m}$ ($0.7-1.4 \text{ lb} \cdot \text{ft}$) is obtained.

During the tightening, make several full revolutions of the drive pinion in both senses.

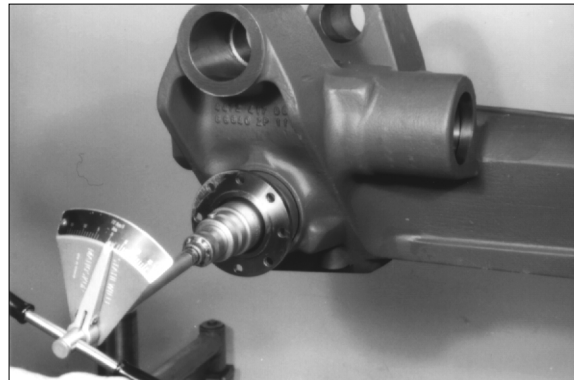


17W78FA150

Check the rolling moment (aim at the upper value).

Rolling moment :

$0.1-0.2 \text{ kg} \cdot \text{m}$ ($0.7-1.4 \text{ lb} \cdot \text{ft}$)

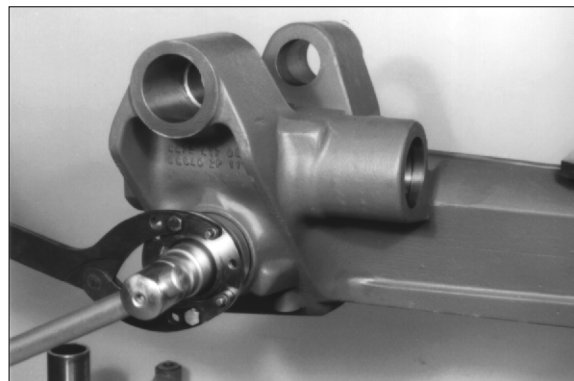


17W78FA151

Loosen hex nut.

Pull off disk and drive flange.

Remove drive pinion again.



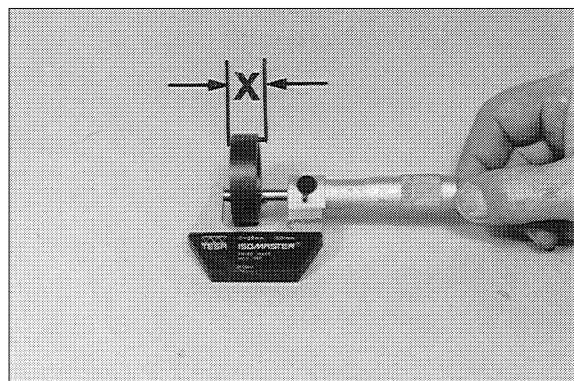
17W78FA152

Remove gauge ring from drive pinion and determine dimension "X"

(see also Draft).

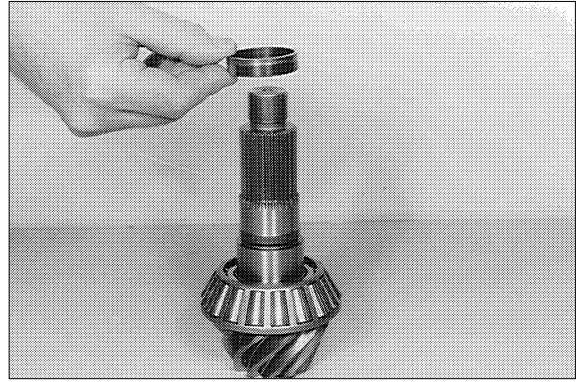
Dimension "X" e.g. $s = 11.45 \text{ mm}$

Dimension "X" corresponds to the thickness of the spacing ring to be installed.



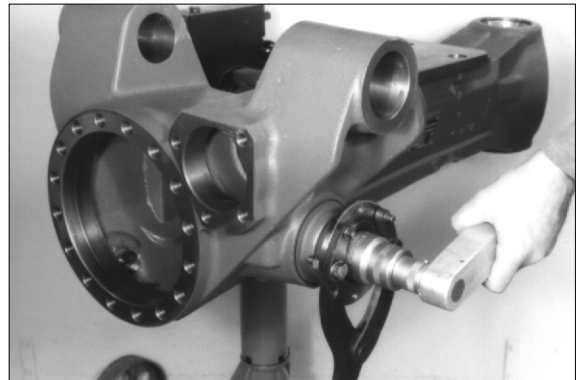
17W78FA153

Assemble instead of the gauge ring the determined spacing ring (e.g. $s = 11.45\text{mm}$).



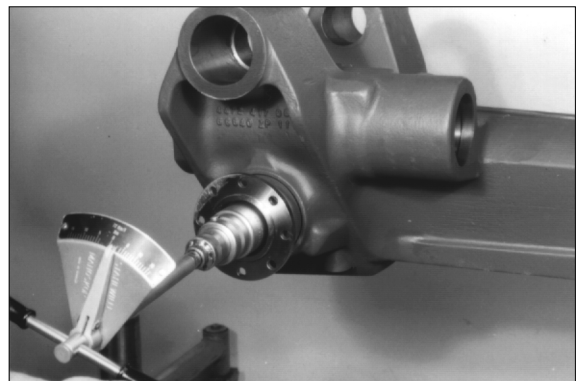
17W78FA154

Install pinion again.
Assemble drive flange and disk and tighten hex nut.
Tightening torque : $43.8\text{kg} \cdot \text{m}$ ($316.8\text{lb} \cdot \text{ft}$)
During the tightening, make several full revolutions of the drive pinion in both senses.



17W78FA155

Check rolling moment again.
If the required rolling moment ($0.1 - 0.2\text{kg} \cdot \text{m}$) is not obtained, correct by means of a corresponding spacing ring.



17W78FA156

Loosen hex nut.
Pull off disk and drive flange.



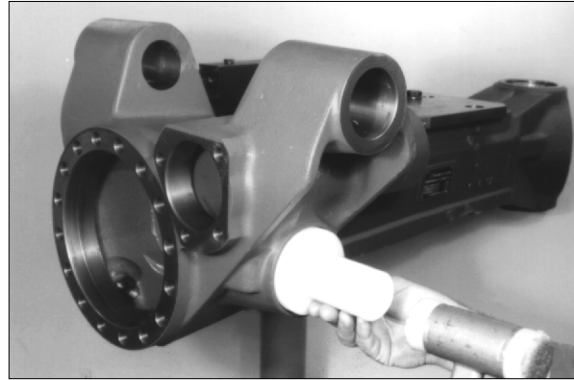
17W78FA157

Install shaft seal and grease it in the zone sealing lip / dust lip.

By using the prescribed driver, the exact installation depth is obtained.

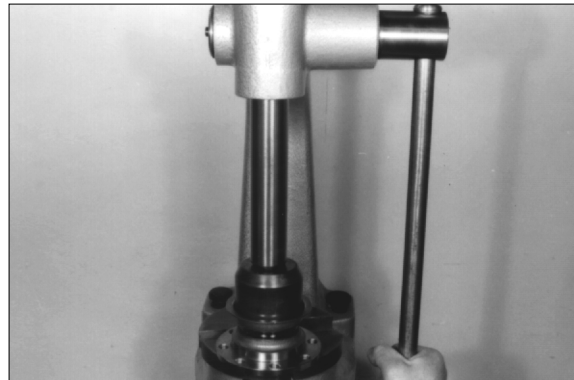
If the outer diameter of the shaft seal is

- a) Rubber-coated-wet with spirit / water mixture(1:1)
- b) Metallic-cover with sealing compound loctite(Type-No. 574).



17W78FA158

Press shield upon the drive flange until contact is obtained, if necessary, insert hex head screws in the drive flange prior to this step.

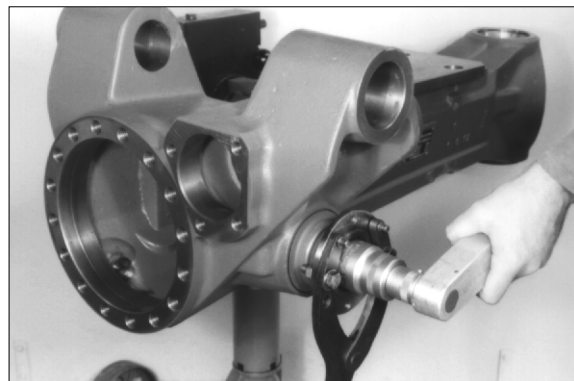


17W78FA159

Assemble drive flange and disk and fasten finally by means of hex nut.

Tightening torque : $43.8\text{kg} \cdot \text{m}$ ($316.8\text{lb} \cdot \text{ft}$)

Carry out securing of the hex nut-after the contact pattern has been taken.



17W78FA160

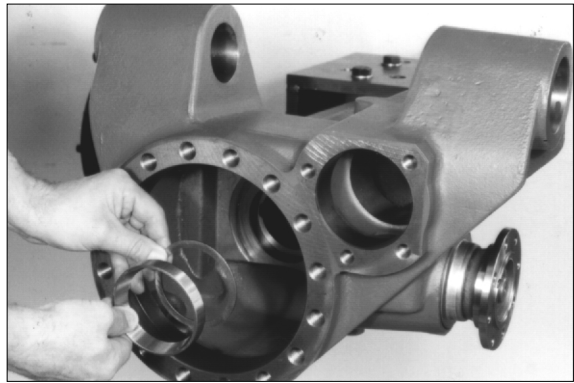
(3) Determine and adjust backlash of the crown wheel set and bearing preload of the differential

Backlash : 0.15-0.25mm

Bearing rolling moment :

0.1- 0.2kg · m(0.7-1.4lb · ft)

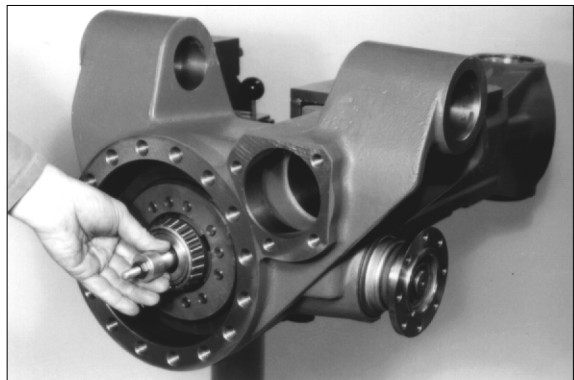
Insert shim e.g. $s = 170\text{mm}$ (empirical value) in the bearing bore(axle housing / part I) and install subsequently bearing outer race.



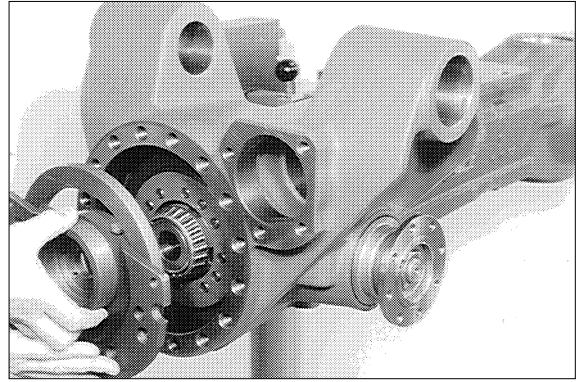
Insert crown-wheel side bearing outer race in the measuring device.



Insert differential in the axle housing and install clamping segment into the stub shaft bore of the differential.

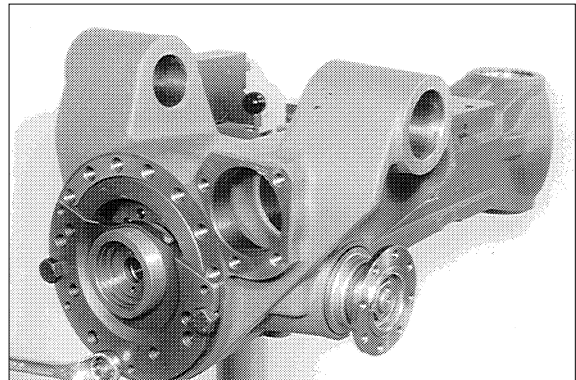


Fix the differential by means of measuring cover.



17W78FA164

Fasten special device by means of hex head screws.

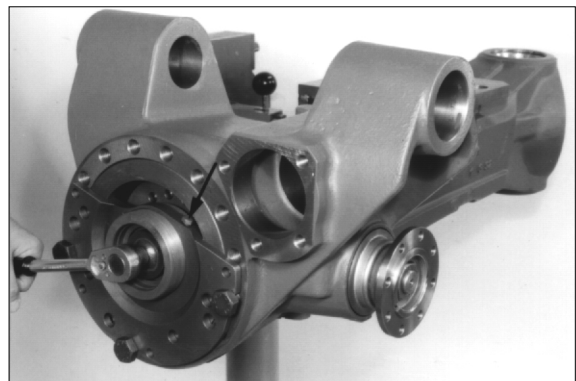


17W78FA165

Adjust the differential by application of the threaded spindle free of play and pressure.

During the adjustment, make several full revolutions of the drive pinion.

Now, fix the threaded spindle by means of locking screw(see Arrow).



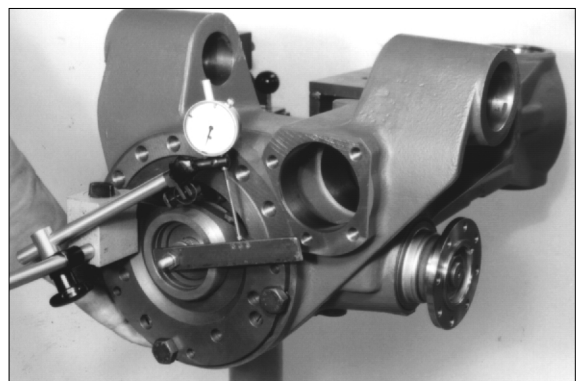
17W78FA166

Check Backlash

Mount straightedge on the clamping segment. Apply dial indicator right-angled(position = outer diameter / crown wheel) on the straight edge and check backlash.

Backlash : 0.15-0.25mm

In case of deviations from the required backlash, correct by means of a corresponding shim(see Figure).

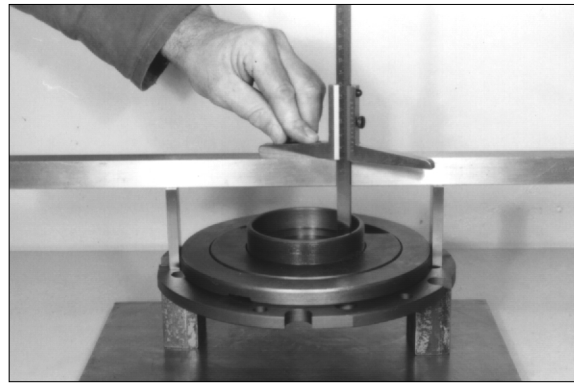


17W78FA167

After termination of the backlash adjustment, remove the measuring device again.

Determine dimension I from the flange-mounted surface to the locating face / bearing outer race.

Dimension I e.g. : 16.55mm



17W78FA168

Measure dimension II from the flange-mounted surface of the axle housing / part II to the locating face/ bearing outer race.

Dimension II e.g. : 13.90mm

With various axle types, the dimension II can be greater than dimension I.

Change the example accordingly.



17W78FA169

Example

Dimension	16.55mm
Dimension	-13.90mm
Difference	2.65mm
Required bearing preload	+0.10mm
Gives shim thickness	$s = 2.75\text{mm}$

With a bearing preload of 0.10mm, the required rolling moment of 0.1-0.4kg · m is obtained.

Insert the determined shim(s) e.g. $s = 2.75\text{mm}$ into the axle housing / part II and install subsequently the bearing outer race until contact is obtained.



17W78FA170

(4) Check contact pattern

Wet some tooth flanks of the crown wheel with gear-marking compound.
Screw in two adjusting screws.
Fasten axle housing/ part II provisionally by means of hex head screws.
Roll the crown wheel several times to and fro over the drive pinion.



17W78FA171

Remove differential.

In case of a greater contact pattern deviation, a measuring error has been made during the determination of the shim (Figure , page 244), which must be absolutely corrected.



17W78FA172

Install differential again.



17W78FA173

(5) Axle bolting

Insert new O-ring in the annular groove (arrow).



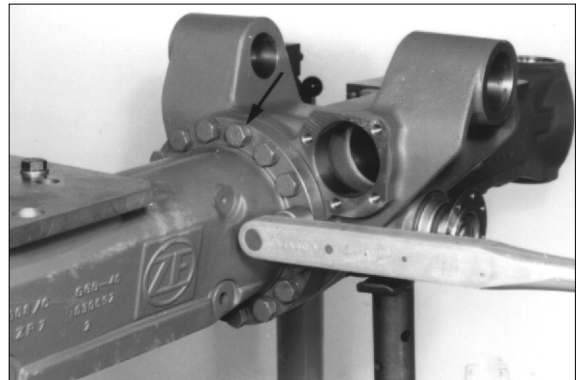
17W78FA174

Combine the axle housing / part II with part I.



17W78FA175

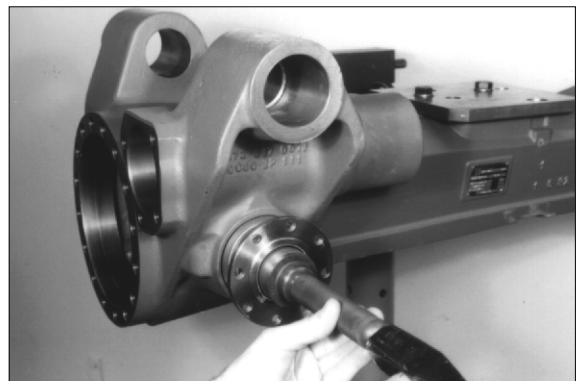
Fasten axle housing / part II by means of hex head screws (with washers).
Pay attention to the installation position of the reamed bolt (1EA), see Arrow.
Tightening torque : 41.8kg · m (302.3lb · ft)



17W78FA176

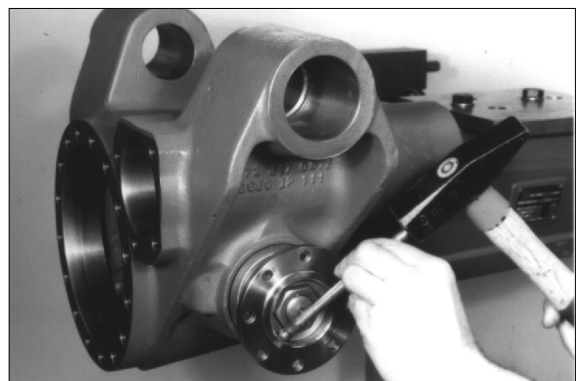
Secure drive pinion bolting

Drive lock plate upon the hex nut.



17W78FA177

Caulk lock plate.

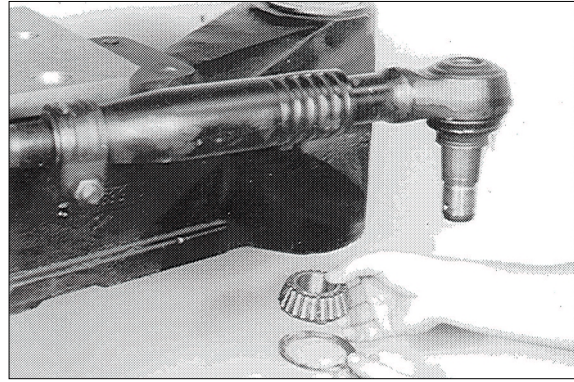


17W78FA178

(6) Mount final drive

Make bearing inner race adhere with grease in the steering knuckle bores and install subsequently sealing caps.

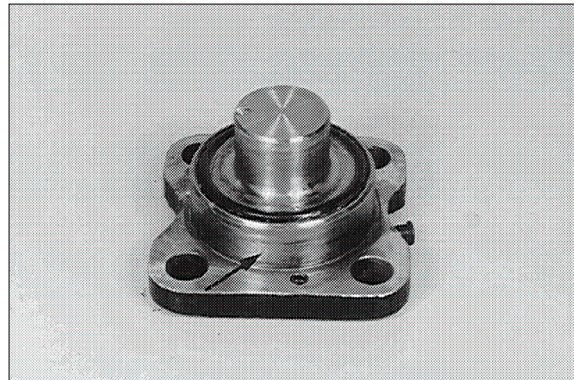
In case of the version bearing inner race(1x) with loose cylindrical rollers install inner race into the lower steering knuckle bore.



17W78FA179

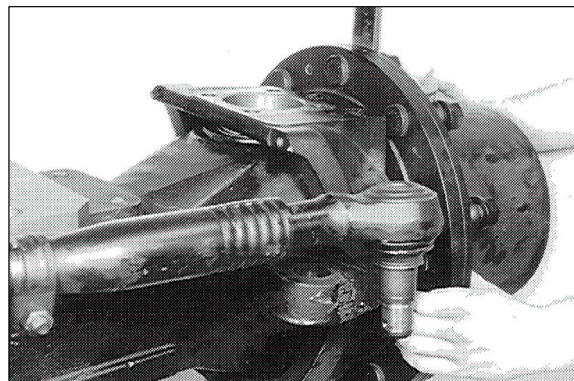
Make O-ring adhere with grease in the bearing pin.

Cover collar of bearing pin(Arrow) with anti corrosive agent.



17W78FA180

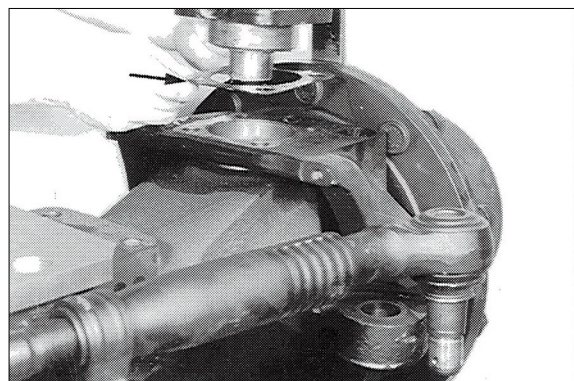
Assemble double joint shaft in the differential and position complete final drive on the axle.



17W78FA181

Fix final drive by means of the two bearing pins.

Insert shims(Arrow) on the upper bearing pin.



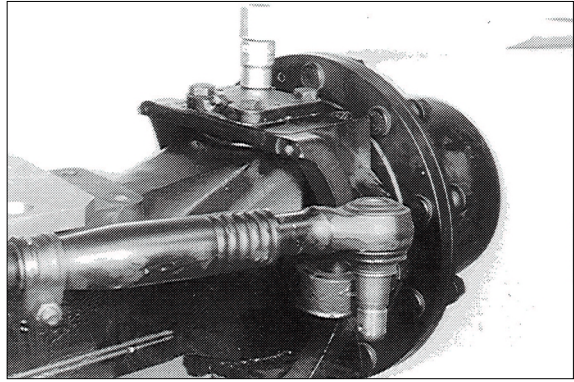
17W78FA182

Fasten bearing pins by means of hex head screws.

- Tightening torque : 28.6kgf · m
(206.5lbf · ft)

Pay attention to the installation position of the bearing pins.

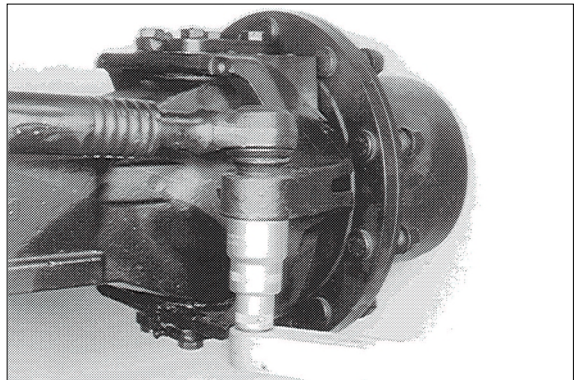
Grease nipple is facing the axle center.



17W78FA183

Engage tie rod in the steering knuckle hull. Tighten castle nut and secure it by means of cotter pin.

- Tightening torque : 30.6kgf · m
(221lbf · ft)



17W78FA184

3. STEERING ASSEMBLY

1) DISASSEMBLY

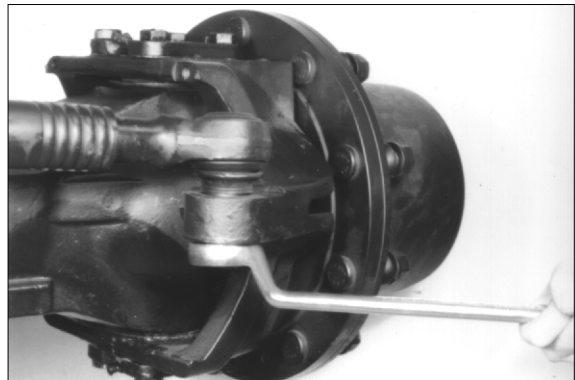
The illustration on the right shows the total view of the axle with integrated hydraulic steering assembly.



17W78FA185

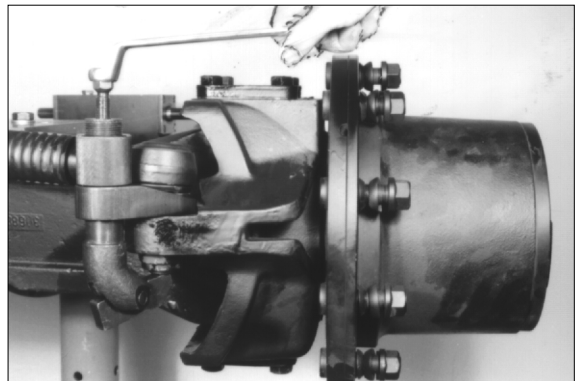
(1) Remove tie rod

Remove cotter pin, loosen castle nut for some threads.



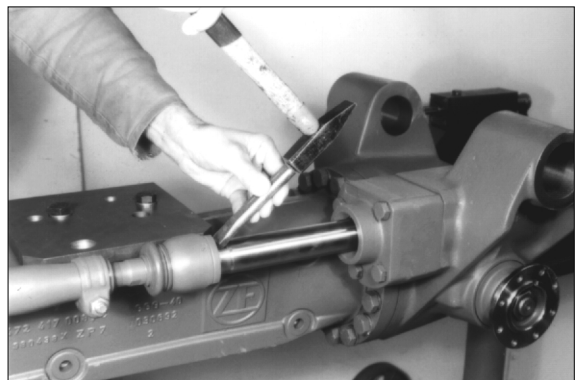
17W78FA186

Loosen tie rod by means of ejection tool. Now, unscrew castle nut and unhook tie rod.



17W78FA187

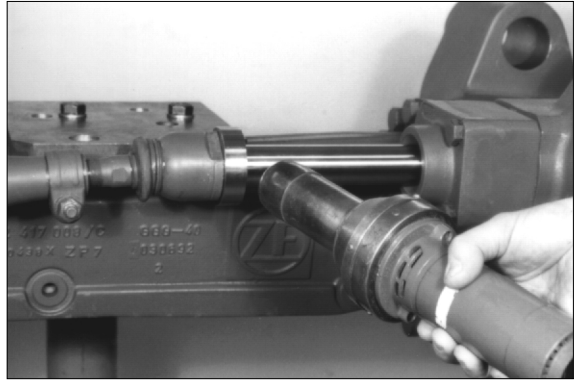
If necessary(according to the version), unlock the bolting piston rod / tie rod.



17W78FA188

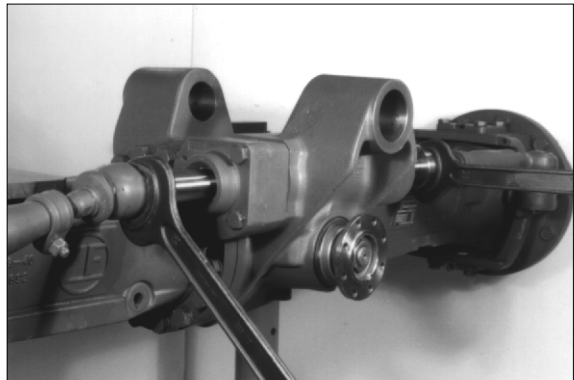
Version-tie rod "with" stop ring for the steering lock

Heat piston rod in the zone of the bolting piston rod / thrust bearing.



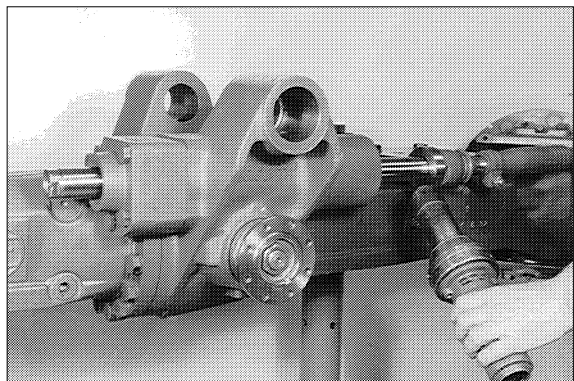
17W78FA189

Loosen bolting and separate the complete tie rod from the piston rod.
Now, pull off stop ring.



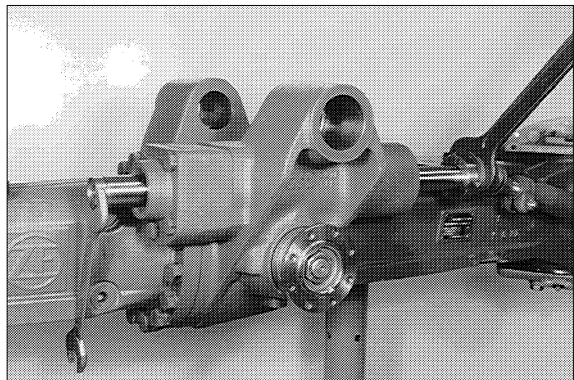
17W78FA190

Heat the second bolting of piston rod / axial joint.



17W78FA191

Remove second tie rod and stop ring.



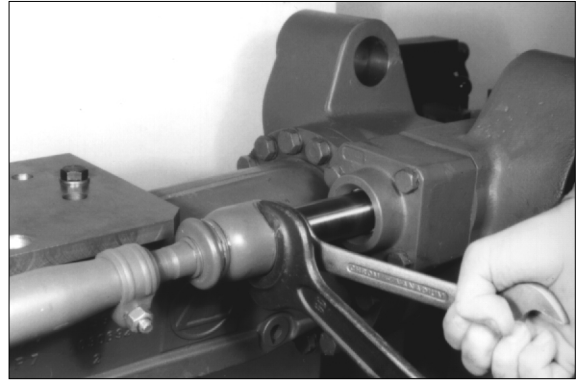
17W78FA192

Version-tie rod "without" stop ring for the steering lock

Heat bolting piston rod / axial joint.

Loosen bolting and remove complete tie rod.

Disassemble second tie rod accordingly.



17W78FA193

(2) Remove piston and cylinder

Loosen hex head screws and pull off guide II.

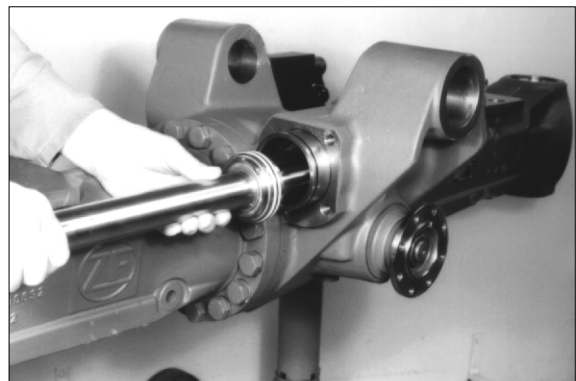
If necessary, remove sealing elements.

Pay attention to the released shim.



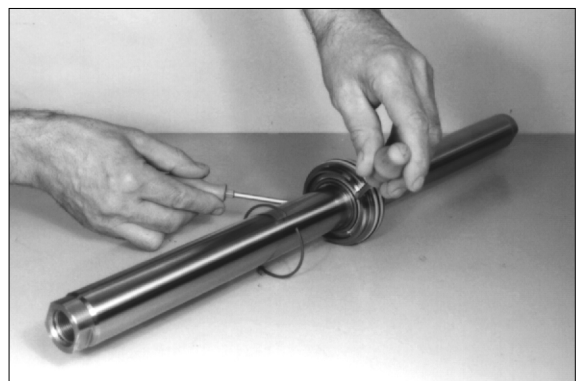
17W78FA194

Pull piston rod out of the cylinder.



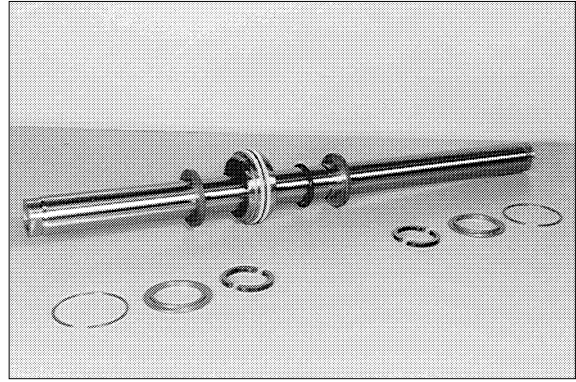
17W78FA195

Remove snap ring, circlip and split ring.



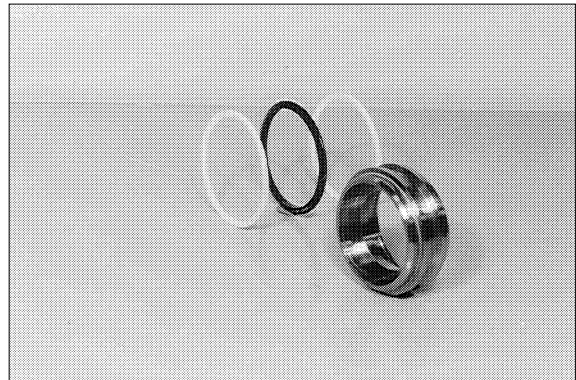
17W78FA196

Remove piston and remaining components.



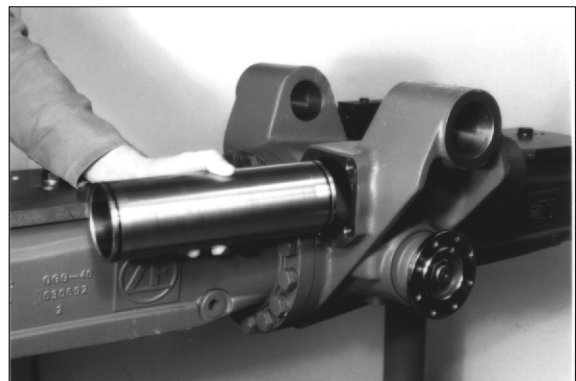
17W78FA197

Take scraper rings and sealing ring from the piston.



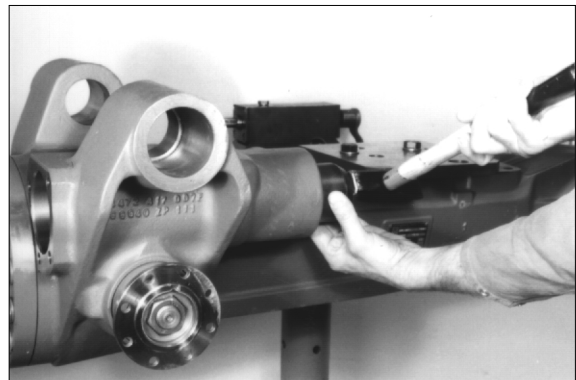
17W78FA198

Pull cylinder out of the housing.
Remove O-rings.



17W78FA199

Drive guide I out of the housing.
If necessary, remove sealing elements.



17W78FA200

2) REASSEMBLY

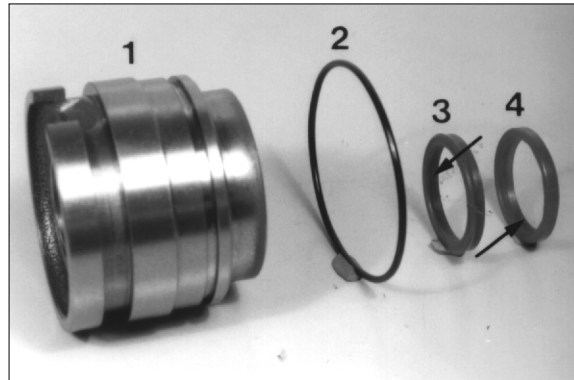
(1) Install guide, cylinder and piston

Pre-assemble guide I.

- 1 Guide
- 2 O-ring
- 3 Grooved ring
- 4 Scraper ring

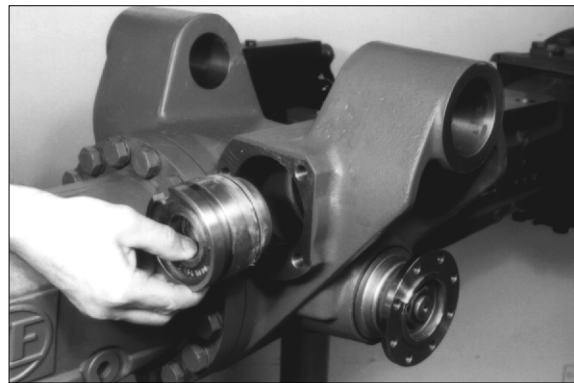
Grooved ring(3)-sealing lip shows inward (see Arrow).

Scraper ring(4)-dust lip shows outward (see Arrow).



17W78FA201

Grease O-ring and sealing elements and insert the pre-assembled guide in the steering box until contact is obtained.



17W78FA202

Grease O-ring (see Arrow) and insert it in the annular groove.

Introduce cylinder and reset it until contact is obtained.

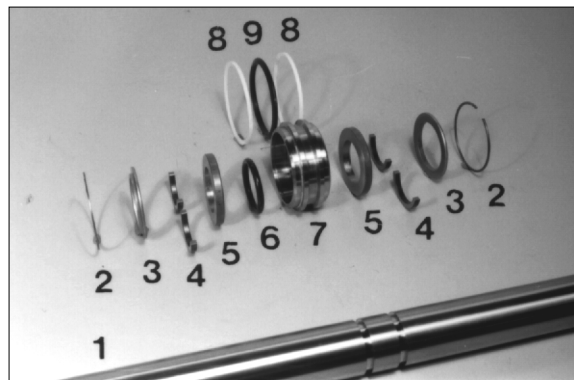
Pay attention to the different diameters of the O-rings.



17W78FA203

Sealing and locking elements of piston / piston rod.

- 1 Piston rod
- 2 Snap ring
- 3 Circlip
- 4 Split ring
- 5 Disk
- 6 O-ring
- 7 Piston
- 8 Scraper ring
- 9 Sealing ring



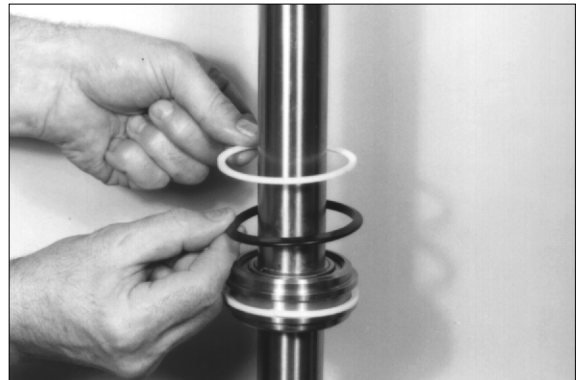
17W78FA204

Lay disk(5) into the piston.
Install subsequently circlip(3) and fix it by means of snap ring(2).



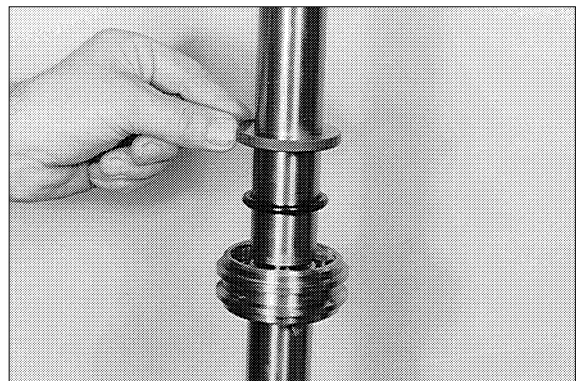
17W78FA205

Insert split ring(4) in the annular groove of the piston rod(see Arrow) and assemble the piston.



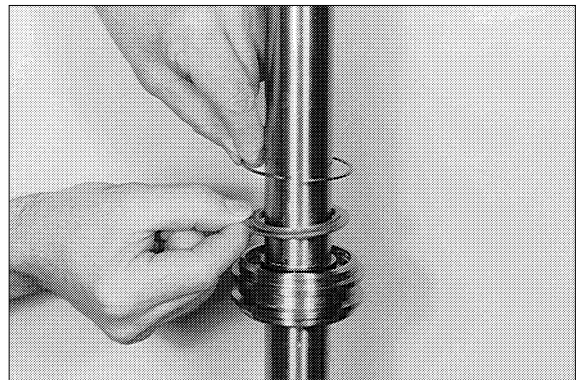
17W78FA206

Grease O-ring(6), mount it along with disk(5) carefully over the second annular groove into the piston.



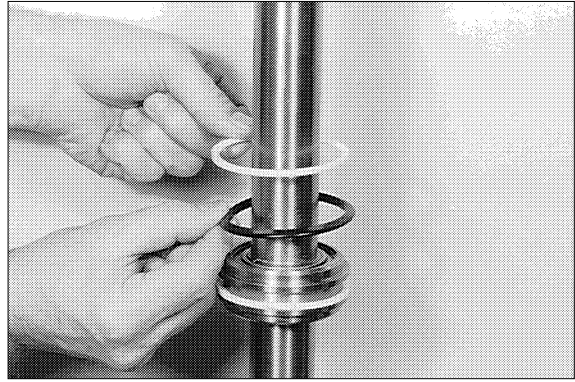
17W78FA207

Insert split ring(4), fix it by means of circlip (3) and snap ring(2).



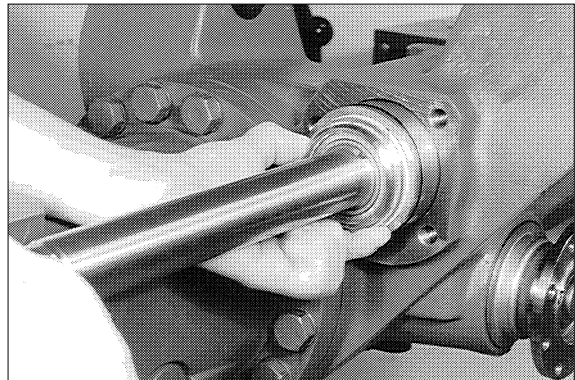
17W78FA208

Assemble scraper ring(8) and sealing ring(9) upon the piston.
Grease sealing elements.



17W78FA209

Introduce complete piston rod into the cylinder.



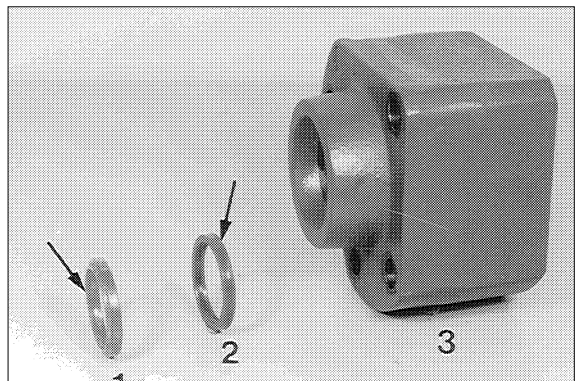
17W78FA210

Pre-assemble guide II.

- 1 Scraper ring
- 2 Grooved ring
- 3 guide

Scraper ring(1)-dust lip shows outward (see Arrow).

Grooved ring(2)-sealing lip shows inward(see Arrow).



17W78FA211

Determination of the spacing washer / steering cylinder

Dimension "A" e.g. : 32.05mm

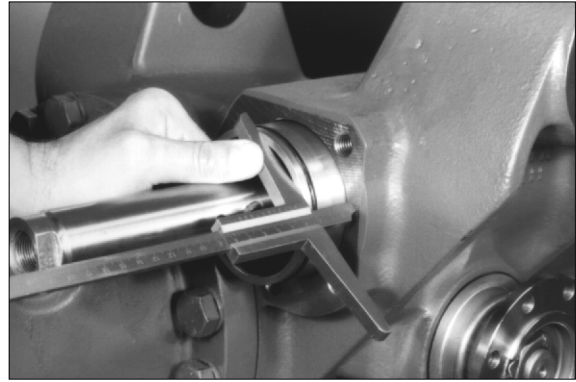


17W78FA212

Slide cylinder in until contact is obtained and measure dimension "B" from the end face / cylinder to the flange-mounted surface / axle housing.

Dimension "B" e.g. : 30.90mm

Pay attention to the contact of guide and cylinder.



17W78FA213

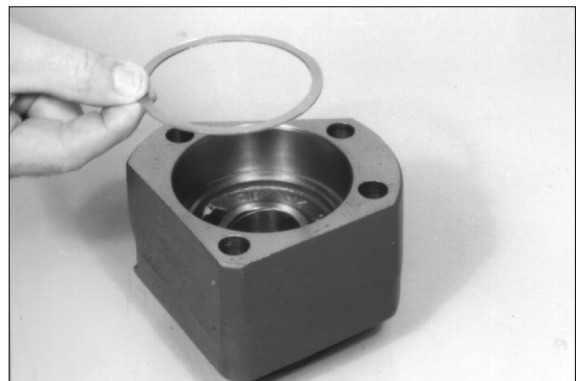
Dimension "A" 32.05mm

Dimension "B" -30.90mm

Difference = Shim thickness s = 1.15mm

Make determined shim(e.g. s = 1.15mm) adhere with grease.

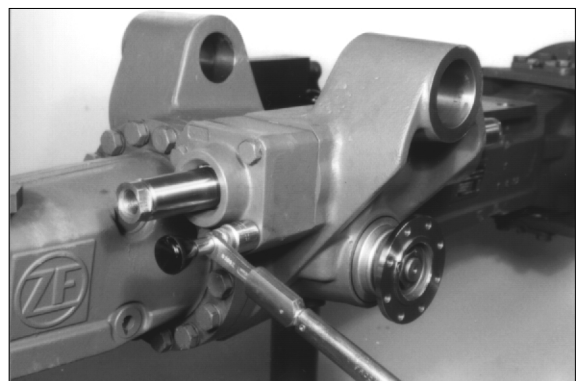
Grease sealing elements of the guide.



17W78FA214

Assemble pre-assembled guide upon piston rod and fasten it by means of hex head screws.

- Tightening torque(M14/10.9) :
18.9kg · m(136.7lb · ft)



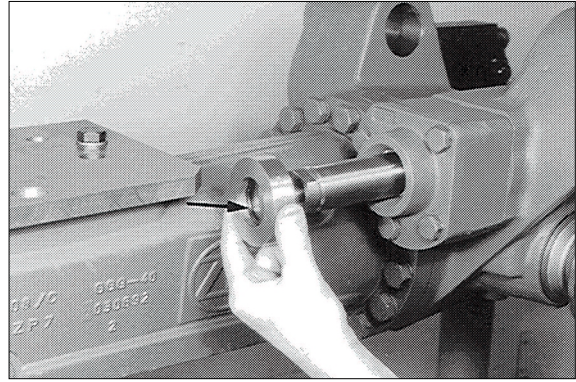
17W78FA215

(2) Adjust track and steering lock

Gresse O-ring and insert it in the groove (arrow) of the stop ring.

The version(thickness) of the stop ring gives the steering lock to be adjusted.

The stop ring to be used can be found in the corresponding spare parts list.

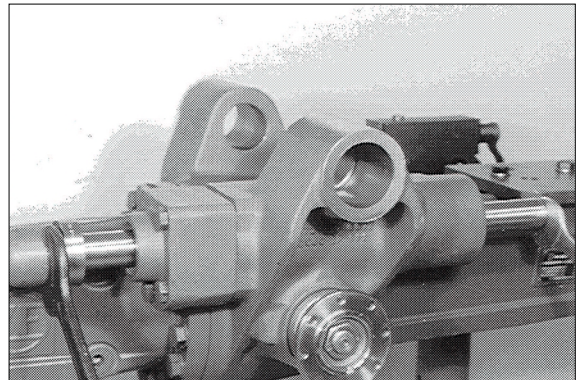


17W78FA216

Cover threads of tie rod with loctite(Type-No.242) and screw it into the piston rod.

Tighten tie rod.

- Tightening torque : 35.7kg · m(258lb · ft)



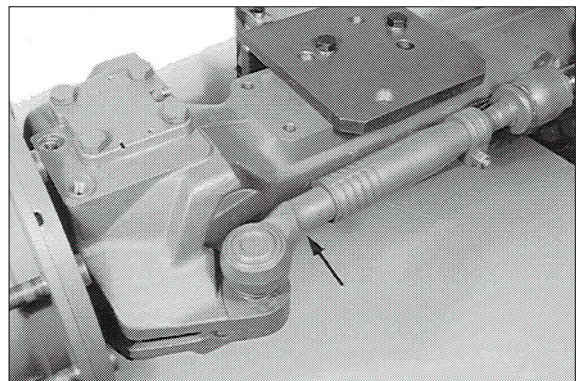
17W78FA217

Engage tie rod.

Pay attention to the installation position of the tie rod.

Standard version shoulder(see arrow) is facing the axle housing.

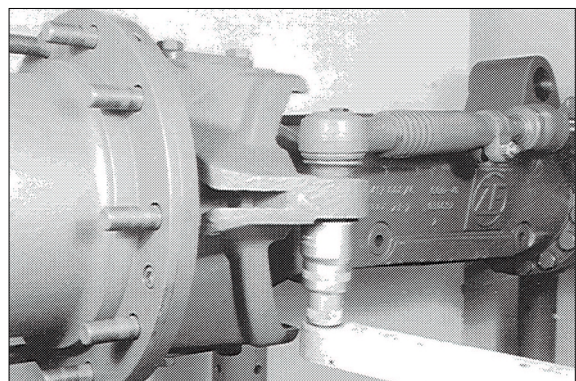
Different versions are possible.



17W78FA218

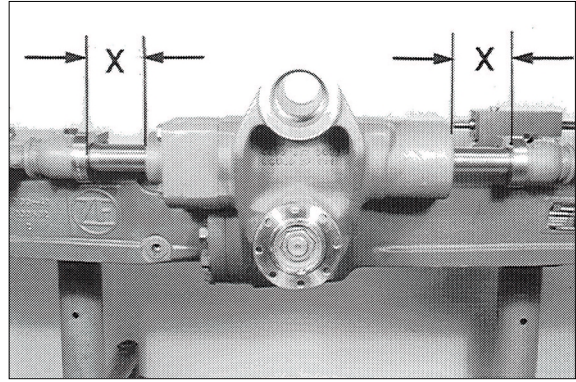
Tighten castle nut and secure it by means of cotter pin.

- Tightening torque : 30.6kg · m(221lb · ft)
- Install the second tie rod accordingly.



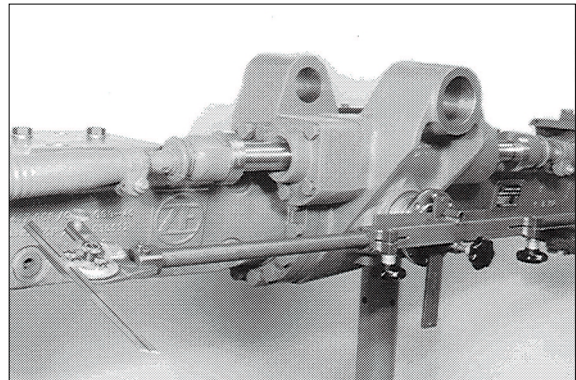
17W78FA219

Track basic adjustment
Locate tie rod to the center position
(centralize).
X = equal distance



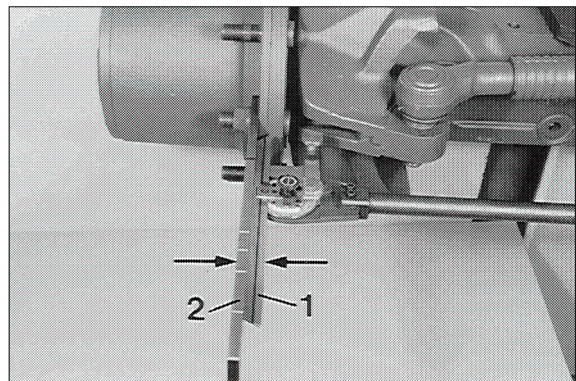
17W78FA220

Fasten measuring device on the drive
flange and the straightedge on the
hub/wheel stud.
Measuring device 5870 200 033
Straightedge 5870 200 029



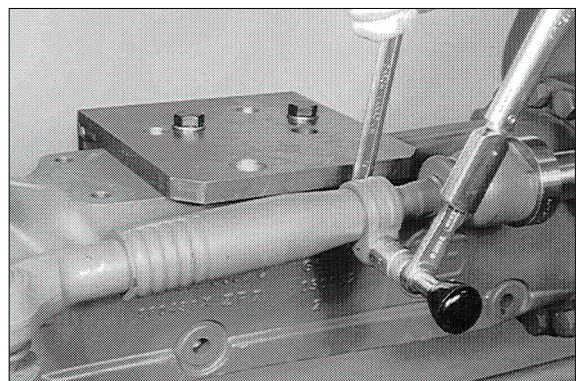
17W78FA221

Check the track position “Zero degrees
(0°)”
Locate measuring device(1) to the 0°
position. Measuring device(1) must be
parallel to the straightedge(2).



17W78FA222

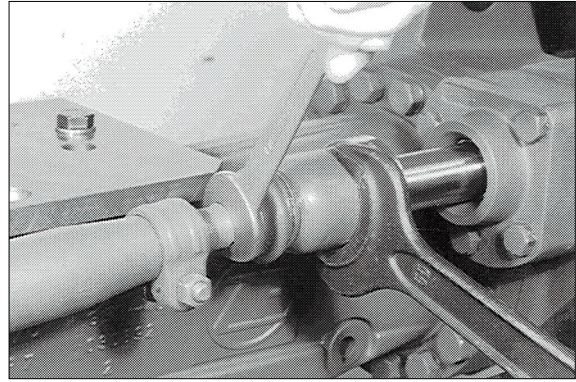
Loosen the clamp of the tie rod.



17W78FA223

Turn axial joint until the parallel position of the measuring device and the straightedge (0°) is obtained.

Pay attention to the exact central position of the tie rod.

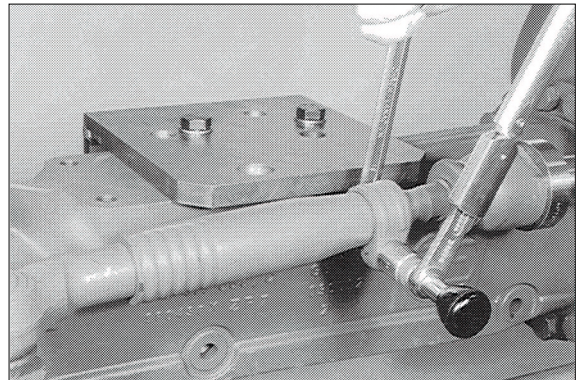


17W78FA224

After termination of the adjustment, tighten the clamp again.

- Tightening torque : 7.1~8.2kgf · m
(52~59lbf · ft)

Adjust second steering half accordingly.

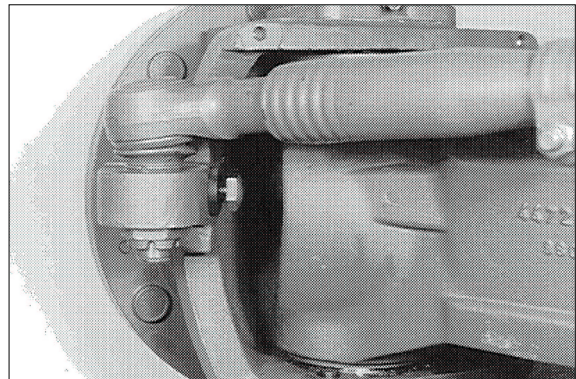


17W78FA225

Adjust stop screw

If a track adjustment(toe-in resp. toe-out) has to be carried out, the following steps(adjust stop screw) should be carried out only after the track adjustment is completed.

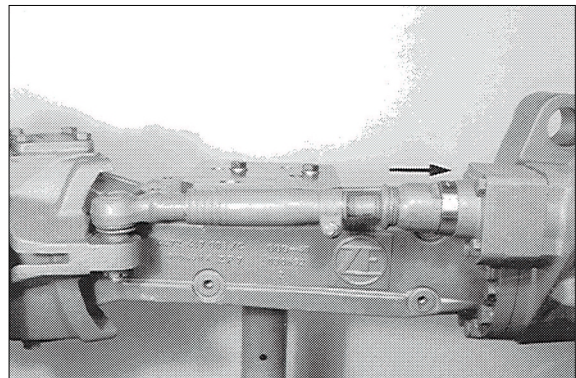
Screw stop screw(without shim) into the steering knuckle hull.



17W78FA226

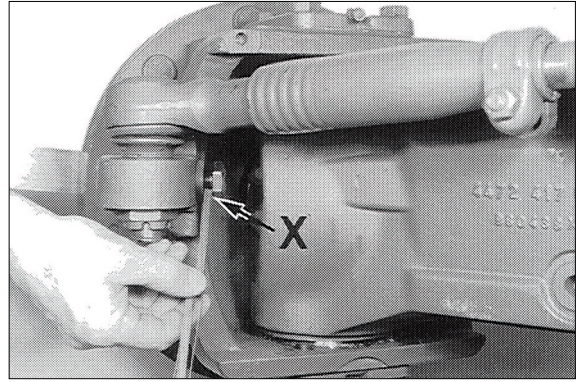
Tilt final drives until the stop ring has contact on the guide(Arrow).

Place stop screw against the axle housing until contact is obtained.



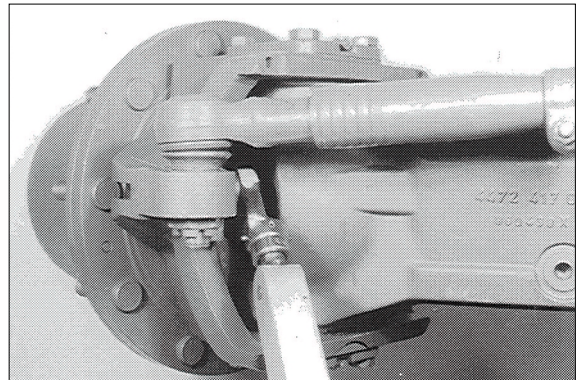
17W78FA227

Determine dimension "X".
Dimension "X"=Shim thickness.

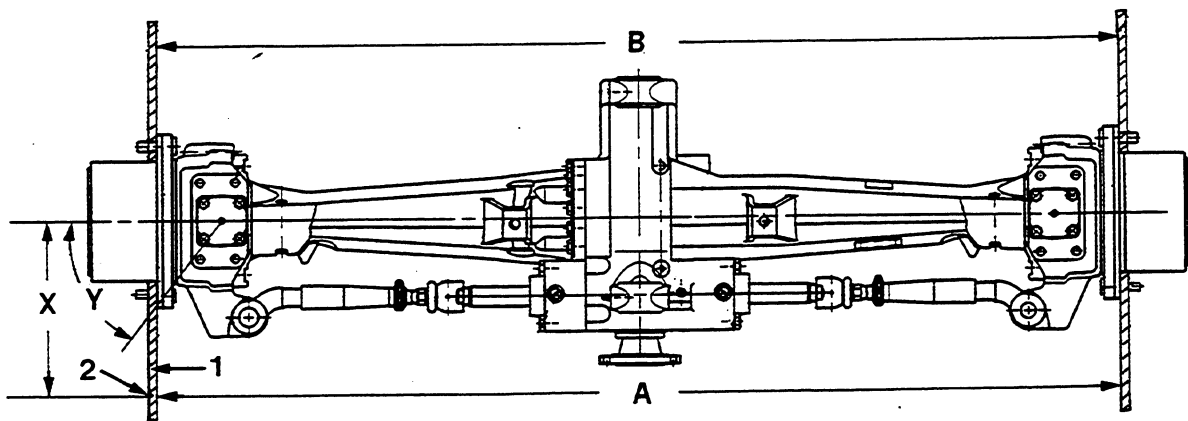


Assemble determined shim(s) and
tighten stop screw.

- Tightening torque : 39.8kg · m(288lbf · ft)
Adjust the second steering lock
accordingly.



Adjust toe-in resp. toe-out



17W78FA230

1 = Straightedge 2 = Marking notch Y = Steering lock

Determine dimension A, starting from the marking notches of the straightedges.

Now, turn the two wheel hubs through 180°, and determine dimension B.

Adjust the track, according to the indications of the manufacturer of the vehicle by axial displacement of the tie rods.

During the track adjustment, the distance of the straightedges(track) must be modified on the two tie rods in the same way.

Dimension "X" (see Draft) corresponds to the distance "wheel center to rim flange".

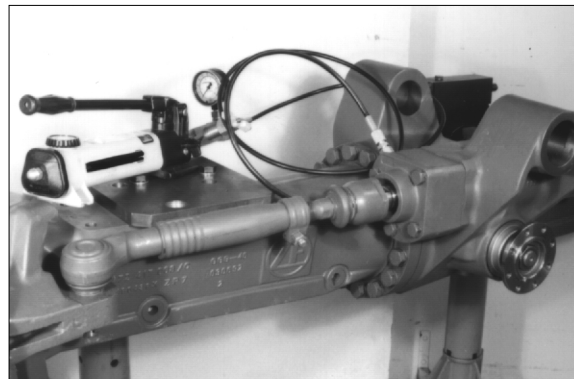
Check tightness of the steering assembly

Check tightness of the steering assembly in both steering directions.

Build up the test pressure of $p = 180$ bar (bleed the pressure chamber).

Close shut-off valve.

During a test duration of 20 seconds, a pressure drop of max. 5 bar is permitted.



17W78FA231

Test media : Motor oils SAE 10 W MIL-L 2104C, MIL-L 46152

Before the axle is put into service, pay attention to the lubrication and maintenance.