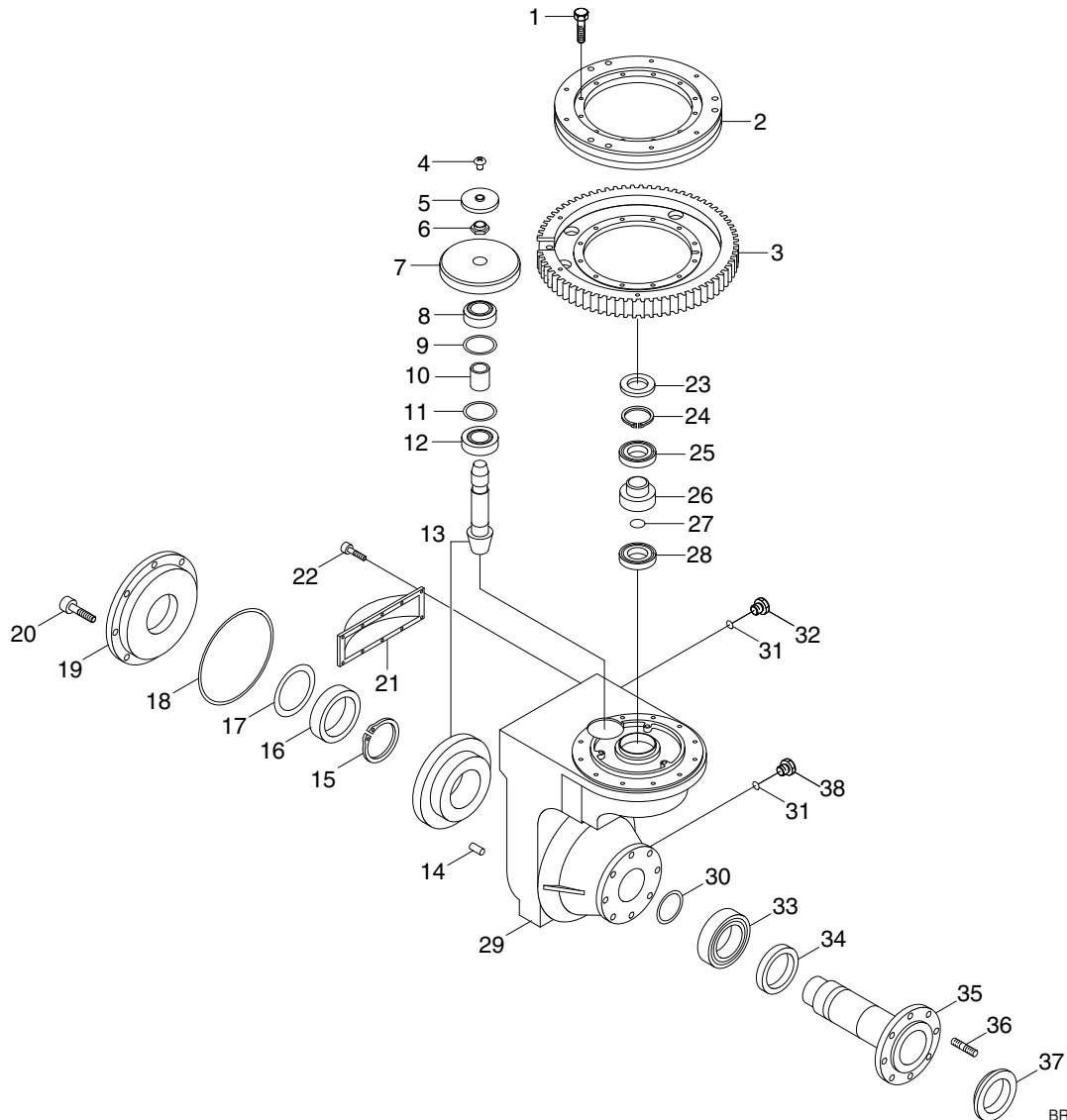


SECTION 3 POWER TRAIN SYSTEM

Group 1	Structure and operation	3-1
Group 2	Troubleshooting	3-3
Group 3	Disassembly and assembly	3-5

GROUP 1 STRUCTURE AND OPERATION

1. DRIVE UNIT STRUCTURE



BRJ7DU101

1	Hexagon screw	14	Slotted pin	27	Protection cap
2	Turntable bearing	15	Retaining ring	28	Bearing ball
3	Steering gear	16	Taper roller bearing	29	Housing
4	Breather valve	17	Shim	30	Shim
5	Protection cap	18	O-ring	31	Seal ring
6	Hexagon nut	19	Bearing cover	32	Plug
7	Spur gear	20	Cap screw	33	Taper roller bearing
8	Taper roller bearing	21	Cover	34	Taper roller bearing
9	Shim	22	Hex screw	35	Wheel shaft
10	Spacer	23	Shaft sealing ring	36	Wheel bolt
11	Shim	24	Retaining ring	37	Wheel shaft protection
12	Taper roller bearing	25	Bearing ball	38	Plug
13	Bevel gear set	26	Input pinion		

2. SPECIFICATION

Item		Unit	Specification
Gear ratio	Total	—	14.5
Oil Quantity		ℓ	2.2

GROUP 2 TROUBLESHOOTING

Problem	Cause	Remedy
1. Noise 1) Loud, beating noise 2) Loud, steady noise 3) Dull, grinding noise	· Gearing of helical gear stage damaged, indentations. · Fault on grooved ball bearing input. · Contaminations. · Motor/transmission connection not ok. · Motor bearing defective. · Wrong bearing preload or incorrect backlash.	- Check tooth flanks of the drive pinion and the helical gear for damage. In case of damage always replace both components. - Remove and replace drive pinion bearing. - Remove and replace drive pinion bearing. - Check motor installation. - Check motor bearing. - Check bearing preload and backlash and readjust it, if necessary.
2. Leakage 1) Breather 2) Housing cover 3) Oil filler or oil drain plug 4) Input shaft / wheel shaft 5) Side cover 6) Sealing disc on drive pinion	· Excessive oil level. · Screws not tightened with the specified tightening torque. · O-Ring sealing defective. · Screws not tightened with the specified tightening torque. · Dirt between sealing ring and housing. · Sealing ring worn. · Radial sealing ring damaged or worn. · Damaged race on input- and/or wheel shaft. · Screws not tightened according to sequence of tightening and the tightening torque. · No uniform adhesive application of LOCTITE 5910. · Joining time not observed. · No uniform adhesive application of LOCTITE 5910. · Joining time not observed.	- Check oil level. - Tighten screws with the specified tightening torque. - Replace O-Ring. - Tighten screws with the specified tightening torque. - Clean. - Install new sealing ring. - Install new radial sealing ring. - Replace input shaft and wheel shaft respectively. - Tighten screws according to correct sequence of tightening and with the tightening torque specified. - Apply LOCTITE 5910 evenly and continuously. - Observe LOCTITE specification and replace the sealing. - Apply LOCTITE 5910 evenly and continuously. - Observe LOCTITE specification and replace the sealing.
3. Other fault possibilities 1) Only sluggish rotation of the pivoted bogie bearing is possible or bearing clearance is sensible	· Cover disc has loosened and dirt got into the bearing. · Cage segments are damaged. · Plastic deformation of the balls or the ball race.	- Replace pivoted bogie bearing. - Replace pivoted bogie bearing. - Replace pivoted bogie bearing.

Fault	Probable cause	Remedy
Oil leakage on oil filler or oil drain plug	<ul style="list-style-type: none"> · Dirt between sealing ring and housing. · Old sealing ring was used. · Bolts not tightened according to the specified tightening torque. 	<ul style="list-style-type: none"> · Cleaning required. · Use new sealing ring · Tighten bolts with the specified tightening torque.
Oil leakage between housing and top section	<ul style="list-style-type: none"> · Seal faces not sealed or uneven. · Burrs on cylinder pin. · Bolts not tightened according to the specified tightening torque. 	<ul style="list-style-type: none"> · Apply LOCTITE 574 onto seal faces. · Touch up seal faces with oil rubber. · Use a new cylinder pin. · Tighten bolts with the specified tightening torque.
Oil leakage on top section within helical gear stage / input	<ul style="list-style-type: none"> · Too much oil in transmission. · O-ring on cover defective. · Breather valve defective. 	<ul style="list-style-type: none"> · Check oil level. · Install new O-ring. · Replace breather valve.
Beating noise at helical gear stage	<ul style="list-style-type: none"> · Teeth on input pinion and/or helical gear damaged by false installation. 	<ul style="list-style-type: none"> · Check tooth flanks for damage and touch up damaged spots with oil rubber.
Ringing noise	<ul style="list-style-type: none"> · Helical gear stage running without oil. 	<ul style="list-style-type: none"> · Check oil level. · Refill oil.
Grinding noise	<ul style="list-style-type: none"> · Bearing preload or backlash not correctly adjusted. 	<ul style="list-style-type: none"> · Checking and new adjustment.
Bearing damage on input pinion	<ul style="list-style-type: none"> · No axial play. 	<ul style="list-style-type: none"> · Install new bearing and adjust axial play.
Pivoting bearing is difficult to rotate or backlash recognizable	<ul style="list-style-type: none"> · Cover disc loosened and dirt entered into the bearing. · Cage segments are damaged. · Plastic deformation of balls or ball race. · Bearing not relubricated. · Grease not distributed. 	<ul style="list-style-type: none"> · Replace pivoting bearing. · Replace pivoting bearing. · Replace pivoting bearing. · Relubricate pivoting bearing. · Rotate pivoting bearing several times by hand.

GROUP 3 DISASSEMBLY AND ASSEMBLY

1. INSTRUCTION

- 1) Pay attention to cleanliness and expert like manner for all work to be carried out. Transmission removed from the vehicle has therefore to be cleaned prior to opening. Both utmost care and cleanliness are essential conditions for a correct disassembly and reassembly of the transmission as well as for the installation of each spare part. A fault during installation can result in an early wear and chips or other foreign particles in the transmission can cause fatal damages.
- 2) Prior to assembly all parts must be cleaned and inspected for wear and other defects.
- 3) If it is found that removed parts are damaged or worn, do not reinstall but replace them by new ones.
- 4) If not separately indicated, the housing and cover faces forming an oil tight connection are to be provided with the corresponding sealing compound during assembly.
- 5) Special devices and special tools are necessary besides the standard tools. Their use is unavoidable for a technically adequate dis- and reassembly. The application of devices, special tools and other fixtures are to be adapted to circumstances of the respective users.
- 6) Commercial tools and fixtures belonging to the basic equipment are assumed to be available.
- 7) If not otherwise indicated all pressing operations are made by means of the hand lever press.
- 8) All screws and threads in this transmission have metric dimensions. Only spanners and socket spanners with metric sizes are allowed to be used.
- 9) For reassembly all of the indicated setting values, test data and tightening torques must be observed.
- 10) Observe the described sequence of the working steps.
- 11) All pictures serve the illustration and are not obliging for this execution.

2. NECESSARY SPECIAL TOOLS FOR DISASSEMBLY AND REASSEMBLY

Reference number	Description	Is necessary for :
225296	Extracting fixture	Removal of drive pinion
62519	Holding fixture	Loosening of taper press fit
62507-1	Counter holder	Determination of shim thickness
62523	Assembly fixture	Installation of drive pinion
62478	Striking mandrel	Roller bearing drive pinion
62507	Locating fixture	Transmission locating jack
62529	Striking mandrel-Insert	Bearing outer ring pinion shaft bottom
62625	Striking mandrel	Roller bearing housing
63428	Press-in/out fixture	Wheel shaft and crown gear
62521	Striking mandrel	Shaft seal drive pinion
62522	Striking mandrel	Breather cover
63290	Press-in sleeve	Grooved ball bearing drive pinion
63293	Striking mandrel without handle	Thread protective shield
63291	Striking mandrel without handle	Shaft seal wheel shaft
62542	Striking mandrel without handle	Bearing outer ring crown gear
63294	Striking mandrel without handle	Bearing inner ring wheel shaft
62748	Striking mandrel	Bearing outer ring cover
63296	Handle	Striking mandrels
62819	Measuring stop	Torsional backlash
62228	Gear lock	Helical gear lock
62222	Pressure oil device	Loosen press fit
223705, 22	Pressure-in sleeve	Bearing inner ring pinion shaft
62747	Striking mandrel	Bearing outer ring pinion shaft top
62846	Striking mandrel	Helical gear on pinion shaft
62825	Measuring fixture	Housing dimension wheel shaft
62827	Measuring fixture	Housing dimension crown shaft
222863.2	Extracting fixture	Pulling-off taper roller bearing outer ring
62532	Measuring fixture	Bearing friction torque wheel shaft

3. SAFETY INSTRUCTIONS

- 1) The use as directed requires the strict observance with the specification for installation, dis-and reassembly, initial operation and maintenance.
- 2) Every person concerned with installation, disassembly and reassembly, initial operation and maintenance of the transmission in the user plant must have read and understood the whole instruction and in particular the safety instructions.
- 3) Any working method which endangers the safety of the transmission is prohibited.
- 4) Modifications and changes without the proper permission are affecting the safety of the transmission and are not allowed.
- 5) Only original spare parts from Hyundai are allowed to be used. It is explicitly pointed out to the fact that spare parts and accessories, which were not supplied by Hyundai are not checked and approved by us either. We do not accept any liability or admit any original parts from Hyundai.
- 6) The described work is only allowed to be made by authorized, skilled and instructed staff.
- 7) The proper repair of this products requires adequately trained specialists. The repairer is responsible for the training.
- 8) Keep away aggressive cleaners from your skin, do not drink it or inhale its vapours. Always wear safety gloves and goggles. If by mistake cleaner was swallowed, call medical aid immediately. Strictly observe manufacturer instruction.
- 9) Do not drain cleaner or transmission oil into the sewerage system or into the soil.
- 10) Prior to start working on the installed or mounted transmission, the wheels must be blocked.
- 11) Prior to any work on the installed transmission(e.g. oil change) or its mounted-on parts the voltage source feeding the motor must always be disconnected resp. switched off.
- 12) The local regulations for safety and prevention of accidents must be observed.

4. COMPLETE DISASSEMBLY

1) GENERAL INSTRUCTIONS DISASSEMBLY

- (1) Prior to dismantling the transmission is to be cleaned carefully.

Parts which are only available as assemblies will not be dismantled further.

It is recommendable to install a locating fixture as shown in Figure 44. It serves to rotate the unit and offers easy working for disassembly and reassembly.

(S) Locating fixture 62507

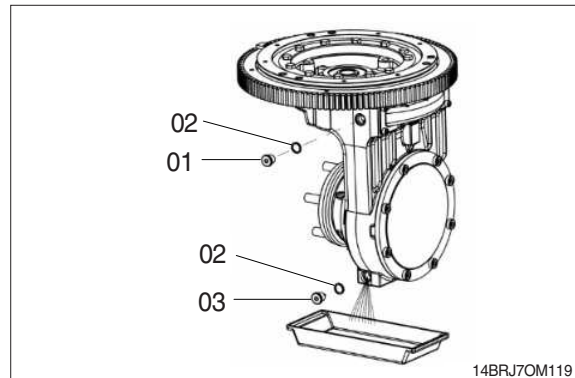


2) DRAIN OFF TRANSMISSION OIL

- (1) Place a suitable big oil collecting vessel under the oil drain plug.
- (2) Loosen the oil filler plug(item 01) with a 6mm allen wrench. Remove the oil filler plug and the sealing ring(item 02).
- (3) Loosen the oil drain plug(item 03) with a 6mm allen wrench. Remove the oil drain plug and the sealing ring(item 02).
- (4) Have the transmission oil drained into the vessel completely.

※ Do not drain transmission oil into the soil or the sewerage system. Pay attention to the type and quantity of debris.

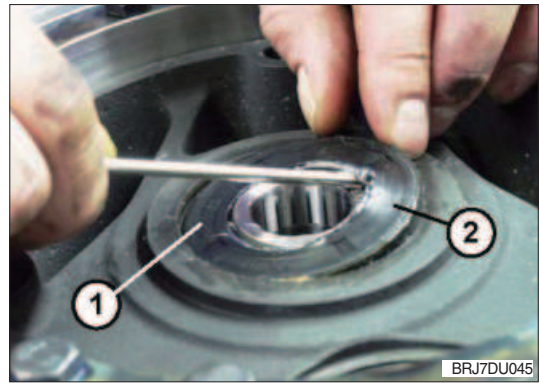
▲ High oil temperatures are to be expected after continuous operation of the transmission. Wear temperature-resistant gloves.



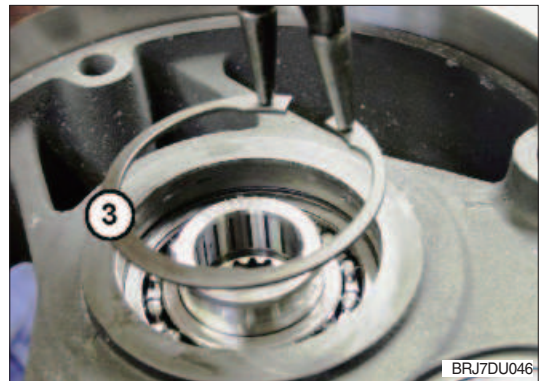
3) REMOVAL OF DRIVE PINION

- (1) With a screwdriver press the radial sealing ring (item 2) upwards from the bore seat of the housing and remove it.

Dispose of the radial sealing ring according to chapter 6.

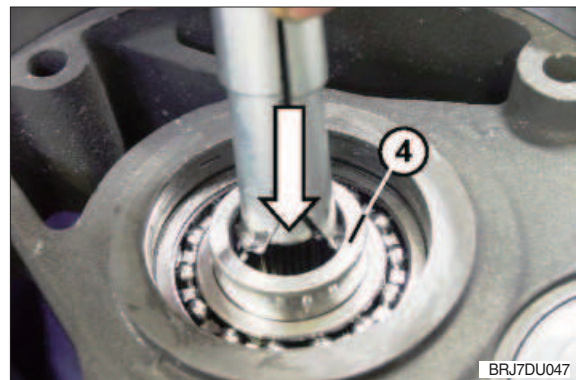


- (2) Unsnap and remove the retaining ring (item 3) from the housing bore by means of flat-head pliers.



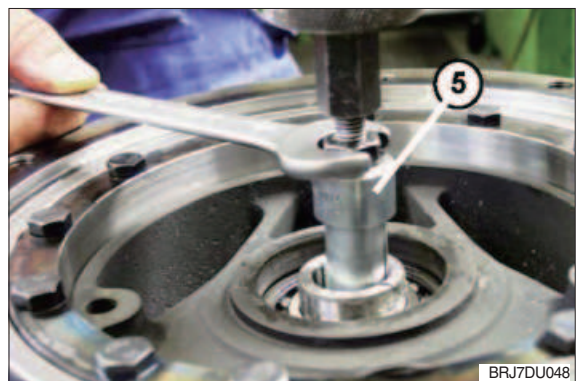
- (3) Extracting fixture 225296 is necessary to remove the drive pinion (item 4) from the bore.

Insert the extracting fixture into the bore of the drive pinion.



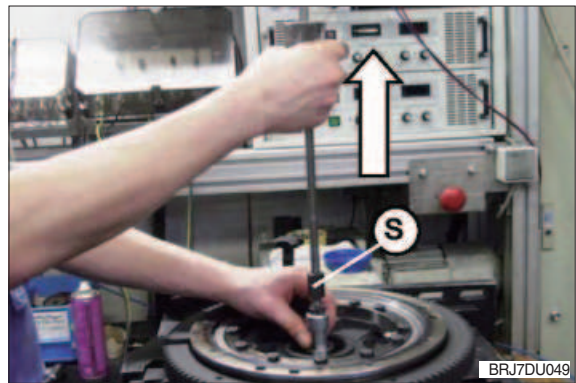
- (4) Fasten the hexagon screw of the bearing puller hand-tight so that a sufficient preload of the clamping jaws is given.

By tightening the hexagon screw expand the clamping jaws of the bearing puller (item 5) in the bore of the drive pinion.

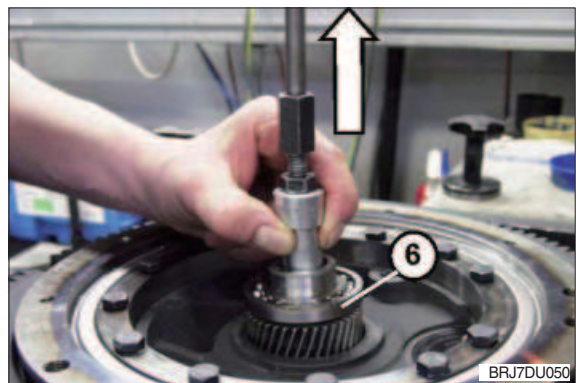


- (5) Handle the extracting fixture "S" as shown on the right. Move the handle on the bar upwards strongly several times until the drive pinion is loosened from the bearing seat completely.

⚠ Do not damage the gearing of the drive pinion at the next work step! Damages might cause louder running noises and consequential damages!

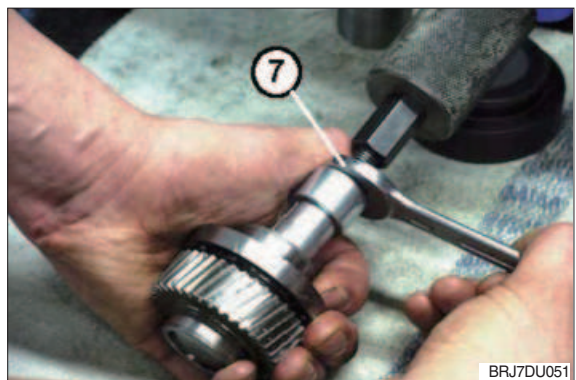


- (6) By means of the extracting fixture pull the drive pinion (item 6) out of the housing bore and remove it.



- (7) Loosen the hexagon bolt (item 7) and remove the extracting fixture from the drive pinion.

⚠ Do not damage the gearing of the drive pinion! Damages might cause louder running noises and consequential damages!

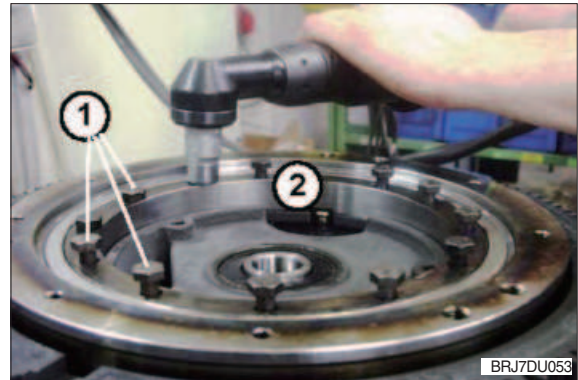


- (8) Pull of the grooved ball bearing (item 8) by means of a puller or a parting tool over the bearing seat of the drive pinion and dispose it of according to chapter 6.



4) REMOVAL OF GEAR RING AND PIVOTED BOGIE BEARING

- (1) Loosen the 12 hexagon screws (item 1) on the pivoted bogie bearing (item 2), remove and dispose them of acc. to chapter 6.



- (2) With a dead-blow soft-face hammer slightly beat against the gear ring (item 3) from the bottom to loosen it from the connecting construction. Take off and remove the pivoted bogie bearing and the gear ring.



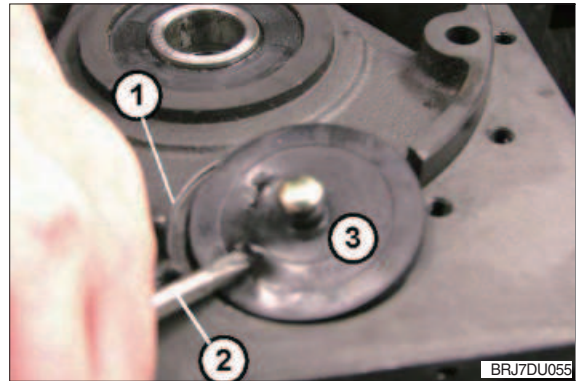
5) DISASSEMBLY OF TRANSMISSION HOUSING WITH TRANSMISSION COMPONENTS

(1) Removal of sealing cap

⚠ The surface (item 1) where the sealing cap is located must not be damaged. The sealing cap itself is destroyed and cannot be reused.

① Insert a screwdriver (item 2) into the sealing cap (item 3) beating cautiously and press it off or by using the lever effect upwards and scrap it.

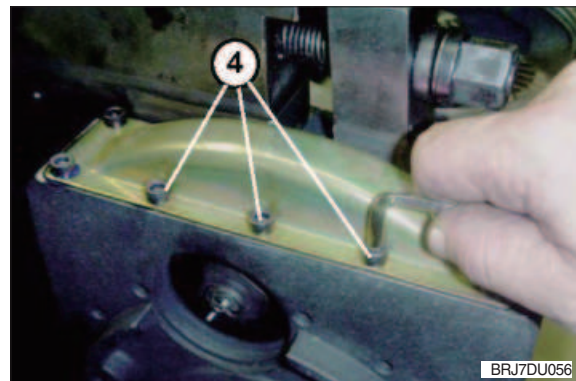
② The breather valve is not to be scrapped.



(2) Removal of side cover

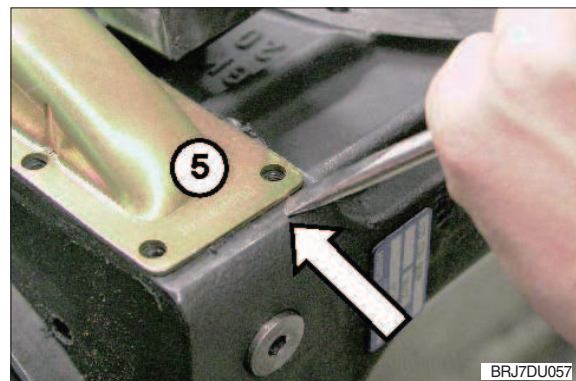
① Loosen and remove the 10 cap screws (item 4) on the side cover.

⚠ Do not damage the housing surface at the next working step! Burrs and other damages on the sealing surface which are caused during the removal have to be eliminated. Touch up damaged sealing surface on the housing with an oil stone!



② Separate the side cover (item 5) from the sealing compound with a suitable screwdriver. Place the tool between housing and cover and press it off slightly from the housing.

③ Loosen the side cover from the housing by tapping onto the outer contour and dispose it of acc. to chapter 6.



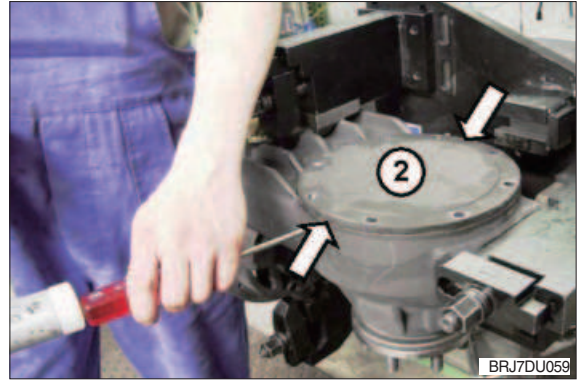
(3) Removal of wheel shaft and crown gear

① Loosen and remove the 8 cap screws (item 1) in the housing cover.

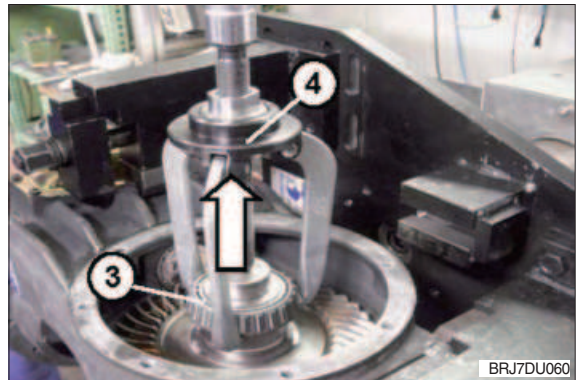
⚠ Do not damage the housing and cover surface! Burrs and other damages on the sealing surface which are caused during the removal have to be eliminated. Touch up damaged sealing surface on the housing with an oil stone!



- ② Loosen the housing cover (item 2) by tapping against the outer edges and remove it. Use the two recesses in the housing.



- ③ With a three-armed puller (item 4) pull the taper roller bearing inner ring (item 3) over the bearing seat of the wheel shaft and remove it.



- ④ Unsnap and remove the retaining ring (item 5) by means of flat-head pliers.



(4) Loosening of taper press fit

※ For work at high oil pressures to loosen the taper press fit there is the danger of eye and skin injuries, if oil would come out under high pressure. Always wear goggles and safety gloves! Observe and follow the instructions of the pressure oil device manufacturer.

- ① A pressure oil device with a maximum pressure of up to 300 MPa is necessary for widening of the taper press fit. There are two possibilities to press out the shaft wheel from the crown gear which are described in the following:

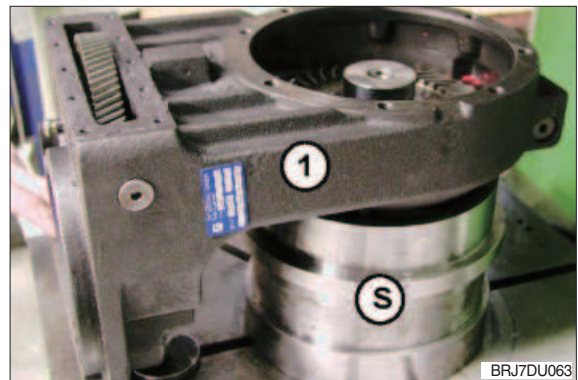
(S) Pressure oil device 62222



- ② Pressing-off by means of press

Locate the housing (item 1) in the press-out fixture "S" on the press as shown in the picture.

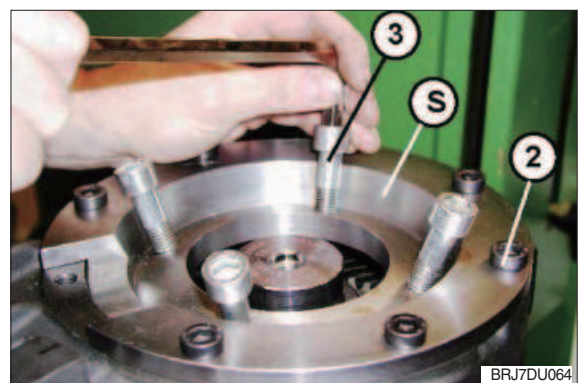
(S) Press-out fixture 63428



- ③ The holding fixture "S" which is used as stop for the gliding off wheel shaft is to be connected to the cover surface with the appropriate cap screws (item 2).

Fasten the 4 supporting bolts (item 3) hand-tight until contact with the crown gear.

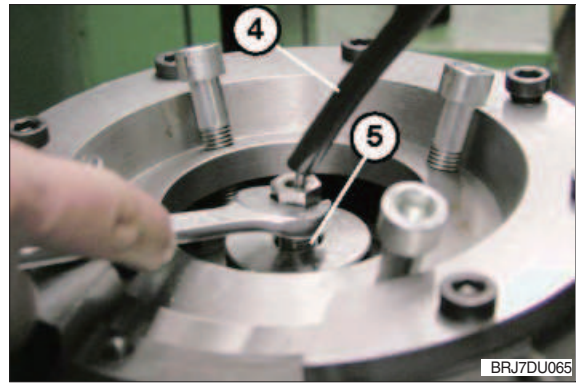
(S) Holding fixture 62519



- ④ Connect the flexible high-pressure pipe (item 4) from the pressure oil device into the connecting bore provided in the wheel shaft (item 5).

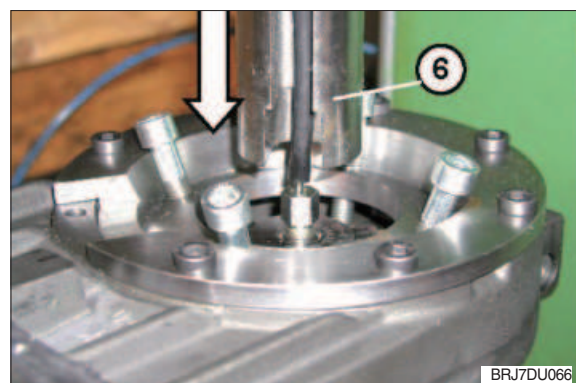
Fixedly tighten the connecting nipple with an openjaw spanner.

- ⚠ Pay attention for pressing-off that there is sufficient clearance in pressing-off direction avoiding that the wheel shaft is bottoming. Do not jam the wheel shaft at the pressing-off procedure.



- ⑤ Mount the stamp (item 6) from the holding fixture (see Figure 64) into the press.

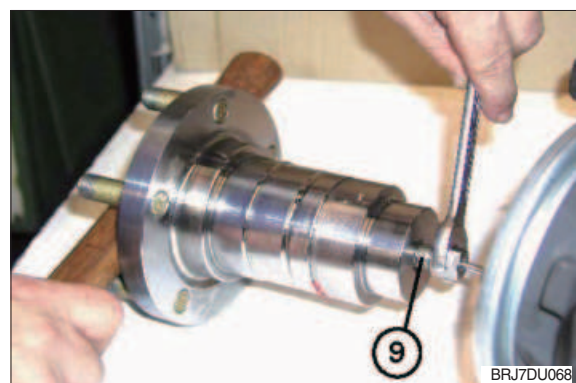
Adjust a pressing-off force from approx. 80 ... max. 120 KN on the press.



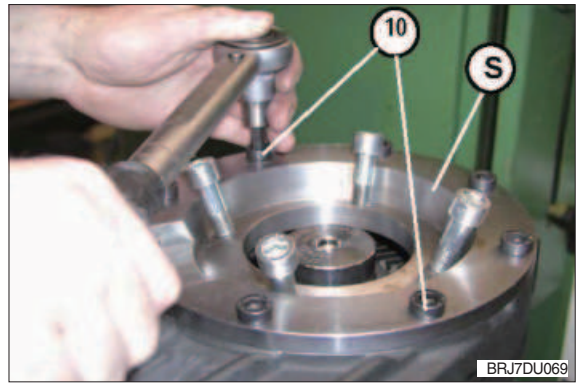
- ⑥ At the same time also use fixture 62222 to produce the necessary pressure until the wheel shaft is pressed out from the crown gear.



- ⑦ Remove and handle the wheel shaft in such a way that the flexible high-pressure pipe can be unscrewed from the connecting bore of the wheel shaft (item 9), removed and put aside.



- ⑧ Loosen the cap screws (item 10), take off and remove the holding fixture "S" from the housing.

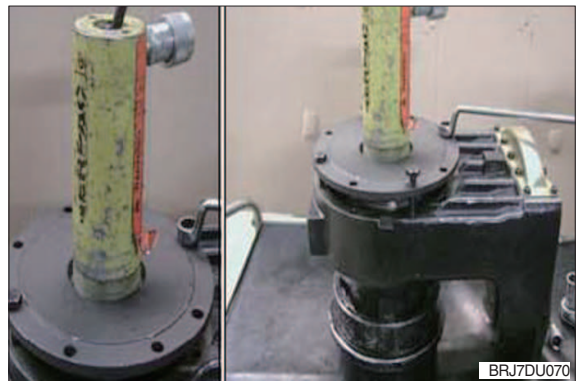


- ⑨ Pressing-off by means of 2nd hand pump

Alternatively the wheel shaft can be pressed off with a second press-out cylinder, e.g. in the mobile area. It is to be proceeded as follows:

Connect the dis- and assembly fixture with the press-out cylinder for the wheel shaft and bolt it with the transmission completely.

(S) Press-out cylinder 63428



- ⑩ Actuate the pressure oil device (item 7) until approx. 30MPa/4300psi is reached. Under this pressure the bevel gear is expanded sufficiently. This pressure is to be kept constant by pumping subsequently until the wheel shaft has been loosened completely.



- ⑪ Actuate the second oil pressure device (item 8) until the pressure oil cylinder has loosened the wheel shaft from the bevel gear completely.



- ⑫ Take the wheel shaft out of the transmission.



- ⑬ Unscrew the hydraulic hose from cylinder 1 of the wheel shaft. Wipe off excessive oil.

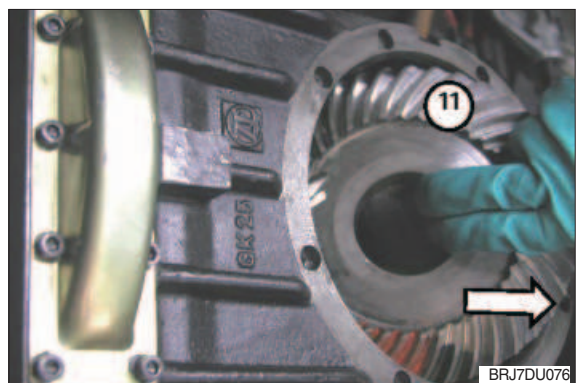


- ⑭ Unscrew the dis- and assembly fixture from the transmission

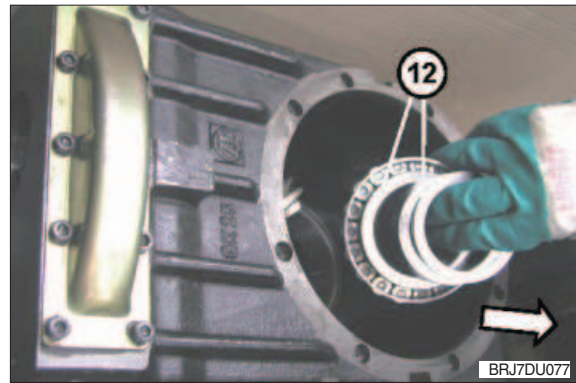
▲ When the gearing is damaged, running noises and consequential damages might occur, so that the bevel gear set has to be replaced.



- ⑮ Take the crown gear (item 11) cautiously out of the housing as shown.



- ⑩ Then remove the following parts from the housing (item 12) : Shims and taper roller bearing



(5) Removal of bevel pinion shaft

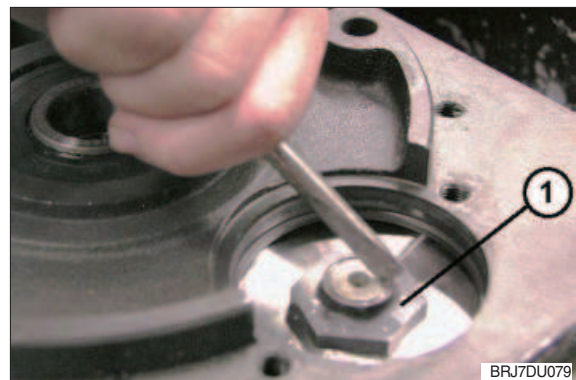
- ① Put the gear lock "S" into the housing bearing bore of the drive pinion and block the helical gear with it.

(S) Gear lock 62228

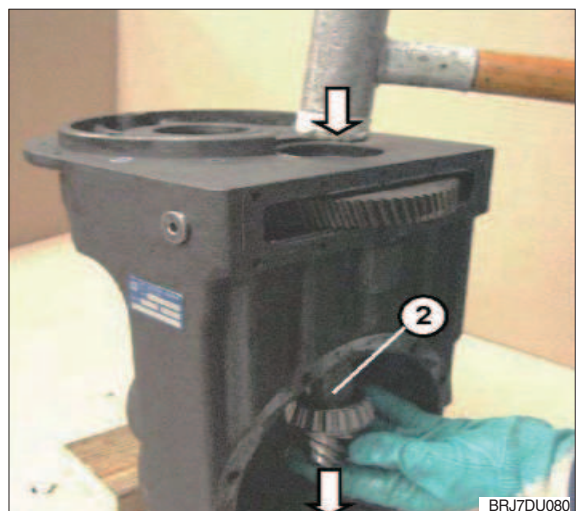


- ② Unlock the hexagon nut (item 1). Loosen, take off and remove the hexagon nut.
③ Take out and remove the gear lock.

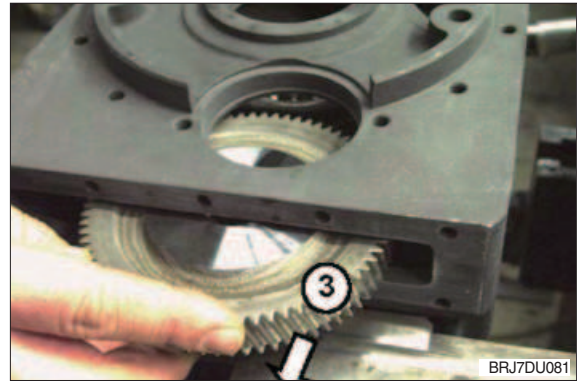
▲ Pay attention not to damage the bevel pinion shaft when it is expelled in the following procedure.



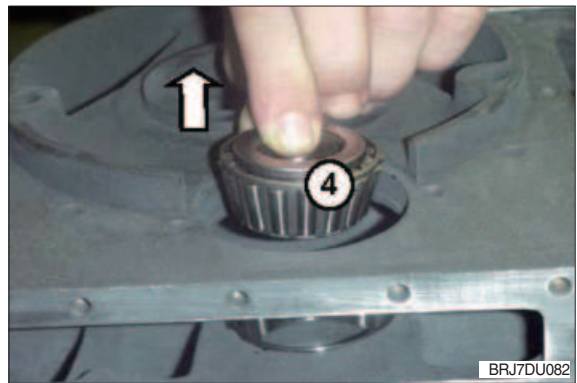
- ④ By means of a dead-blow soft face hammer expel the bevel pinion shaft (item 2) from the internal gearing and the bearings.



- ⑤ Pull out, remove and keep the helical gear (item 3) from the cover opening of the housing.



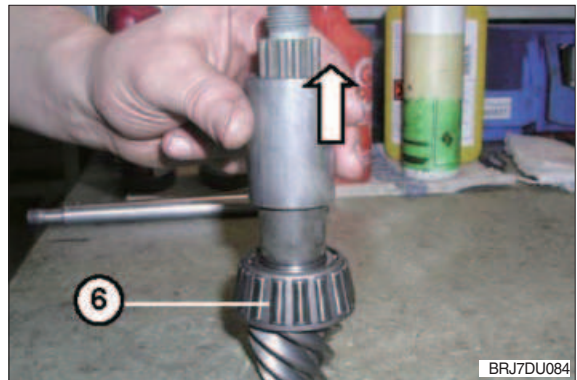
- ⑥ Take out and remove the taper roller bearing inner ring (item 4) upwards from the bearing bore:



- ⑦ Take off and remove the spacer bush (item 5) from the bevel pinion shaft.

⚠ If disassembly of the bearing inner ring is not possible with a special tool or puller, the bearing cage must be destroyed and the inner ring must be removed by heating.

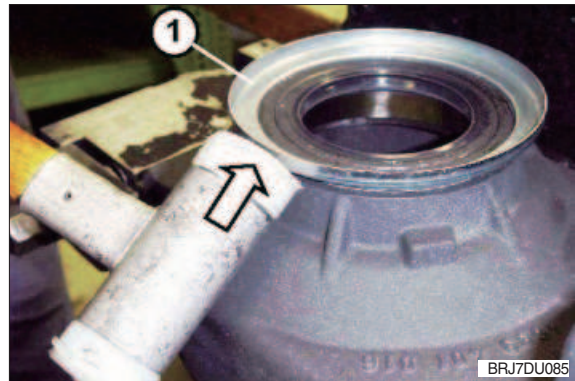
⚠ When the gearing of the bevel pinion shaft is damaged, running noises and consequential damages might occur, so that the bevel gear set has to be replaced.



(6) Removal of thread protective shield and radial sealing ring

- ① By means of a hammer remove the thread protective shield (item 1) from the glued joint on the housing.

⚠ Do not damage the housing and supporting face!



- ② With a screwdriver and a hammer expel and remove the radial sealing ring (item 2) cautiously from the housing seat.

⚠ Do not damage the surface where the radial sealing ring is seated! At this working step the radial sealing ring is destroyed completely.



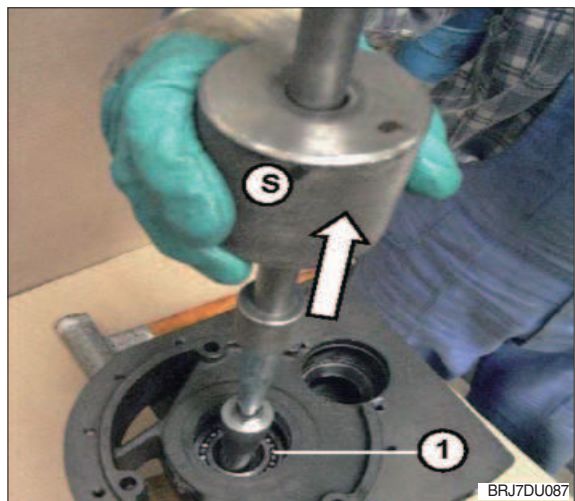
(7) Disassembly of bearings

Disassembly bearings drive pinion

- ① With an extracting fixture (S) pull out the grooved ball bearing (item 1) from the bore of the housing seat and dispose it of acc. to chapter 6.
- ② The service of the extracting fixture (S) is analogous like in the figures 47 to 51 shown.

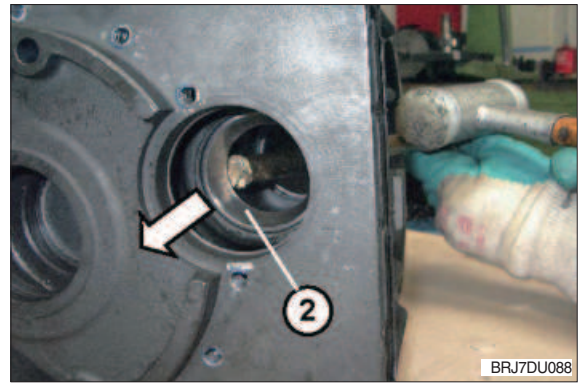
(S) Extracting fixture 225296

⚠ Upon removal of the bearing outer rings put them to the respective bearing inner ring.



Disassembly bearings bevel pinion shaft

- ① Expel the outer rings of the taper roller bearings (item 2) on both sides from the housing seat cautiously.
- ② Shims which were damaged have to be replaced by new shims of the same size.

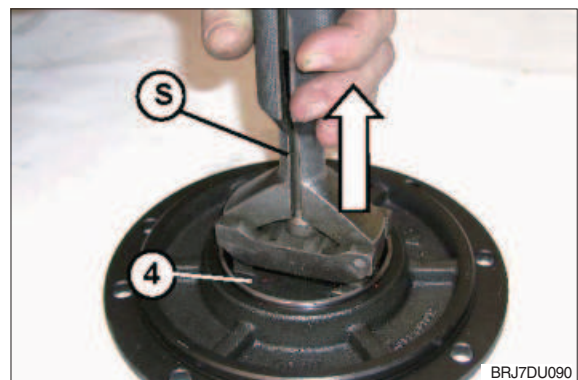


Disassembly bearings wheel shaft

- ① Expel the outer ring of the taper roller bearing (item 3) by means of a copper mandrel and a hammer from the housing cautiously.



- ② Pull out and remove the outer ring of the 2nd taper bevel bearing (item 4) with the bearing extracting fixture "S" from the bore of the housing cover.
- ③ The service of the extracting fixture (S) is analogous like in the figures 49 to 50 shown.
- ④ Shims which were damaged have to be replaced by new shims of the same size.



(S) Extracting fixture 222863.2

Thus the disassembly is ended.

5. COMPLETE REASSEMBLY

1) GENERAL INSTRUCTIONS FOR REASSEMBLY

- (1) Clean components by means of cleaning agent if necessary and remove the loctite residues.
- (2) Check all components for wear, damage and cracks, if necessary components have to be replaced.
- (3) All connection faces and plan face clean and steadily smoothing.

2) CONSUMABLES

Suitable cold cleaners, e.g. LOCTITE.

Only use suitable agents, which are non toxic, non-combustible and permissible on the market.

Never use benzens, solvents or other combustible agents for cleaning purposes.

Description	To be used for
Loctite No. 243	Screw lock up to size M10 and bigger
Loctite No. 270	Screw lock for studs
Loctite No. 574	To glue the shaft seals into the housing & sealing of housing and cover
Loctite No. 5910	Surface sealing for side cover on the housing
Grease "Shell Alvania R3"	To grease or wet the sealing lip of the shaft seal
Sillicone grease 704 or transmission oil acc. to API GL-5 or MIL-L-2105C/D	To grease or wet the O-rings

3) USED DESCRIPTIONS AND SYMBOLS

You will find again all descriptions used in the following sections and their calculations.

Description	Symbol
Bearing width taper roller bearing	Dimension "B"
Housing dimension	Dimension "G"
Housing bearing bore 1	L1
Housing bearing bore 2	L2
Housing bearing bore 3	L3
Zero position at measuring fixture I(Part I) with dial gauge	Dimension "1"
Difference dimension bevel pinion shaft calculation of L3	Dimension "2"
Zero position at measuring fixture II(Part I) with dial gauge	Dimension "3"
Difference dimension crown gear calculation of L3	Dimension "4"
Installation dimension bevel pinion shaft	Dimension "E"
Bearing difference dimension	Dimension "D"
Constant	K1
Constant	K2
Free constant	a
Shim dimension	Dimension "P"
Bush width	Dimension "H"
Shim thickness	Dimension "X"

4) USE OF REMOVED SHIMS AS BASIS FOR REASSEMBLY

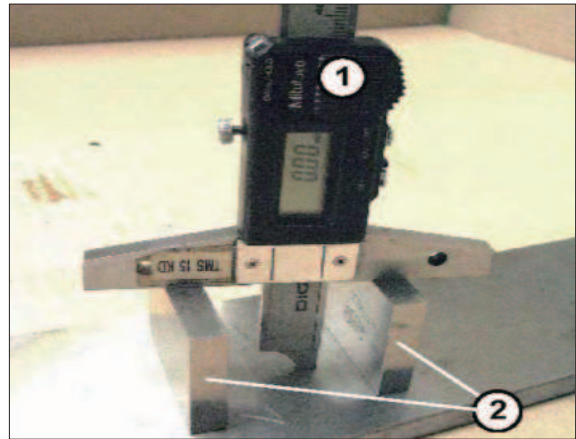
The bevel gear set, consisting of bevel pinion shaft and crown gear, has fixed installation dimensions. However the transmission housing and the taper roller bearings have to be measured.

- (1) If the removed shims are used as basis it is not necessary to measure the transmission housing.
- (2) If all of the removed components are to be reused, the original shim thickness has also to be used again.
- (3) If the taper roller bearings with the bevel gear set replaced, only the taper roller bearings have to be measured.

5) DETERMINATION OF BEARING WIDTH DIFFERENCE OF A TAPER ROLLER BEARING

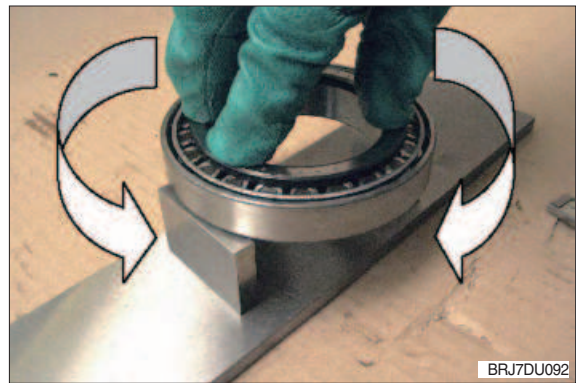
(1) Determination of bearing width general

- ① Zeroize depth gauge (item 1) by means of gauge blocks (item 2).



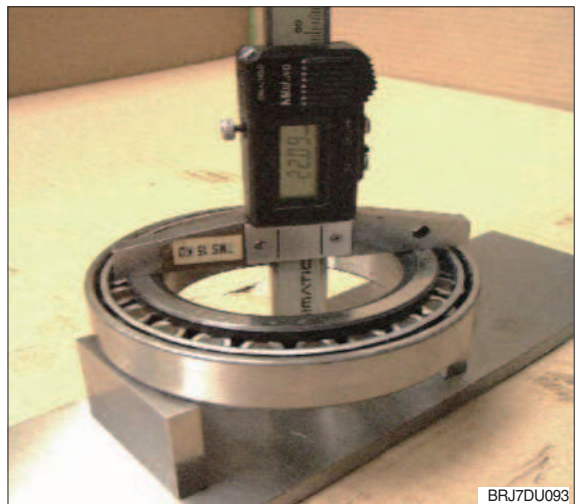
BRJ7DU091

- ② Put the new bearing on both gauge blocks and roll it as shown.



BRJ7DU092

- ③ Determine dimension "B".
Example : Dimension "B" = 22.09 mm



BRJ7DU093

(2) Determination of bearing difference for the installation of removal shims

- ① The difference dimension "D" of the new bearings to the bearings to be replaced is compensated with the shim dimension.

Example :

New bearing dimension "B" 22.09 mm

Difference "D" 0.10 mm

Original bearing -21.99 mm

The height of the existing shim set must be reduced by 0.1 mm.

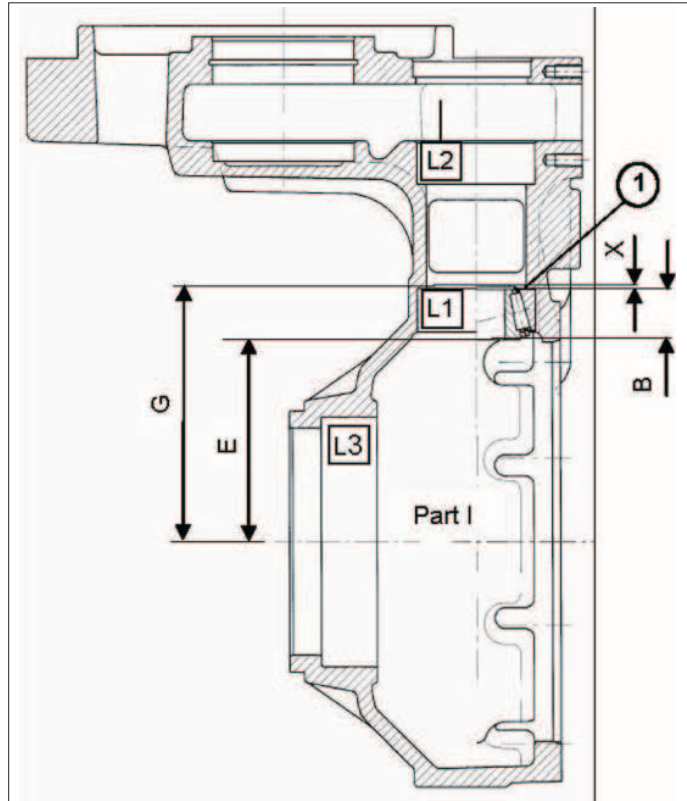
6) DETERMINATION OF BASIC INSTALLATION DIMENSIONS

(1) Determination of the necessary shim thickness for the exact installation dimension setting of the bevel pinion shaft

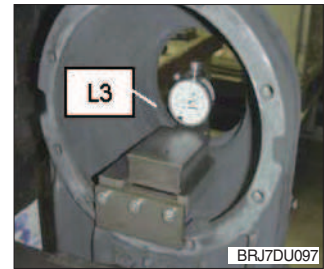
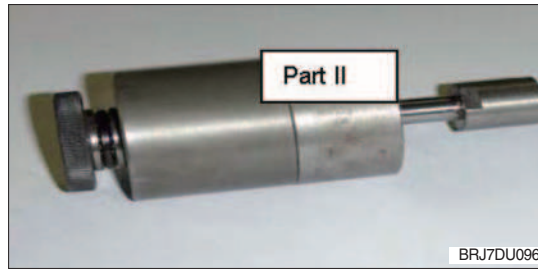
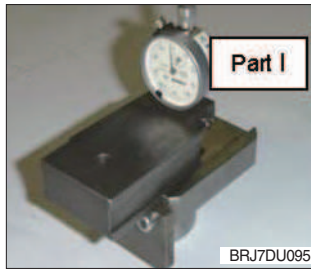
The correct position of the bevel pinion shaft is required for an optimum service life of the transmission.

Thickness of the shim (Item 1) and the correct setting of the bevel pinion shaft respectively will be determined according to the following method:

- ① Put measuring fixture I Part I (see figure 95) into the housing bearing bore L1 until contact is obtained.
- ② Put measuring fixture I Part II (see figure 96) into the housing bearing bore L2 until contact is obtained and fasten it hand-tight with measuring fixture I Part I.
- ③ Put measuring fixture part I to zero.
(S) Measuring fixture I 62231



BRJ7DU094



At zero position of the dial gauge the following can be taken as basis:

Dimension "1" = 111.50 mm

Determine Dimension "2" in housing bearing bore L3 (see figure 94) and add it to the respective Dimension "1".

Example :

Dimension "1" 111.50 mm

Dimension "2" 0.05 mm

Housing dimension "G" 111.55 mm

By means of the equation

$$X = G - E - B$$

The required thickness of the shim (Item 1, Figure 94) can be calculated. "E" means the installation dimension of the bevel pinion shaft

Dimension "E" : 89.00 mm

Calculation example

Dimension "G" - 111.55 mm

Dimension "B" - 22.09 mm

Dimension "E" - 89.00 mm

$$X = G - E - B$$

$$X = 111.55 - 89.00 - 22.09 = 0.46 \text{ mm}$$

Add shims according to thickness $X = 0.46 \text{ mm}$

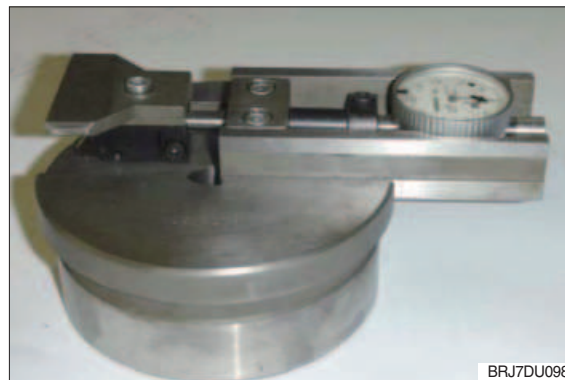
(2) Determination of necessary shim thickness for optimum setting of torsional backlash of the crown gear

Correct setting of the crown gear is necessary to obtain an optimum torsional backlash of the bevel gearing.

Bearing width "B" for the taper roller bearing on the crown gear can be measured according to chapter 5) at page 3-24 "Determination of bearing width and difference of a taper roller bearing".

Thickness of the shim and the correct setting of the crown gear respectively will be determined according to the following method :

- ① Put the measuring fixture into the housing bearing bore L3 until contact is obtained (see Figure 100 or 101).
(S) Measuring fixture 62827



- ② Put measuring fixture dial gauge to zero position.

At zero position of the dial gauge the following can be taken as basis :

Dimension "3" = 68.50 mm

Determine Dimension "4" in housing bearing bore L3 and add it to the respective Dimension "3".

Example:

Dimension "3"	68.50 mm
Dimension "4"	0.03 mm
Housing dimension "G"	68.53 mm



By means of the equation

$$X = G - E - B - K1$$

the required thickness of the shim (Item 3) can be calculated, i.e. with

Dimension "E" = 46.00 mm

Example :

Dimension "G" 68.53 mm

Dimension "B" 22.09 mm

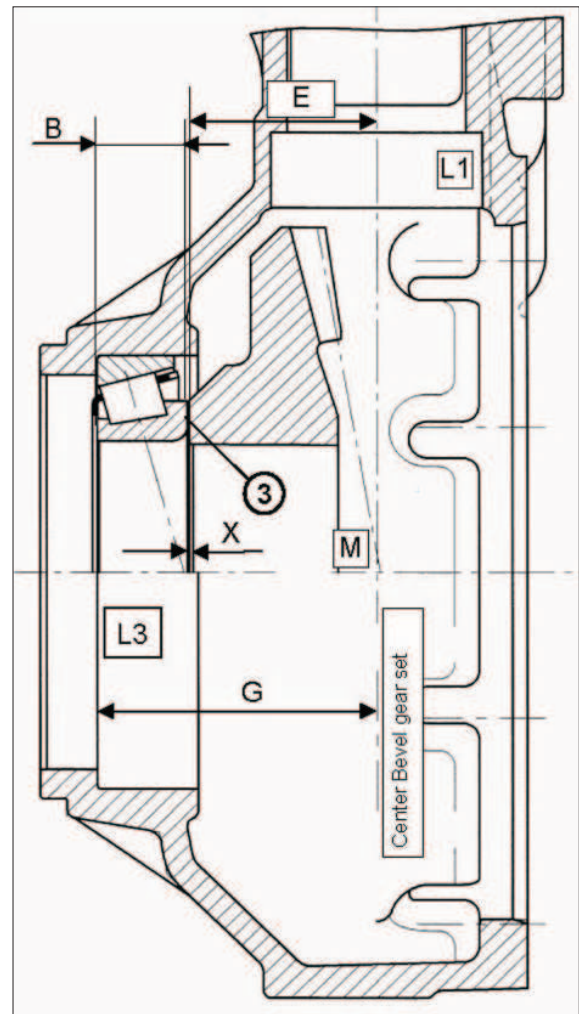
Dimension "E" 46.00 mm

Dimension "K1" 0.11 mm

$$X = G - E - B - K1$$

$$X = 68.53 - 46.00 - 22.09 - 0.11 = 0.37 \text{ mm}$$

Schematic sketch



BRJ7DU100

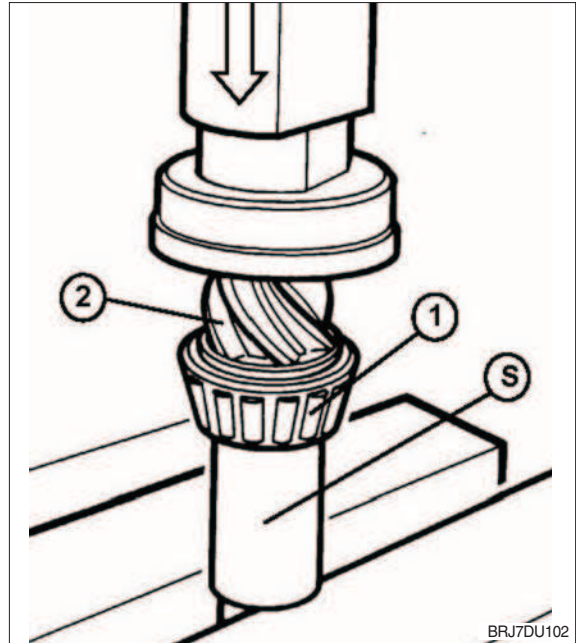
7) INSTALLATION OF BEARING FOR BEVEL PINION SHAFT AND EXACT SETTING OF THE BEARING PRELOAD

(1) Preassembly of bevel pinion shaft with bearing

- ① Use a hand-lever press for pressing the taper roller bearing inner ring (item 1) with the press-in sleeve "S" cautiously on the bevel pinion shaft (item 2) until contact is obtained.

▲ Pay attention to the gearing when the bearing of the bevel pinion shaft is installed. In case of damage, noise problems can be caused later.

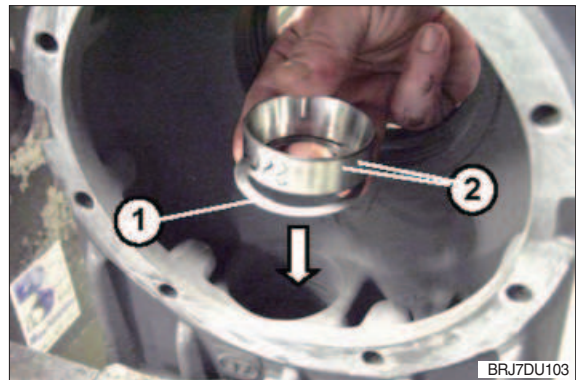
(S) Press-in sleeve 223705.22



(2) Installation of bearing outer ring into the housing

- ① Prepare the shim thickness determined according to chapter (1) at page 3-26 "Determination of the necessary shim thickness for the exact installation dimension setting of the bevel pinion shaft" by means of the differently thick shims.

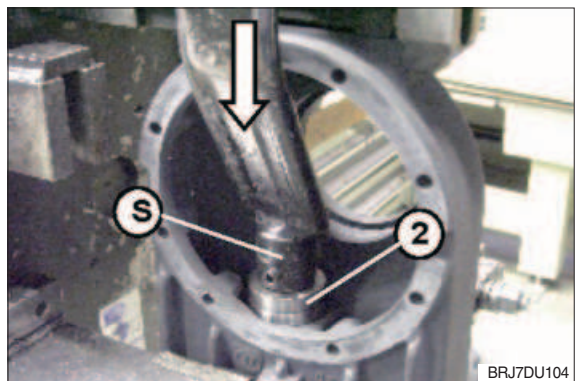
- ② Put the shim(s) (item 1) and the bearing outer ring (item 2) into the bearing seat.



- ③ By means of striking mandrel "S" install the shim (s) and the bearing outer ring into the bearing seat of the housing until contact is obtained.

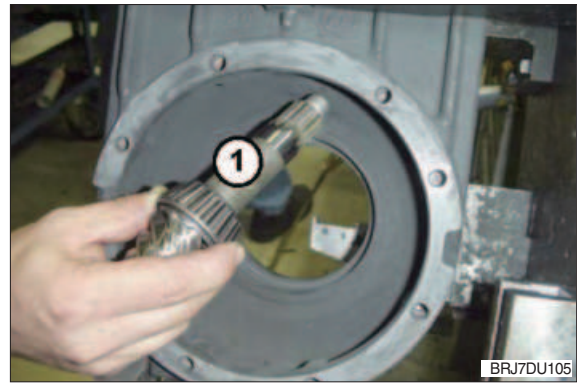
▲ A repeated measurement of the bearing height is only allowed to result in a deviation of max. ± 0.05 mm. Otherwise the process of the shim calculation has to be repeated.

(S) Striking mandrel 62529

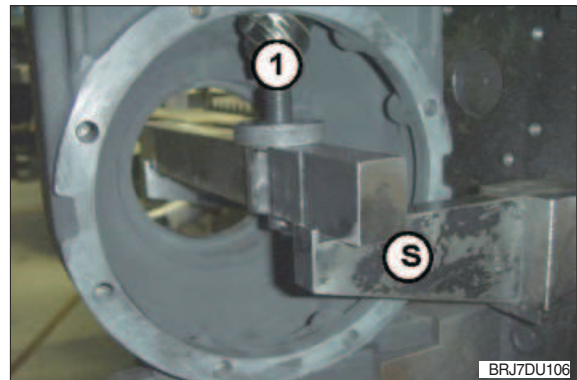


(3) Calculation of distance dimension between collar bevel pinion shaft and housing

- ① Install the preassembled bevel pinion shaft (item 1) from the bottom into the housing.



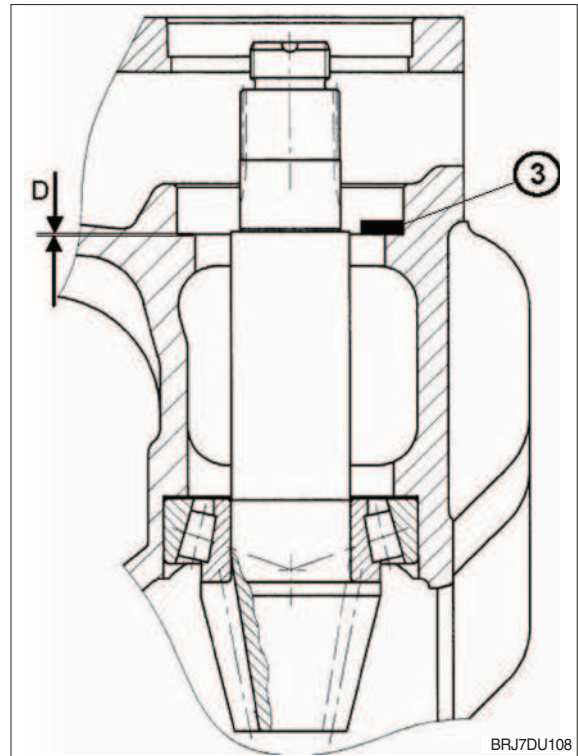
- ② By means of the counter holder "S" preload the bearing outer ring in the housing hand-tight.
(S) Counter holder 62507-1



- ③ Put the spacer bush (item 2) onto the bevel pinion shaft.

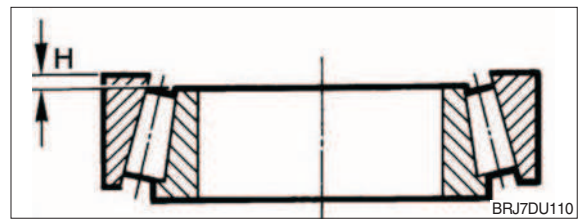


Determine distance dimension "D" from the spacer bush (item 2) to contact of the bearing outer ring in the housing.
(item 3 is the required shim thickness)



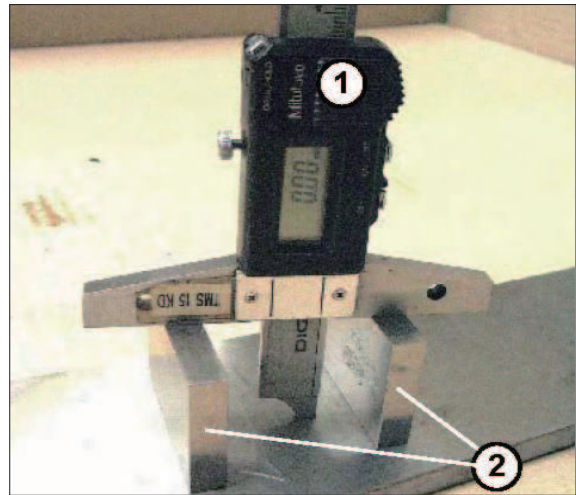
(4) Determination of bearing slack of the taper roller bearing

① Arrow gap = Bearing slack H



Measure the bearing slack "H" with a measuring fixture and gauge blocks/ measuring ledge in the following steps :

- ① Zeroizing of depth gauge (item 1) by means of gauge blocks (item 2).



BRJ7DU111

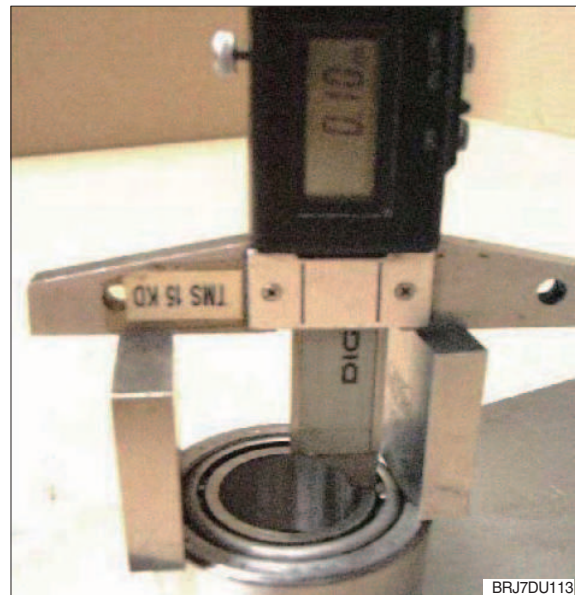
- ② Rolling-in of bearing.



BRJ7DU112

- ③ Measuring of bearing slack H.

Example : Dimension "H" = 0.10 mm



BRJ7DU113

(5) Calculation of shims required for upper bevel pinion shaft bearing

By means of the equation

$$X = D - H$$

the required thickness of the shim (Item 3 figure 108 or 109) can be calculated, i.e. with

Dimension "D" Distance from spacer bush

Dimension "H" Bearing slack of taper roller bearing

Dimension "a" Constant = 0.04 mm

Example :

Distance dimension : Dimension D measured on the housing - 0.7 mm

Bearing slack : Dimension H measured on the bearing - 0.10 mm

$$X = D - H - a$$

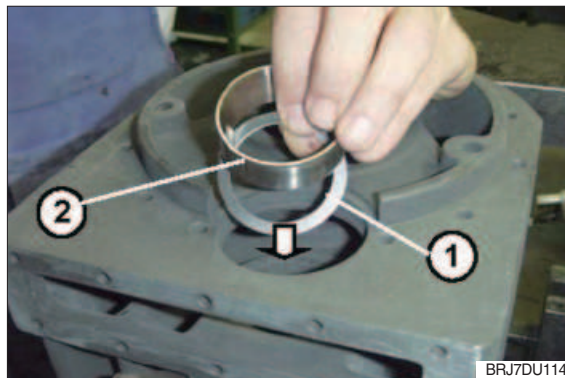
$$X = 0.7 - 0.10 - 0.04 = 0.56 \text{ mm}$$

Add shims corresponding to thickness $X = 0.56 \text{ mm}$.

8) INSTALLATION OF UPPER TAPER ROLLER BEARING OF THE BEVEL PINION SHAFT

Prepare the shim thickness determined according to chapter (5) above "Calculation of shims required for upper bevel pinion shaft bearing" by means of the differently thick shims and continue the installation as follows:

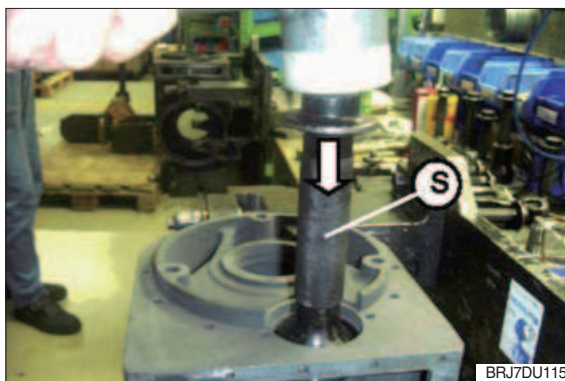
- ① Put shim(s) (item 1) and bearing outer ring (item 2) into the bearing seat.



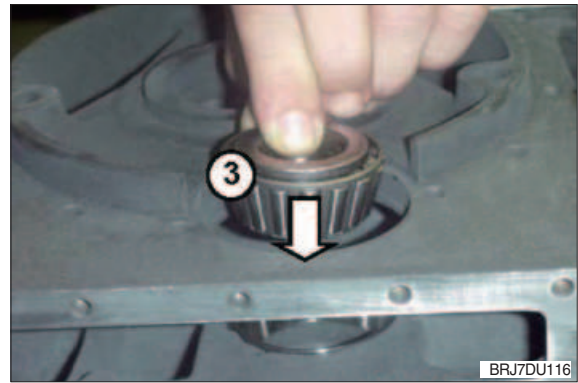
- ② By means of striking mandrel "S" install the shim(s) and the bearing outer ring into the bearing seat of the housing until contact is obtained.

▲ A repeated measurement of the bearing height is only allowed to result in a deviation of max. $\pm 0.05 \text{ mm}$. Otherwise the process of the shim calculation has to be repeated.

(S) Striking mandrel 62747



- ③ Put the bearing inner ring (item 3) into the outer ring of the taper roller bearing.

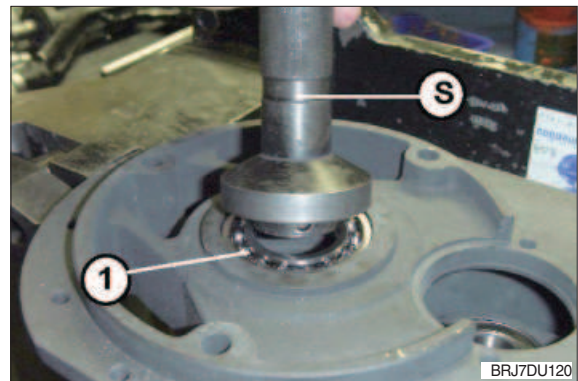


(1) Installation of grooved ball bearing for drive pinion

- ① Install the grooved ball bearing (item 1) with the striking mandrel "S" into the bearing seat of the housing until contact is obtained.

(S) Striking mandrel 62625

- ⚠ Prior to installation of the helical gear the lower grooved ball bearing has to be installed into the housing bearing bore.



(2) Installation of helical gear with bevel pinion shaft

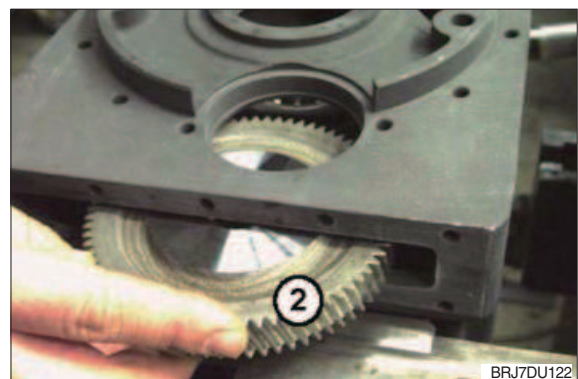
- ① Apply a thin and even layer of LOCTITE 270 onto the internal gearing of the helical gear (item 1).

- ⚠ Wear safety gloves for working with adhesives and observe the LOCTITE instructions.

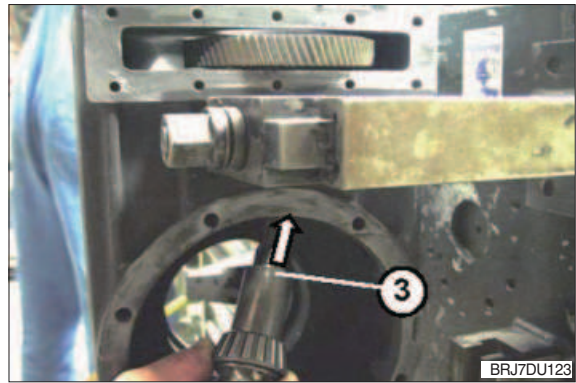


- ② Insert the helical gear (item 2) by the lateral opening of the housing, align it centrally and put it onto the taper roller bearing.

- ⚠ When inserting the helical gear pay attention that the helical gear is not damaged. In case of damage noise problems can occur later.

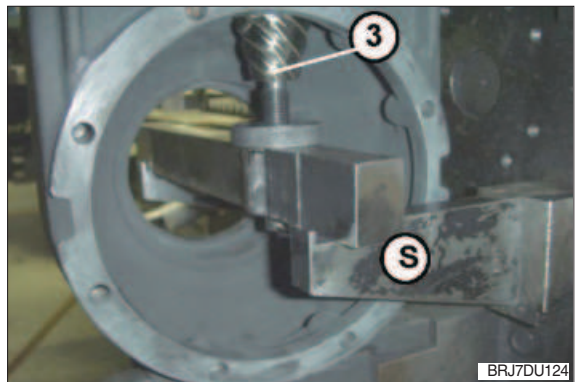


- ③ Install the bevel pinion with space bush (item 3) from the bottom into the housing and assemble it through the profiled seat of the helical gear bore.



- ④ Preload the bevel pinion shaft (item 3) with the counter holder "S" hand-tight against the bearing outer rings in the housing.

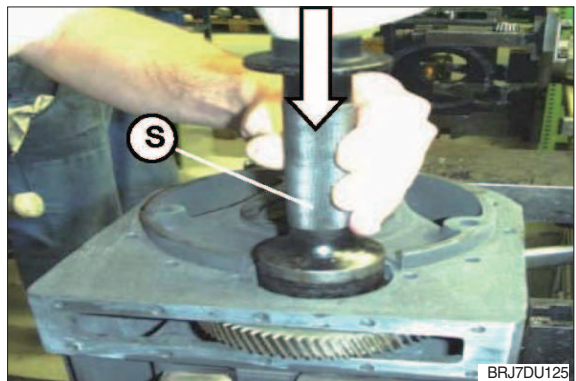
(S) Counter holder 62507-1



- ⑤ By means of striking mandrel "S" install the helical gear until contact is obtained. Hand-tighten the adjusting screw on the counter holder repeatedly, so that all components like taper roller bearing, spacer bush and shims are located exactly.

- ⑥ When all components are located tightly the counter holder can be removed again.

(S) Striking mandrel 62846



- ⑦ Insert gear lock "S" into the housing bearing bore of the drive pinion and block the helical gear.

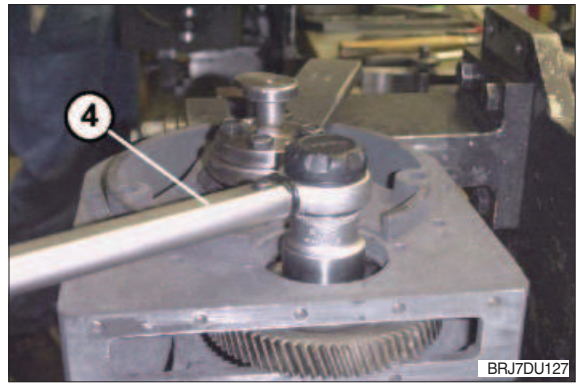
(S) Gear lock 62228



- ⑧ Place the hexagon nut (M16×1.5) onto the bevel pinion shaft and tighten it with a torque spanner (item 4).

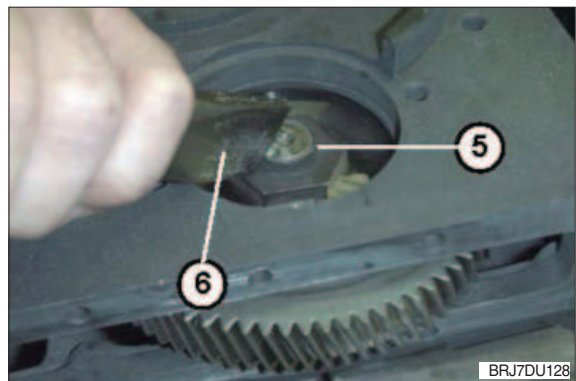
Tightening torque : 100 Nm

- ⚠ Do not yet peen the hexagon nut with the bevel pinion shaft! The hexagon nut must only be peened after setting and checking of the bearing preload. Use the hexagon nut only once.



- ⑨ Turn the bevel pinion shaft and the helical gear respectively by hand several times, that the taper rollers can align in the bearing rings.
- ⑩ Check the bearing preload by means of a drag torque spanner with dial gauge. The bearing preload is adjusted correctly, when a bearing friction torque of
0.5 ... 1.0 Nm
is reached on the bevel pinion shaft. If this value deviates the procedure must be repeated.

- ⑪ Drive the collar of the hexagon nut (item 5) by means of a chisel (item 6, edge of the chisel must be a radius of approx. 2.0 mm) into the recesses of the bevel pinion shaft. Lock the hexagon nut by peening!

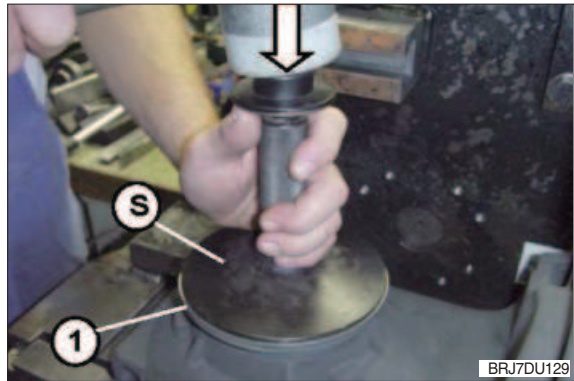


9) INSTALLATION OF CROWN GEAR AND WHEEL SHAFT INTO THE HOUSING

(1) Installation of thread protective shield and radial sealing ring

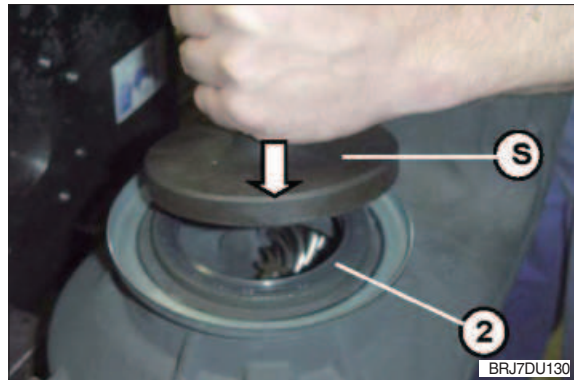
- ① Wet the thread protective shield (item 1) on the bore seat evenly with LOCTITE 270 and install it until contact by means of the striking mandrel "S".

(S) Striking mandrel 63293



- ② Apply a thin and even layer of LOCTITE 574 onto the outer diameter of the radial sealing ring.
- ③ By means of the striking mandrel "S" drive the radial sealing ring (item 2) into the housing seat until contact is obtained at the mandrel.

(S) Striking mandrel 63291



▲ Pay attention that the radial sealing ring is not jammed during installation. Jamming will cause leakage.

▲ Do not damage the sealing lip of the radial sealing ring.

- ③ Wet the sealing lip of the radial sealing ring with grease (e.g. Shell Alvania R3) slightly.

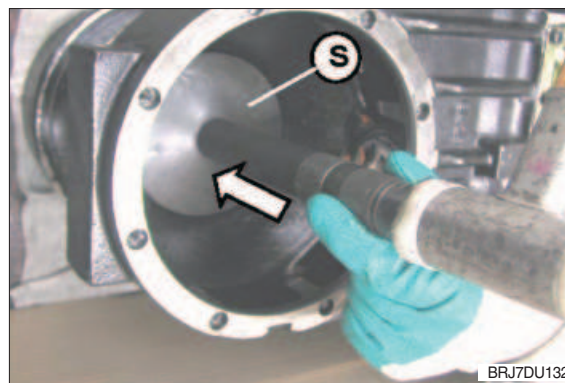


(2) Installation of taper roller bearing into the housing

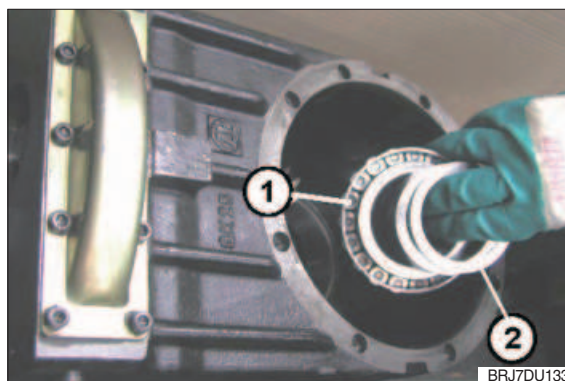
- ① By means of striking mandrel "S" drive the bearing outer ring into the bearing seat of the housing until contact is obtained.

(S) Striking mandrel

62542



- ② Insert the bearing inner ring (item 1) into the outer ring of the taper roller bearing.
- ③ Prepare the shim thickness (thickness X) with the differently thick shims as determined in Chapter 7) (5) at page 3-33 "Calculation of shims required for upper bevel pinion shaft bearing".
- ④ Insert shim(s) (item 2).

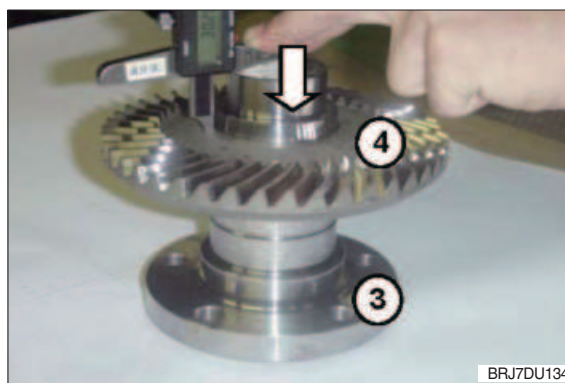


(3) Determination of control dimension for seat

- ① Place the wheel shaft (item 3) onto a plane and solid support. Mount the crown gear (item 4) onto the taper seat of the wheel shaft by hand cautiously and press it on slightly.

Determine distance "A" from plane face P of the wheel shaft to face S of the crown gear as shown in Figure135.

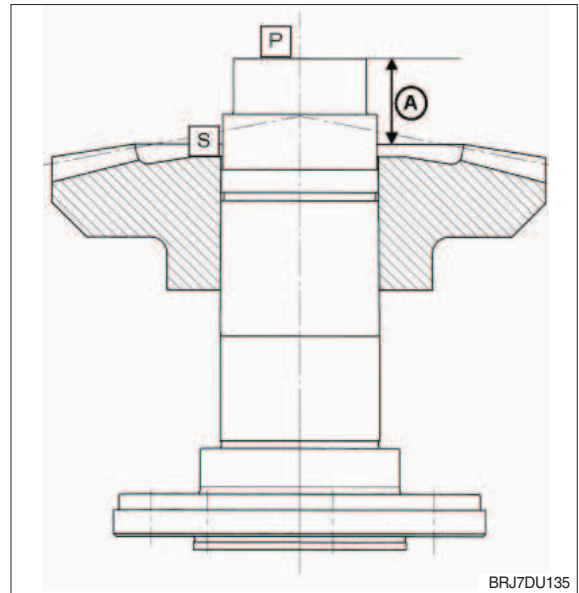
Dimension "A" e.g. 30.85 mm



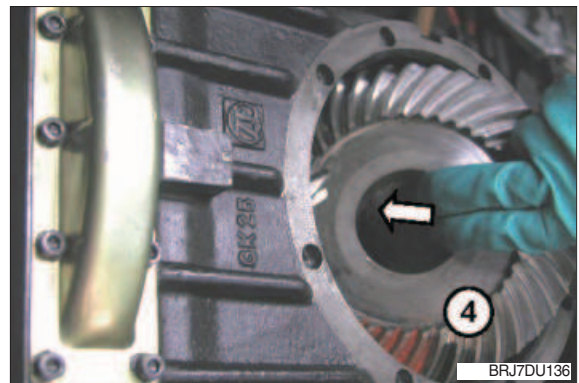
▲ Carry out this measuring procedure to 1/100mm exactly.

▲ Pay attention not to damage the gearing of the crown gear, when the crown gear is mounted onto the wheel shaft. In case of damage, noise problems can occur later.

- ▲ Pay attention not to damage the gearing, when the crown gear is assembled.



- ① Assemble the crown gear (item 4) into the housing carefully and insert it into the gearing of the bevel pinion shaft at the same time. Pay attention that the crown gear is aligned centrally to the shim and the bush.



(4) Pressing-on wheel shaft

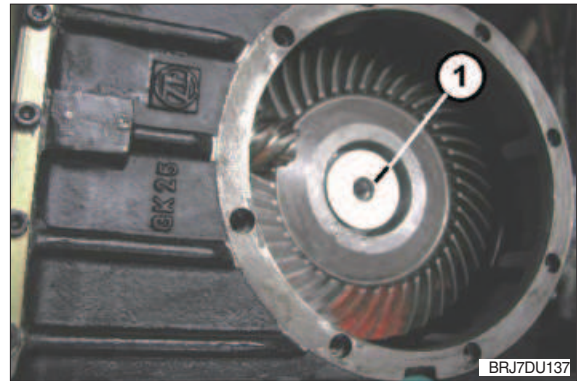
⚠ Taper press fit must be grease- and oilfree. Pay attention to an impeccable surface of the press fit. In case of damage use a new wheel shaft.

All components must be aligned and centered for the press-on procedure.

For this installation procedure a press with a controllable press-on force is required.

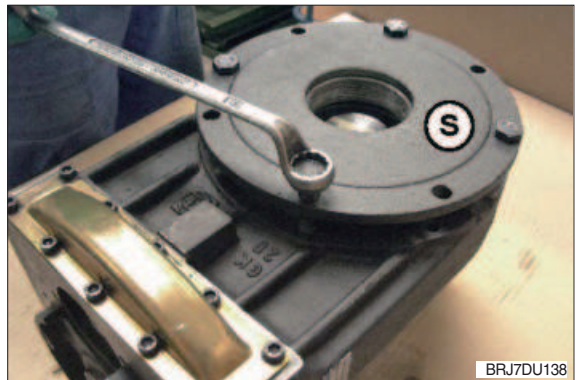
Press-on force: 250 kN up to max. 300 kN.

- ① Assemble the wheel shaft (item 1) cautiously and install it until contact is obtained.



- ② Screw on the press-on fixture (S).

(S) Press-on fixture 63428



- ③ Press the wheel shaft onto the crown gear.

During this procedure the shim(s) and the taper roller bearing inner ring are pressed on until contact is obtained.

⚠ For pressing on the wheel shaft, only apply the press-on force to the wheel shaft.



(5) Determination of seat

▲ The seat must be 10 to 15 mm.

- ① Measure Dimension A from plane face/ wheel shaft to face/crown gear once again (see chapter 9) (3) at page 3-38 "Determination of control dimension for seat".

Dimension "A" e.g. 44.34 mm

Example:

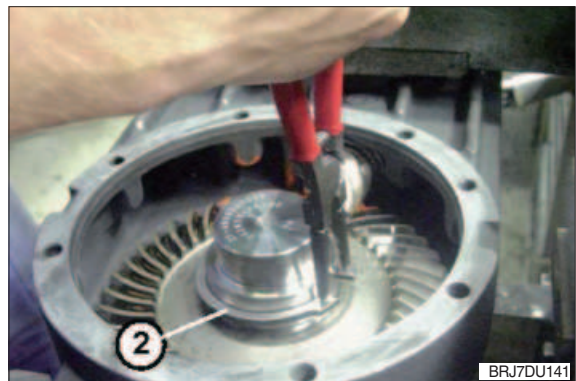
Dimension "A" after pressing-on 44.43 mm

Dimension "A" after pressing-on 30.85 mm

Resulting difference = Seat 13.49 mm

▲ If the seat determined is not between 10 and 15 mm a new wheel shaft and a new crown gear have to be installed.

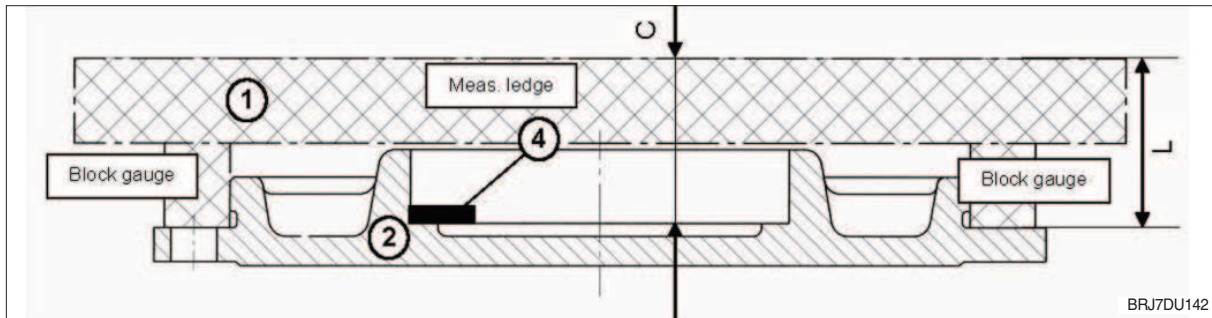
- ② Install the retaining ring (item 2).



10) INSTALLATION OF BEARING FOR WHEEL SHAFT

(1) Determination of required shim thickness for exact bearing preload of the wheel shaft

Thickness of the shim (item 4) to be added can be determined with the following method:



- 1 Measuring ledge
- 2 Housing cover

Dim. "L" Distance from mounting face/housing cover equal to zero position on measuring instrument

Dim. "C" Measure distance from contact shim/housing cover.

Dim. "L" e.g. Zero position on measuring instrument = 0

Dim. "C" e.g. 0.85 mm

- 1 Measuring ledge
- 2 Bevel pinion shaft
- 3 Wheel shaft
- 4 Crown gear
- 5 Housing

Dim. "A"

Distance from mounting face / housing equal to zero position on measuring instrument

Dim. "F"

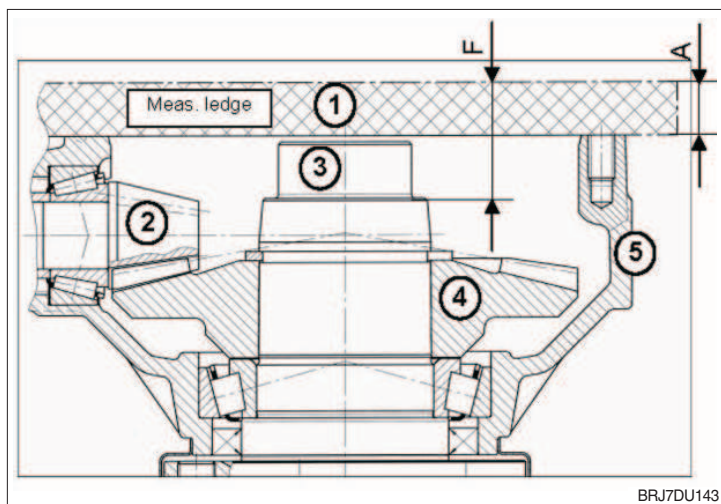
Measure distance from contact bearing inner ring / wheel shaft.

Dim. "A"

e.g. zero position on measuring instrument = 0

Dim. "F"

e.g. 23.01 mm



(2) Calculation of shim required

Thickness of shim can be calculated with the dimensions determined.

Example :

Cover dimension : Dim. C measured on housing cover 0.85 mm

Housing dimension : Dim. F measured on housing 23.01 mm

Bearing dimension : Dim. B measured on bearing under preloading force 21.85 mm

$$X1 = F - (C + B)$$

$$X1 = 23.01 - (0.85 + 21.85) = 0.31 \text{ mm}$$

Constant : $a = 0.20$ at $X1 \geq 0.31$

$a = 0.25$ at $X1 \leq 0.30$

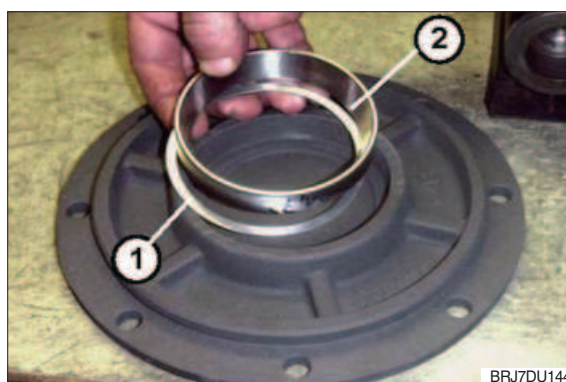
$$X = X1 + a$$

$$X = 0.31 + 0.20 \text{ mm} = 0.51$$

Add shims according to thickness X.

(3) Installation of bearing into housing cover and wheel shaft

- ① Prepare the shim thickness determined under chapter (2) above "Calculation of shim required" by means of the differently thick shims.
- ② Put shim(s) (item 1) and bearing outer ring (item 2) into the bearing seat.



- ③ By means of striking mandrel "S" drive shim(s) and bearing outer ring (item 1) into the bearing seat of the housing cover until contact is obtained.

(S) Striking mandrel 62748



- ④ Place counter holder "N" into the assembly fixture and preload it hand-tight against the wheel shaft (cf. figure 124).
(N) Counter holder 62507-1

- ⑤ Mount the taper roller bearing inner ring (item 2) by means of striking mandrel "S" onto the bearing seat of the wheel shaft (item 3) until contact is obtained.

(S) Striking mandrel 63294



(4) Installation of housing cover

- ▲ Use a new O-ring for the installation. Wet the O-ring with transmission oil or grease slightly. Clean plane face of the housing cover carefully and do not damage it.

- ① Put the o-ring (item 4) into the groove of the housing cover.



- ② Plane face for housing cover on the housing is to be cleaned carefully and must be grease-free.

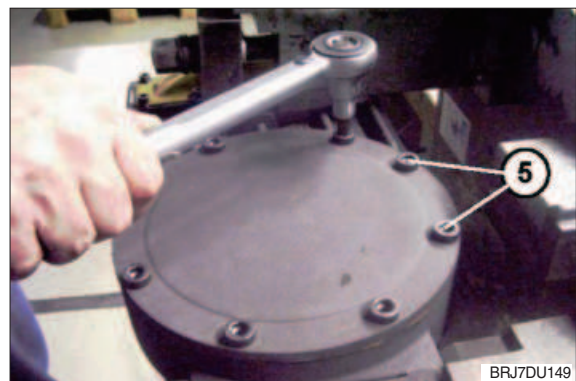
- ③ Apply a thin and even layer of LOCTITE 574 onto the plane face.



- ④ Place the housing cover cautiously and install it slightly tapping with a dead-blow soft face hammer until contact is obtained.

By means of cap screws M10×25 (item 5) bolt the cover to the housing. Tighten the cap screws crosswise evenly!

Tightening torque of the cap screws : 46 Nm.

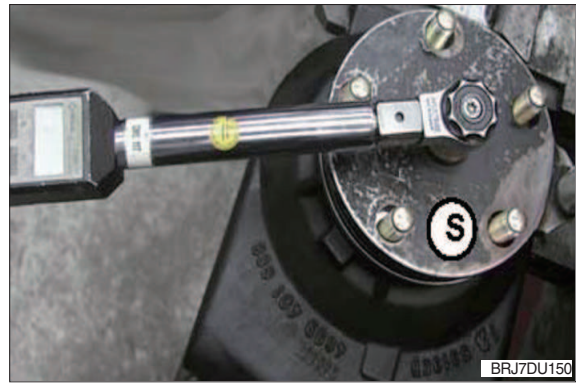


(5) Checking of bearing friction torque on wheel shaft

Rolling

For measuring of the bearing friction torque place tool "S" on the wheel shaft congruent with the wheel bolts and by means of the torque spanner turn the wheel shaft several times.

(S) : Measuring fixture 62532



Bearing preload is adjusted correctly when a bearing friction torque of is obtained at the wheel shaft.

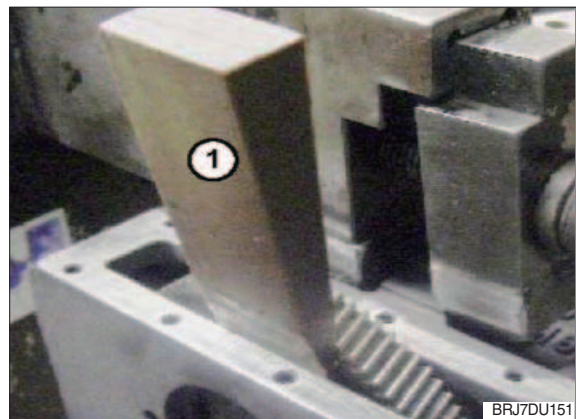
If this value is not reached the working steps from Chapter 10) (2) have to be repeated. The cover has to be removed again.

If the measured value is greater than the above mentioned value, the shim thickness of value "X" in "Chapter 10) (2) calculation of shim required" has to be reduced.

If the measured value is smaller than the above mentioned, the shim thickness of value "X" in "Chapter 10) (2) at page 3-43 calculation of shim required" has to be increased.

(6) Measuring of torsional backlash on wheel shaft

- ① For measuring of the torsional backlash lock the bevel pinion shaft against distortion, e.g. with a wooden wedge (item 1).

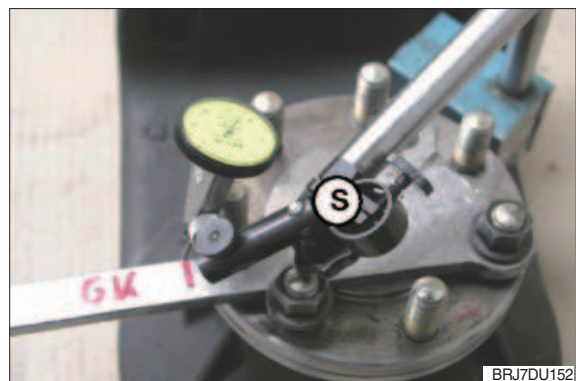


- ② Measure the torsional backlash with measuring stop "S".

(S) Measuring stop 62819

Admissible torsional backlash :
0.10 ~ 0.15 mm

The torsional backlash can be adjusted by adding or removing of the shim(s) (see chapter 6) (2) at page 3-27 "determination of the necessary shim thickness for optimum setting of the torsional backlash of crown gear"). The wheel shaft has to be removed again.



(7) Installation of side cover

Prior to the installation of the side cover clean the sealing surface on the housing and remove the oil residues. The sealing surface must not be damaged.

▲ Wear safety gloves for working with adhesives and observe the LOCTITE instructions.

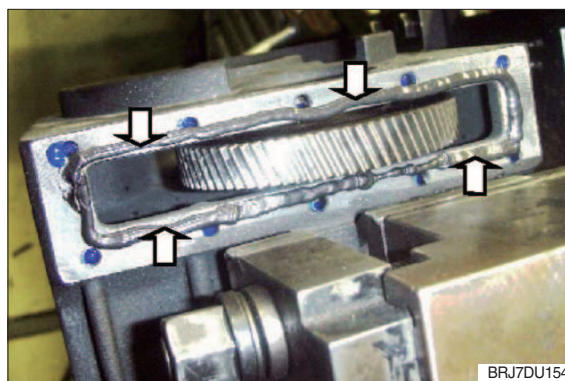
▲ The following step must be carried out within 10 minutes since the LOCTITE hardens.

- ① For sealing of the through holes as well as of the area around the screw the following sealing application is required:
LOCTITE 243 : Product application into the threaded blind holes M6 as sealing function by excess product.

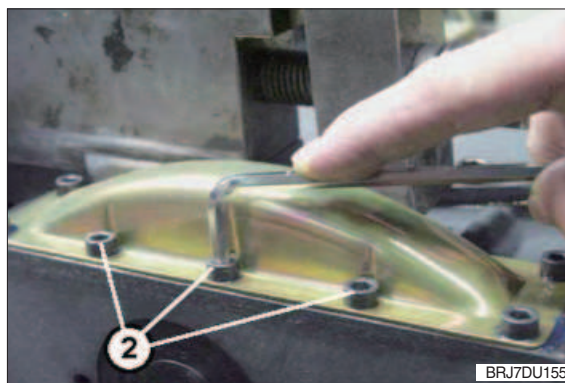


- ② Sealing of the cover:

LOCTITE 5910: Product application as uniform adhesive application onto the sealing surface at the housing as sealing function.



- ③ Put on the side cover (sheet cover) and fasten it hand-tight with 10 cap screws M6 × 10 (item 2) onto the housing.



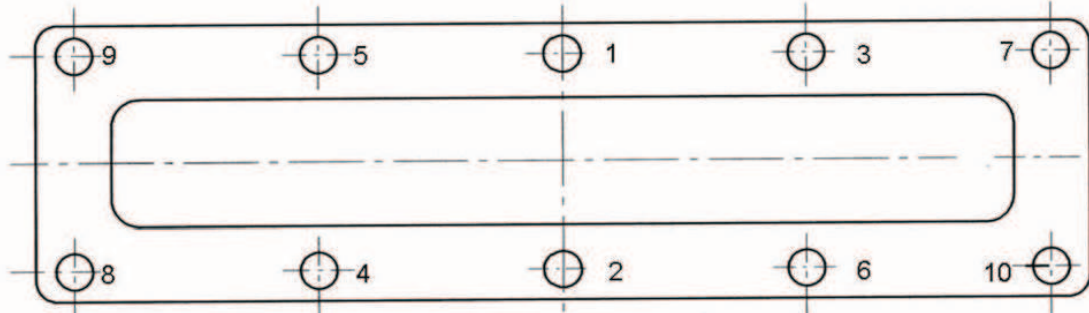
▲ Do not yet tighten the cap screws with the corresponding tightening torque.

Tighten the 10 cap screws evenly only in the tightening sequence shown in Figure 156.

Sequence of tightening :

Number 1 beginning Number 10 end

Tightening torque of the cap screws : 9.5 Nm



BRJ7DU156

11) PREASSEMBLY AND INSTALLATION OF DRIVE PINION

(1) Installation of ball bearing

- ① For mounting of the bearing onto the drive pinion use assembly fixture "S", as shown.

(S) Assembly fixture 62523

- ② Put the drive pinion (item 1) onto the guide mandrel (item 2) of the assembly fixture and install it until contact is obtained.

- ③ Put on the ball bearing (item 4) and the pressing sleeve (item 3). By means of a hand lever press, press on the ball bearing with the pressing sleeve onto the drive pinion (item 1) until contact is obtained.

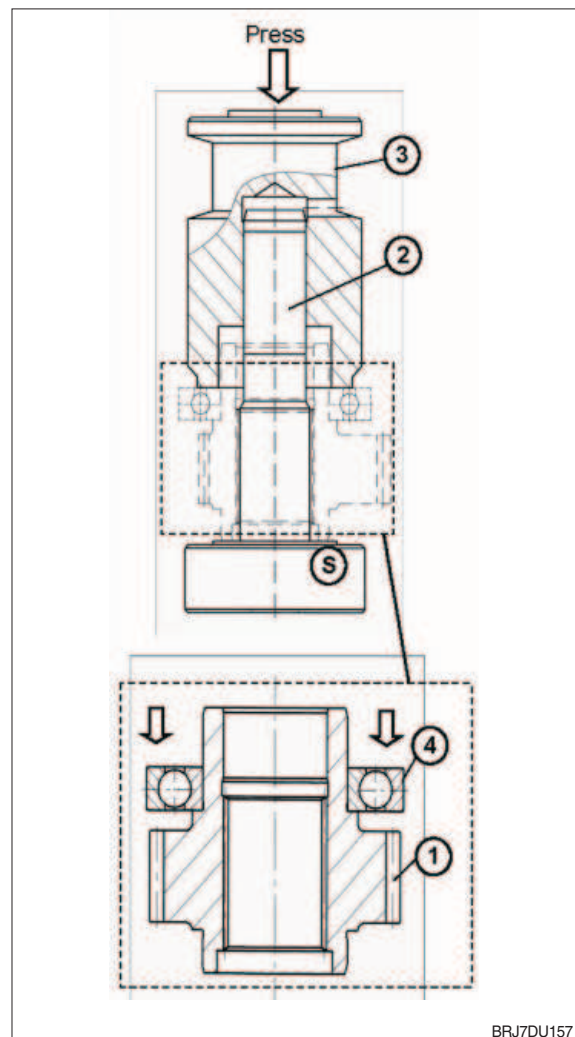
(item 3) Pressing sleeve 63290

- ④ If there is no hand press available, the bearing can be installed as follows:

▲ Danger of burnings! Wear safety gloves.

- ⑤ Heat the ball bearing to max. 90 °C and install it onto the drive pinion until contact is obtained.

- ⑥ After cooling down install the bearing subsequently.



BRJ7DU157

(2) Mounting of sealing cap

For sealing of the bore in the drive pinion a sealing cap (item 5) must be mounted. This requires the following sealing application:

- ① LOCTITE 5910 : Product application as adhesive application onto the supporting face and around the bore in the drive pinion as sealing function by excessive product.
- ② Insert the sealing cap.
- ③ Press in the sealing cap with a press until contact is obtained.



(3) Installation of drive pinion

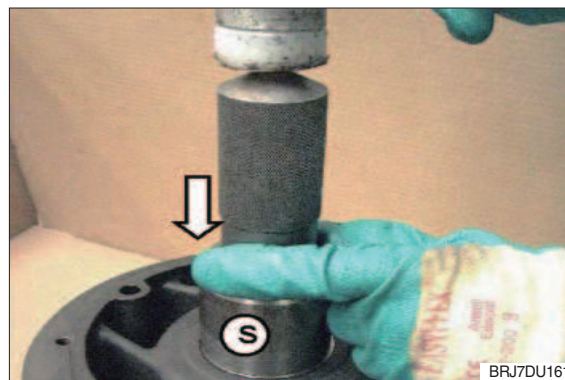
▲ Pay attention when inserting the drive pinion not to damage the gearing of drive pinion and helical gear. Damages might cause louder running noises and consequential damages!

- ① Install the preassembled drive pinion (item 1) into the housing bearing bore cautiously. For joining turn the wheel shaft of the transmission cautiously until the drive pinion engages into the gearing of the helical gear.



- ② By means of the striking mandrel "S" install the drive pinion into the bearing seat until contact is obtained.

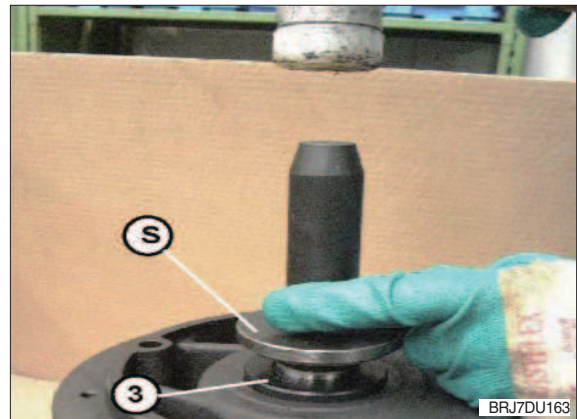
(S) Striking mandrel 62478



- ③ Snap the retaining ring (item 2) by means of flat-head pliers into the groove of the housing bore and install it until contact is obtained.



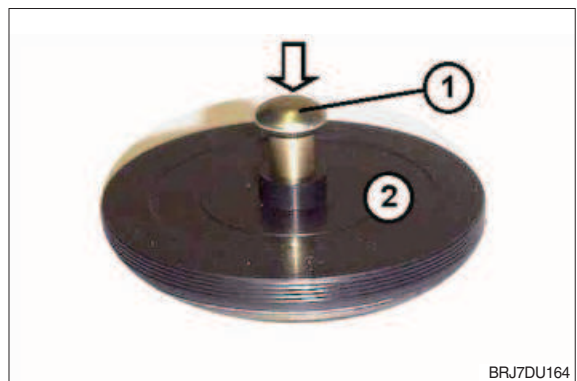
- ④ Wet the sealing lip of the radial sealing ring with grease (e.g. Shell Alvania R3) slightly.
- ⑤ Apply a thin and even layer of LOCTITE 574 onto the outer diameter of the radial sealing ring.
- ⑥ By means of striking mandrel "S" drive the radial sealing ring with the closed surface upwards into the housing seat until contact at the mandrel is obtained.



(S) Striking mandrel 62521

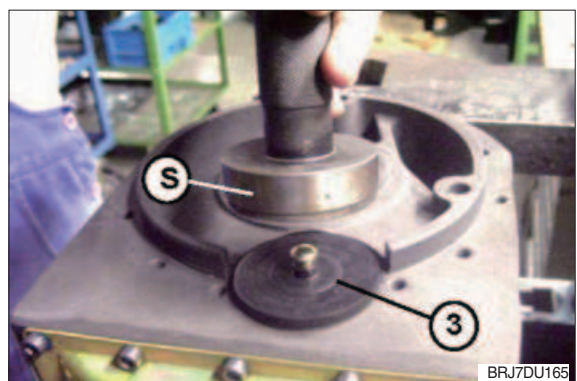
(4) Installation of sealing cap

- ① Press the breather valve (item 1) slightly by hand into the central bore of the sealing cap (item 2) (Reference depth approx. 5mm).



- ③ Insert the sealing cap with breather valve (item 3) into the boring seat of the housing bore in the bevel pinion shaft.
- ④ By means of the striking mandrel "S" install the sealing cap subsequently until contact is obtained.

(S) Striking mandrel 62522

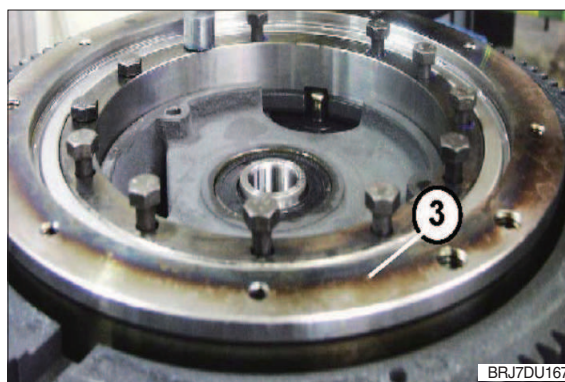


(5) Attachment of pivoted connection geared steering

- ① Place the gear ring (item 2) and turn it so that the bolt holes match the threaded holes of the connecting construction.
- ② Install the gear ring with a dead-blow soft face hammer until contact is obtained.



- ③ Put on the pivoted bogie bearing (item 3) with the peripheral recess upwards and turn it that the bolt holes in the pivoted bogie bearing match with the gear ring and housing hole pattern.



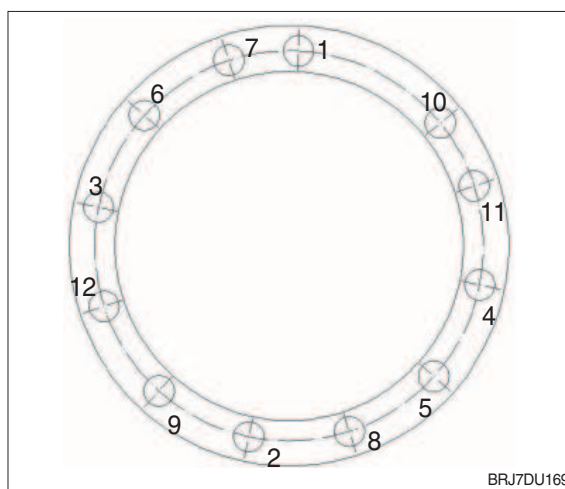
- ④ Wet screws M8x40-10.9 with LOCTITE 243.
- ⑤ By means of the screws fasten the pivoted bogie bearing and the gear ring onto the connecting constructions.
- ⑥ Tighten the screws evenly in the tightening sequence shown in figure 169.

Sequence of tightening:

Number 1 beginning Number 12 end

Tightening torque of cap screws : 34 Nm

- ▲ Pay attention for installing of the drive pinion that the gearing of drive pinion and helical gear are not damaged. Damages might cause louder running noises and consequential damages!**



Thus the reassembly is ended.

12) GENERAL INSTRUCTIONS AFTER REASSEMBLY

- (1) For reinstallation of the power train into the vehicle observe the installation instructions at page 2-7.
- (2) Fill in oil according to the operating instructions.
- (3) Transmission and vehicle respectively may be used or operated at the earliest 24 hours after the reassembly again.

6. DISPOSAL

Disposal of the replaced components, materials and substances adequately, environmentally friendly and in accordance with the legal regulations for disposal for the respective material :

Component	Consisting of	Disposal acc. to the regulations :
Transmission oil		Waste oil
Side cover	Sheet	Scrap metal
Radial sealing ring	Sheet	
Shims	Sheet	
Wheel bolts	Steel	
Grooved ball bearing	Steel	
Screw	Steel	
O-ring	PE	PE plastic materials
Shaft seal	PE	
Sealing cap	PE	