

# REPAIR MANUAL

## 5 HP-19 FL/A



**ZF GETRIEBE GMBH SAARBRÜCKEN**

Version 00/08/01  
CD

subject to alterations

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# Preliminary information

This manual covers the procedure for repairing the complete transmission.

The repairing of this transmission is only allowed to persons with specific training from ZF Getriebe GmbH.

The entire disassembly and assembly procedure is described in chronological order.

The photographs were kept general in nature so that they can be used with various applications; they are not binding in every case.

We use *Service Bulletins* and training courses to announce important information and application-specific changes that must be taken into consideration in maintenance work. If this repair manual is given to a third party, there will be no modification service.

The *Service Bulletins* regulations and specifications must be followed when making repairs.

Depending on the type of damage that has occurred, the repair work can be limited to that which is necessary to repair the damage.

In this case you must observe the following:

- Seals (such as O-rings, shaft seals, gaskets, and filters) should always be renewed.
- All O-rings, rectangular-section rings, and other sealing rings must always be lubricated with petroleum jelly before installation.
- All bearings must always be oiled lightly when installed.
- For transmissions that have covered a large number of kilometers (> 80,000 km), all lined clutch discs and steel clutch discs should be replaced.
- After clutches/brakes have been damaged, the converter, oil tubes, and oil cooler, must be cleaned thoroughly with a suitable cleaning agent.
- If brakes C or D has been damaged, or if a considerable distance has been covered (> 80,000 km), pistons C and D must be replaced.

The following requirements should be met before the repair work is started:

- The required special tools should be available.  
(The complete set of special tools is listed in Chapter 1.7)
- A suitable transmission testing rig should be available.  
The required testing values can be found in the *Service Bulletins*.

**Note:**

This manual treats the valve body as a complete unit, which should not be disassembled without special knowledge; it should be exchanged as a complete unit.

A separate repair manual is planned for the valve body.

**Important:**

The transmission is filled with long-life oil.

**The oil does not have to be changed until it has been in use for ten years.**

The transmission must only be delivered with the oil type and oil amount specified in the corresponding parts list documentation (see Part List).

Technical Service

Technical Documentation

Training Center

Bach

Reus

Schultz



# 1. General information

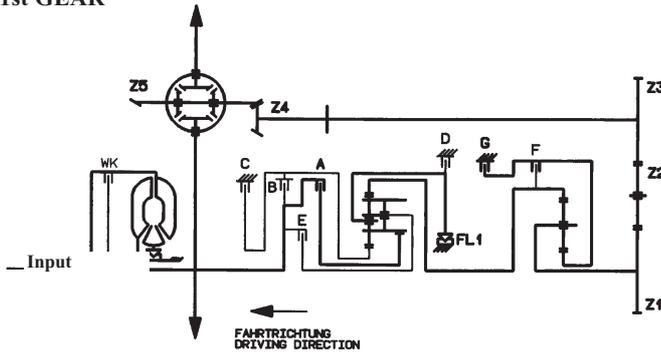
## 1.1 Picture of the transmission



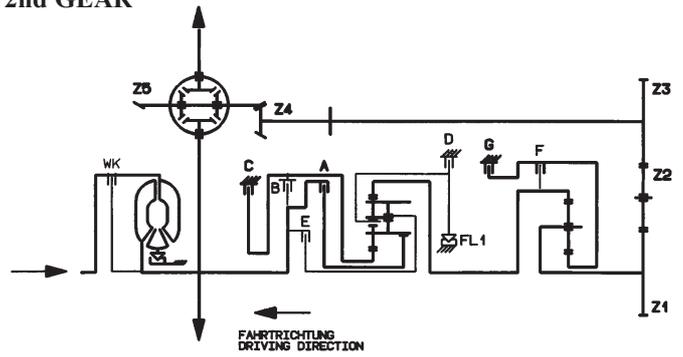


## 1.2 Power flow diagram

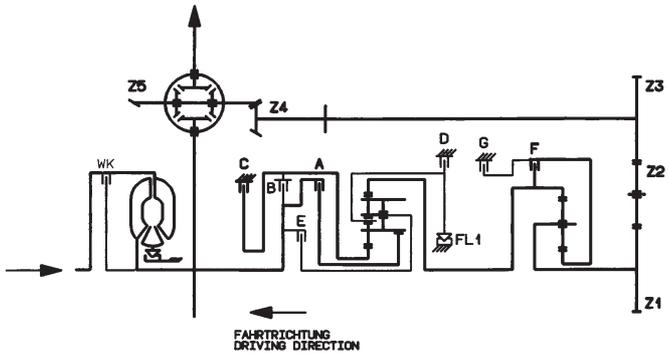
1st GEAR



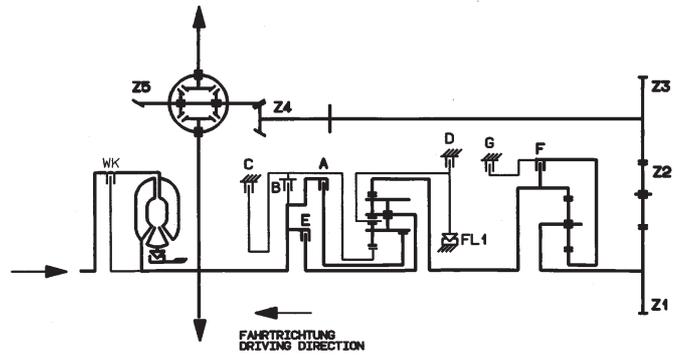
2nd GEAR



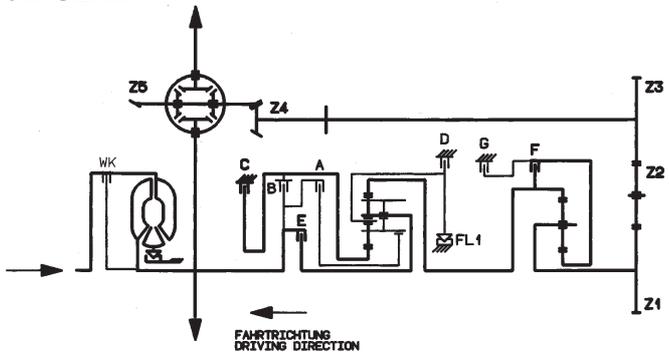
3rd GEAR



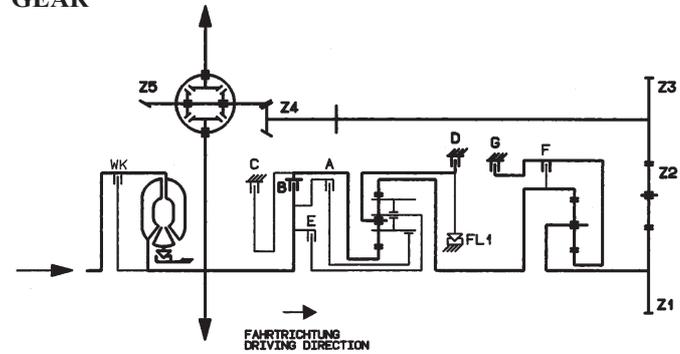
4th GEAR



5th GEAR



Reverse GEAR

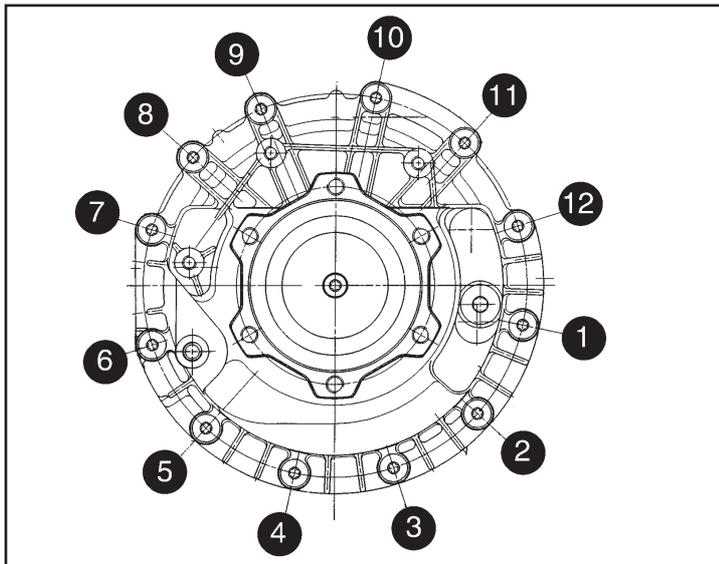




### 1.3 Specifications

#### 1.3.1 Screw specifications

##### 1.3.1.1 Differential cover



Initial tightening of the screws is in the following order:

7 ⇨ 3 ⇨ 11

Then tighten the screws finally in numerical order (see diagram):

1 ⇨ 2 ⇨ 3 ⇨ ... ⇨ 12

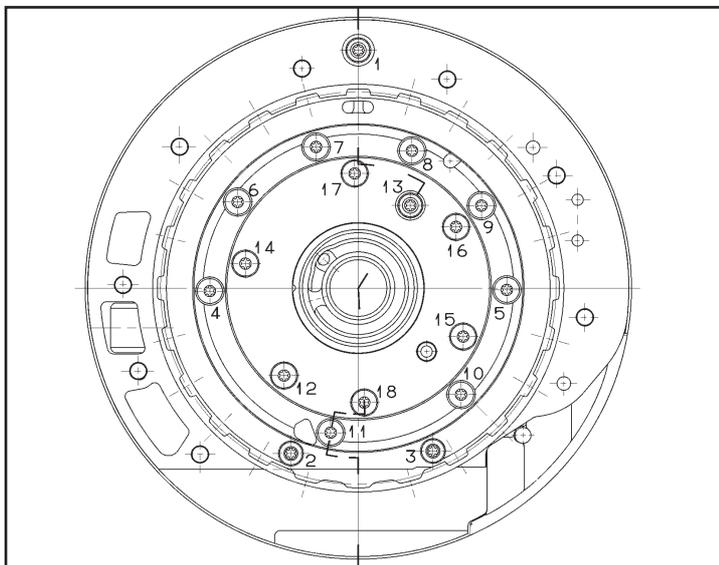
**Note:**

The numbers represent the *actual* final tightening order.

(This is a simplification of **Specification 1060 700 134**)

(Tightening torques: see Chapter 1.5)

##### 1.3.1.2 Intermediate plate - pump - cylinder C



Initial tightening of the screws is in the following order:

1 ⇨ 2 ⇨ 3 (= 10.220)

Tighten screw 1, as long as piston C is build in.

Then pretightening of the screws is in the following order:

4 ⇨ 5 (= 10.100)

Then tighten the screws finally in numerical order :

6 ⇨ 7 ⇨ ... ⇨ 11 ⇨ 4 ⇨ 5 (=10.100)

⇨ 12 (=10.120)

⇨ 13 (=10.160)

⇨ 14 ⇨ ... ⇨ 18 (=10.060/130)

(Specification 1060 700 015)

(Tightening torques: see Chapter 1.5)

### 1.3.1.3 Tightening yield strength crown gear differential

#### Preconditions:

- Crown gear, differential case and screws were washed and are dry
- Parts should have room temperature

#### The following data should be entered in the wrench:

Mounting torque	=	50 Nm
Lower torque limit	=	90 Nm
Upper torque limit	=	160 Nm
Lower angle limit	=	30°
Upper angle limit	=	70°
Wrench case	=	hard

#### Tightening

Tighten screws crosswise.  
First tighten all screws to mounting torque  
and then to yield strength !

*Attention to the limit values!*

## 1.4 Making adjustments

### 1.4.0 Measuring the clutch packs (procedure)

Place the two intermediate pieces 5p01 050 329/5p01 060 329 on the marked position on measuring fixture 5p01 000 330.



Using the knurled screw, turn adjusting device 5p01 001 458 to the upper limit.

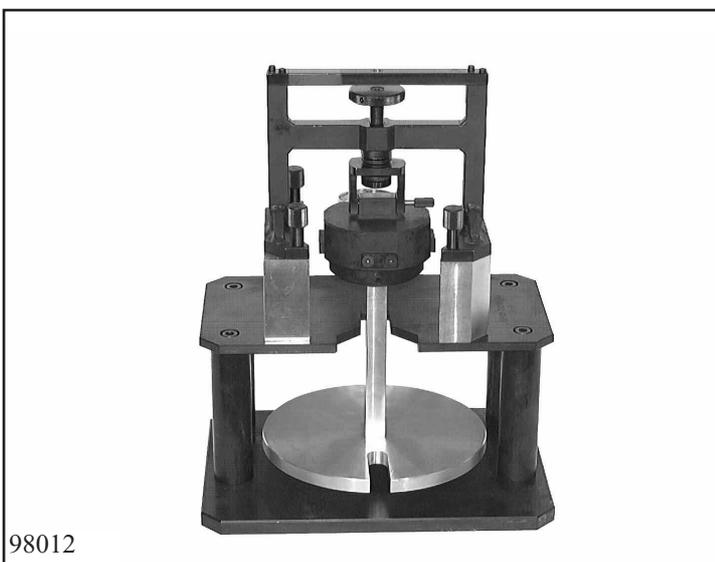
Attach force measuring unit 5p01 000 329 to adjusting device.



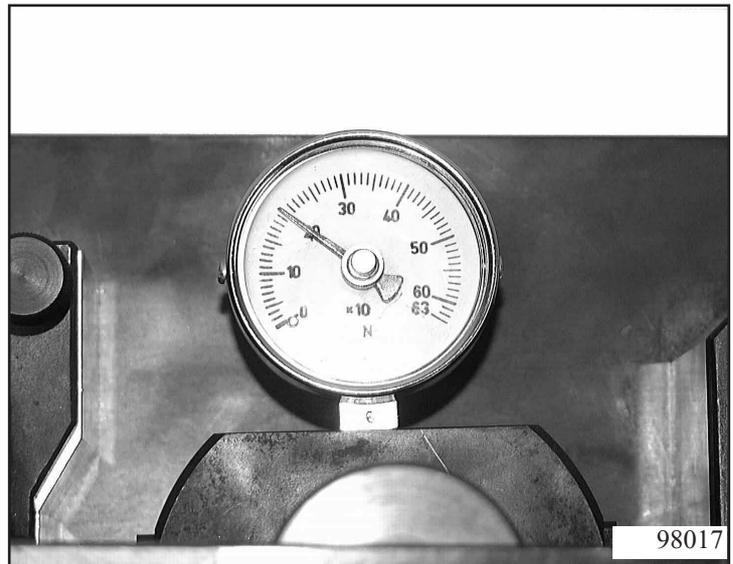
Fasten it with 4 knurled screws to the measuring fixture using the intermediate pieces.

Using a fixing pin, connect measuring plate 5p01 040 330 with the force measuring unit.

Using the knurled screw, clamp the clutch pack to be measured (with steel disc on the top and corrugated disc – if there is one – on the bottom) in the device at 200N.



Check the value on the force measuring unit's display.

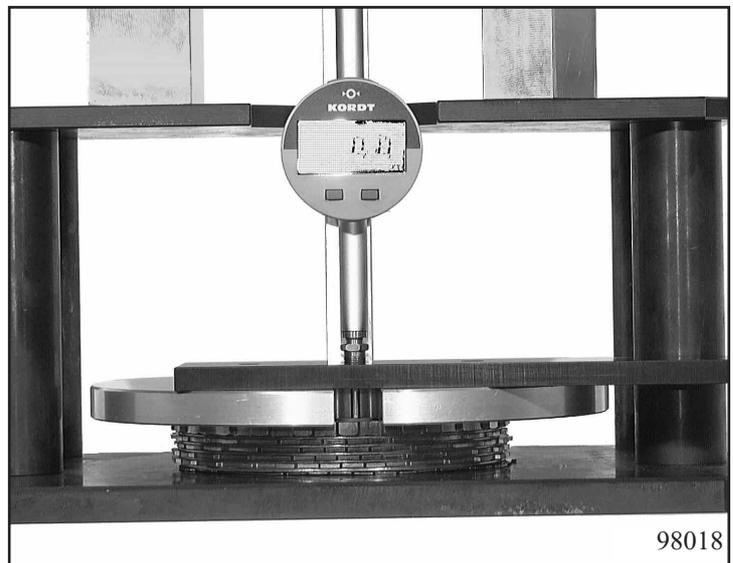


Then place measuring bar 5p01 060 330 on the measuring plate, put the dial gauge's measuring base in the measuring plate's groove on the top disc of the set, and set the dial gauge to 0. Now use the measuring bar to measure down to the base plate.

Read the measurement value  $\Rightarrow M_X$

**Note!**

In each case, the X index in  $M_X$  stands for the brake/ clutch packs that are put in (A, B, C, D, E, F, G).





## 1.4.1 Clearances

### 1.4.1.1 Clearance, clutch F (snap ring)

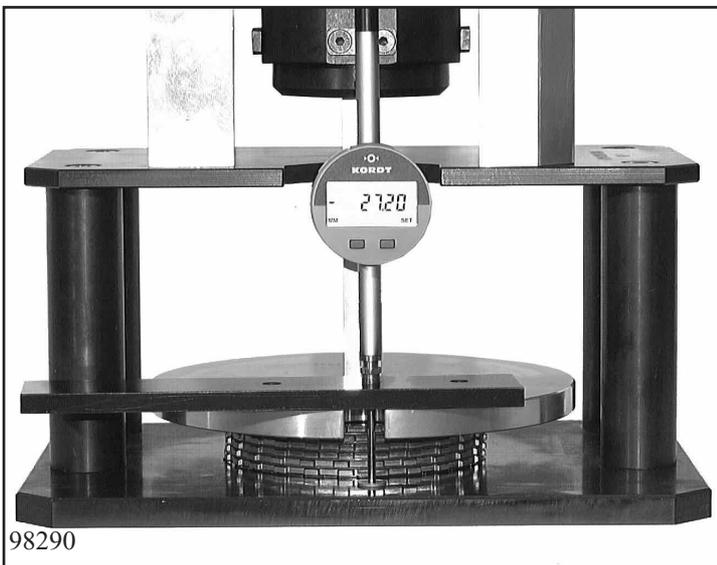
Determine installation space  $E_F$  of brake F with measuring bar 5p01 000 330.

To do this, place measuring bar 5p01 000 330 on the edge of the cylinder of brake F. Apply the measuring base of the dial gauge to the highest point on the disc contact surface at the pressure plate and set the dial gauge to "0".

Pull the measuring sensor up, insert it into the snap ring groove and press it against the upper edge of the groove.

Repeat the measurement twice after turning through  $120^\circ$ .

Take an average of  $F_1, F_2, F_3 \Rightarrow W_F$



Determine thickness  $M_F$  of clutch F disc set as described in **Chapter 1.4.0 "Measuring the clutch packs"**.

$\Rightarrow M_F$

Installation space  $E_F$  is obtained from  $W_F$  plus thickness of base F.  $\Rightarrow E_F$

Test value  $P_F$  is then obtained from installation space  $E_F$  minus  $M_F$

Value  $P_F$  must be between 3.10 and 4.89 mm. **Test specification 1060 700 062 - version B**

Select snap ring  $S_F$  with test gauge  $P_F$ .

#### Calculation:

$$E_F = W_F + F$$

$$P_F = E_F - M_F$$

Clearance  $L_F$  should be 1.9 - 2.2 mm with 5 lined discs.

**Example (for 1.4.1.1):**

$$F = 1.48 \text{ mm (base thickness)}$$

$$F_1 = 29.78 \text{ mm}$$

$$F_2 = 29.75 \text{ mm}$$

$$F_3 = 29.75 \text{ mm}$$

$$W_F = (29.78 + 29.75 + 29.75)/3 \\ = 29.76 \text{ mm}$$

$$M_F = 27.2 \text{ mm}$$

$$E_F = 29.76 + 1.48 \\ = 31.24 \text{ mm}$$

$$P_F = 31.24 - 27.2 \\ = 4.04 \text{ mm}$$

$$S_F = 2.0 \text{ mm}$$

$$L_F = 4.04 - 2.0$$

$$\Rightarrow L_F = 2.04 \text{ mm}$$



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### 1.4.1.2 Adjusting Clearance of brake D (snap ring)

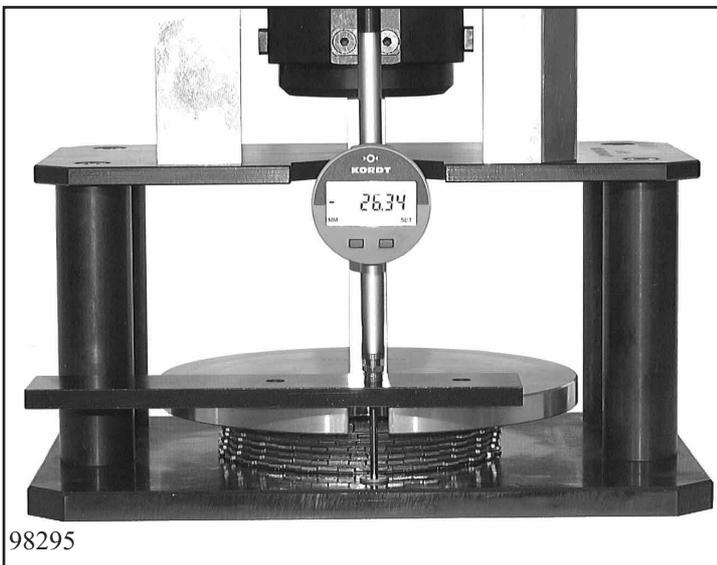
Determine installation space  $E_D$  of brake D with measuring bar 5p01 000 330.

To do this, place measuring bar 5p01 000 330 on the edge of the cylinder of brake D. Place the base of the dial gauge on the highest point on the disc contact surface of the piston and set the dial gauge to "0".

Pull the measuring sensor up, insert it into the snap ring groove and press it against the upper edge of the groove.

Repeat the measurement twice after turning through  $120^\circ$ .

Take the average of  $D_1, D_2, D_3 \Rightarrow W_D$



98295

Measure thickness  $M_D$  of the disc set for brake D as described in **Chapter 1.4.0 "Measuring the clutch packs"**.

$\Rightarrow M_D$

Installation space  $E_D$  is obtained from measured value  $W_D$  plus base thickness  $F$ .  $\Rightarrow E_D$

Test value  $P_D$  is then installation space  $E_D$  minus disc set thickness  $M_D$

Value  $P_D$  must be between 4.65 - 6.45 mm. **Test specification 1056 700 265 - version A**

Use test gauge  $P_D$  to select snap ring  $S_D$ .

#### Calculation:

$$E_D = W_D + F$$

$$P_D = E_D - M_D$$

Clearance  $L_D$  should be 2.29 - 2.59 mm with six lined discs.

**Example (for 1.4.1.2):**

$$F = 1.48 \text{ mm (base thickness)}$$

$$D_1 = 30.21 \text{ mm}$$

$$D_2 = 30.22 \text{ mm}$$

$$D_3 = 30.26 \text{ mm}$$

$$W_D = (30.21 + 30.22 + 30.26)/3 \\ = 30.23 \text{ mm}$$

$$M_D = 26.34 \text{ mm}$$

$$E_D = 30.23 + 1.48$$

$$= 31.71 \text{ mm}$$

$$P_D = 31.71 - 26.34$$

$$= 5.37 \text{ mm}$$

$$S_D = 3.0 \text{ mm}$$

$$L_D = 5.37 - 3.0$$

$$\Rightarrow L_D = 2.37 \text{ mm}$$



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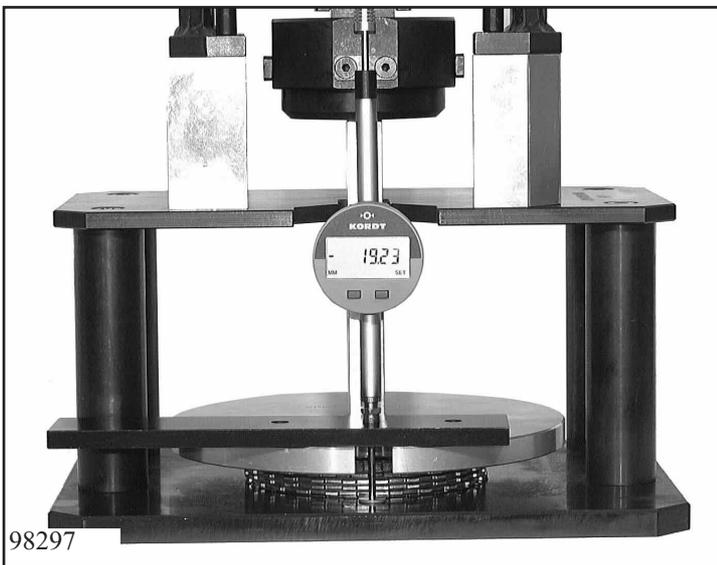
### 1.4.1.3 Adjusting Clearance of brake G (snap ring)

Determine brake G installation space  $E_G$  with measuring bar 5p01 000 330.

To do this, place measuring bar 5p01 000 330 on the edge of the cylinder of brake G. Place the base of the dial gauge against the highest point on the disc contact surface of the piston and set the dial gauge to "0".

Pull the measuring sensor up, insert it into the snap ring groove and press it against the upper edge of the groove. Repeat the measurement twice after turning through  $120^\circ$ .

Take the average of  $G_1, G_2, G_3 \Rightarrow W_G$



98297

Determine thickness  $M_G$  of the disc set for brake G as described in **Chapter 1.4.0 "Measuring the clutch packs"**.

$\Rightarrow M_G$

Installation space  $E_G$  is obtained from measured value  $W_G$  plus base thickness  $F$ .  $\Rightarrow E_G$

Test value  $P_G$  is then installation space  $E_G$  minus  $M_G$

Value  $P_G$  should be between 3.41 and 5.12 mm. **Test specification 1056 700 188**, version A.

Use test gauge  $P_G$  to select snap ring  $S_G$ .

#### Calculation:

$$E_G = W_G + F$$

$$P_G = E_G - M_G$$

Clearance  $L_G$  should be 1.52 - 1.82 mm with 4 lined discs.

**Example (for 1.4.1.3):**

$$F = 1.48 \text{ mm (base thickness)}$$

$$G_1 = 21.98 \text{ mm}$$

$$G_2 = 21.97 \text{ mm}$$

$$G_3 = 21.99 \text{ mm}$$

$$W_G = (21.98 + 21.97 + 21.99)/3 \\ = 21.98 \text{ mm}$$

$$M_G = 19.23 \text{ mm}$$

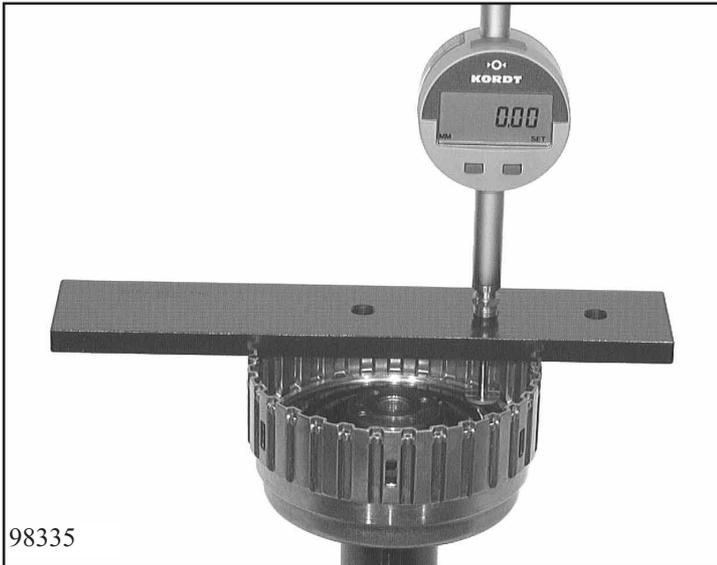
$$E_G = 21.98 + 1.48 \\ = 23.46 \text{ mm}$$

$$P_G = 23.46 - 19.23 \\ = 4.23 \text{ mm}$$

$$S_G = 2.6 \text{ mm}$$

$$L_G = 4.23 - 2.6$$

$$\Rightarrow L_G = 1.63 \text{ mm}$$



#### 1.4.1.4 Adjusting Clearance of clutch E (snap ring)

Determine installation space  $E_E$  of brake E with measuring bar 5p01 000 330.

To do this, place measuring bar 5p01 000 330 on the edge of the cylinder of brake E. Place the base of the dial gauge on the highest point of the disc contact surface on the piston and set the dial gauge to "0".

Pull the measuring sensor up, insert it into the snap ring groove and press it against the upper edge of the groove. Repeat the measurement twice after turning through  $120^\circ$ .

Take the average of  $E_1, E_2, E_3 \Rightarrow W_E$

98335



Determine thickness  $M_E$  of the disc set for brake E as described in **Chapter 1.4.0 "Measuring the clutch packs"**.

$\Rightarrow M_E$

Installation space  $E_E$  is obtained from measured value  $W_E$  plus base thickness  $F \Rightarrow E_E$

Test value  $P_E$  is then installation space  $E_E$  minus  $M_E$

98336

Value  $P_E$  should be between 3.04 and 4.46 mm. **Test specification 1056 700 309, version A**

Use test gauge  $P_E$  to select snap ring  $S_E$ .

#### Calculation:

$$E_E = W_E + F$$

$$P_E = E_E - M_E$$

Clearance  $L_E$  should be 1.78 - 2.08 mm with 5 lined discs.

**Example (for 1.4.1.4):**

$$F = 1.48 \text{ mm (base thickness)}$$

$$E_1 = 23.22 \text{ mm}$$

$$E_2 = 23.23 \text{ mm}$$

$$E_3 = 23.27 \text{ mm}$$

$$W_E = (23.22 + 23.23 + 23.27)/3 \\ = 23.24 \text{ mm}$$

$$M_E = 21.64 \text{ mm}$$

$$E_E = 23.24 + 1.48 \\ = 24.72 \text{ mm}$$

$$P_E = 24.72 - 21.64 \\ = 3.08 \text{ mm}$$

$$S_E = 1.2 \text{ mm}$$

$$L_E = 3.08 - 1.2$$

$$\Rightarrow L_E = 1.88 \text{ mm}$$



99200

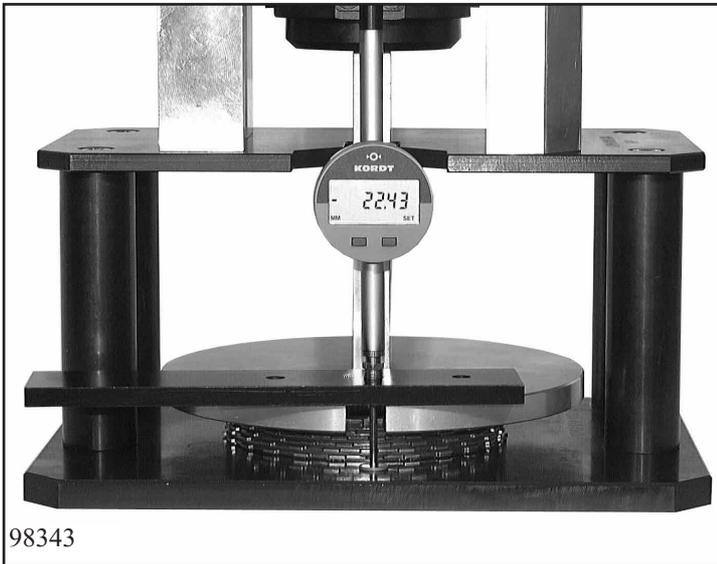
#### 1.4.1.5 Adjusting Clearance of clutch A (snap ring)

Determine clutch A installation space  $E_A$  with measuring bar 5p01 000 330.

To do this, place measuring bar 5p01 000 330 on the edge of the cylinder of clutch A. Place the base of the dial gauge on the highest point of the disc contact surface at the piston and set the dial gauge to "0".

Pull the measuring sensor up, insert it into the snap ring groove and press it against the upper edge of the groove. Repeat the measurement twice, after turning through  $120^\circ$ .

Take the average of  $A_1, A_2, A_3 \Rightarrow W_A$



98343

Determine thickness  $M_A$  of the disc set for clutch A as described in **Chapter 1.4.0 "Measuring the clutch packs"**.

$\Rightarrow M_A$

Installation space  $E_A$  is obtained from measured value  $W_A$  plus base thickness  $F \Rightarrow E_A$

Test value  $P_A$  is then installation space  $E_A$  minus  $M_A$ .

Value  $P_A$  must be between 2.83 and 4.40 mm. **Test specification 1056 700 268**, version A

Use test gauge  $P_A$  to select snap ring  $S_A$ .

#### Calculation:

$$E_A = W_A + F$$

$$P_A = E_A - M_A$$

Clearance  $L_A$  should be 1.73 - 2.03 mm with five lined discs.

**Example (for 1.4.1.5):**

$$F = 1.48 \text{ mm (base thickness)}$$

$$A_1 = 24.83 \text{ mm}$$

$$A_2 = 24.85 \text{ mm}$$

$$A_3 = 24.87 \text{ mm}$$

$$W_D = (24.83 + 24.85 + 24.87)/3$$

$$W_A = 24.85 \text{ mm}$$

$$M_A = 22.43 \text{ mm}$$

$$E_A = 24.85 + 1.48$$

$$= 26.33 \text{ mm}$$

$$P_A = 26.33 - 22.43$$

$$= 3.9 \text{ mm}$$

$$S_A = 2.0 \text{ mm}$$

$$L_A = 3.9 - 2.0$$

$$\Rightarrow L_A = 1.9 \text{ mm}$$



98349

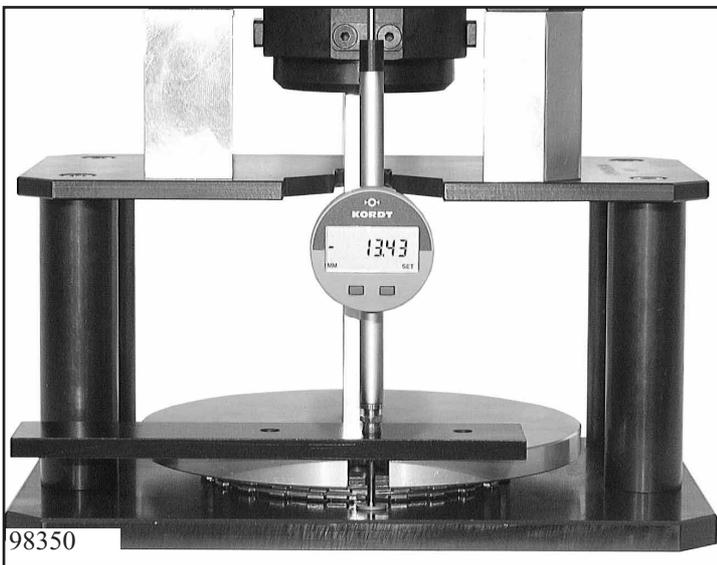
#### 1.4.1.6 Adjusting Clearance of clutch B (snap ring)

Determine clutch B installation space  $E_B$  with measuring bar 5p01 000 330.

To do this, place measuring bar 5p01 000 330 on the edge of the cylinder of clutch B. Place the gage of the dial gauge against the highest point of the disc contact surface of the piston, and set the dial gauge to "0".

Pull the measuring sensor up, insert it into the snap ring groove and press it against the upper edge of the groove. Repeat the measurement twice after turning by  $120^\circ$ .

Take the average of  $B_1, B_2, B_3 \Rightarrow W_B$



98350

Determine the thickness  $M_B$  of the clutch B disc set as described in **Chapter 1.4.0 "Measuring the clutch packs"**.

$\Rightarrow M_B$

Installation space  $E_C$  is obtained from measured value  $W_B$  plus base thickness  $F \Rightarrow E_B$

Test value  $P_B$  is then installation space  $E_B$  minus  $M_B$

Value  $P_B$  should be between 1.87 and 2.64 mm. **Test specification 1056 700 236, version B**

Use test gauge  $P_B$  to select snap ring  $S_B$ .

#### Calculation:

$$E_B = W_B + F$$

$$P_B = E_B - M_B$$

Clearance  $L_B$  should be 0.64 - 0.94 mm with 2 lined discs.

**Example (for 1.4.1.6):**

$$F = 1.48 \text{ mm (base thickness)}$$

$$B_1 = 14.11 \text{ mm}$$

$$B_2 = 14.15 \text{ mm}$$

$$B_3 = 14.16 \text{ mm}$$

$$W_B = (14.11 + 14.15 + 14.16)/3 \\ = 14.14 \text{ mm}$$

$$M_B = 13.43 \text{ mm}$$

$$E_B = 14.14 + 1.48 \\ = 15.62 \text{ mm}$$

$$P_B = 15.62 - 13.43 \\ = 2.19 \text{ mm}$$

$$S_B = 1.4 \text{ mm}$$

$$L_B = 2.19 \text{ mm} - 1.4 \text{ mm}$$

$$\Rightarrow L_B = 0.79 \text{ mm}$$

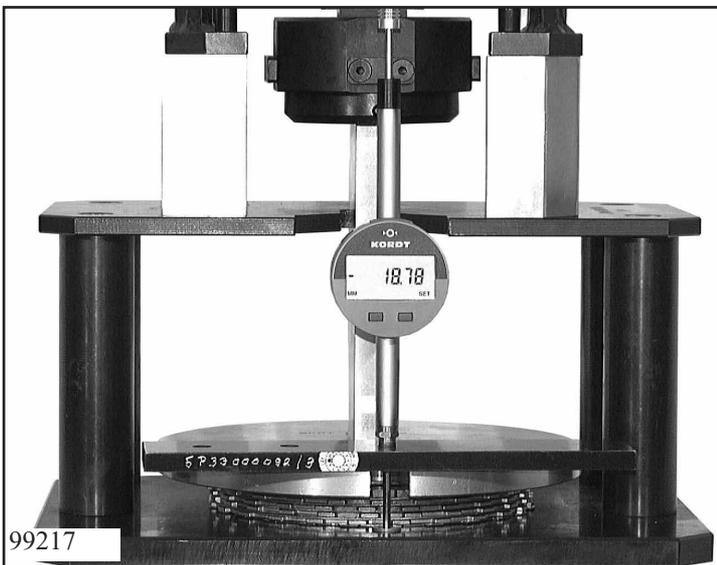


### 1.4.1.7 Adjusting Clearance of brake C (snap ring)

Screw the cylinder to the oil supply with 2 M6 x 16 screws (tightening torque 8 Nm). Determine installation space  $E_C$  for brake C with measuring bar 5p01 000 330 . To do this, place measuring bar 5p01 000 330 on the edge of the cylinder for brake C. Place the base of the dial gauge against the piston at the highest point on the disc contact surface and set the dial gauge to "0". Pull the measuring sensor up, insert it into the snap ring groove and press it against the upper edge of the groove. Repeat the measurement twice after turning through  $120^\circ$ .

Take the average of  $C_1, C_2, C_3 \Rightarrow W_C$

99216



#### Important:

Remove the screws again afterwards. Determine thickness  $M_C$  of the brake C disc set as described in **Chapter 1.4.0 "Measuring the clutch packs"**.

$\Rightarrow M_C$

Installation space  $E_C$  is obtained from measured value  $W_C$  plus base thickness  $F$ .  $\Rightarrow E_C$

Test value  $P_C$  is then installation space  $E_C$  minus  $M_C$

99217

Value  $P_C$  should be between 3.16 and 4.40 mm. **Test specification 1056 700 264, version B**

Use test gauge  $P_C$  to select snap ring  $S_C$ .

#### Calculation:

$$E_C = W_C + F$$

$$P_C = E_C - M_C$$

Clearance  $L_C$  should be 1.63 - 1.93 mm with 4 lined discs.

**Example: (for 1.4.1.7)**

$$F = 1.48 \text{ mm (base thickness)}$$

$$C_1 = 20.82 \text{ mm}$$

$$C_2 = 20.8 \text{ mm}$$

$$C_3 = 20.84 \text{ mm}$$

$$W_C = (20.82 + 20.8 + 20.84)/3 \\ = 20.82 \text{ mm}$$

$$M_C = 18.78 \text{ mm}$$

$$E_C = 20.82 + 1.48 \\ = 22.3 \text{ mm}$$

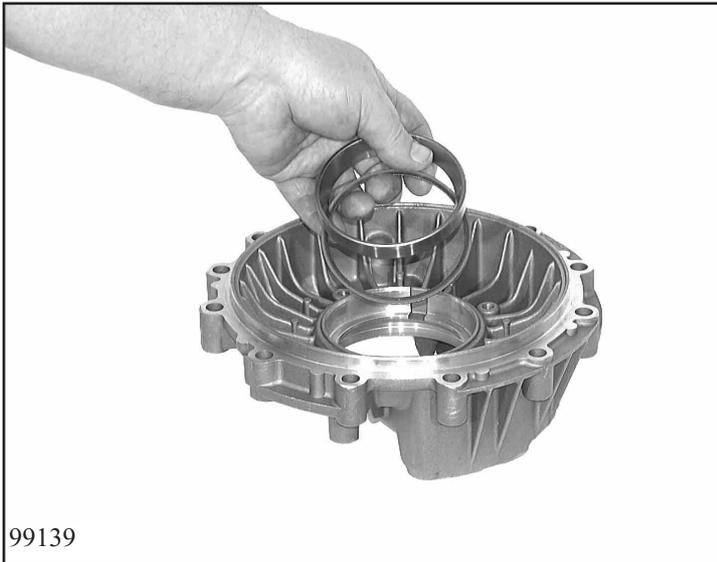
$$P_C = 22.3 - 18.78 \\ = 3.52 \text{ mm}$$

$$S_C = 1.8 \text{ mm}$$

$$L_C = 3.52 \text{ mm} - 1.8 \text{ mm}$$

$$\Rightarrow L_C = 1.72 \text{ mm}$$

## 1.4.2 Preload, differential



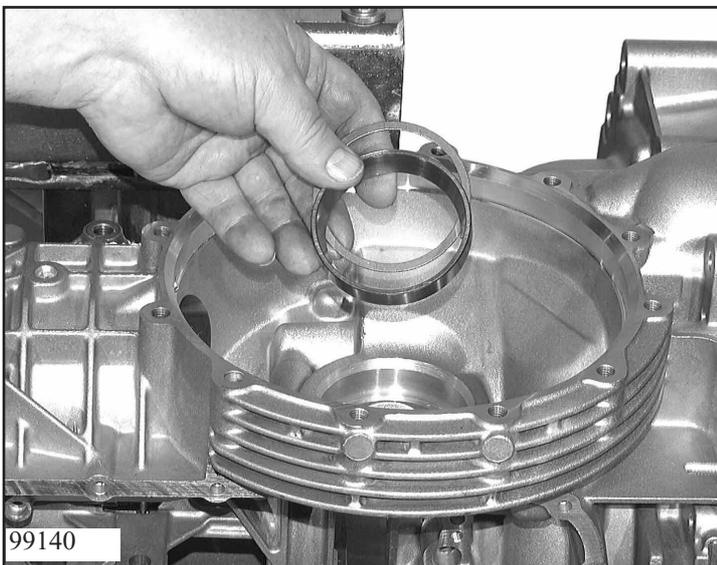
Determine total washer thickness  $M_G$ . To do this, measure shim thickness 35.080, and 35.120  $\Rightarrow M_U, M_O$

Insert the shim 35.120 previously removed into the differential cover with bearing race 35.150/110.

This can normally be done by hand, but if necessary heat the bearing seat lightly with a hot air blower.

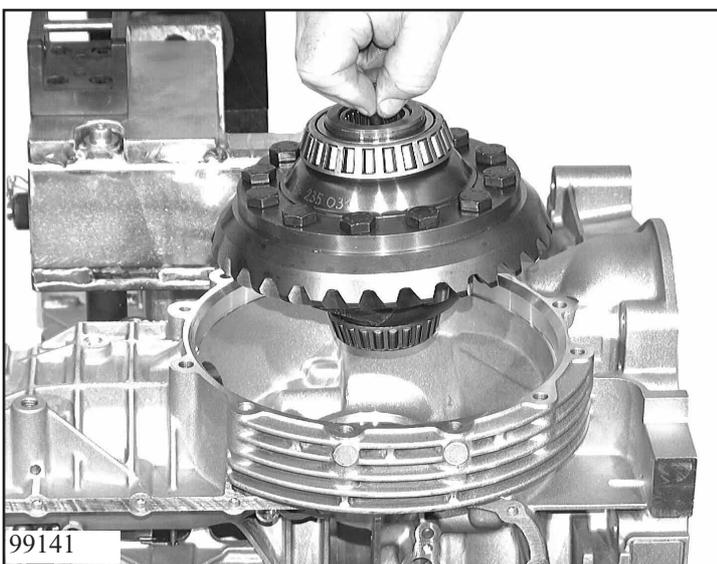
### Calculation:

$$M_G = M_U + M_O$$



Insert the shim 35.080 previously removed into the transmission housing with the bearing race.

This can normally be done by hand, but if necessary heat the bearing seat lightly with a hot air blower.



Install the differential in the transmission housing and fit the differential cover.

### Important !

There must be a gap (app. 0.1 - 0.3 mm) between the transmission housing and the differential cover. Check with a feeler gauge.

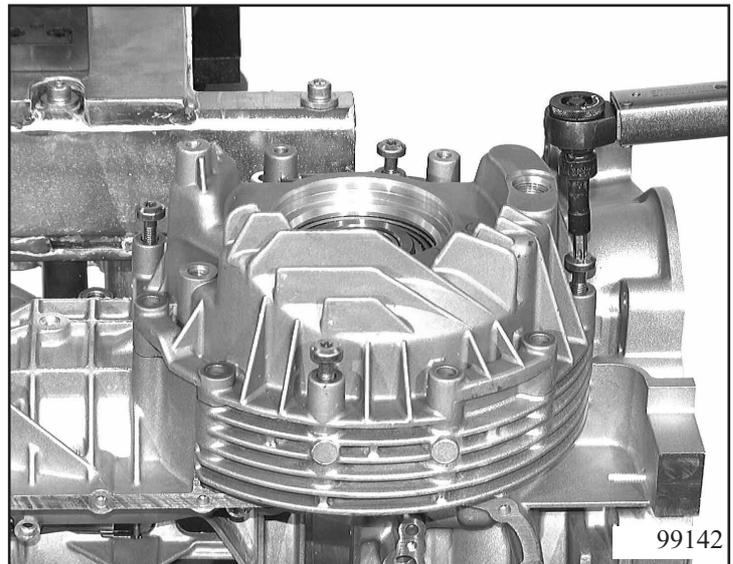
*Note risk of distortion* if the gap is too large, e.g. 0.7 mm.  $\Rightarrow$  preload too high. In this case, first reduce the thickness of the shim, e.g. in the differential cover, by 0.5 mm.

Measure with no shaft sealing ring and O-ring in the differential cover.

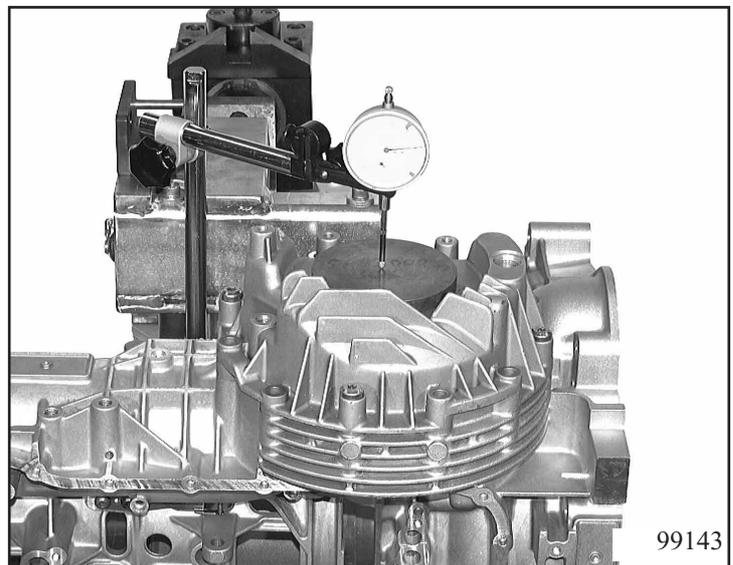
Tighten the differential cover with 4 screws 35.184 at 90-degree intervals.

Place measuring plate 5p01 000 353 on the differential cover.

(Tightening torques: see Chapter 1.5)



Screw post 5p01 020 347 of the measuring stand with M10 thread into the matching tapped hole in the transmission housing. Clamp cross-holder 5p01 010 347 so that the dial gauge sensor is central and at a right angle to the measuring plate. Set the dial gauge to "0".

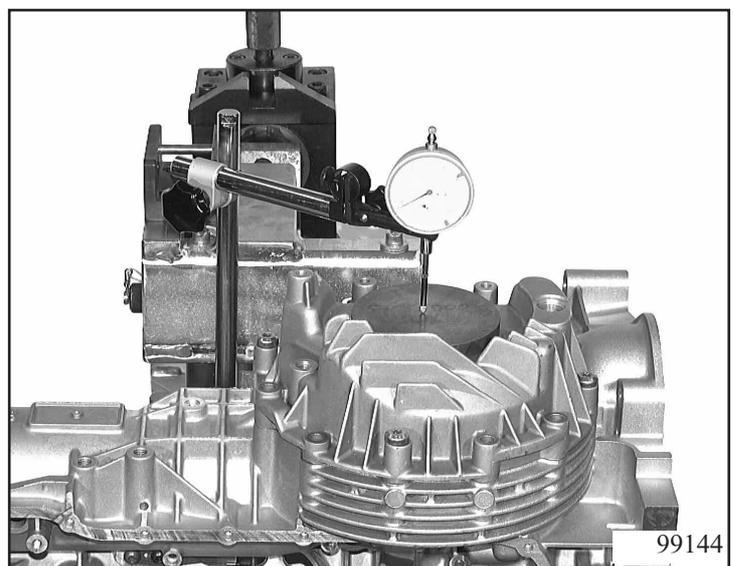


Slacken off the 4 screws by 1/2 turn each in a crosswise pattern until they are loose, but the dial gauge reading does not change.

⇒ Read off value  $M_D$ .

**Important:**

The measuring stand must not be touched or an incorrect reading will be obtained.



According to test specification 1056 700 282, measured value  $M_D$  must be between  $M_{Dmin} = 0.18\text{mm}$  und  $M_{Dmax} = 0.28\text{ mm}$  preload.

If the correct value is not obtained, determine the desired thickness and check again.

**Calculation:**

$$\begin{aligned} D_D &= M_D - [M_{Dmin} \text{ to } M_{Dmax}] \\ D &= M_D - [M_{Dmax} + M_{Dmin}] / 2 \\ M_{GV} &= D_D \text{ (change limit)} \end{aligned}$$

$D_M$  (chosen average value from  $D_D$ )

Remove the measuring stand and plate.  
Take off the cover.  
Remove the differential, bearing races and shims.

Adjusting shims 35.080 and 35.120 are available in thickness steps of 0.05 mm. Alter the shims (total shim thickness from check  $M_{GV}$ ) according to the average  $D_D$  value.

$D_M > 0 \Rightarrow$  reduce shim thickness  
 $D_M < 0 \Rightarrow$  increase shim thickness  
 $D_M = 0 \Rightarrow$  leave shim thickness unchanged

**Example:**

$$M_D = 0.38 \text{ mm (preload)}$$

$$M_U = 1.35 \text{ mm}$$

$$M_O = 1.25 \text{ mm}$$

$$M_{GV} = 1.35 + 1.25 = 2.6 \text{ mm}$$

$$D_D = 0.38 - [0.18 \text{ to } 0.28]$$

$$= 0.1 \text{ to } 0.2 \text{ mm}$$

$$D_M = 0.38 - [0.28 + 0.18] / 2$$

$$= 0.15 \text{ mm}$$

$M_{GV}$  reduced by 0.15 mm

$$\Leftrightarrow M_{GA} = 2.45 \text{ mm}$$

[total measured shim thickness]

Repeat the measuring procedure with

$$M_{GA} = 2.45 \text{ mm.}$$

$$\Leftrightarrow M_D = 0.23 \text{ mm (preload)}$$

$\Leftrightarrow$  correct according to test specification

### 1.4.3 Bevel gear drive

#### 1.4.3.1 Determining pinion position

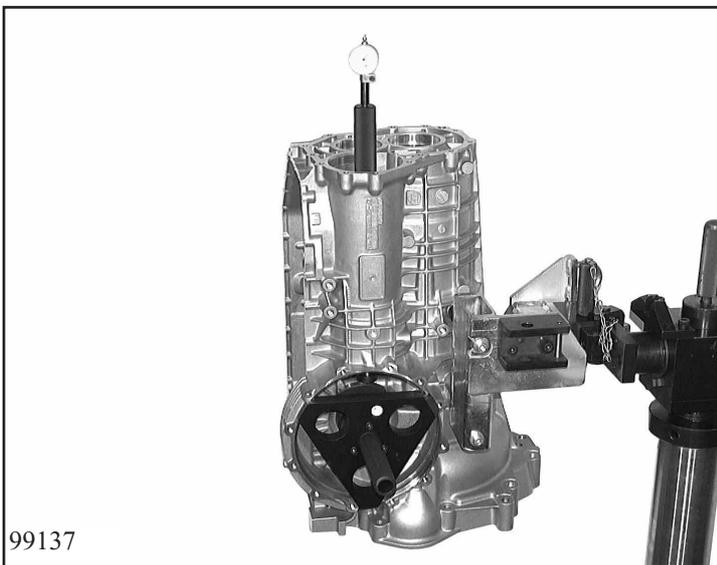


Turn the transmission through 90° (converter bell facing down).

Insert fixture 5p01 002 706 into differential housing with measuring radius facing bore in pinion shaft.

Set measuring element 5p01 002 706 in calibrating device 5p89 004 524 to zero. Reference dimension = 93.6 mm (calibrating device)

Adjust according to instruction 1056 700 282 [washer thickness steps = 0.03 mm]



Place measuring element in transmission housing on the bearing contact surface.

Read off dimension  $M_R$  (measuring pin at measuring radius). Turn the transmission back through 90°.

Overall dimension  $G$  is obtained from the calibrating device measurement  $M_{ER}$  plus the measuring radius  $M_{MR}$  and the measured dimension  $M_R$ .

#### Calculation:

$$G = M_{ER} + M_{MR} + M_R$$

#### Note: !

$M_R$  can also be negative; note direction of dial gauge pointer movement.



#### 1.4.3.2 Installed bearing height pinion shaft bearing

Place the differential-side inner bearing race on the measuring plate.

Insert the outer bearing race in measuring sleeve 5p01 030 355 and place it on the bearing race.

Attach weight 5p01 010 355 and place centrally under the dial gauge sensor.

Set the dial gauge to "0".

Raise the measuring sensor and pull the measured component set forwards.

Take off the weight and remove the outer bearing race from the measuring sleeve.

Place the differential-side inner bearing race on the measuring plate.  
 Place the outer bearing race on the inner race and apply weight 5p01 010 355.  
 Place the set of components to be measured centrally under the dial gauge sensor.  
 Rotate the bearing several times. Read off dimension  $\varnothing M_L$   
 Installed bearing height L is sleeve height  $H_H$  minus  $M_L$

**Calculation:**

$$L = H_H - M_L$$



Read off pinion dimension R.  
 The shim for adjusting pinion position S is obtained from

**Calculation:**

$$S = G - L - R$$

**Example:**

$$\begin{aligned} M_{ER} &= 93.6 \text{ mm} \\ M_{MR} &= 60 \text{ mm} \\ M_R &= -0.03 \text{ mm} \\ R &= 96 \text{ mm} \end{aligned}$$

$$\begin{aligned} H_H &= 57 \text{ mm} \\ M_L &= -0.76 \text{ mm} \end{aligned}$$

$$\begin{aligned} G &= 93.6 + 60 - 0.03 \\ &= 153.57 \text{ mm} \\ L &= 57 - 0.76 \\ &= 56.24 \text{ mm} \end{aligned}$$

$$\begin{aligned} S &= 153.57 - 56.24 - 96 \\ &= 1.33 \text{ mm} \end{aligned}$$

Select the correct washer.  
The washer may be max. 0.02 mm larger than the nominal dimension, but not smaller.

$$\varnothing S = 1,33 \text{ mm}$$

### 1.4.3.3 Determining backlash / crown wheel position

**Note:**

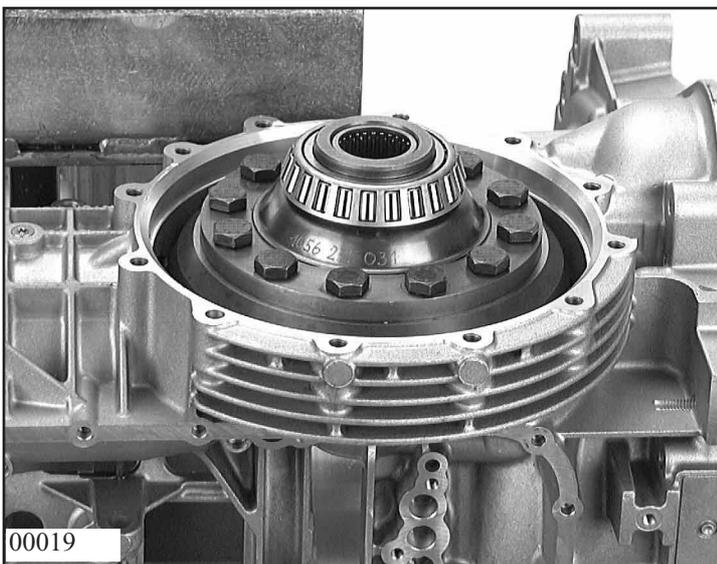
Experience has shown that the washer in the differential cover is 0.1 - 0.5 mm thinner than the washer in the differential housing.

$$D_G = 0.1 - 0.5 \text{ mm}$$

**Calculation:**

$$M_U = (M_{GA} + D_G) / 2$$

$$M_O = M_{GA} - M_U$$



Install the washer and the outer bearing race in the transmission housing.  
Install the differential in the transmission housing.  
Add the washer and outer bearing race to the cover.

Screw the cover to the transmission housing, using 4 screws in a crosswise pattern, making sure that backlash is not lost..

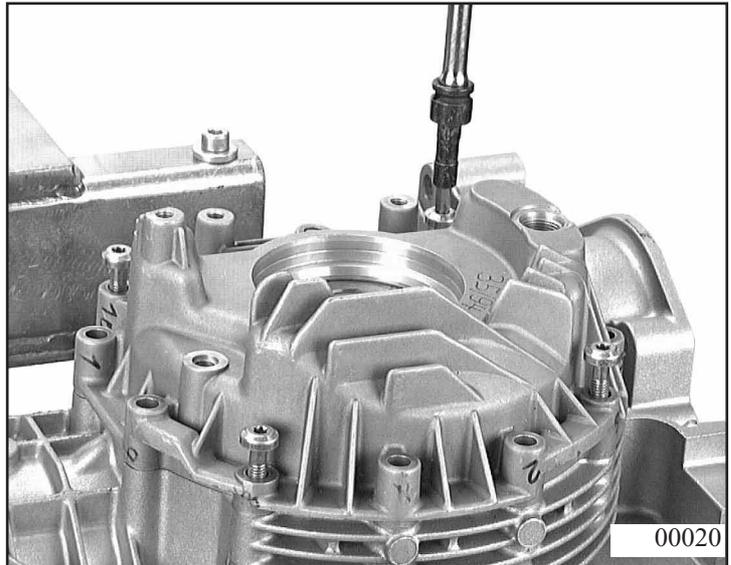
Backlash can be checked by turning the pinion shaft.

Rotate the pinion shaft by approx. 15 turns.

(Tightening torques: see Chapter 1.5)

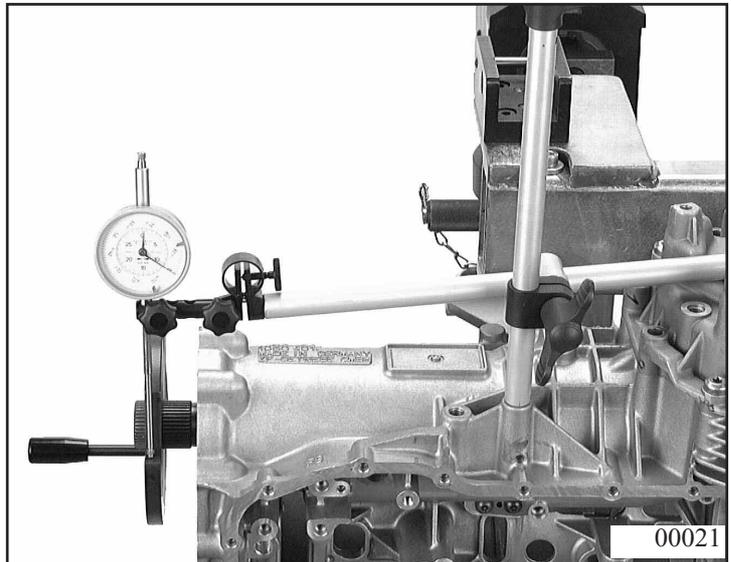
**Important:**

Measure without the O-ring seal on the differential cover



Clamp backlash measuring disc 5p01 000 354 to the pinion shaft.

Screw the column of measuring stand 5p01 020 347 into the transmission housing and clamp cross-holder 5p01 010 347 so that the measuring sensor is at a right angle on the marked measuring area of the measuring disc.



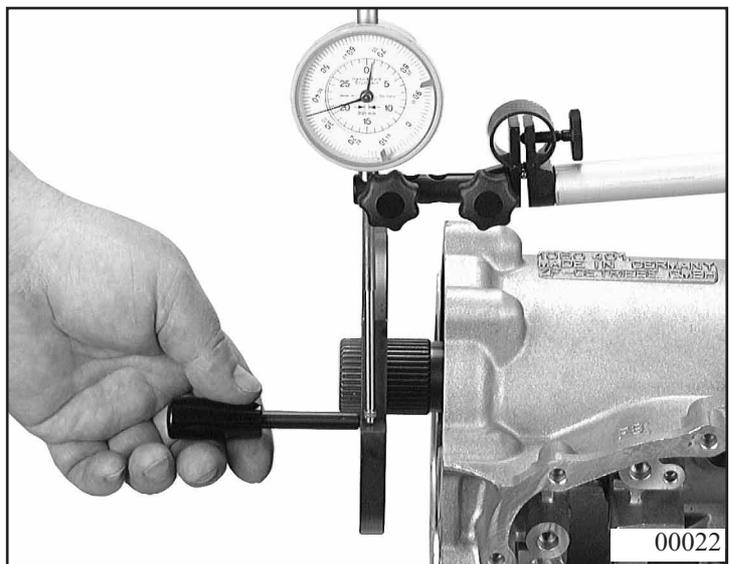
Turn the pinion shaft in one direction until the pinion/crown wheel teeth make contact.

Set the dial gauge to "0".

Turn the pinion carefully as far as possible in the opposite direction.

Repeat the procedure twice after turning the pinion shaft through 360° and take the average value of the readings  $M_1$ ,  $M_2$  and  $M_3 \Rightarrow M_F$

Backlash  $M_F$  must be between 0.27 and 0.37 mm according to specification 1056 700 282.



$M_F >$  permitted value:  $M_F$  too thick

$M_F <$  permitted value:  $M_F$  too thin

**Warning!**

If the nominal backlash value is not obtained, recalculate shim thickness, but do not alter the overall shim thickness.

Repeat the measurement.

Afterwards, remove the measuring stand and disc.

Unscrew and remove the differential cover.

**Example:**

$$M_{GA} = 2.45 \text{ mm}$$

$$D_G = 0.25 \text{ mm}$$

(selected washer thickness difference)

**1st measurement:**

$$M_U = (2.45 + 0.25) / 2$$

$$= 1.35 \text{ mm}$$

$$M_O = 2.45 - 1.35$$

$$= 1.1 \text{ mm}$$

**Measured backlash:**

$$M_F = 0.4 \text{ mm}$$

⇨ **incorrect!**

$M_F >$  permitted value ⇨ reduce  $M_U$  :

**2nd measurement:**

$$M_U = 1.30 \text{ mm}$$

$$M_O = 2.45 - 1.30$$

$$= 1.15 \text{ mm}$$

**Measured backlash:**

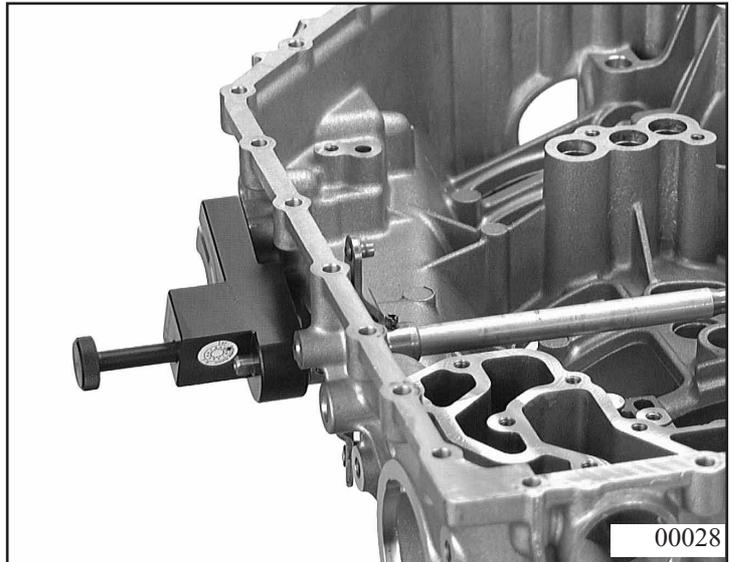
$$M_F = 0.35 \text{ mm}$$

⇨ **correct!**

#### 1.4.4 Detent spring switch

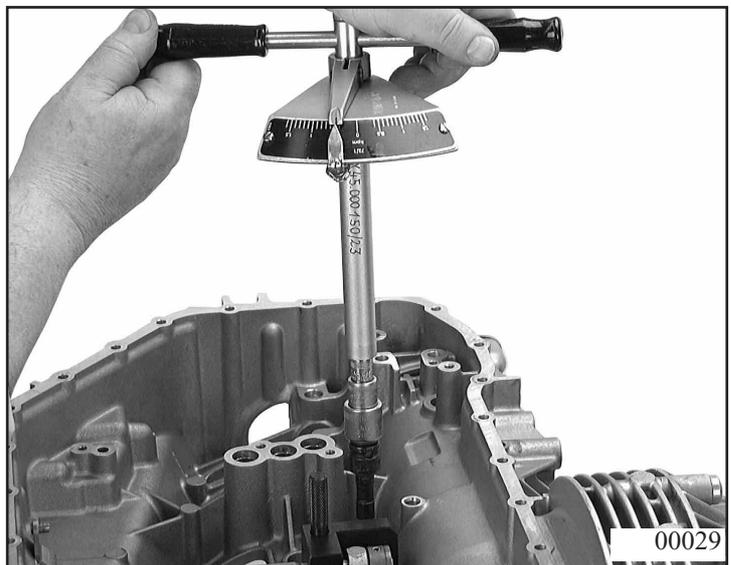
Using a suitable tool or by hand, set the detent disc to position N (Neutral).

Mount position gauge 5p01 002 609 on the selector shaft and turn the gauge until the locating pin in the transmission housing engages in the gauge, then turn the knurled screw to eliminate play.



Align the detent spring with centring device 5x46 001 250 and in this position screw the spring down. Tighten the screw at the output end first.

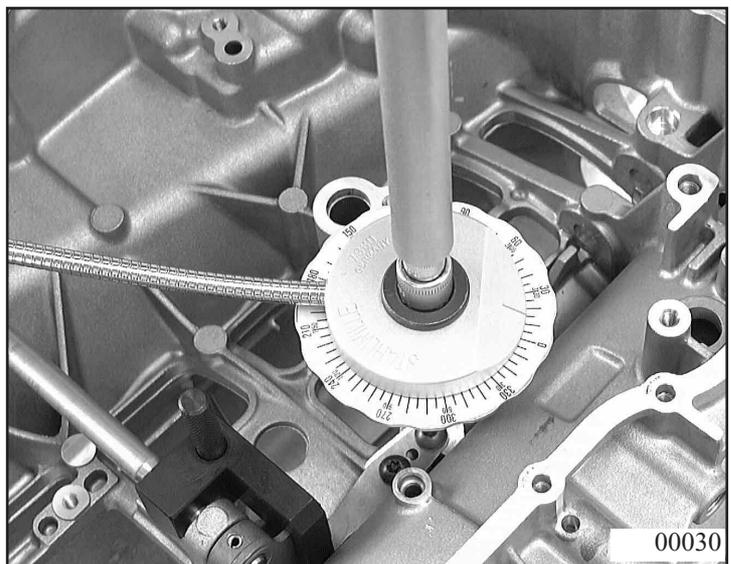
(Tightening torques: see Chapter 1.5)



With auxiliary tool 5w04 000 583 turn forward until distortion angle is reached. Unscrew the position gauge, move the selector shaft to all positions in turn and then move it back to position "N".

#### Note !

If assembly was correct, it should be easy to push the position gauge on to the selector shaft until it makes contact with the transmission housing.



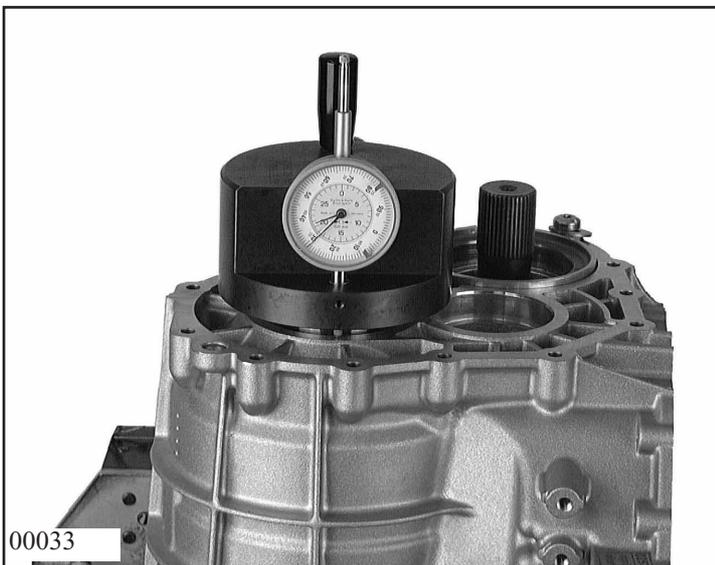
## 1.4.5 Output play (shim)

### 1.4.5.1 Installation space, output



Output endplay according to the parts list is 0.15 bis 0.35 mm.

Place fixture 5p01 010 356 on measuring ring 5p01 030 356 and set the dial to "0".



Place thrust bearing 37.030 over input shaft.

Place the fixture over the output shaft on the thrust bearing and turn it several times.

Read off measured value  $M_1$  at the dial. Repeat the measurement twice after turning on through  $120^\circ$  to a new position, then take the average of the three values  $M_1, M_2, M_3 \Rightarrow M_A$

#### Calculation:

$$M_A = (M_1 + M_2 + M_3) / 3$$

Lift the measuring fixture und the thrust bearing off the transmission.

The insertion depth is obtained as follows:

#### Calculation:

$$M_{TA} = K_A - M_A$$

#### Note !

$K_A$  = engraved on the fixture.

$M_A$  = measured value

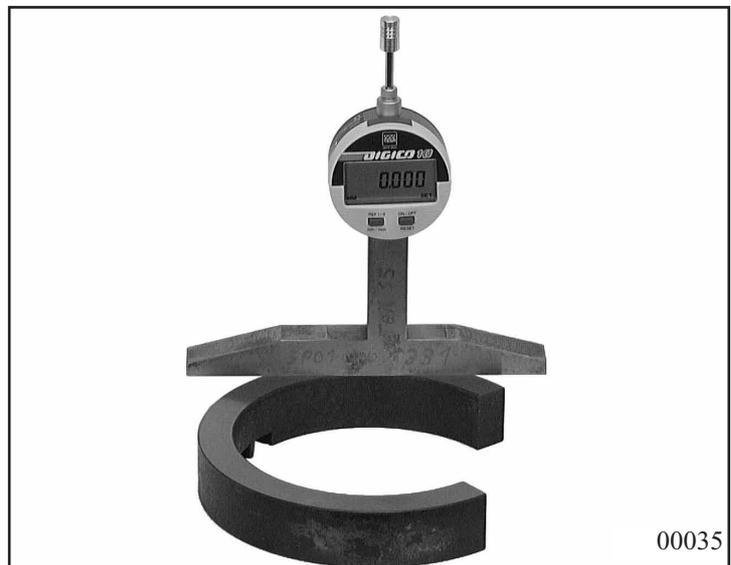
### 1.4.5.2 Pinion projection

Insert the complete pinion with the closed side first into the front-axle housing.

Turn the pinion several times.



Place the dial gauge from measuring bar 5p01 150 331 on measuring ring 5p01 020 356 and set to "0".



Place the measuring ring on the front-axle housing, place measuring ring 5p01 040 356 on the pinion and measured as far as the measuring ring with the measuring bar  $\Rightarrow M_R$

#### Calculation:

Pinion projection is obtained as follows:

$$M_{RA} = K_{RV} - K_{RR} + M_R - K_D$$

Washer thickness is obtained as follows :

$$S_M = (S_{MIN} + S_{MAX}) / 2$$

$$S_R = M_{TA} - M_{RA} - S_M$$



**Example: (for 1.4.5)**

$$\begin{aligned}K_D &= 0.26 \text{ mm (gasket thickness)} \\K_A &= 30 \text{ mm} \\K_{RR} &= 8 \text{ mm (measuring ring thickness,} \\&\quad \text{engraved on)} \\K_{RV} &= 30.045 \text{ mm ( " )}\end{aligned}$$

$$\begin{aligned}S_{MIN} &= 0.15 \text{ mm} \\S_{MAX} &= 0.35 \text{ mm}\end{aligned}$$

$$M_R = -6.249 \text{ mm}$$

$$\begin{aligned}M_1 &= 10.68 \text{ mm} \\M_2 &= 10.73 \text{ mm} \\M_3 &= 10.71 \text{ mm}\end{aligned}$$

$$\begin{aligned}M_A &= (10.68 + 10.73 + 10.71)/3 \\&= 10.71 \text{ mm}\end{aligned}$$

$$\begin{aligned}S_M &= (0.15 + 0.35) / 2 \\&= 0.25 \text{ mm}\end{aligned}$$

$$\begin{aligned}M_{TA} &= 29.97 - 10.71 \\&= 19.26 \text{ mm}\end{aligned}$$

$$\begin{aligned}M_{RA} &= 30.045 - 8 + (-6.249) - 0.26 \\&= 15.536 \text{ mm}\end{aligned}$$

$$\begin{aligned}S_R &= 19.26 - 15.536 - 0.25 \\&= 3.474 \text{ mm}\end{aligned}$$

Install washer S from optional technical kit (OTK) that is closest to the value  $S_R$  determined in this way.

**chosen:**

$$\square S = 3.5 \text{ mm}$$

## 1.4.6 Bearing adjustment, output gears

### 1.4.6.0 Preparation for bearing adjustment, shim washers

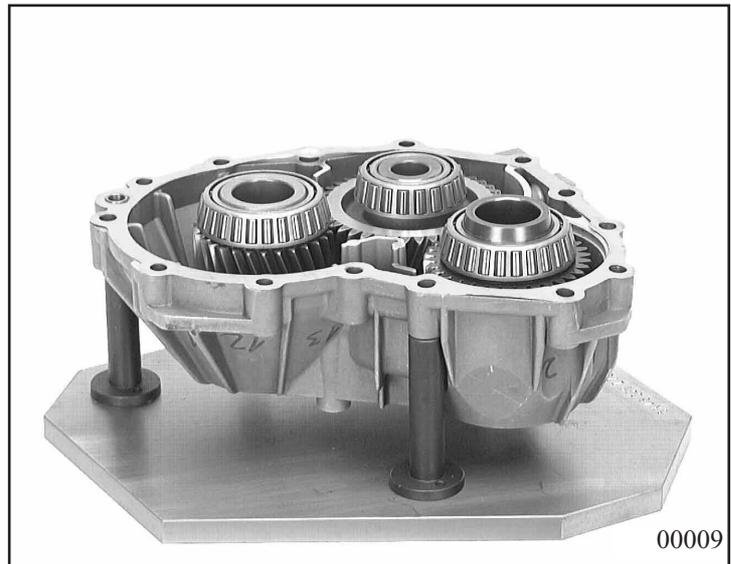
Place front axle housing on baseplate 5x46 001 275.

Install the pinion, helical and intermediate gear into the front axle housing in the correct positions.

Place the gasket on the front axle housing.

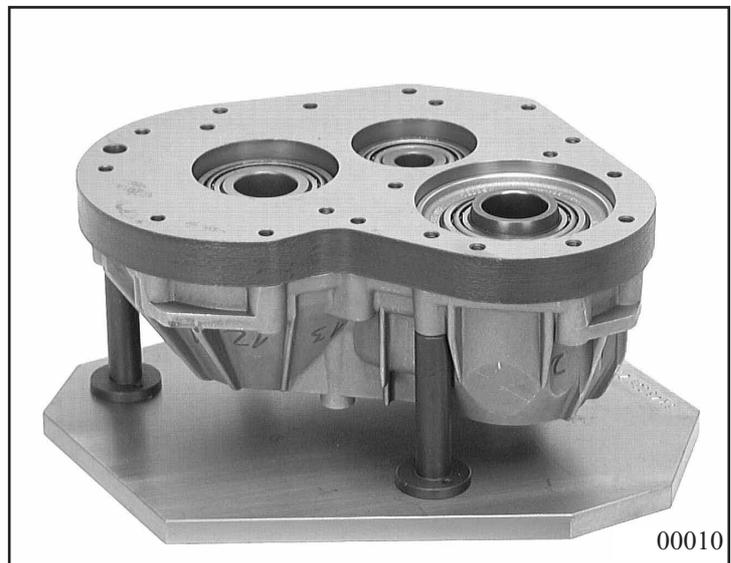
**Important!** (to avoid falsifying the measurement)

The inscriptions on the gearwheels face down, into the front axle housing.



Place measuring plate 5p01 002 704 on the front axle housing. Insert centring ring 5p01 070 357 into helical gear hole in measuring plate.

Place the bearing shells on the pinion, helical and intermediate gears.



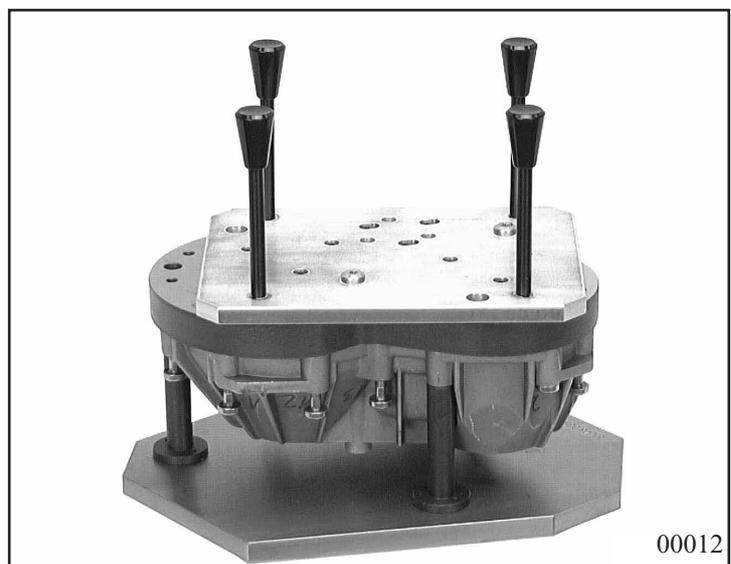
Insert and tighten all screws through the front axle housing into the measuring plate. Place gearwheel holding plate 5x46 002 173 on the measuring plate and secure it with 2 screws.

Lift the front axle housing off the baseplate. Turn through 180° with handles on gearwheel retaining plate, and set the housing down on the handles.

Next, tighten all screws.

Place the front axle housing (turned through 180°) back in the baseplate and remove the gearwheel retaining plate.

(Tightening torques: see Chapter 1.5)



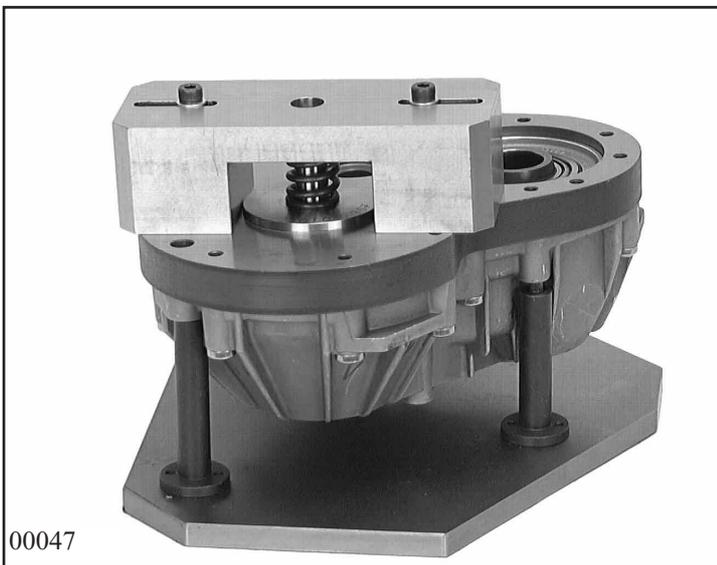


#### 1.4.6.1 Projection, pinion bearing

Place thrust bell 5p01 030 357 on the measuring plate.

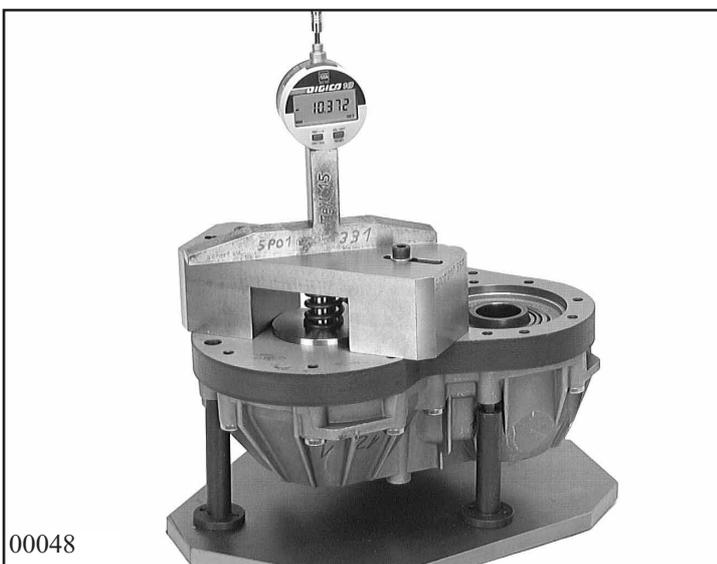
Place measuring bridge 5p01 010 357 over the thrust bell.

Place measuring bar 5p01 150 331 on the measuring bridge and set the dial on the thrust bell to "0".



Place the thrust bell on the pinion bearing outer race, place spring 5p01 000 357 over the thrust bell and secure the measuring bridge over the thrust bell with 2 screws M8x80 inserted into the tapped holes provided in the measuring plate.

(Tightening torques = 10 Nm)



Turn the gearwheels.

Place the measuring bar on the measuring bridge and measure the thrust bell.

Read off value  $M_{DR}$ .

#### Note!

Continue to turn the gearwheels until the value remains constant.

#### **1.4.6.2 Projection, helical/intermediate gear bearing**

Use the same procedure as for the pinion, helical gear and intermediate gear.

Measure values  $M_{DS}$  (helical gear) and  $M_{DZ}$  (intermediate gear).

After measuring gearwheel projection, dismantle the measuring equipment.

#### **Important!**

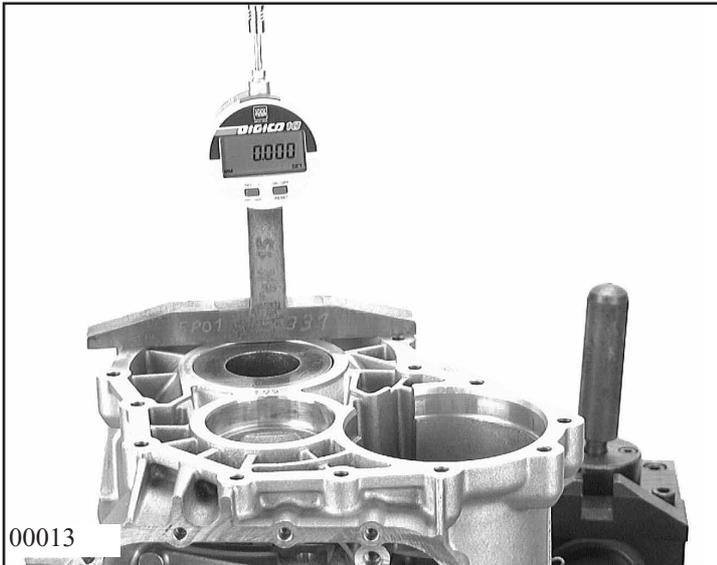
Use thrust bell 5p01 020 357 for the intermediate gear.

### 1.4.6.3 Installation space, pinion

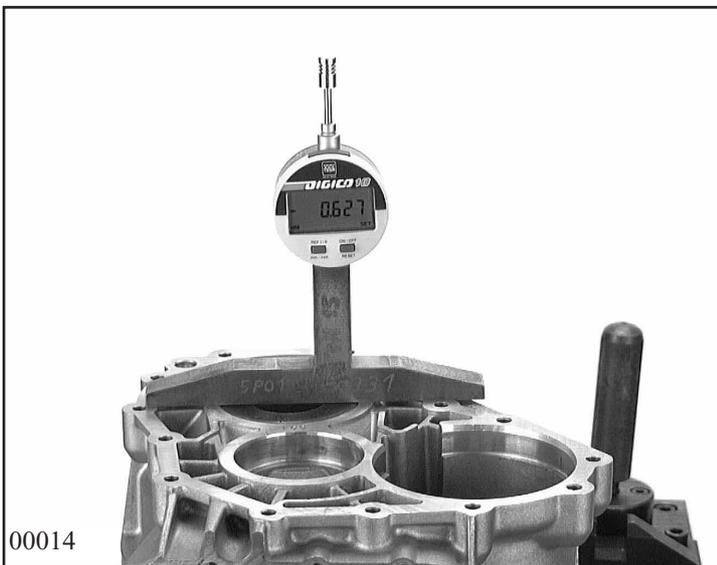
Place measuring ring 5p01 040 357 in pinion bearing hole.  
Set the dial to “0” with measuring bar 5p01 150 331 against the transmission housing sealing face.

**Note:**  
The measuring ring must be correctly seated in the bore.

*Cleanliness is essential!*



Place the dial gauge centrally on the measuring ring and read off value  $M_{RR}$  ⇨  $M_{RR}$



### 1.4.6.4 Installation space, intermediate gear

For the intermediate gear, follow the same procedure as for the pinion.  
Determine value  $M_{RZ}$  ⇨  $M_{RZ}$

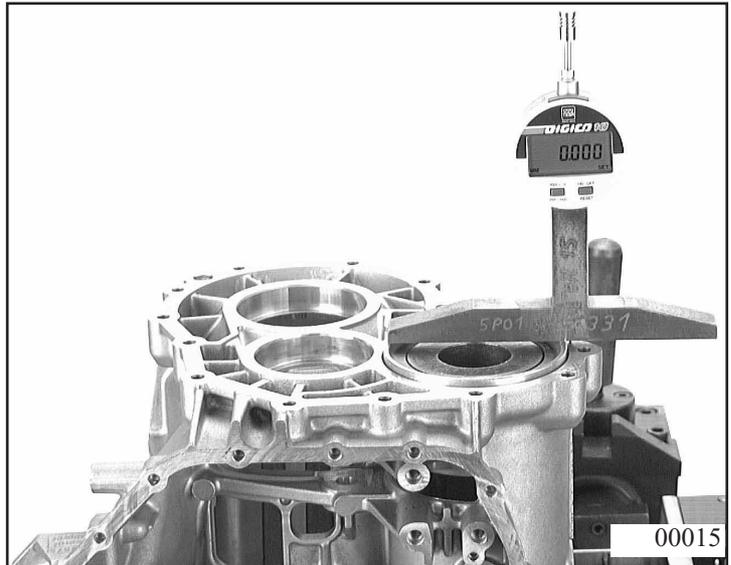
**Note:**  
A different measuring ring, 5p01 050 357, is used.

#### 1.4.6.5 Installation space, helical gear

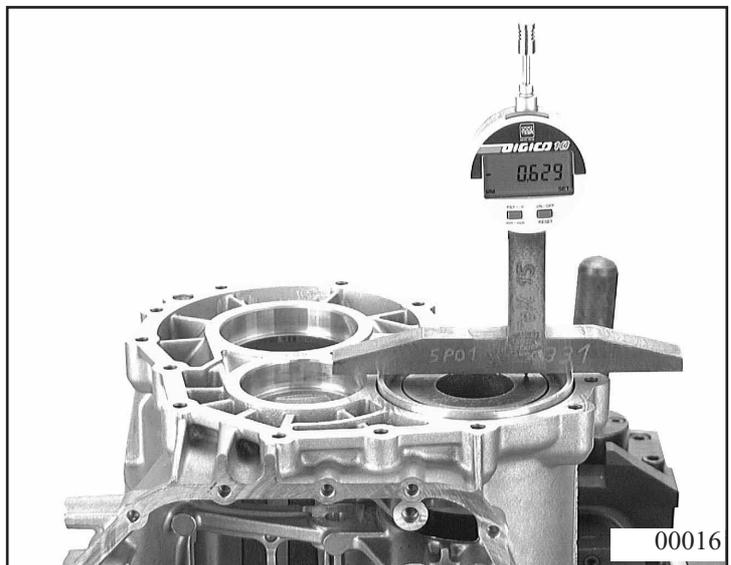
Press bearing race 35.190 into transmission housing.

Place measuring ring 5p01 040 357 in pinion bearing hole.

Measure with measuring bar 5p01 150 331 on bearing race against the transmission housing sealing face and set the dial to "0".



Measure down on bearing race and determine value  $M_{RS} \leftrightarrow M_{RS}$



#### Abbreviations:

$K_{VR/RS}$  = meas. ring thickness 5p01 040 357

$K_{RZ}$  = measuring ring thickness 5p01 050 357

$K_P$  = measuring plate thickness 5p01 002 704

#### (pinion, helical and intermediate gears)

$N_R, N_S, N_Z$  = zero line

$B_R, B_S, B_Z$  = installation space

$H_R, H_S, H_Z$  = projection

$M_{RR}, M_{RS}, M_{RZ}$  = installation space  
measured value

$M_{DR}, M_{DS}, M_{DZ}$  = projection measured  
value

$S_R, S_S, S_Z$  = washer thickness

$S_{PR}, S_{PS}$  = play

$V_Z$  = preload

### 1.4.6.6 Determining shim thickness – pinion, helical and intermediate gears

The washer thicknesses can be determined from the measured values.

#### Calculation:

$$B_R = K_{RR} - M_{RR}$$

$$B_S = K_{RS} - M_{RS}$$

$$B_Z = K_{RZ} - M_{RZ}$$

$$H_R = K_P + M_{DR}$$

$$H_S = K_P + M_{DS}$$

$$H_Z = K_P + M_{DZ}$$

$$N_R = B_R - H_R$$

$$N_S = B_S - H_S$$

$$N_Z = B_Z - H_Z$$

$$S_R = N_R - S_{PR}$$

$$S_S = N_S - S_{PS}$$

$$S_Z = N_Z - V_Z$$

#### Attention! (important!)

The K-measures of the measuring rings and measuring plates are engraved in the parts.

Please use the K-measures of your measuring rings and -plates.

#### Adjusting values (acc. to parts list)

Pinion: (play)

Setting: 0 to 0.05 mm

Test value: -0.03 to 0.08 mm

Helical gear: (play)

Setting: 0 to 0.05 mm

Test value: -0.03 to 0.08 mm

Intermediate gear: (preload)

Setting: - 0.03 to - 0.08 mm

Test value: 0 to - 0.11 mm

#### Important !

Note the meaning of the +/- sign:

+ means play (clearance);

- means preload

**Example: (for 1.4.6)****Pinion:**

$$\begin{aligned} K_{RR} &= 15.466 \text{ mm} \\ K_P &= 25.002 \text{ mm} \\ M_{RR} &= -0.627 \text{ mm} \\ M_{DR} &= -10.372 \text{ mm} \\ S_{PR} &= 0 \text{ bis } 0.5 \text{ mm} \end{aligned}$$

$$\begin{aligned} B_R &= 15.466 - (-0.627) \\ &= 16.093 \text{ mm} \\ H_R &= 25.002 + (-10.372) \\ &= 14.63 \text{ mm} \\ N_R &= 16.093 - 14.63 \\ &= 1.463 \text{ mm} \\ S_R &= 1.45 \text{ mm selected} \\ \Leftrightarrow S_{PR} &= 0.013 \text{ mm (play)} \end{aligned}$$

**Helical gear:**

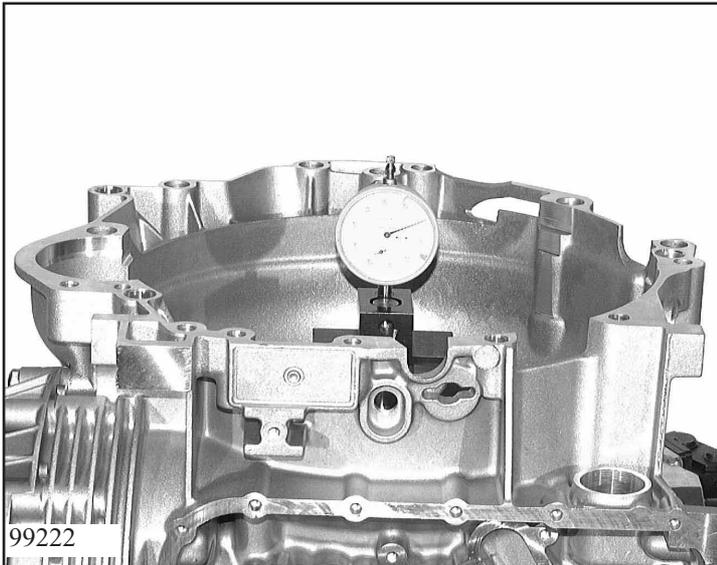
$$\begin{aligned} K_{RS} &= 15.466 \text{ mm} \\ K_P &= 25.002 \text{ mm} \\ M_{RS} &= -0.629 \text{ mm} \\ M_{DS} &= -10.33 \\ S_{PS} &= 0 \text{ bis } 0.5 \text{ mm} \end{aligned}$$

$$\begin{aligned} B_S &= 15.466 - (-0.629) \\ &= 16.095 \text{ mm} \\ H_S &= 25.002 + (-10.33) \\ &= 14.672 \text{ mm} \\ N_R &= 16.095 - 14.672 \\ &= 1.423 \text{ mm} \\ S_S &= 1.4 \text{ mm selected} \\ \Leftrightarrow S_{PS} &= 0.023 \text{ mm (play)} \end{aligned}$$

**Intermediate gear:**

$$\begin{aligned} K_{RZ} &= 15.47 \text{ mm} \\ K_P &= 25.002 \text{ mm} \\ M_{RZ} &= -0.617 \text{ mm} \\ M_{DZ} &= -10.14 \text{ mm} \\ V_Z &= -0.03 \text{ bis } -0.08 \text{ mm} \end{aligned}$$

$$\begin{aligned} B_Z &= 15.47 - (-0.617) \\ &= 16.087 \text{ mm} \\ H_Z &= 25.002 + (-10.14) \\ &= 14.862 \text{ mm} \\ N_Z &= 16.087 - 14.682 \\ &= 1.405 \text{ mm} \\ S_Z &= 1.45 \text{ mm selected} \\ \Leftrightarrow V_Z &= -0.045 \text{ mm (preload)} \end{aligned}$$



### 1.4.7 Play at input (washer)

Attach the oil supply with at least two machine screws in opposed positions.

(Tightening torques: see Chapter 1.5)

Clamp measuring fixture 5p01 002 379 on the input shaft about 2 mm above the stator shaft, so that no play is present. Set the dial to "0".

#### **Initial requirement:**

Needle thrust bearing 10.390 and the thinnest shim 10.400 ( $S_D = 1$  mm) have been placed in position.

Determine endplay by pressing and pulling the handle (repeat the measurement).

Nominal endplay  $D = 0.05 - 0.35$  mm acc. to **test specification 1056 700 203**.

Take measurements  $M_1$ ,  $M_2$  and determine the average value  $\square M$

#### **Calculation:**

$$M = (M_1 + M_2) / 2$$

$$S = M + S_D - D$$

If there is a deviation, install a correspondingly thicker shim washer 10.400.

To do this, *take off the oil supply and the input* and install the shim of determined thickness in place of the original shim.

Then re-install the components according to 3. *Assembly of input with oil supply*. Check endplay again.

**Example (for 1.4.7):**

$$M_1 = 0.88 \text{ mm}$$

$$M_2 = 0.86 \text{ mm}$$

$$S_D = 1.00 \text{ mm}$$

$$D = 0.05 \text{ to } 0.35 \text{ mm}$$

$$M = (0.88 + 0.86) / 2 = 0.87 \text{ mm}$$

$$S = 0.87 + 1.00 - (0.05 \text{ to } 0.35)$$

$$= 1.87 - (0.05 \text{ to } 0.35)$$

$$= 1.52 \text{ bis } 1.82 \text{ mm}$$

**Selected:**

$$\square S = 1.7 \text{ mm}$$

## 1.5 Tightening torques

No.	Designation	Part List-Item-No.	Wrench size No.	Page	Tightening torque [Nm]
1	Hex bolt (differential)	09.120	Hex, 17 mm	1.3/1 3.1/3	Yield limit!
2	Slotted nut (pinion shaft)	35.030	Wrench 5x46 002 174	3.1/5	120 Nm (± 12 Nm)
3	Countersunk screw (pinion shaft bearing)	01.440	TORX - TX 27	3.1/6	10 Nm (± 1 Nm)
4	Machine screw (oil baffle plate)	35.150/150	TORX - TX 27	3.1/8	8 Nm (± 0.8 Nm)
5	Machine screw (differential)	35.184	TORX - TX 40	1.4/18 1.4/24 3.1/8	23 Nm (± 2.3 Nm)
6	Machine screw (detent spring)	01.200	TORX - TX 27 H	1.4/26 3.2/2	4 (+0.5) Nm + 15° (+5°)
7	Machine screw (guide plate)	01.080	TORX - TX 40	3.2/4	23 Nm (± 2.3 Nm)
8	Machine screw (front axle housing)	37.220	TORX - TX 40	1.4/30 3.4/2	23 Nm (± 2.3 Nm)
9	Machine screw (pump) (disc carrier, cyl. C)	10.160 10.220	TORX - TX 27	1.3/1 3.7/3	5 Nm (± 0.5 Nm)
10	Machine screw (pre-tightening pump)	10.100	TORX - TX 27	1.3/1 3.7/3	5 Nm (± 0,5 Nm)
	(final tightening pump) (stator shaft)	10.100 10.060/130	TORX - TX 27	1.3/1 3.7/3	10 Nm (± 1 Nm)
11	Machine screw (oil supply)	10.440	TORX - TX 27	1.4/37 3.7/6	10 Nm (± 1 Nm)
12	Machine screw (side shaft)	35.250	TORX - TX 40	3.8/3	23 Nm (± 2.3 Nm)
13	Expansion bolt (flange)	35.200	TORX - TX 40	3.8/3	25 Nm (± 2.5 Nm)
14	Machine screw (inductive sensor)	01.140	TORX - TX 27	3.9/3	10 Nm (± 1 Nm)

No.	Designation	Part List- Item-No.	Wrench size No.	Page	Tightening torque [Nm]
15	Machine screw (valve body)	27.400 27.410	TORX - TX 27	3.8/3	8 Nm (± 0.8 Nm)
16	Machine screw (Ölfilter)	27.440	TORX - TX 27	3.9/4	5 Nm (± 0.5 Nm)
17	Machine screw (oil pan)	03.040	TORX - TX 27	3.9/4	10 Nm (± 1 Nm)
18	Filler plug M30x1.5 (oil pan)	03.130	Intl. hex 17 mm	3.9/4	80 Nm (± 8 Nm)
19	Drain plug M16x1.5 (oil pan)	03.120	Intl. hex 8 mm	3.9/4	40 Nm (± 4 Nm)
20	Filler plug M18x1.5 (differential)	35.370	Intl. hex 8 mm	3.9/5	35 Nm (± 3.5 Nm)
21	Machine screw (position switch)	01.430	TORX - TX 27	3.9/6	8 Nm (± 0.8 Nm)
22	Hex screw (M12x70) (converter retaining bracket)	22.120	(incl. nut) 19 mm	3.9/8	15 Nm (± 1.5 Nm)
23	Hex screw (M10x14) ( converter retaining bracket)	22.130	17 mm	3.9/8	15 Nm (± 1.5 Nm)

## **1.6 Transmission test (test bench)**

The following points must be checked:

### **Correct oil level**

Proper oil level; observe the vehicle manufacturer's specifications and Part List.

### **Oil level too low**

This can result in:

- Engine over-revving or no power flow in curves or when starting from a stop
- Valve chatter due to air pockets in the oil
- General malfunctions

Among other things, burned clutches can be the result.

### **Oil level too high**

Danger of loss due to splashing, formation of foam, strong increases in temperature at high road speeds. Loss of oil via breather; among other things, burned clutches and shifting problems can result.

### **Proper engine settings**

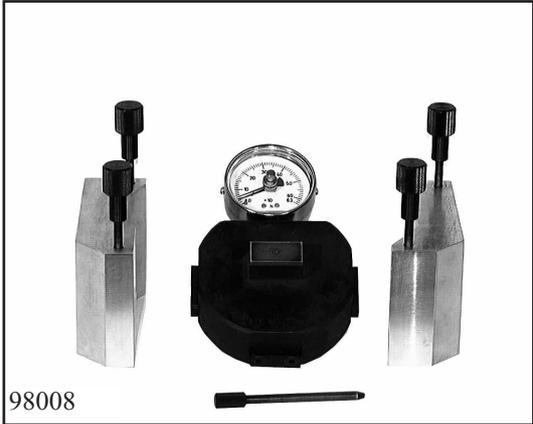
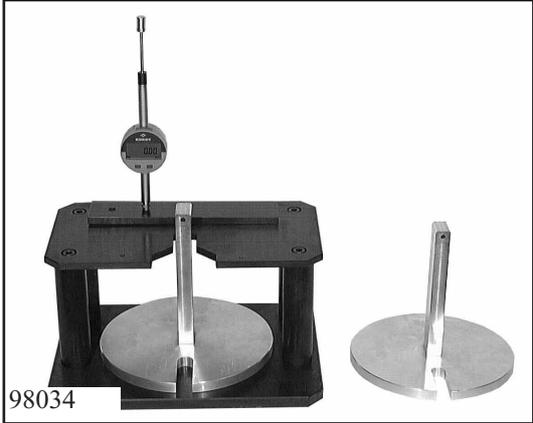
Correct idle speed; follow specifications from vehicle manufacturer.

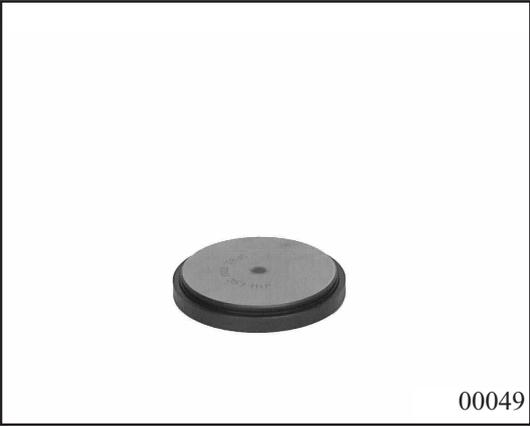
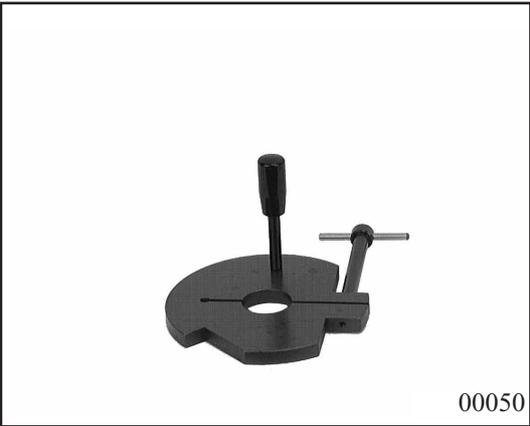
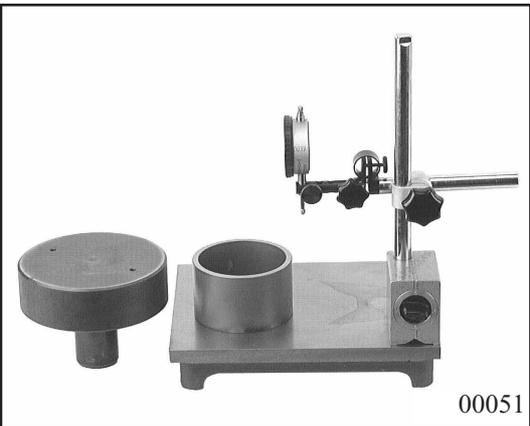
### **Power flow, forward and reverse**

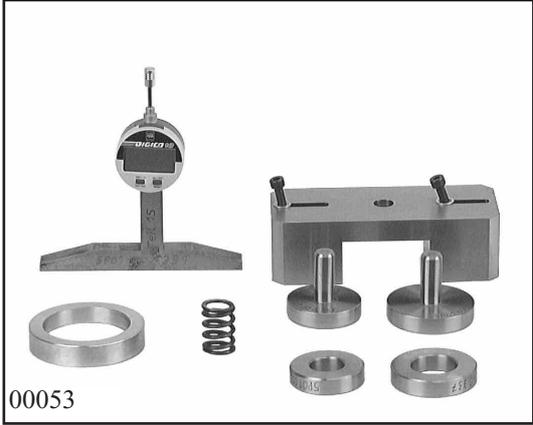
Correct adjustment of selector linkage or control cable; observe the vehicle manufacturer's specifications.



## 1.7 Special tools

OBJECT	Order-No. / Application	Remarks
<p style="text-align: center;">1</p>  <p>98008</p>	<p>5p01 000 329 -Force measuring unit</p>	<p>Identical</p> <p>4 HP 20 5 HP 19 5 HP 24</p>
<p style="text-align: center;">2</p>  <p>98034</p>	<p>5p01 000 330 -Measuring fixture, clutch play</p> <p>(Measuring plate: - short neck &gt;20 mm - long neck &lt;20 mm clutch pack thickness)</p>	<p>Identical</p> <p>4 HP 20 5 HP 19 5 HP 24</p>
<p style="text-align: center;">3</p>  <p>00045</p>	<p>5p01 000 331 -Height-measuring fixture, differential and side shaft</p>	

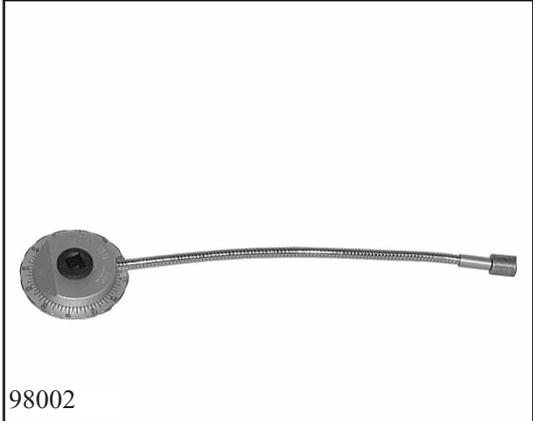
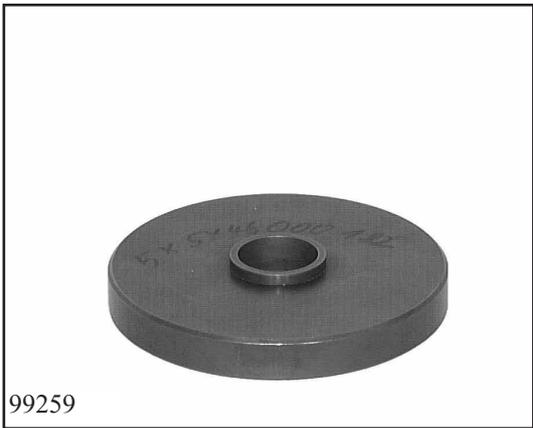
Remarks	Order-No. / Application	OBJECT
	5p01 000 353 Preload measuring plate	<p style="text-align: center;"><b>4</b></p> <div style="text-align: center;">  <p>00049</p> </div>
	5p01 000 354 Backlash measuring fixture	<p style="text-align: center;"><b>5</b></p> <div style="text-align: center;">  <p>00050</p> </div>
	5p01 000 355 Measuring fixture for installed bearing height, pinion shaft	<p style="text-align: center;"><b>6</b></p> <div style="text-align: center;">  <p>00051</p> </div>

OBJECT	Order-No. / Application	Remarks
<p style="text-align: center;">7</p>  <p>00108</p>	<p>5p01 000 356 Measuring device, output play</p>	
<p style="text-align: center;">8</p>  <p>00053</p>	<p>5p01 000 357 Preload measuring plate (300N)</p>	
<p style="text-align: center;">9</p>  <p>97301</p>	<p>5p01 001 458 -Adjusting device, preload</p>	<p>Identical</p> <p>4 HP 18 Q 4 HP 20 5 HP 190 5 HP 24</p>

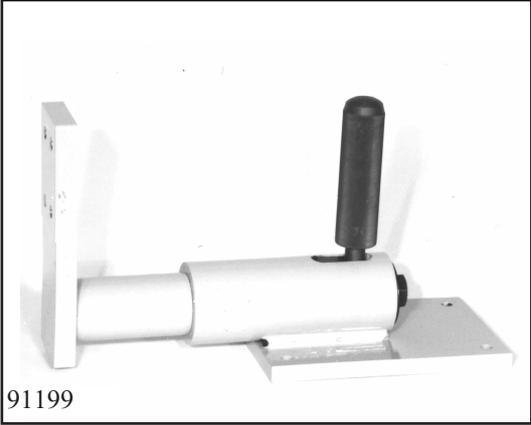
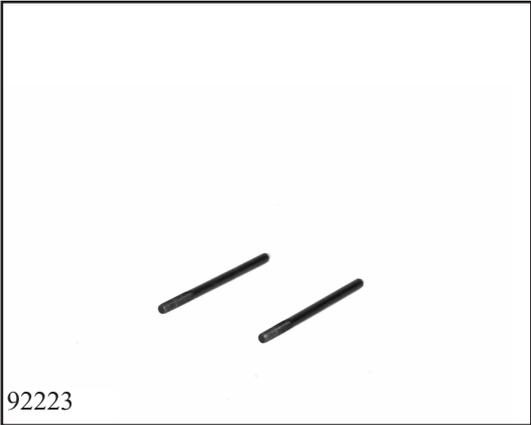
Remarks	Order-No. / Application	OBJECT
	<p>5p01 002 609 Position gauge</p> <p>5p01 002 704 Measuring plates for gearwheel measurement (3 versions for different gear ratios)</p> <p>5p01 002 706 Measuring device for washer, pin- ion drive and shaft</p>	<p style="text-align: center;"><b>10</b></p> <div style="text-align: center;">  <p style="text-align: right;">99263</p> </div> <p style="text-align: center;"><b>11</b></p> <div style="text-align: center;">  <p style="text-align: right;">99248</p> </div> <p style="text-align: center;"><b>12</b></p> <div style="text-align: center;">  <p style="text-align: right;">99261</p> </div>

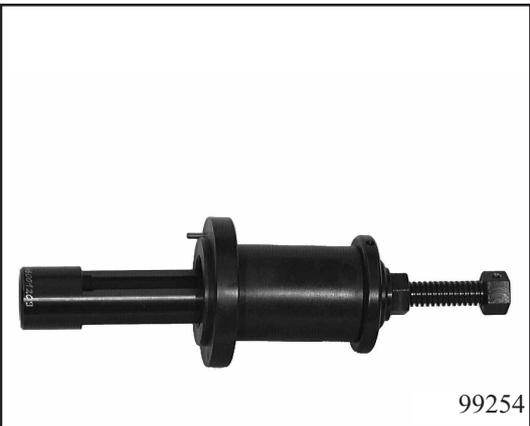
OBJECT	Order-No. / Application	Remarks
<p style="text-align: center;"><b>13</b></p> <div style="border: 1px solid black; padding: 10px; text-align: center;">  </div> <p>99250</p>	<p>5p01 003 033 Measuring fixture, pump drag torque</p>	
<p style="text-align: center;"><b>14</b></p> <div style="border: 1px solid black; padding: 10px; text-align: center;">  </div> <p>99265</p>	<p>5p01 150 331 Measuring bar (part 15 from device 5p01 000 331)</p>	<p>Identical 4 HP 20</p>
<p style="text-align: center;"><b>15</b></p> <div style="border: 1px solid black; padding: 10px; text-align: center;">  </div> <p>99274</p>	<p>5x66 000 029 Connector, from 1/4" external hexagon to 1/4" external square</p>	

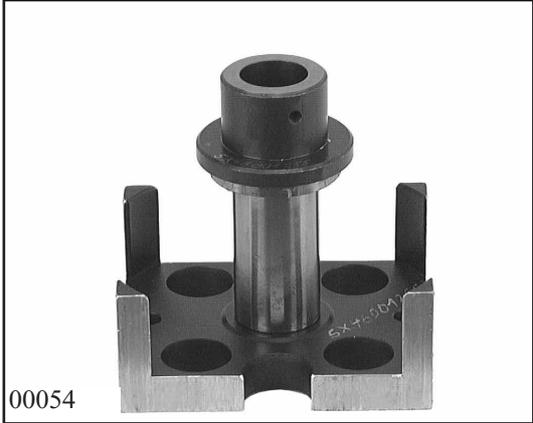
Remarks	Order-No. / Application	OBJECT
	<p>5x66 000 030 Insert tool, ring</p>	<p style="text-align: center;"><b>16</b></p> <div style="text-align: center;">  </div> <p style="text-align: right;">99275</p>
	<p>5p66 000 058 Torsiometer, size 12, Stahlwille 52205212</p>	<p style="text-align: center;"><b>17</b></p> <div style="text-align: center;">  </div> <p style="text-align: right;">99272</p>
	<p>5p66 000 059 Torsiometer, size 50 Stahlwille 52205250</p>	<p style="text-align: center;"><b>18</b></p> <div style="text-align: center;">  </div> <p style="text-align: right;">99273</p>

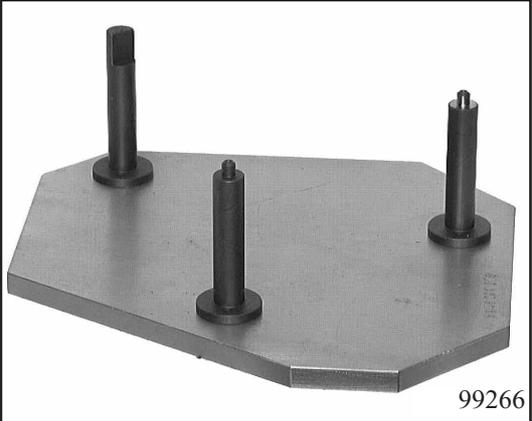
OBJECT	Order-No. / Application	Remarks
<p style="text-align: center;"><b>19</b></p>  <p>99262</p>	<p>5p89 004 524 Calibration fixture for pinion shaft shim</p>	
<p style="text-align: center;"><b>20</b></p>  <p>98002</p>	<p>5w04 000 583 Turning angle measuring disc</p>	<p>Identical 5 HP 19 5 HP 24</p>
<p style="text-align: center;"><b>21</b></p>  <p>99259</p>	<p>5x46 000 182 Assembly fixture for speedometer housing ball bearing</p>	<p>Identical 4 HP 14</p>

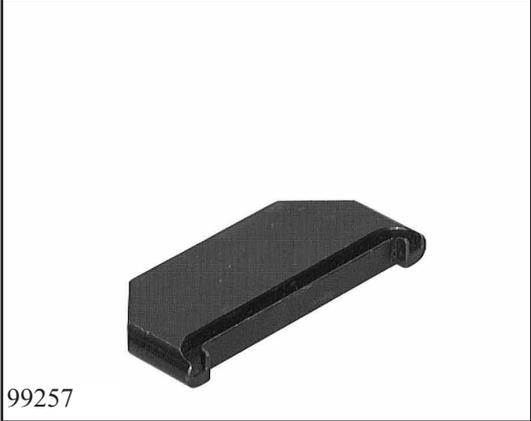
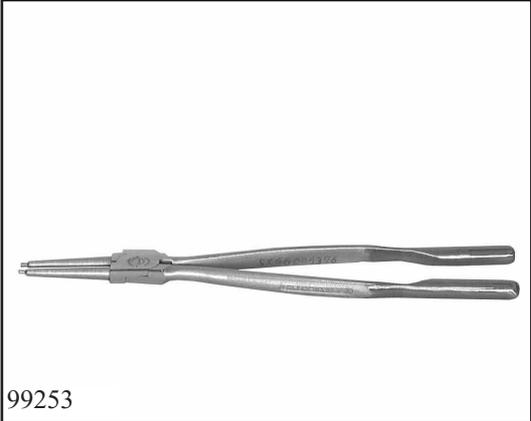
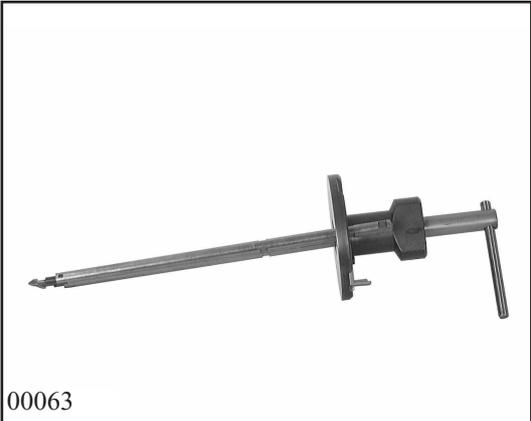
Remarks	Order-No. / Application	OBJECT
<p>Identical</p> <p>4 HP 18 FL</p>	<p>5x46 000 530 Dismantling sleeve for double pinion-shaft bearing</p>	<p style="text-align: center;"><b>22</b></p> <div style="border: 1px solid black; padding: 10px; text-align: center;">  <p style="text-align: right;">99255</p> </div>
<p>Identical</p> <p>5 HP 18 5 HP 19</p>	<p>5x46 000 545 Tower lifting fixture</p>	<p style="text-align: center;"><b>23</b></p> <div style="border: 1px solid black; padding: 10px; text-align: center;">  <p style="text-align: right;">99245</p> </div>
<p>Identical</p> <p>5 HP 18 5 HP 19</p>	<p>5x46 000 576 Assembly bracket, taper,, thrust block brake C and DG</p>	<p style="text-align: center;"><b>24</b></p> <div style="border: 1px solid black; padding: 10px; text-align: center;">  <p style="text-align: right;">98394</p> </div>

OBJECT	Order-No. / Application	Remarks
<p style="text-align: center;"><b>25</b></p>  <p>98395</p>	<p>5x46 000 577 - Rotation prevention device</p>	<p>Identical</p> <p>5 HP 18 5 HP 19</p>
<p style="text-align: center;"><b>26</b></p>  <p>91199</p>	<p>5x46 000 763 - Workbench holder</p>	<p>Identical</p> <p>4 HP 20 5 HP 18 5 HP 19 5 HP 24 5 HP 30</p>
<p style="text-align: center;"><b>27</b></p>  <p>92223</p>	<p>5x46 001 007 - Locating pin for oil supply (2)</p>	<p>Identical</p> <p>5 HP 19 5 HP 24 5 HP 30</p>

Remarks	Order-No. / Application	OBJECT
<p>Identical</p> <p>4 HP 20</p>	<p>5x46 001 134 -Assembly drift for selector shaft sealing ring</p>	<p style="text-align: center;"><b>28</b></p> <div style="text-align: center;">  </div> <p style="text-align: right;">98142</p>
	<p>5x46 001 160 Assembly fixture, ring/circlip on hub, cylinder A</p>	<p style="text-align: center;"><b>29</b></p> <div style="text-align: center;">  </div> <p style="text-align: right;">99267</p>
	<p>5x46 001 209 Dismantling fixture, pinion shaft</p>	<p style="text-align: center;"><b>30</b></p> <div style="text-align: center;">  </div> <p style="text-align: right;">99254</p>

OBJECT	Order-No. / Application	Remarks
<p style="text-align: center;"><b>31</b></p> <div style="border: 1px solid black; padding: 10px; text-align: center;">  <p>99264</p> </div>	<p>5x46 001 250 Detent spring centring device</p>	
<p style="text-align: center;"><b>32</b></p> <div style="border: 1px solid black; padding: 10px; text-align: center;">  <p>00054</p> </div>	<p>5x46 001 255 Assembly fixture for shaft sealing ring, differential cover</p>	
<p style="text-align: center;"><b>33</b></p> <div style="border: 1px solid black; padding: 10px; text-align: center;">  <p>99256</p> </div>	<p>5x46 001 266 Assembly fixture for pinion shaft sealing ring</p>	

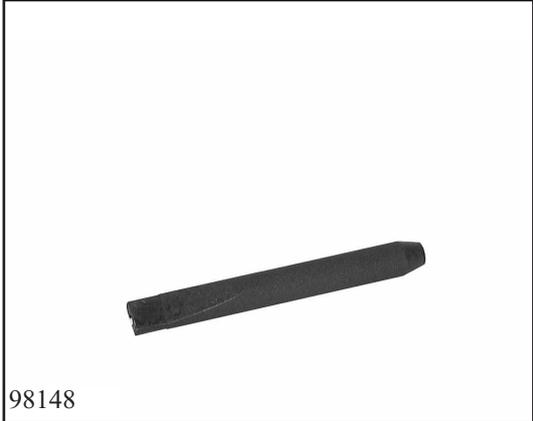
Remarks	Order-No. / Application	OBJECT
	<p>5x46 001 272            Assembly fixture for shaft sealing ring, speedometer housing</p> <p>5x46 001 275            Stand plate, front axle housing</p> <p>5x46 001 284            Assembly fixture for snap ring, transmission housing</p>	<p style="text-align: center;"><b>34</b></p>  <p style="text-align: center;"><b>35</b></p>  <p style="text-align: center;"><b>36</b></p> 

OBJECT	Order-No. / Application	Remarks
<p style="text-align: center;"><b>37</b></p> <div style="border: 1px solid black; padding: 10px; text-align: center;">  <p>99257</p> </div>	<p>5x46 001 290 Driving-in tool, oil pipe</p>	
<p style="text-align: center;"><b>38</b></p> <div style="border: 1px solid black; padding: 10px; text-align: center;">  <p>99253</p> </div>	<p>5x46 001 376 Snap ring pliers, pinion shaft and transmission housing</p>	
<p style="text-align: center;"><b>39</b></p> <div style="border: 1px solid black; padding: 10px; text-align: center;">  <p>00063</p> </div>	<p>5x46 001 400 Dismantling fixture, pinion shaft sealing ring</p>	

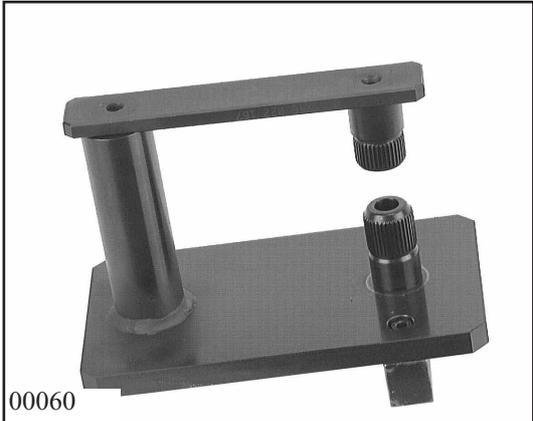
Remarks	Order-No. / Application	OBJECT
	5x46 001 422 Wrench, pinion shaft nut	<p style="text-align: center;"><b>40</b></p> <div style="text-align: right; margin-right: 20px;">99252</div> 
Identical  4 HP 20	5x46 001 955 Core insert for ROLLEX puller (intermediate gear)	<p style="text-align: center;"><b>41</b></p> <div style="text-align: right; margin-right: 20px;">98171</div> 
Identical  4 HP 20	5x46 001 956 Core insert for ROLLEX puller (pinion and helical gear)	<p style="text-align: center;"><b>42</b></p> <div style="text-align: right; margin-right: 20px;">98168</div> 

OBJECT	Order-No. / Application	Remarks
<p style="text-align: center;"><b>43</b></p> 	<p>5x46 002 004 - Assembly bracket for pressing down cup spring A</p>	<p>Identical  5 HP 19</p>
<p style="text-align: center;"><b>44</b></p> 	<p>5x46 002 005 - Assembly bracket for pressing down cup springs B + F</p>	<p>Identical  5 HP 19</p>
<p style="text-align: center;"><b>45</b></p> 	<p>5x46 002 006 - Mounting fixture for tower</p>	<p>Identical  5 HP 19</p>

Remarks	Order-No. / Application	OBJECT
Identical  5 HP 19	5x46 002 007 - Centring fixture, brake C (with centring pin and wedge)	<p style="text-align: center;"><b>46</b></p> <p style="text-align: right;">98402</p>
Identical  5 HP 19	5x46 002 008 - Assembly pin for pump shaft sealing ring	<p style="text-align: center;"><b>47</b></p> <p style="text-align: right;">98403</p>
Identical  5 HP 19	5x46 002 009 - Dismantling device, oil supply	<p style="text-align: center;"><b>48</b></p> <p style="text-align: right;">98404</p>

OBJECT	Order-No. / Application	Remarks
<p style="text-align: center;"><b>49</b></p>  <p>98405</p>	<p>5x46 002 010 - Assembly fixture, oil supply with input</p>	<p>Identical 5 HP 19</p>
<p style="text-align: center;"><b>50</b></p>  <p>98148</p>	<p>5x46 002 033 Driving-in tool, clamping sleeve (selector shaft)</p>	<p>Identical 4 HP 20</p>
<p style="text-align: center;"><b>51</b></p>  <p>98406</p>	<p>5x46 002 088 - Removal fixture, piston F</p>	<p>Identical 5 HP 19</p>

Remarks	Order-No. / Application	OBJECT
	<p data-bbox="379 427 600 499">5x46 002 156 Wedge, brake C</p> <p data-bbox="379 987 802 1099">5x46 002 159 Core insert, roller bearing inner race, differential cover end</p> <p data-bbox="379 1547 730 1619">5x46 002 164 Output sleeve (sun wheel)</p>	<p data-bbox="1134 409 1174 443"><b>52</b></p> <div data-bbox="890 477 1422 902">  <p data-bbox="1345 857 1422 891">99247</p> </div> <p data-bbox="1134 969 1174 1003"><b>53</b></p> <div data-bbox="890 1037 1422 1462">  <p data-bbox="1345 1417 1422 1451">00055</p> </div> <p data-bbox="1134 1529 1174 1563"><b>54</b></p> <div data-bbox="890 1597 1422 2022">  <p data-bbox="1345 1977 1422 2011">00056</p> </div>

OBJECT	Order-No. / Application	Remarks
<p style="text-align: center;"><b>55</b></p>  <p>99246</p>	<p>5x46 002 165 Gearbox mounting bracket</p>	
<p style="text-align: center;"><b>56</b></p>  <p>00059</p>	<p>5x46 002 166 2 converter pull-out handles</p>	
<p style="text-align: center;"><b>57</b></p>  <p>00060</p>	<p>5x46 002 167 Differential locking fixture</p>	

Remarks	Order-No. / Application	OBJECT
	5x46 002 173 Gearwheel retaining plate	<p style="text-align: center;"><b>58</b></p>  <p style="text-align: right;">00057</p>
	5x46 002 174 Fixture for pinion shaft nut	<p style="text-align: center;"><b>59</b></p>  <p style="text-align: right;">00058</p>
	5x46 002 217 Drift, pinion shaft bearing inner race	<p style="text-align: center;"><b>60</b></p>  <p style="text-align: right;">00064</p>

OBJECT	Order-No. / Application	Remarks
<p style="text-align: center;"><b>61</b></p> <div style="border: 1px solid black; padding: 10px; text-align: center;">  <p>00065</p> </div>	<p>5x46 002 218 Drift, pinion shaft and helical gear bearing inner races</p>	
<p style="text-align: center;"><b>62</b></p> <div style="border: 1px solid black; padding: 10px; text-align: center;">  <p>00066</p> </div>	<p>5x46 002 219 Pin, intermediate gear bearing inner race</p>	
<p style="text-align: center;"><b>63</b></p> <div style="border: 1px solid black; padding: 10px; text-align: center;">  <p>00067</p> </div>	<p>5x46 002 220 Drift, differential bearing, large</p>	

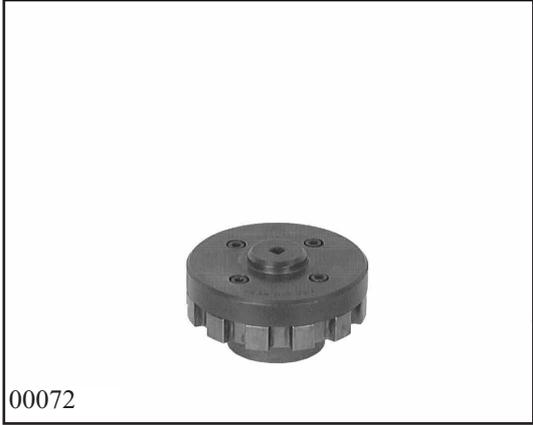
Remarks	Order-No. / Application	OBJECT
	5x46 002 221 Drift, differential bearing, small	<p style="text-align: center;"><b>64</b></p> <div style="border: 1px solid black; padding: 10px; text-align: center;">  <p style="text-align: right;">00068</p> </div>
	5x46 002 222 Drift, cylindrical pin for position switch	<p style="text-align: center;"><b>65</b></p> <div style="border: 1px solid black; padding: 10px; text-align: center;">  <p style="text-align: right;">00069</p> </div>
	5x46 002 223 Drift, transmission breather	<p style="text-align: center;"><b>66</b></p> <div style="border: 1px solid black; padding: 10px; text-align: center;">  <p style="text-align: right;">00070</p> </div>

OBJECT	Order-No. / Application	Remarks
<p style="text-align: center;"><b>67</b></p> <div style="border: 1px solid black; padding: 10px; text-align: center;">  <p>00071</p> </div>	<p>5x46 001 468 Drift, differential breather</p>	
<p style="text-align: center;"><b>68</b></p> <div style="border: 1px solid black; padding: 10px; text-align: center;">  <p>99249</p> </div>	<p>5x46 002 246 Drift, differential shaft sealing ring</p>	
<p style="text-align: center;"><b>69</b></p> <div style="border: 1px solid black; padding: 10px; text-align: center;">  <p>00061</p> </div>	<p>5x46 002 287 Core insert, roller bearing inner race, differential (housing end)</p>	

Remarks	Order-No. / Application	OBJECT
<p>Identical</p> <p>3 HP 22 Q 4 HP 14 Q 4 HP 18 Q 4 HP 20</p>	<p>5x46 010 011 Rollex puller 1000/1 (basic unit)</p>	<p style="text-align: center;"><b>70</b></p> <div style="border: 1px solid black; padding: 10px; text-align: center;">  <p style="text-align: right;">98152</p> </div>
<p>Identical</p> <p>4 HP 14 Q 4 HP 18 Q 4 HP 20</p>	<p>5x46 021 007 Kukko puller 21/7</p> <p>or</p> <p>5x46 021 008 Kukko puller 21/8</p>	<p style="text-align: center;"><b>71</b></p> <div style="border: 1px solid black; padding: 10px; text-align: center;">  <p style="text-align: right;">98149</p> </div>
<p>Identical</p> <p>4 HP 14 Q 4 HP 18 Q 4 HP 20</p>	<p>5x46 022 002 Kukko puller 22-2 (basic unit)</p>	<p style="text-align: center;"><b>72</b></p> <div style="border: 1px solid black; padding: 10px; text-align: center;">  <p style="text-align: right;">98150</p> </div>

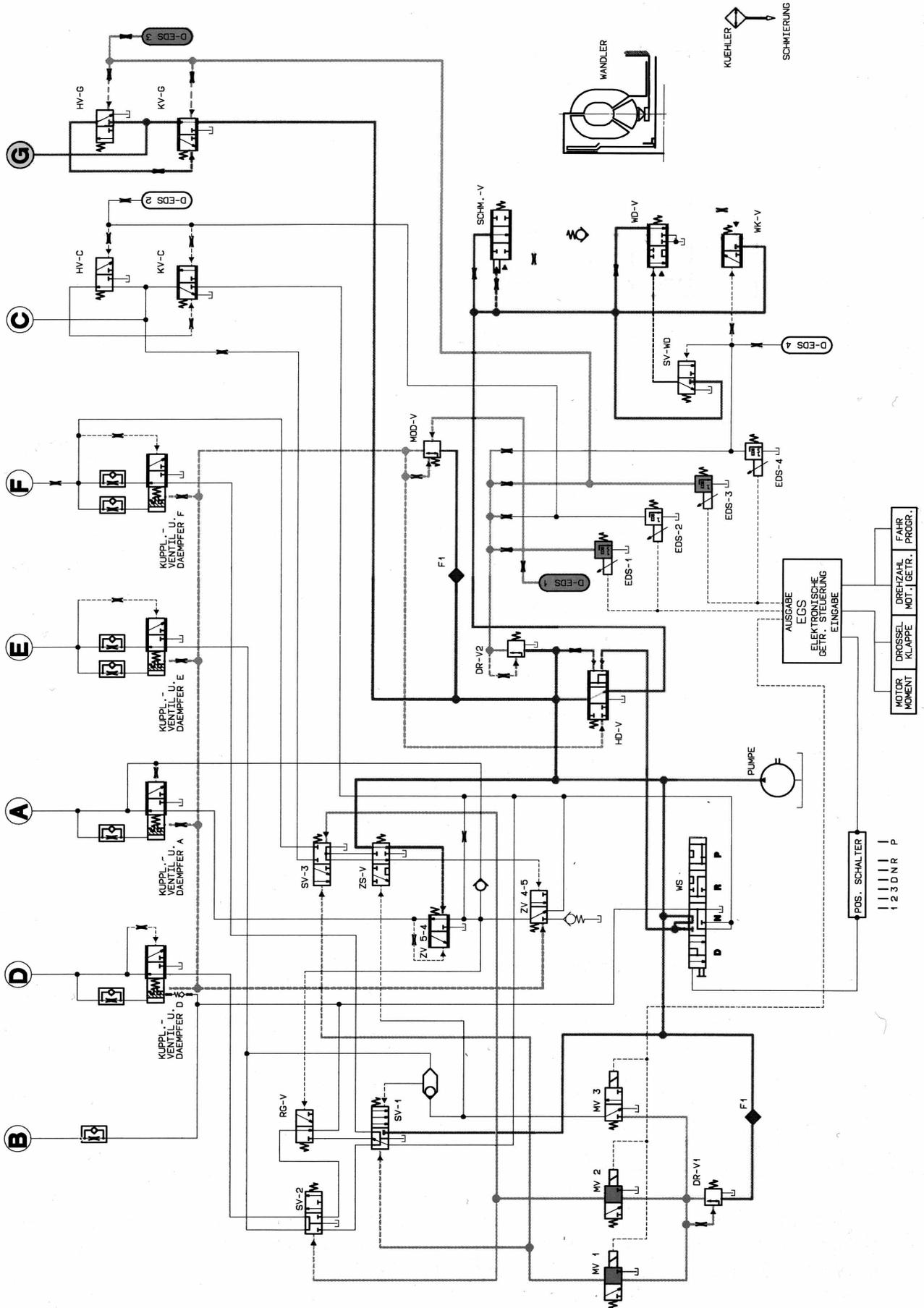
OBJECT	Order-No. / Application	Remarks
<p style="text-align: center;"><b>73</b></p> <div style="border: 1px solid black; padding: 10px; text-align: center;">  </div> <p>97305</p>	<p>5x46 030 167  - Assembly bracket for pressing  down cup spring E    (equivalent to Item 3 of fixture  5x46 000 167)</p>	<p>Identical</p> <p>4 HP 14 Q  4 HP 18 Q  4 HP 20  4 HP 22  5 HP 18  5 HP 19  5 HP 24</p>
<p style="text-align: center;"><b>74</b></p> <div style="border: 1px solid black; padding: 10px; text-align: center;">  </div> <p>98155</p>	<p>5x46 032 010  Rollex puller 32010X/1  (differential)</p>	<p>Identical</p> <p>4 HP 20</p>
<p style="text-align: center;"><b>75</b></p> <div style="border: 1px solid black; padding: 10px; text-align: center;">  </div> <p>99271</p>	<p>5x46 300 849  Rollex 300849 inner bearing race  puller</p>	<p>Identical</p> <p>4 HP 18 Q</p>

Remarks	Order-No. / Application	OBJECT
	5x46 485 481 Rollex 48548 inner bearing race puller	<p style="text-align: center;"><b>76</b></p> <div style="border: 1px solid black; padding: 10px; text-align: center;">  <p style="text-align: right; margin-top: 5px;">99268</p> </div>
Identical  4 HP 18 Q	5x46 501 349 Rollex 501349 inner bearing race puller	<p style="text-align: center;"><b>77</b></p> <div style="border: 1px solid black; padding: 10px; text-align: center;">  <p style="text-align: right; margin-top: 5px;">99269</p> </div>
Identical  4 HP 18 Q 4 HP 20	5x46 503 491 Rollex puller, size IA (basic unit)	<p style="text-align: center;"><b>78</b></p> <div style="border: 1px solid black; padding: 10px; text-align: center;">  <p style="text-align: right; margin-top: 5px;">98151</p> </div>

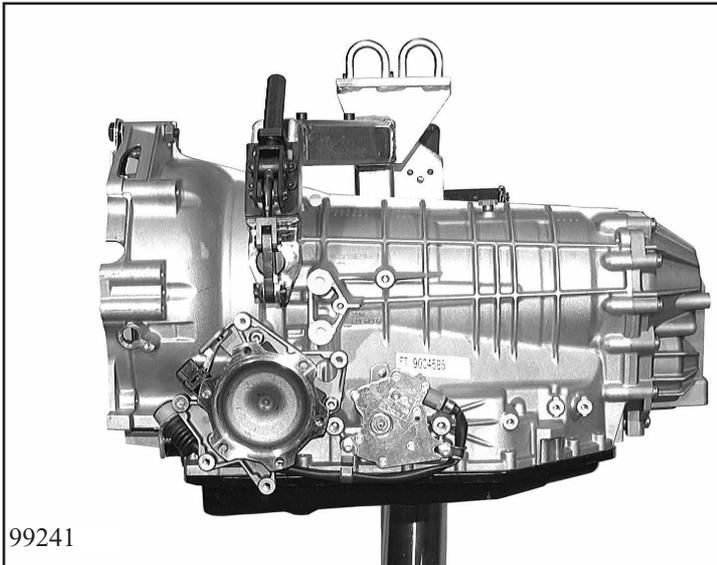
OBJECT	Order-No. / Application	Remarks
<p style="text-align: center;"><b>79</b></p> <div style="border: 1px solid black; padding: 10px; text-align: center;">  <p>99270</p> </div>	<p>5x46 806 649          Rollex 806649 inner bearing race          puller</p>	
<p style="text-align: center;"><b>80</b></p> <div style="border: 1px solid black; padding: 10px; text-align: center;">  <p>00072</p> </div>	<p>5x66 000 027          Drag torque measuring fixture,          pinion shaft</p>	
<p style="text-align: center;"><b>81</b></p> <div style="border: 1px solid black; padding: 10px; text-align: center;">  <p>00062</p> </div>	<p>5x95 000 440          Pull-out handle, sealing sleevesaft          seal, transmission housing, differ-          ential</p>	

Remarks	Order-No. / Application	OBJECT
	<p>5x45 000 016 -Torque wrench with yield-limit control (Type Quantec EMS 7086 ISI)</p> <p style="text-align: center;"><b>or</b></p> <p>5x45 000 017 -Torque wrench with yield-limit control (Type Operator<sup>five</sup> + software paket for yield resistance)</p>	<p style="text-align: center;"><b>82</b></p> <div data-bbox="890 474 1422 898" data-label="Image"> <p style="text-align: right;">00104</p> </div> <p style="text-align: center;"><b>83</b></p> <div data-bbox="890 1034 1422 1458" data-label="Image"> <p style="text-align: right;">00105</p> </div>

# 1.8 Oilflow chart (position N according to DIN scheme)





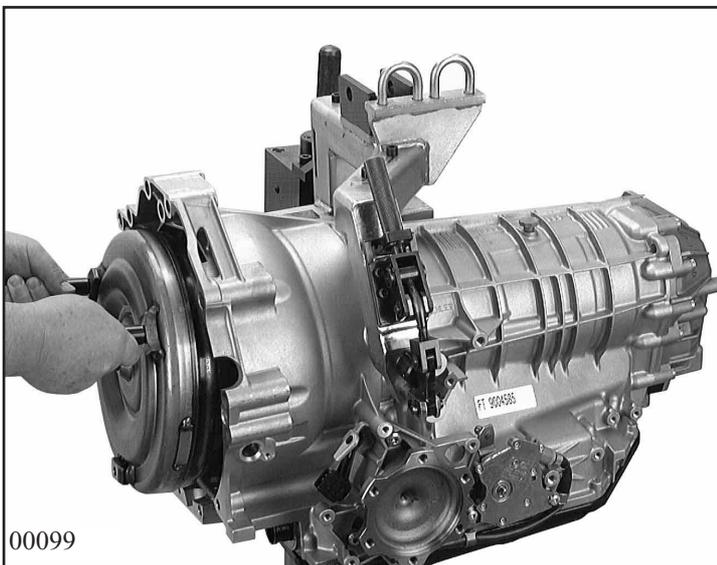


## 2. Removal

### 2.1 Removing converter, front axle output, valve body and position switch

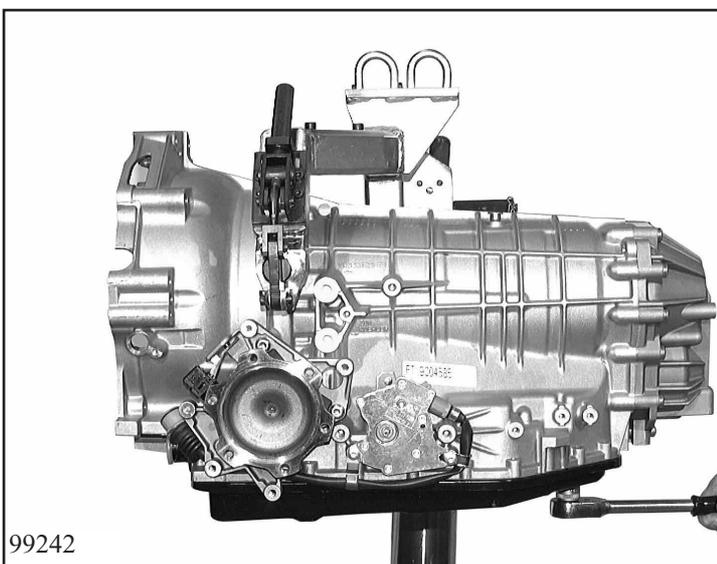
#### 2.1.1 Removing converter

Mount the complete transmission with oil pan facing down in assembly bracket 5x46 002 165 and attach to assembly truck or workbench holder 5x46 000 763.



Remove the converter retaining bracket and lift out the converter with 2 handles 5x46 002 166.

(Wrench size = 19 mm)



Pull the cover off the breather.

#### **Important:**

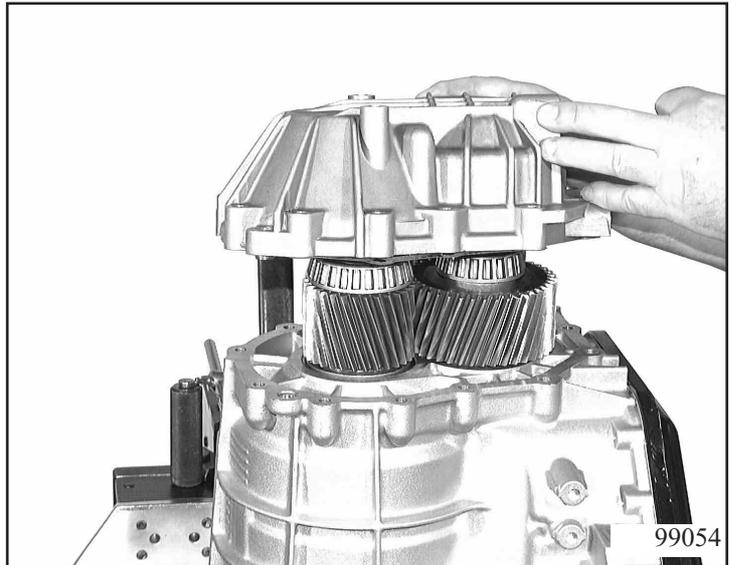
The transmission has two oil contents.

- a) Drain transmission oil by removing the drain and filler plugs.  
(Intl. hex = 17 mm for filler plug  
8 mm for drain plug)
- b) Turn the transmission through 90° with the converter bell downwards and drain out the differential oil by unscrewing the filler plug.  
(Intl. hex = 8 mm)

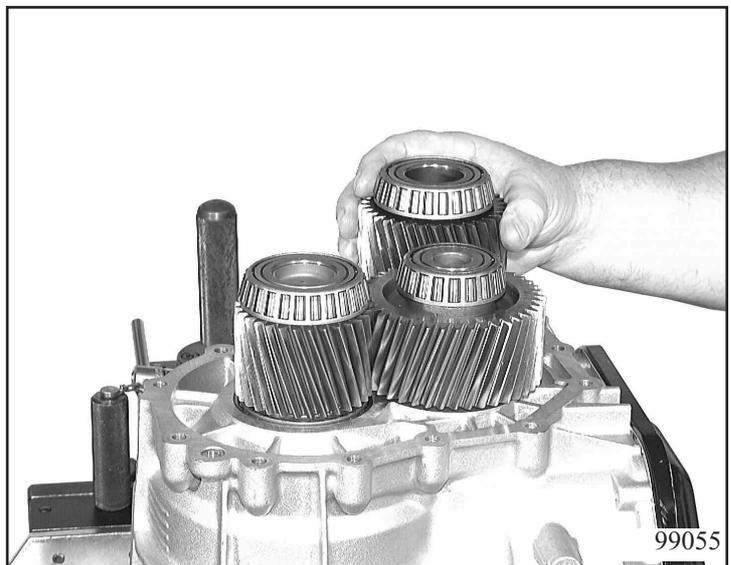
### 2.1.2 Removing front axle output

Take out the 14 screws and lift off the front axle housing with gasket.

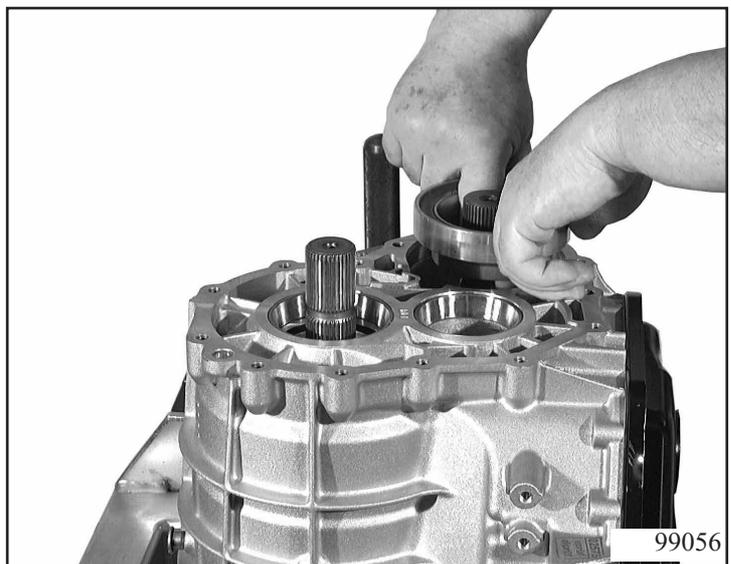
(Wrench size = Torx TX-40)



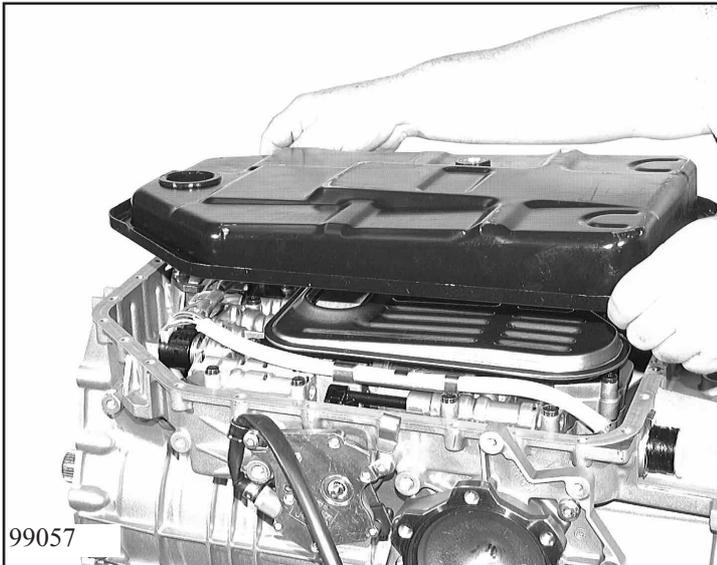
Take off the helical gear.  
Lift off the intermediate gear with the pinion.  
Remove the spring from the pinion shaft.  
Lift the shim washer off the output shaft.



Remove the bearing retaining ring by hand or with a two-arm puller.  
Lift the thrust bearing off the output shaft.



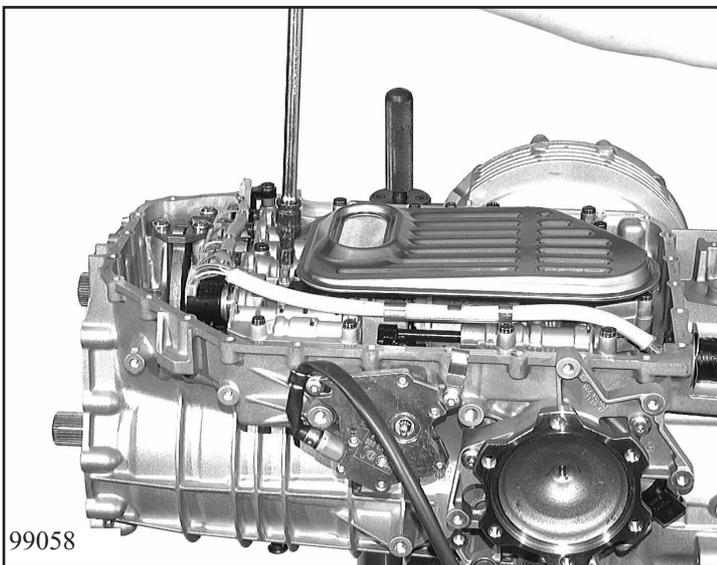
**Warning:**  
Do not damage the sealing face.



### 2.1.3 Removing valve body

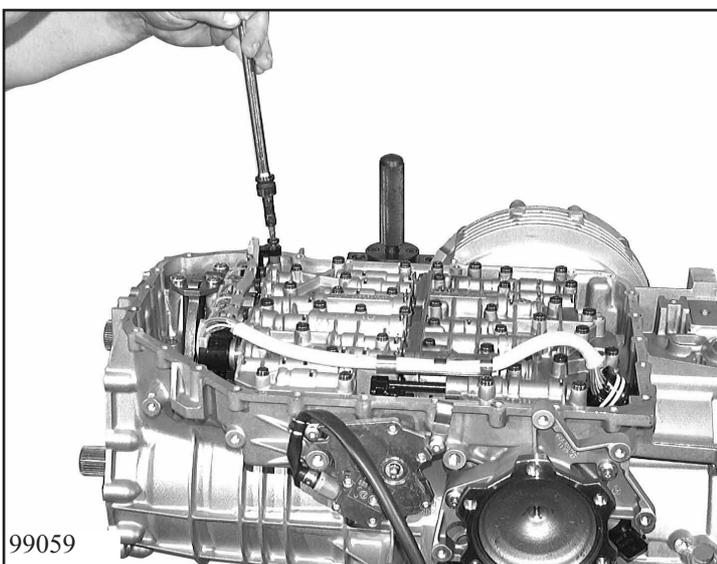
Turn the transmission through 90° with the oil pan at the bottom.  
 Take out the 27 screws holding the oil pan and remove it.  
 Remove the gasket from the transmission housing.  
 Remove the magnets from the oil pan.

(Wrench size = Torx TX-27)



Take out the 2 screws and remove the oil filter.  
 Remove the seal from the oil filter connection or from the bore in the valve body.

(Wrench size = Torx TX-27)

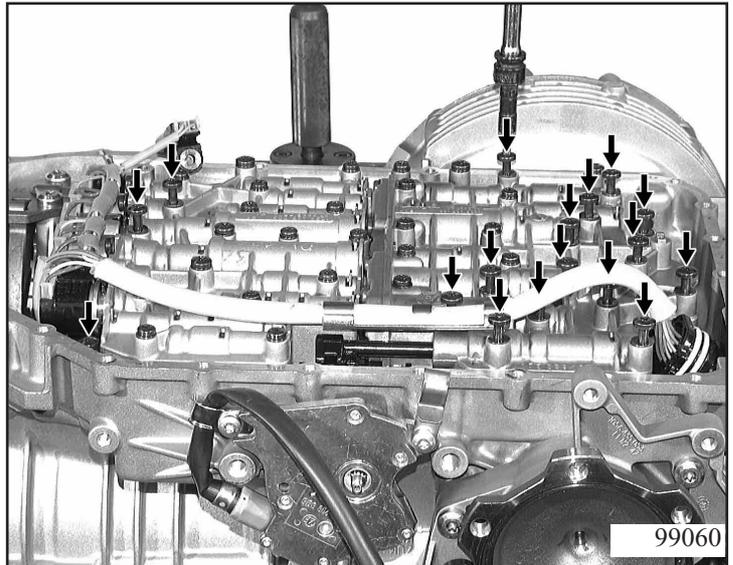
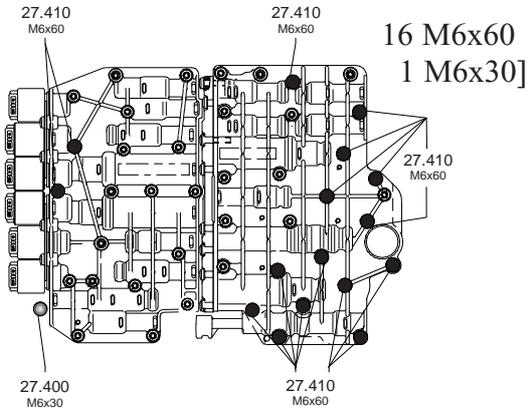


Detach the keeper plate from the wiring harness plug and press the plug into the transmission.  
 Remove the protective cap from the wiring harness plug.  
 Take out the inductive sensor (output speed) screw and pull out the sensor with spacing sleeve.

(Wrench size = Torx TX-27)

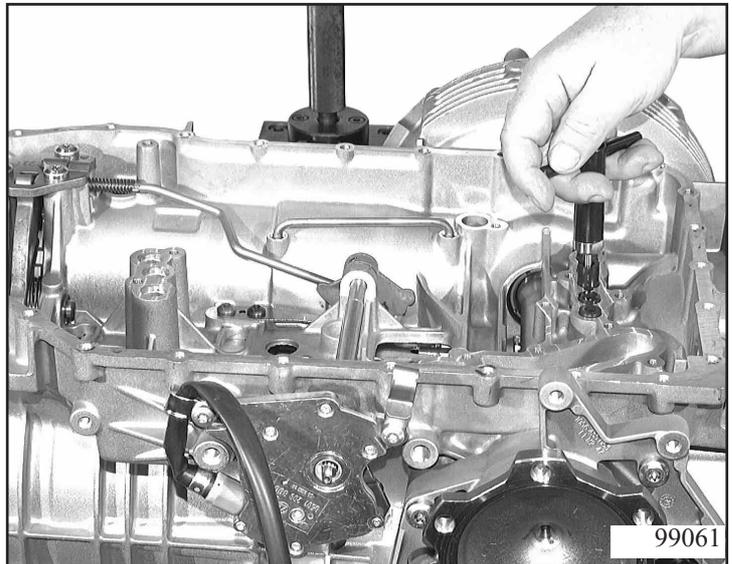
Unscrew and remove the 17 large-headed screws as shown in this picture, and lift out the valve body.

(Wrench size = Torx TX-27 / TX-40)

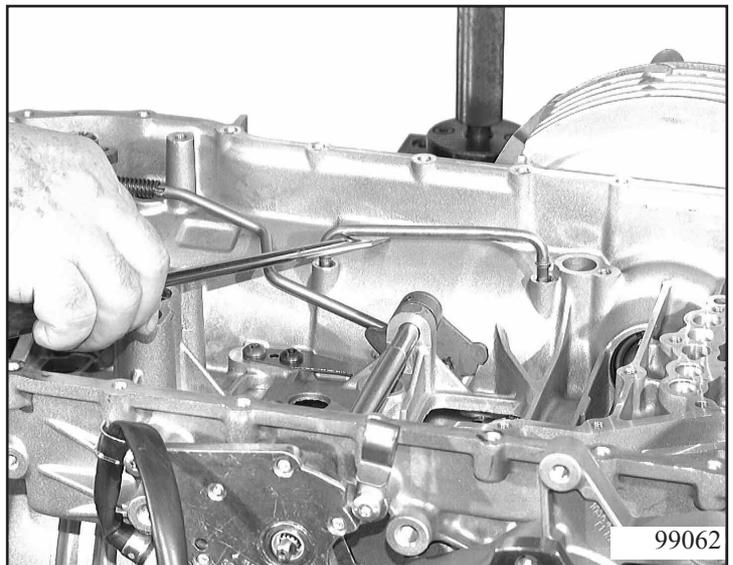


Remove the 3 snap rings with springs from brake D, clutch F and brake G, using suitable pliers.

Next, remove the sealing sleeves from bores D / F / G and C, A, B, E and the converter clutch supply line with puller 5x95 000 440.



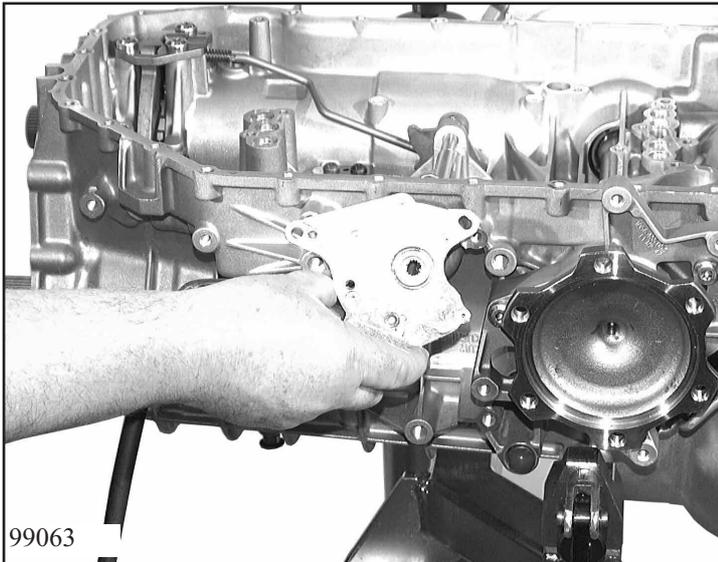
Lever out the oil pipe with a suitable tool and remove the two O-rings.



#### 2.1.4 Removing the position switch

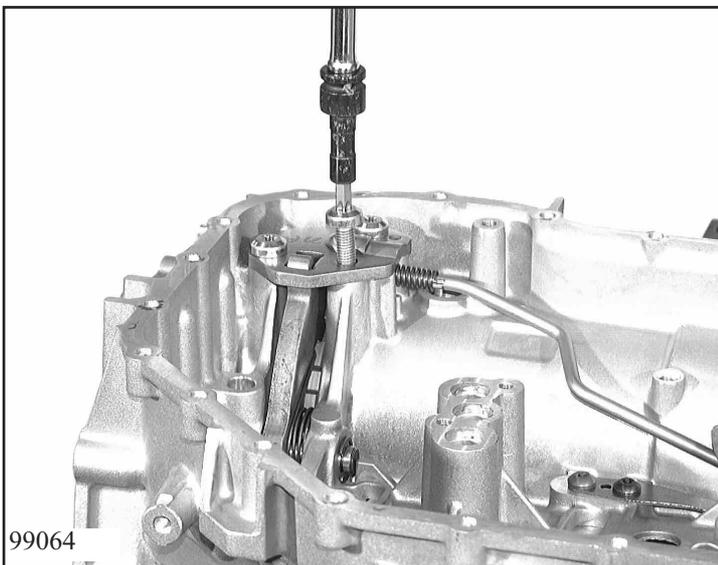
Set the selector shaft to position “N”.  
Remove the position switch screws with the cable retaining clips and take off the position switch.

(Wrench size = Torx TX-27)



Remove the 3 screws for the guide plate and take off the plate.

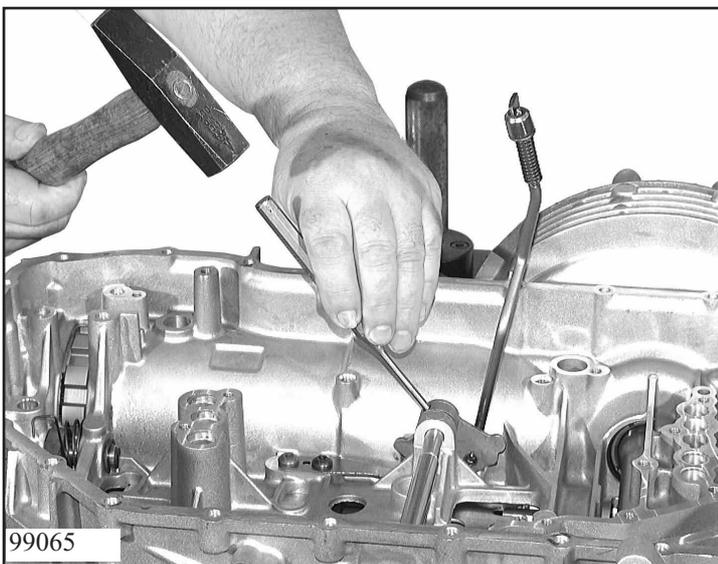
(Wrench size = Torx TX-40)



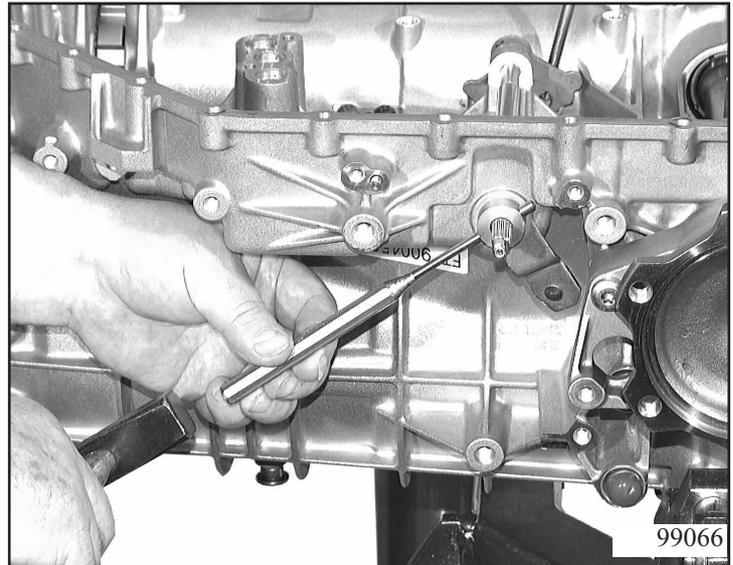
Set the detent disc to position “P”.

Tilt the connecting rod to the other side and pull the guide journal out as far as possible.

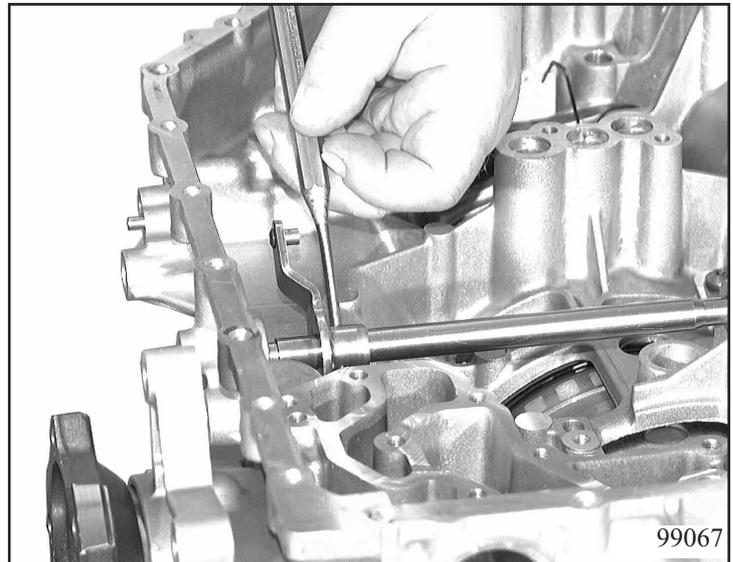
Using a suitable drift, force the clamping sleeve out of the detent disc.



Drive the clamping sleeve out of the selector lever and take off the lever.



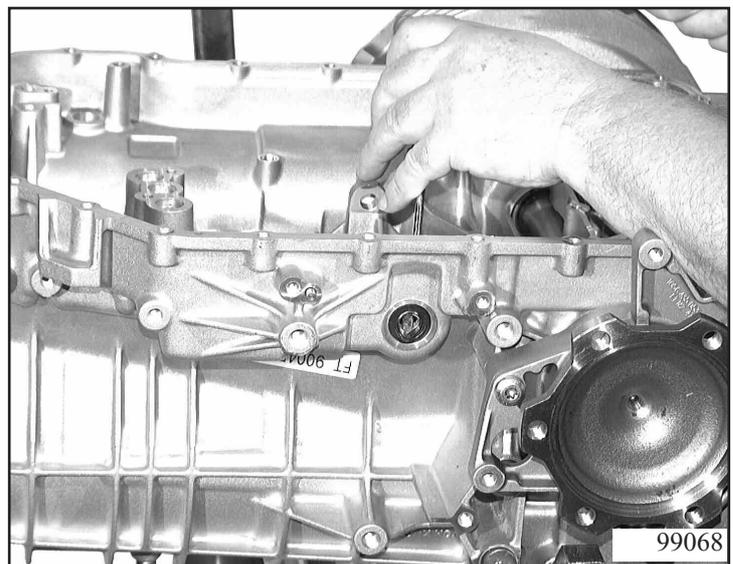
Press the selector shaft as far as possible into the transmission housing and drive the clamping sleeve out of the selector shaft.  
Pull out the selector shaft. Take out the detent disc with connecting rod and selector lever.



**Note:**

The detent spring normally remains installed.

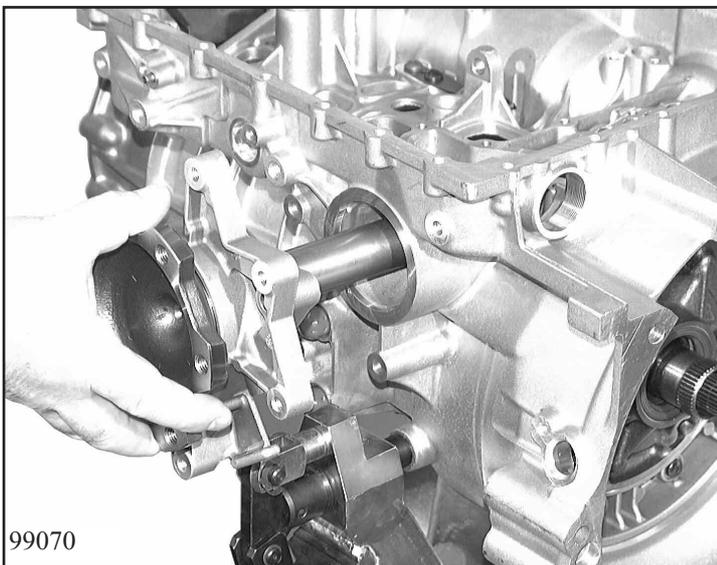
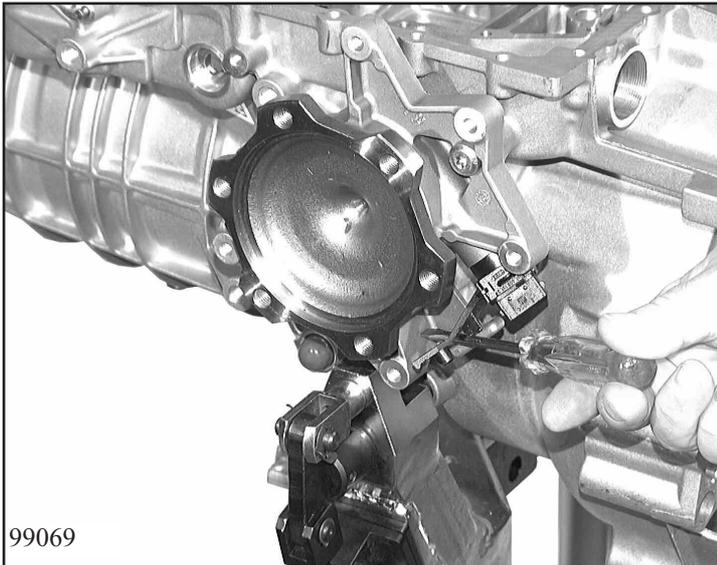
Take off the shaft sealing ring, using a suitable tool.



## 2.2 Removing flange shaft, front-axle differential and parking lock

### 2.2.1 Removing flange shaft

Release the speedometer sensor and pull it out.



Unscrew the 3 speedometer housing screws. Carefully remove the flange shaft with the speedometer housing.

(Wrench size = Torx TX-40)

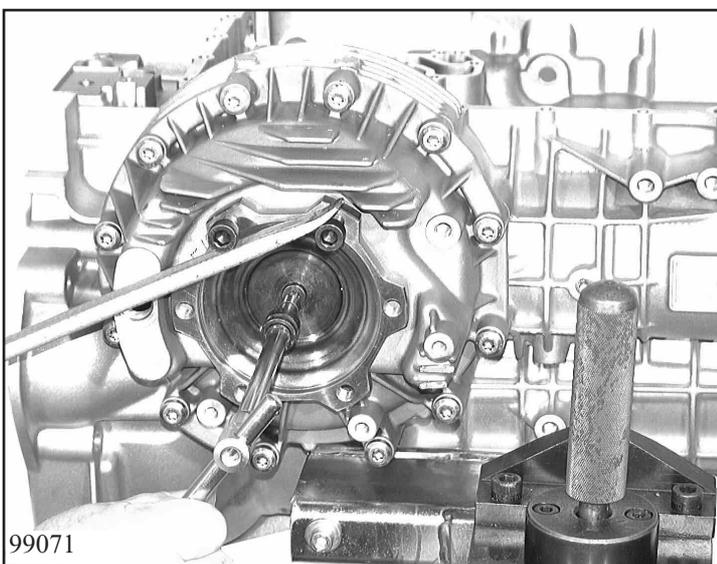
### 2.2.2 Removing the differential

Remove the expansion bolt from the flange, at the same time preventing the flange from turning.

Take out the flange or lever it out.

(depending on which version is installed)

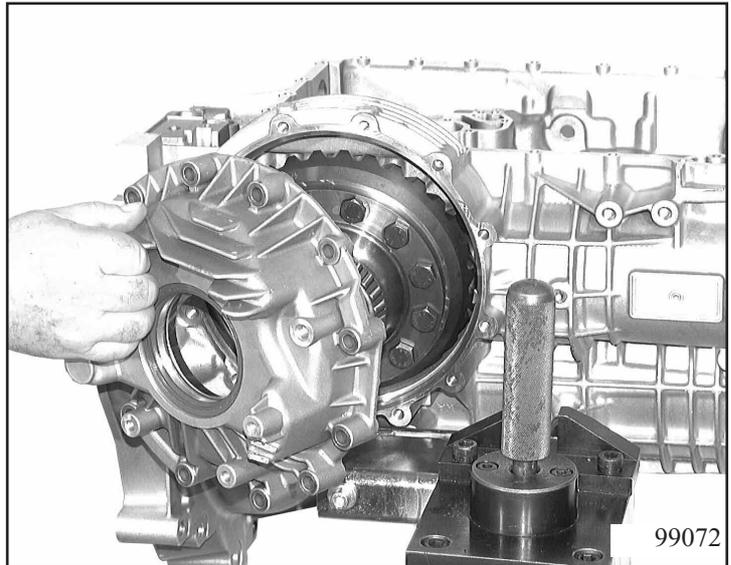
(Wrench size = Torx TX-40)



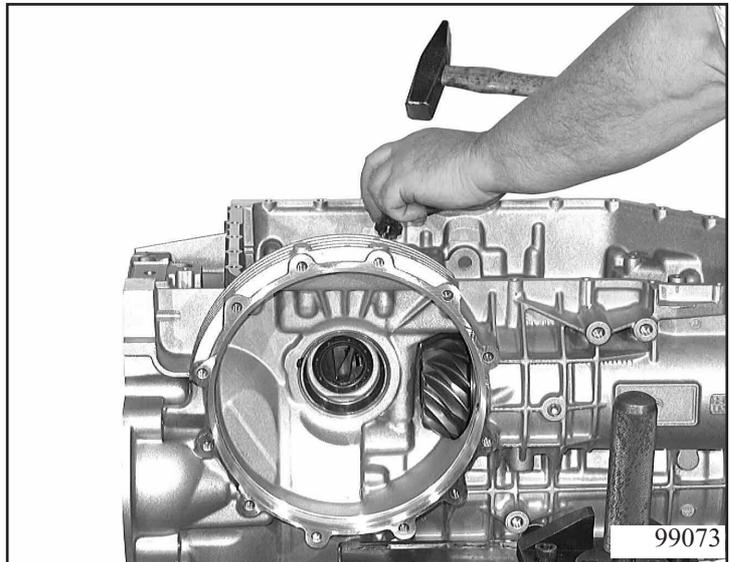
Remove the 12 differential cover screws.  
Take off the cover and pull out the differential.  
Remove the O-ring from the cover.

(Wrench size = Torx TX-40)

**Warning:!**  
The differential could fall out.

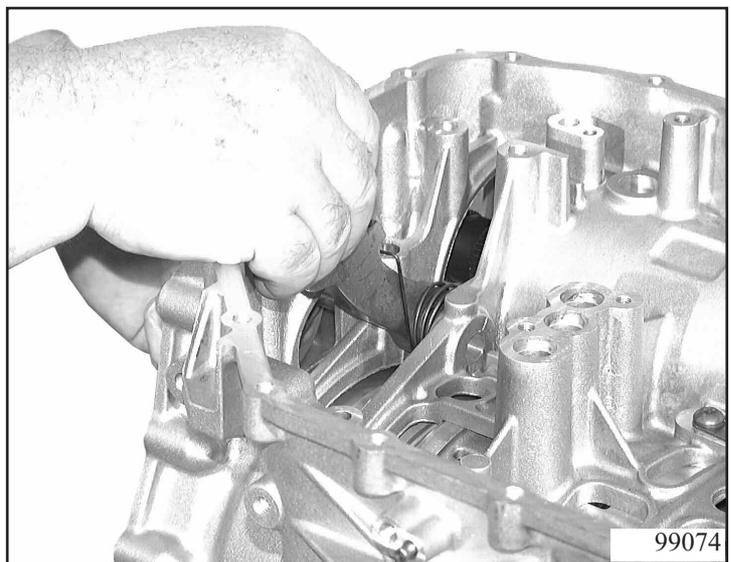


Drive the flange shaft sealing ring out of the differential housing.

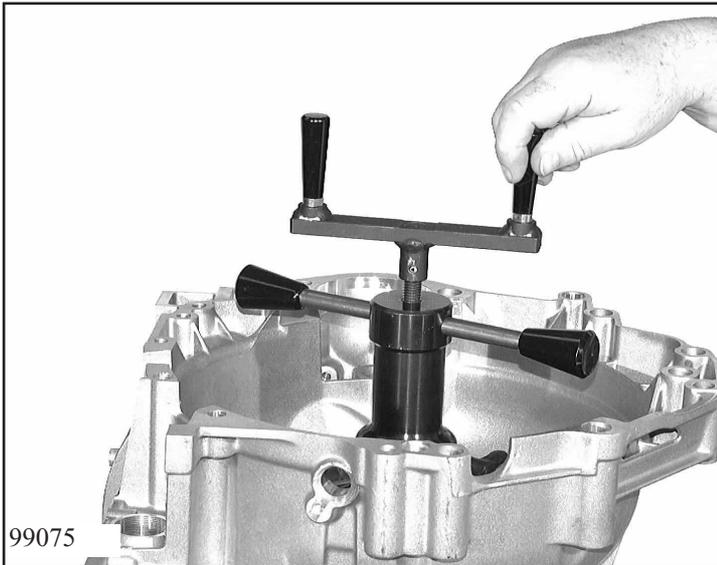


### 2.2.3 Removing the parking lock

Take off the parking lock gearwheel.  
Pull the keeper off the parking lock pin.  
Press the parking lock pin out to the rear.  
Remove the pawl with spring and shim washer (if fitted).



### 2.3 Removing oil supply



Turn the transmission through 90° (with converter bell upwards). Remove the 9 screws holding the oil supply.

Clamp fixture 5x46 002 009 on to the stator shaft.

Turn the spindle of the fixture downwards and lift out the complete oil supply unit. Remove the shim washer for end-play adjustment and the needle roller cage.

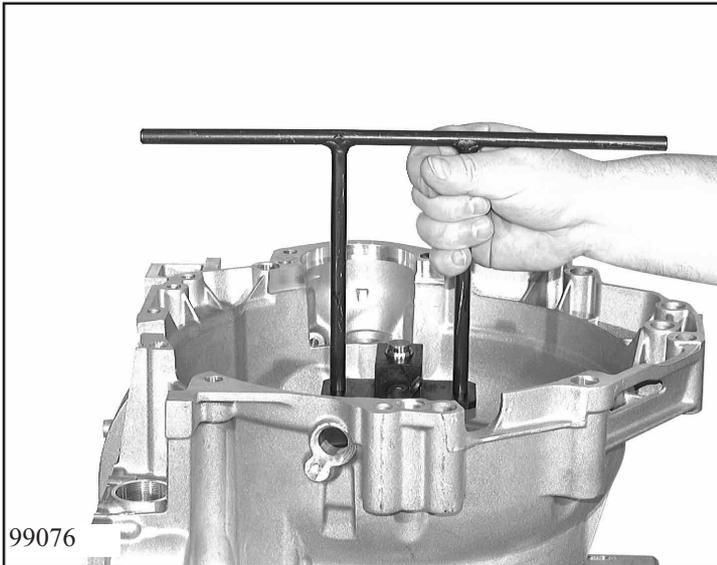
(Wrench size = Torx TX-27)



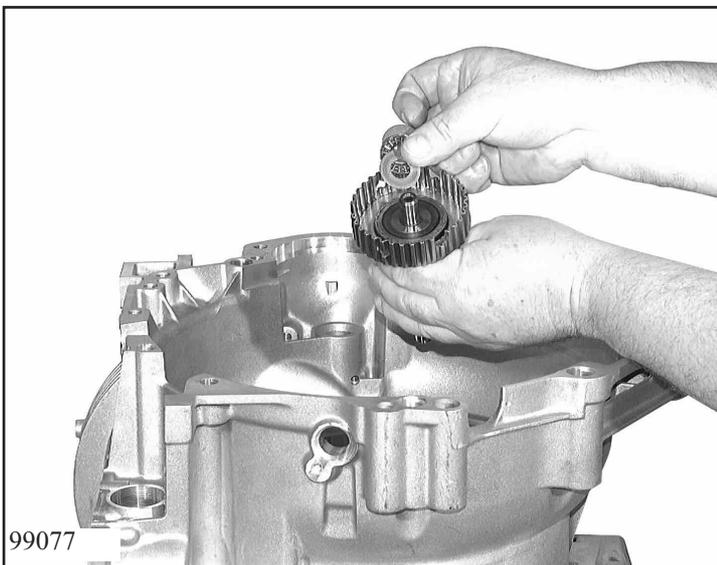
## 2.4 Removing input with tower

### 2.4.1 Removing input

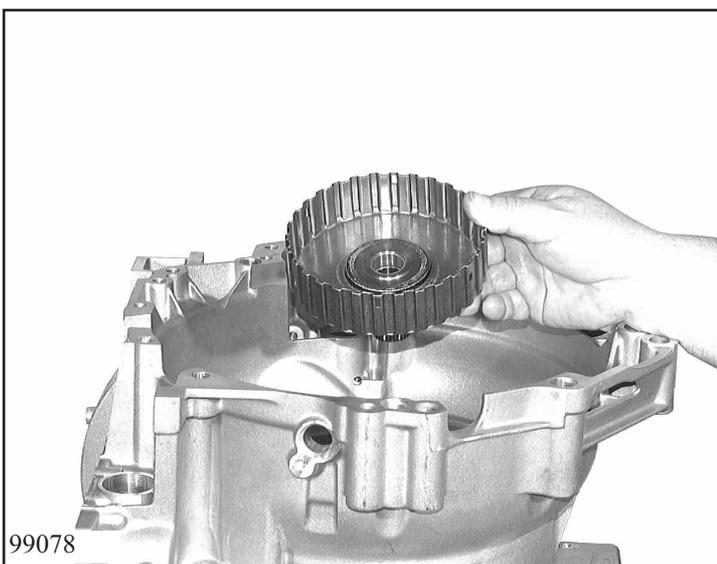
Lift out the input shaft together with clutches A, B and E, either by hand or using fixture 5x46 002 010.



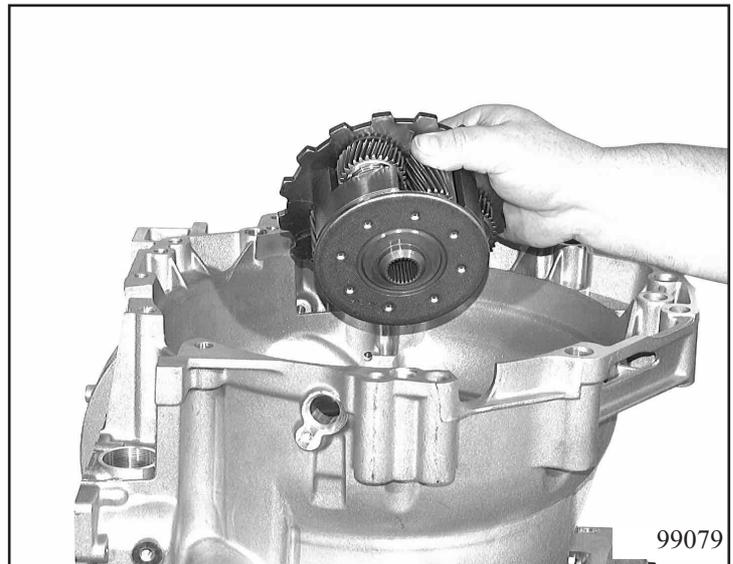
Remove the 2 thrust washers and the needle roller cage. Lift out the intermediate shaft.



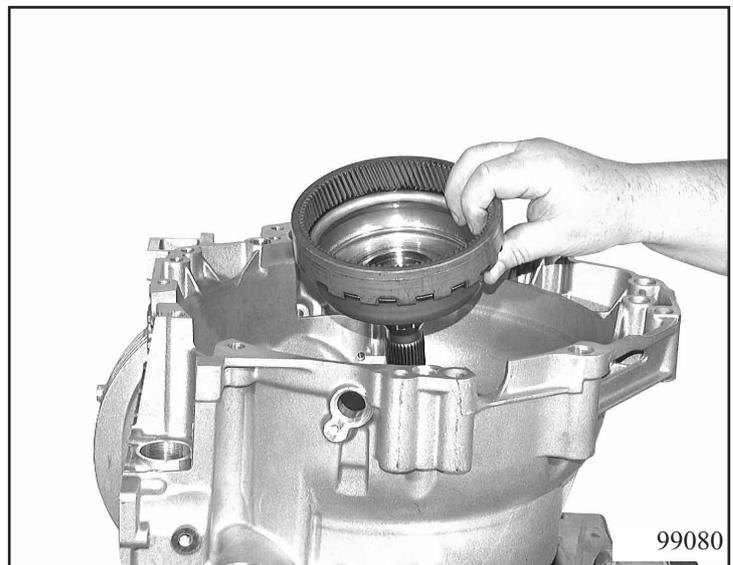
Take out the angle washer, needle roller cage and thrust washer. Remove the sun gear shaft and the needle thrust bearing cage.



Take out the sun gear and the planetary gear set and the angle washer, needle roller cage and thrust washer.



Remove the shaft with the ring gear, thrust washer, needle roller cage, angle washer and pot.

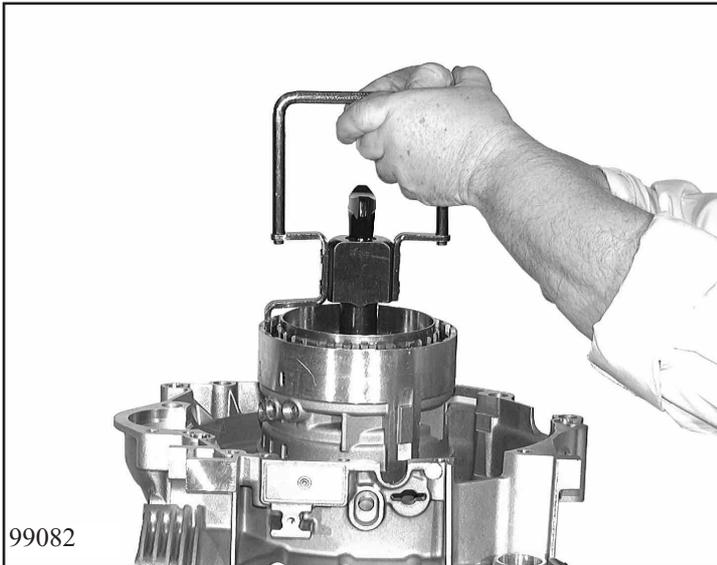


#### 2.4.2 Removing the tower

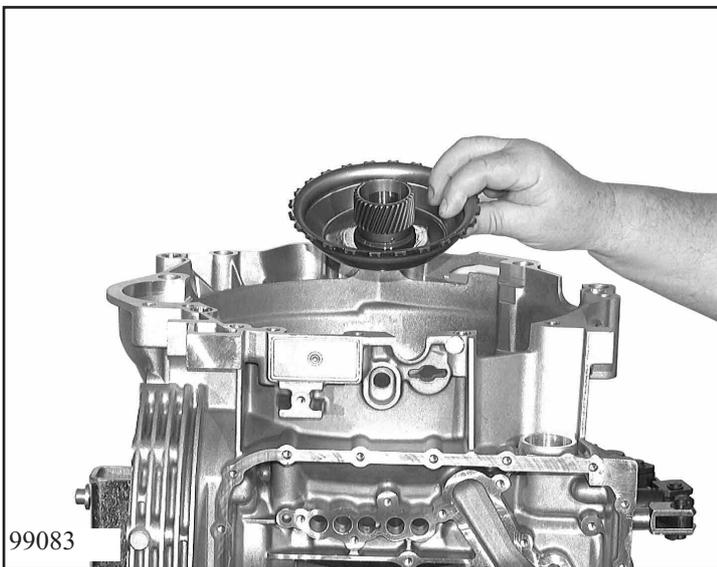
Release snap ring from transmission housing.

Place lifter 5x46 000 545 in the planet wheel carrier of the tower and press the tensioner down in the centre to lock it into position.





Lift out the tower and insert it into mounting fixture 5x46 002 006.

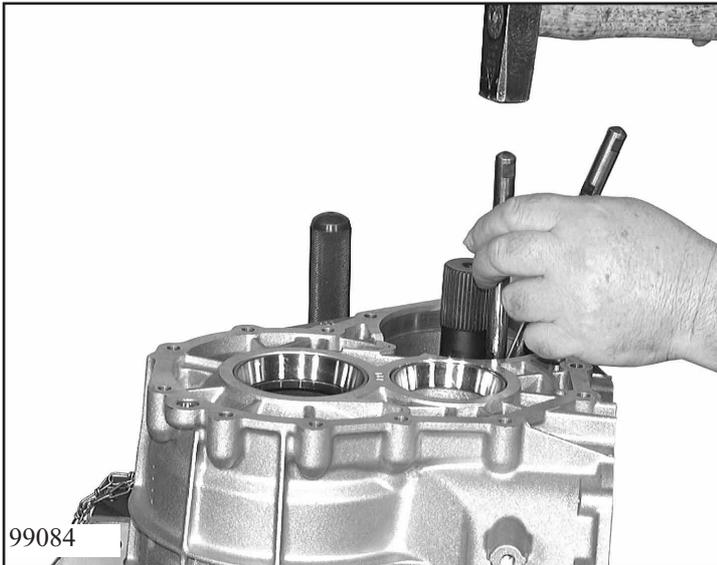


Remove angle washer, needle thrust bearing cage and angled washer.

**Note:**  
The angle washer may adhere to the planet wheel carrier and be difficult to remove.

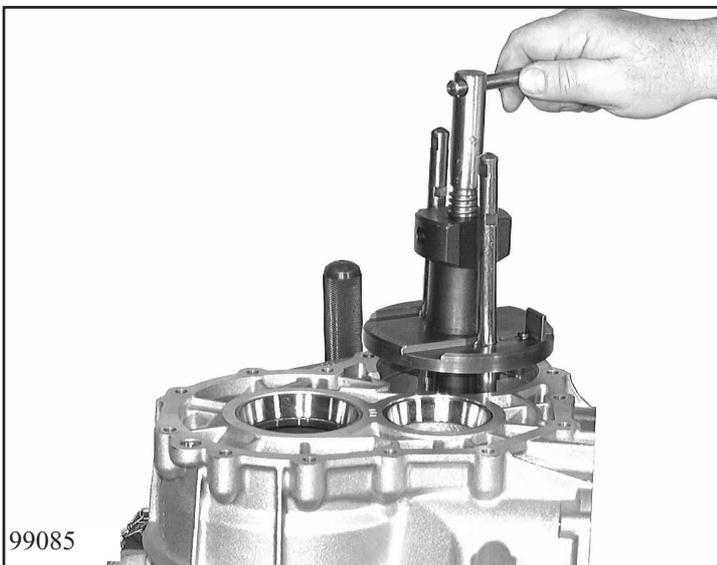


## 2.5 Removing pinion shaft



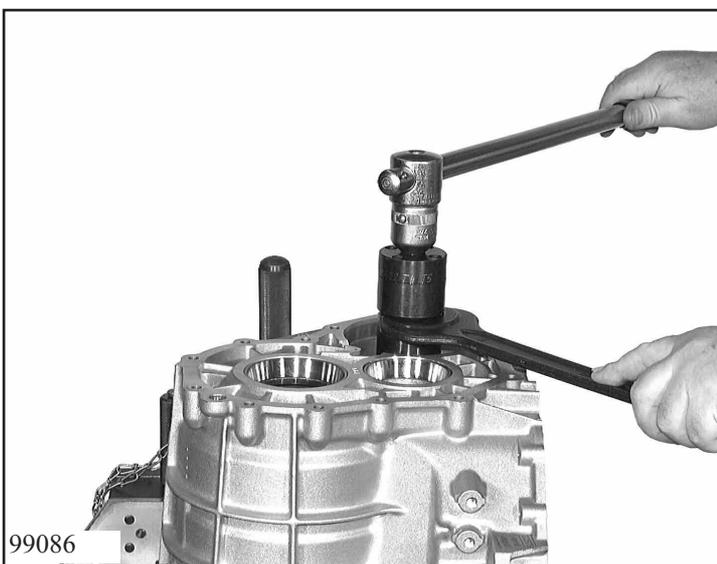
Turn the transmission through 180 degrees.

Using a suitable hammer, drive the tightening rods of tool 5x46 001 400 through the marks on the shaft sealing ring.



Mount the spindle plate on the tightening rods and secure in the second notch from the top.

Turn the spindle to pull out the shaft sealing ring.



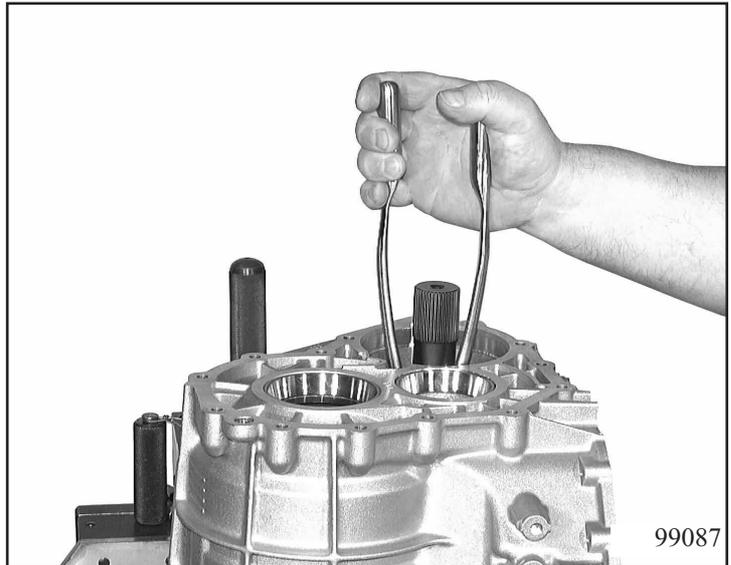
Place wrench 5x46 001 422 on the nut. Place the counter-holder on the shaft. With a suitable lever and open-ended wrench, unscrew and remove the nut.

(Wrench size = 41 mm)

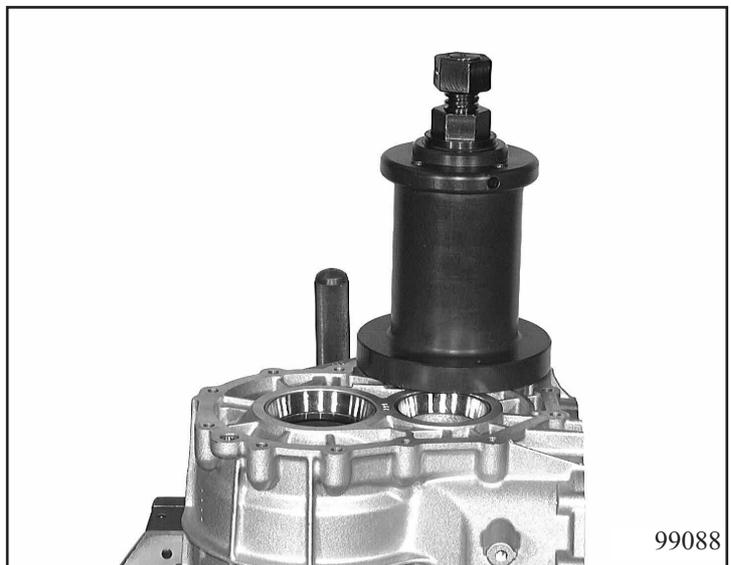
### Note:

If necessary turn the screw in a suitable threaded hole of the gearbox housing in order to create a support for the open-end-wrench for the unscrew procedure.

Use pliers 5x46 001 376 to remove the snap ring from the transmission housing.

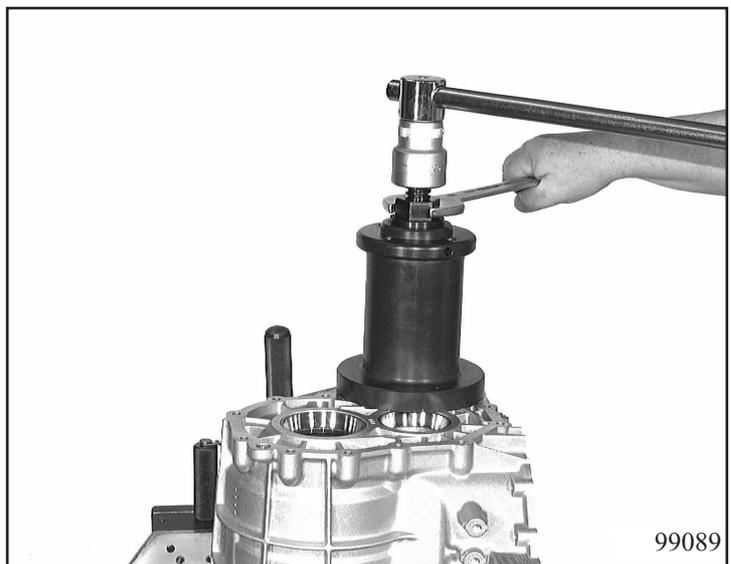


Using fixture 5x46 001 209, remove the pinion shaft from the transmission housing.  
Screw the threaded bracket of the fixture into the thread on the pinion shaft (if necessary hold the pinion shaft with one hand at the pinion).



Insert the pin of the bell on the fixture into a tapped hole in the housing.  
To pull out the pinion shaft, turn the nut above the bell and hold the nut on the spindle.  
Remove the countersunk screw for locating the pinion shaft bearing from the transmission housing.

(Wrench size – 36 mm)  
(Torx TX-27)



## Dismantling

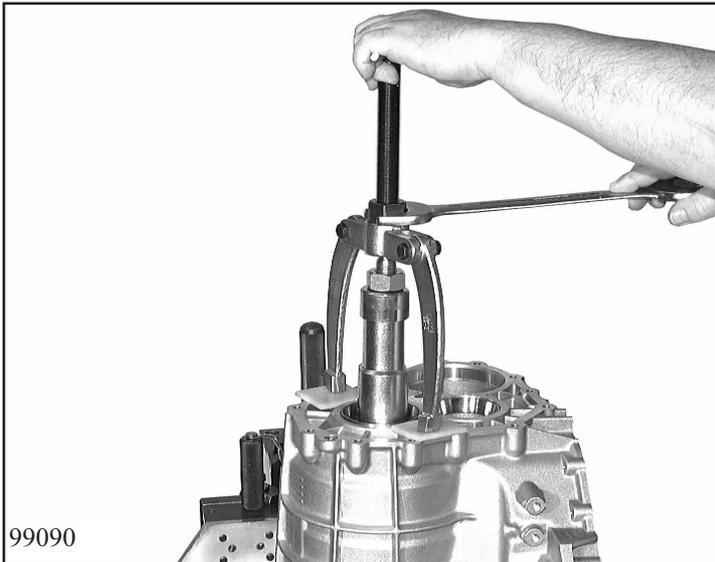
### 2.6 Removing bearing shells, bearings etc.

#### 2.6.1 Transmission housing

Remove front-axle output bearing shells with tool 5x46 022 002 (Kukko 22-2) combined with 5x46 021 008 (Kukko 21-8) or 5x46 021 007 (Kukko 21-7). Take off the shim washers.

#### **Important:**

Insert plastic tabs between the support bracket and the sealing face, or else the sealing face will be damaged beyond repair. Allocate the bearing shells and shim washers to the correct bearings. Do not exchange them, or noise problems will occur ⇨ transmission failure.

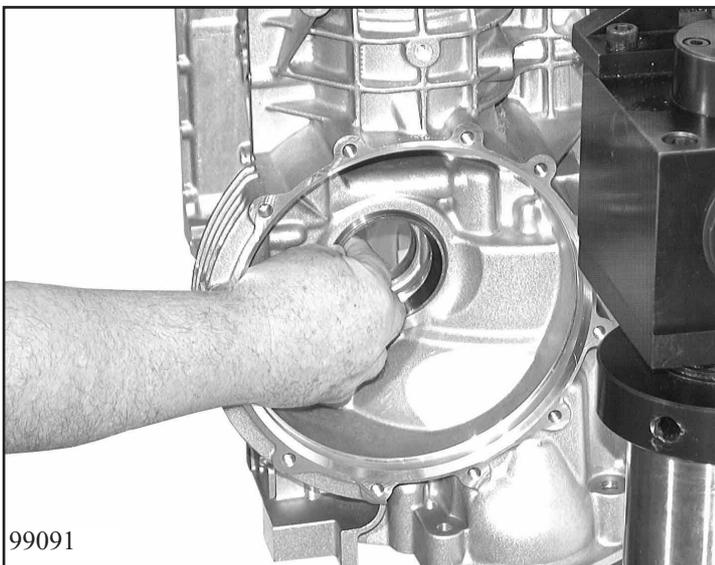


Remove the differential bearing shell from the transmission housing; this can normally be done by hand, but if necessary use tool 5x46 022 002 combined with 5x46 021 007.

Remove the shim washer.

#### **Note:**

The breather does not have to be removed unless it is damaged or malfunctioning.



#### 2.6.2 Bearing race

Heat the bearing shell with a hot-air blower to remove it from the bearing race. To do this, place the bearing race on assembly bracket 5x46 000 576, take off the shim washer and allocate it to the shim washer and allocate it to the correct bearing with the bearing shell.



### 2.6.3 Front axle housing

Pull the bearing shells out of the front axle housing using tool 5x46 022 002 combined with 5x46 021 008 or 5x46 021 007.

**Important:**

Allocate the bearing shells to the correct bearings. Do not confuse them accidentally!

⇒ Noise problems



### 2.6.4 Differential cover

Pull off the O-ring seal.  
Remove the 3 screws for the oil baffle plate from the differential cover.  
Take out the oil baffle plate with magnet.  
Remove the bearing shell and shim washer; this is normally done by hand, but if necessary use tool 5x46 022 002 combined with 5x46 021 008 .  
Lever out the shaft sealing ring with a suitable tool.



### 2.6.5 Pinion shaft

Place the pinion shaft in sleeve 5x46 000 530 and press out the double bearing in the hydraulic press.  
Take off the double bearing with inner bearing race and spacing washer.





Press the inner bearing race off the pinion shaft, using puller 5x46 032 010 (Rollex 32010x1), tool 5x46 000 530 and a hydraulic press.  
Take off the shim washer.

## 2.6.6 Intermediate and helical gears and pinion

### 2.6.6.1 Intermediate gear



Using puller 5x46 485 481 (Rollex 48548), core insert 5x46 001 955 and basic unit 5x46 503 491 (Rollex 1 A), pull both inner bearing races off the intermediate gear.

### 2.6.6.2 Helical gear



Using puller 5x46 501 349 (Rollex 501349), core insert 5x46 001 956 and basic unit 5x46 503 491, pull both inner bearing races off the helical gear.

### 2.6.6.3 Pinion

Using puller 5x46 501 349 (Rollex 501349), core inserts 5x46 001 956 and 5x46 002 161 and basic unit 5x46 503 491, pull both inner bearing races off the pinion.



### 2.6.7 Differential (visual check)

Pull the inner bearing race at the cover end off the differential, using puller 5x46 806 649 (Rollex 806649), core insert 5x46 002 159 and basic unit 5x46 010 011 (Rollex 10001).

Pull off the other inner bearing race with puller 5x46 300 849 (Rollex 300849), core insert 5x46 002 161 and basic unit 5x46 010 011 .



*(only if a torque wrench with yield-limit control is available !!!)*

Clamp fixture 5x46 002 167 into a vice, remove the 12 crownwheel screws and take off the crownwheel, if necessary dislodging it with a plastic drift. Remove the differential from the fixture, turn through 180° and push out the pin.

#### **Important:**

All parts must be installed again exactly as they were installed originally. The bevel gears with shim washers and the planetary gears with thrust washers must not be accidentally confused.

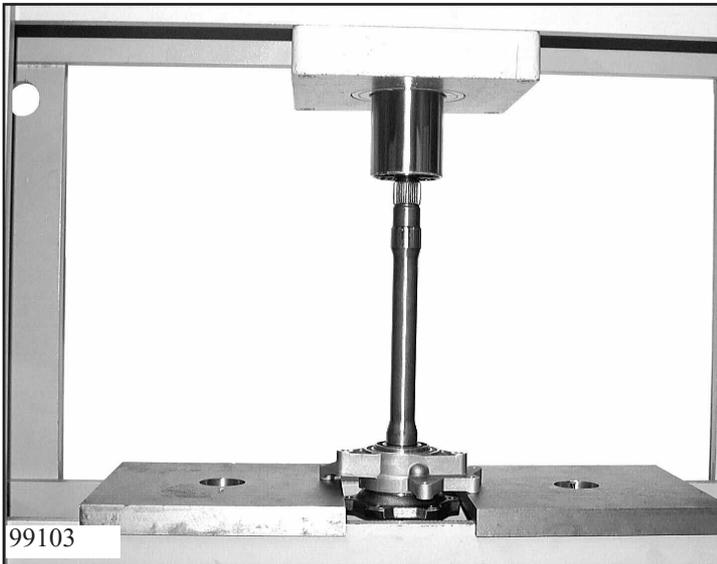




Turn the planet wheels through 90° around the differential shaft and remove them through inspection aperture complete with the thrust washer.  
Take out the upper bevel gear with shim washer.  
Remove the flange retaining washer and the lower bevel gear with shim washer.

99102

### 2.6.8 Flange shaft



Lift the sealing ring away from the flange shaft.  
Using suitable pliers, extract the snap ring from the groove in the flange shaft.  
Separate the flange shaft from the speedometer housing in the hydraulic press.  
Take off the speedometer housing and remove the magnetic ring.

99103



Lever the shaft sealing ring out of the speedometer housing.  
Heat the speedometer housing slightly and remove the ball bearing.

99104



## 2.7 Tower

Take brake D/G and clutch F off the tower.

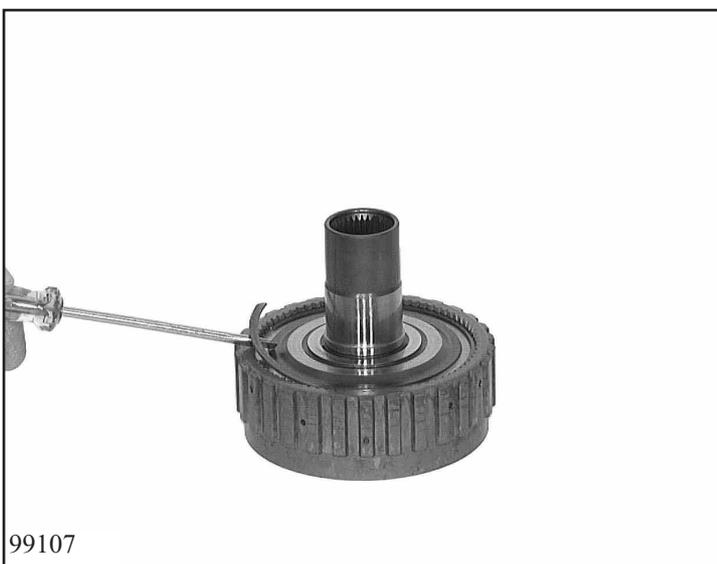


### 2.7.1 Planetary gears

Remove angle washer, needle roller cage and thrust washer from the ring gear. Remove the shaft with the ring gear.



Separate the ring gear from the shaft by removing the snap ring.



Remove the angle washer, needle roller cage and thrust washer from the planetary gear carrier.  
Remove the planetary gear carrier from the fixture.

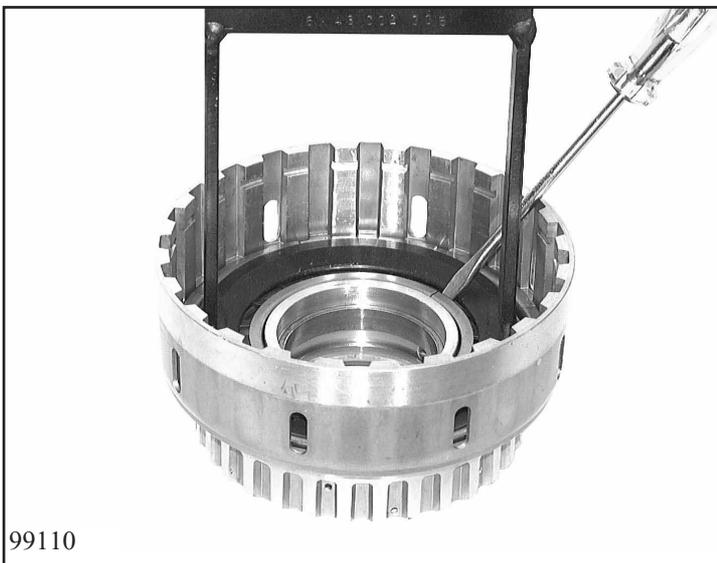


## 2.7.2 Clutch F

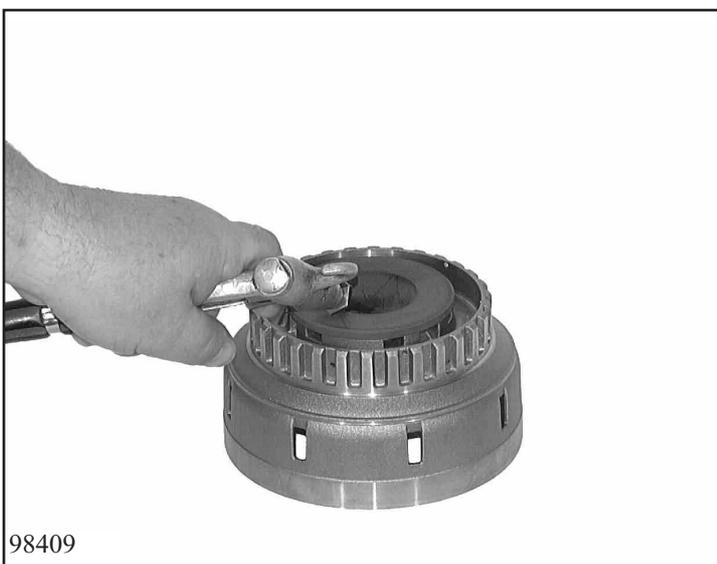
Extract the snap ring from cylinder F and take out the disc set.



Using assembly bracket 5x46 002 005, press the cup spring out under a mandrel press and take out the split retaining ring. Remove the crownwheel and pressure plate.



Block the two bores with the fingers. Press the piston out with compressed air. Pull the 2 O-ring seals off the piston.



### **Important:**

On more recent transmissions with a needle roller bearing, insert fixture 5x46 002 088 into cylinder F and press the piston out with compressed air.

### 2.7.3 Brake D/G with 1st gear freewheel

Engage the three straight pins of counter-holding fixture 5x46 000 577 in the holes on the freewheel carrier.

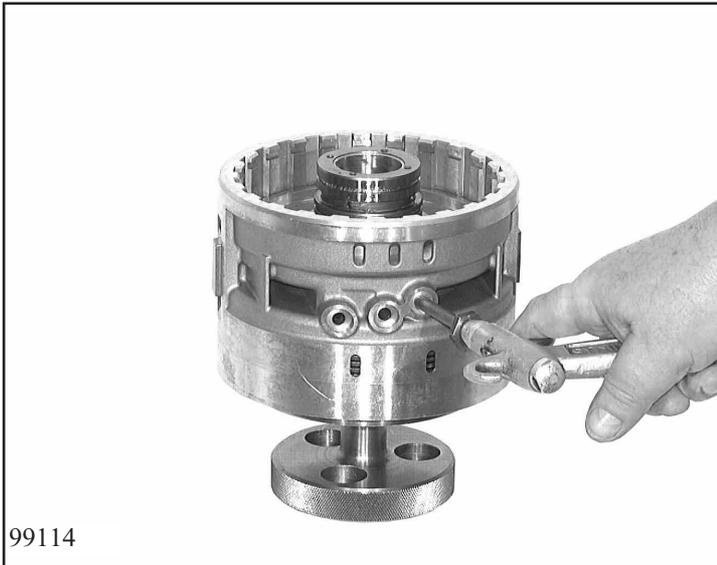


Turn the complete assembly through 180°. Extract the snap ring for brake G. Take off the disc set. Remove the two rectangular-section rings from the carrier.



Using assembly bracket 5x46 000 576, press out the cup spring in a mandrel press. Remove the snap ring with suitable pliers. Remove the assembly bracket. Take out the thrust washer and cup spring.





Press out piston G by applying compressed air to the oil feed bore.  
Pull the two O-ring seals off piston G.

99114



Take cylinder D/G off the carrier and turn through 180°.

99115



Extract the snap ring for brake D.  
Take off the disc set and the cup spring.

99116

Press out piston D by applying compressed air to the feed bore.  
Remove the 2 O-ring seals from the piston.

**Note:**  
If the keys are a firm fit, leave them on the cylinder.



Remove the 2 O-ring seals and the retaining washer from the carrier.  
Turn the carrier through 180°.  
Disengage the three pins of the counter-holding fixture and remove it.



Press the freewheel out of the carrier.



## 2.8 Input

Lift clutch B away from A.  
Remove the thrust bearing.



Using suitable pliers, extract the snap ring from the input shaft.



Press clutch E out of clutch A by applying light pressure to the input shaft.  
Remove the two rectangular-section rings and the O-ring seal from the input shaft.



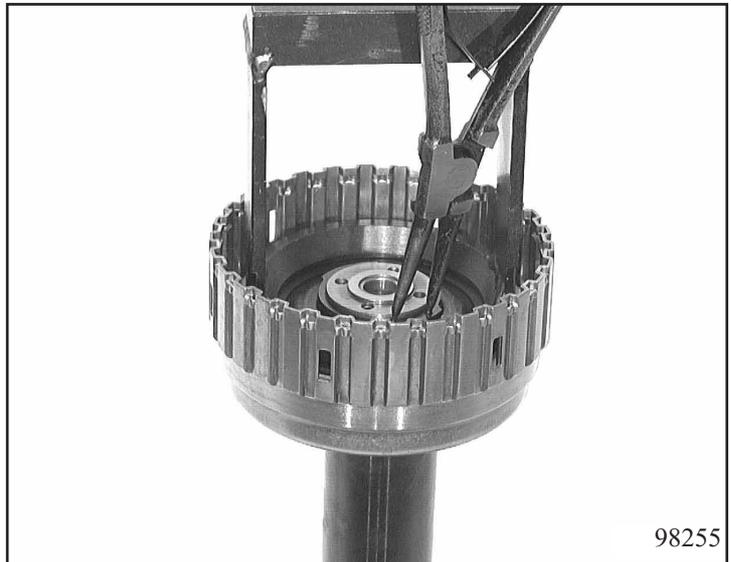
**Note:**  
Cylinder A is splined to the input shaft.

### 2.8.1 Clutch E

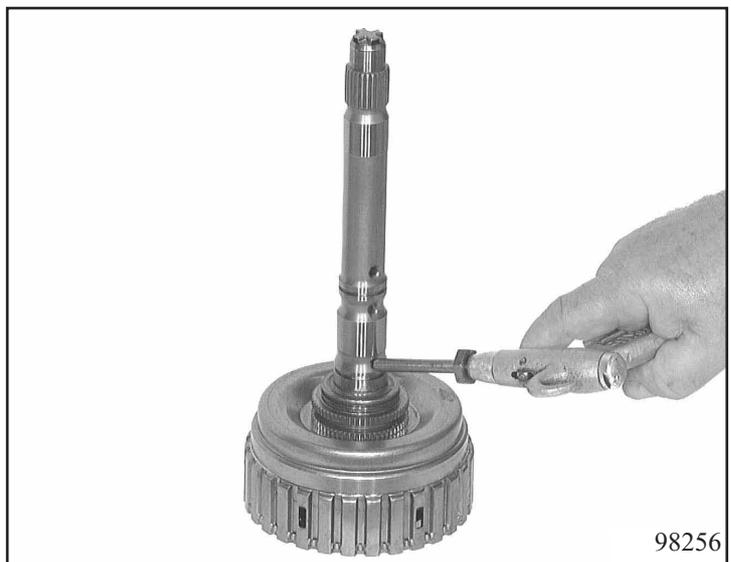
Insert the input shaft into retaining fixture 5x46 002 006.  
Extract the snap ring and remove the disc set.



Using assembly fixture 5x46 030 167, press the cup spring out in a mandrel press and remove the snap ring with suitable pliers.



Apply compressed air to the oil feed bore to press out the piston, cup spring and oil dam.  
Remove the oil dam and cup spring from the piston.  
Pull the O-ring seal off the oil dam and the 2 O-ring seals off the piston.



## 2.8.2 Clutch A

Extract the snap ring.  
Take out the disc set.



Using assembly fixture 5x46 002 004,  
press out the cup spring in a mandrel  
press and remove the split retaining ring  
and cup spring.



Block the 2 bores with the fingers, and  
apply compressed air to the third bore to  
force out the piston.  
Pull the three O-ring seals off piston A.  
Press the ring with O-ring seal out of the  
hub of cylinder A.  
Pull the O-ring seal off the ring.



### 2.8.3 Dismantling clutch B

Extract the snap ring.  
Take out the disc set.



Using assembly bracket 5x46 002 005,  
press the cup spring down and remove  
the split retaining ring.  
Remove the cup spring.



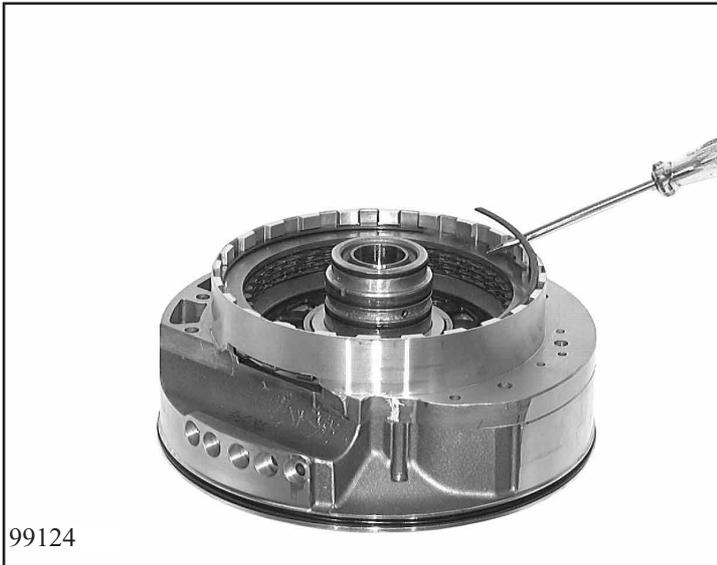
Use compressed air at the oil feed bore to  
force out the piston, holding the other  
bore closed.  
Pull the 2 O-ring seals off the piston.



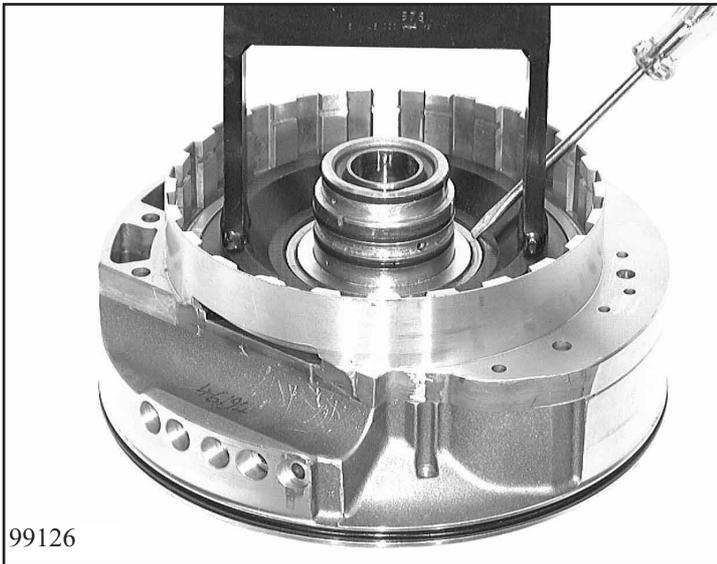
## 2.9 Oil supply with brake C

### 2.9.1 Brake C

Extract the snap ring.  
Take out the disc set.

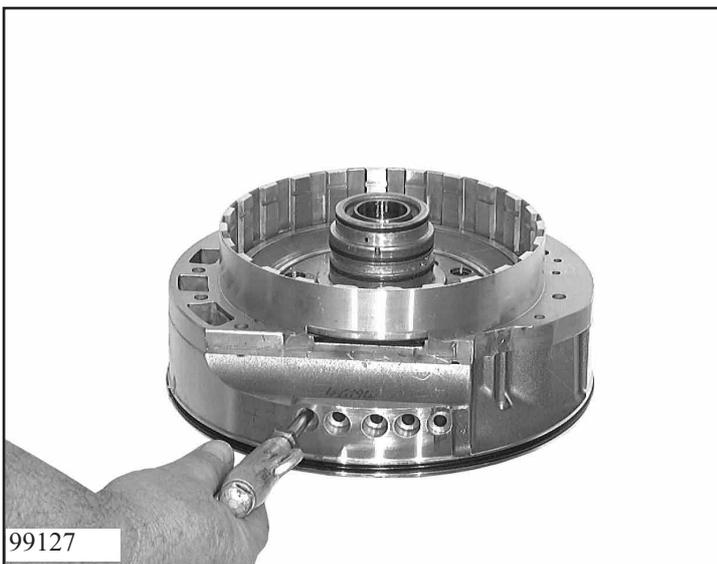


Using assembly bracket 5x46 000 576,  
press the cup spring down and take out  
the split retaining ring and the cup  
spring.



Apply compressed air to the oil feed bore  
to separate the piston from the outer disc  
carrier.

Pull the two O-ring seals off the piston.  
Remove the 3 outer screws from the  
outer disc carrier and lift the carrier away  
from the oil supply.



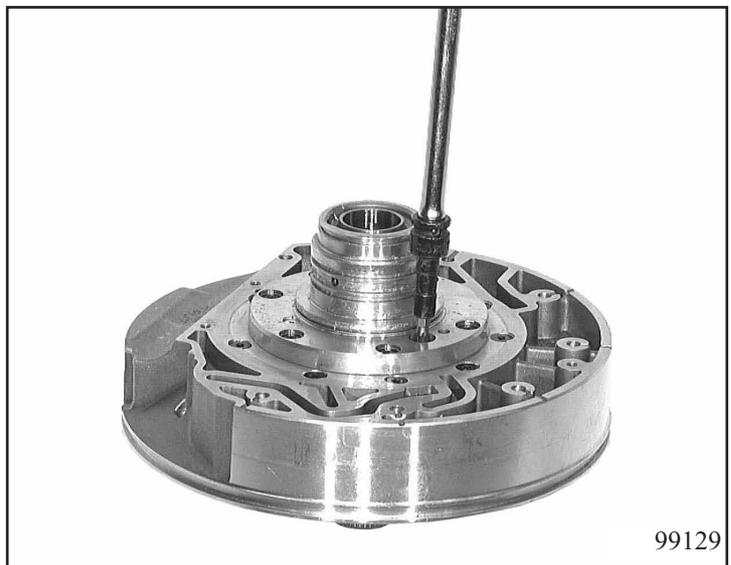
Pull O-ring seal off intermediate plate and 3 rectangular-section rings off the stator hub.



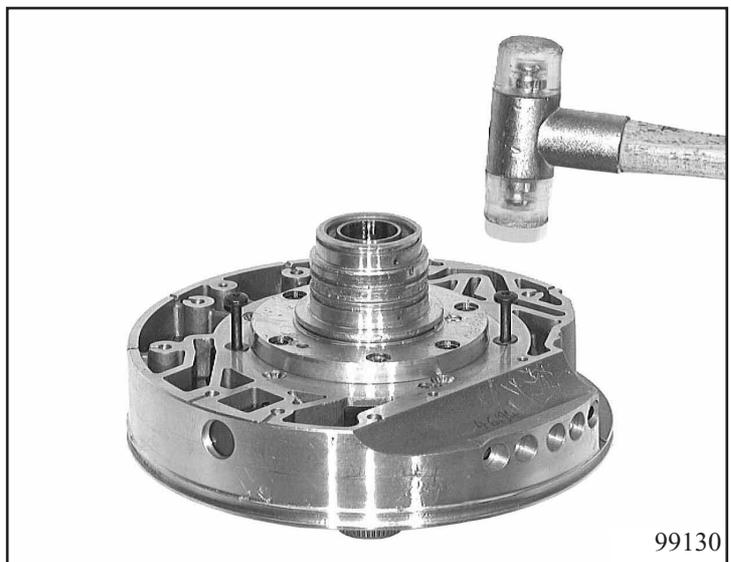
### 2.9.2 Pump

Take out the 8 countersunk screws at the outer circle of holes and the machine screw and the countersunk screw opposite it from the inner circle of holes.

(Wrench size = Torx TX 27)



Insert two long-stem screws into opposed holes in the outer circle and strike the screw heads lightly to force out the pump.





Remove the centring sleeve, intermediate plate, pump wheel and pump ring gear.



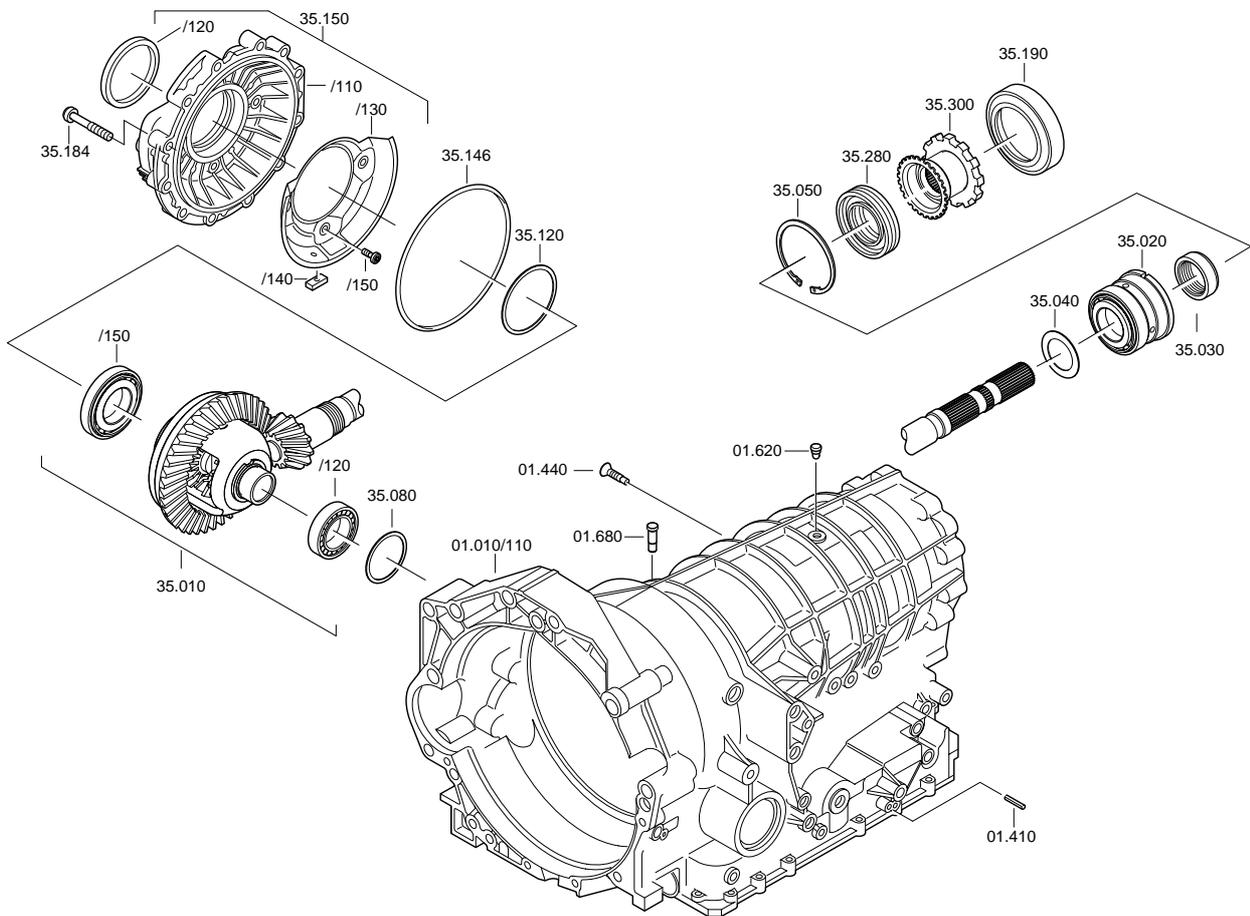
Lever out the shaft sealing ring with a suitable screwdriver and take off the washer.  
Pull the O-ring seal off the pump housing.



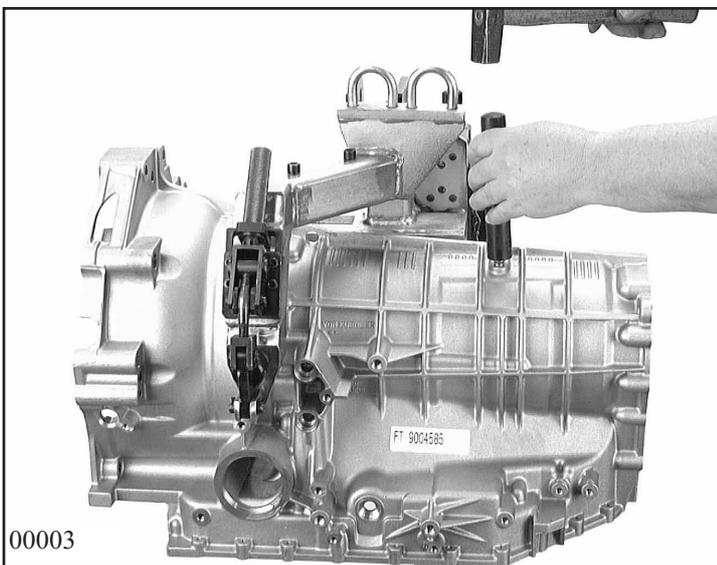
**Important:**  
Only if the intermediate plate is damaged: take out the 5 stator shaft screws and force the shaft out of the intermediate plate in a suitable mandrel press.



### 3. Installation



*(with new transmission housing only)*



Drive the following into transmission housing 10.010/110: breather 01.620 using drift 5x46 002 223, differential breather 01.680 using drift 5x46 001 468 and position switch pin 01.410 using drift 5x46 002 222.

00003

## Adjustment overview

### Note:

During transmission assembly work the bevel drive (pinion shaft, crownwheel and differential) does not have to be re-adjusted unless components that directly affect its settings were renewed .

To avoid unnecessary adjustment work, note the following table:

### Components renewed:

Transmission housing	: A+B+C
Differential cover	: A+ C
Pinion shaft taper roller bearing	: B+C
Differential taper roller bearing	: A+ C
Pinion shaft bevel gear set + crownwheel	: A+B+C

### Components to be adjusted:

A	⇔ Differential $S_{ges}$ ( $= S_1 + S_2$ )
B	⇔ Pinion shaft $S_3$
C	⇔ Backlash 0.27 – 0.37mm

### 3.1 Installing pinion shaft and differential

#### 3.1.1 Adding parts to differential



Install the lower bevel gear with flange retaining and shim washers and the upper bevel gear with shim washer into the differential cage, working through the inspection aperture.

Raise the upper bevel gear and insert the planetary gears with thrust washer through the inspection aperture.

Turn the planetary gears through 90° round the differential axis and locate in position with the pin.

**Important:**

The bevel and planetary gears must be paired with their shim washers and installed exactly as they were previously removed.



Clamp fixture 5x46 002 167 in the vice, insert differential into fixture and secure crown wheel 09.110 with 12 screws 09.120 to differential cage 09.070, using Quantec EMS ISI No. 7086 yield-limit controlled wrench.

**Important:**

Note screw connection specification, Chapter 1.3

(Wrench operation is explained during training.)



Install inner bearing races 35.010/150, 35.010/120 with sleeves 5x46 002 220/221 on the differential in the mandrel press.

### 3.1.2 Front axle housing and front axle gears

Press inner bearing races 37.130/120 + 37.130/130 on to intermediate gear with drift 5x46 002 219, inner bearing races 37.080/120 + 37.080/130 on to pinion and inner bearing races 37.150/120 + 37.150/130 on to helical gear with drift 5x46 002 218.



Heat the front axle housing strongly at the bearing seats with a hot-air blower and insert the outer bearing races for the intermediate and helical gears and the pinion.



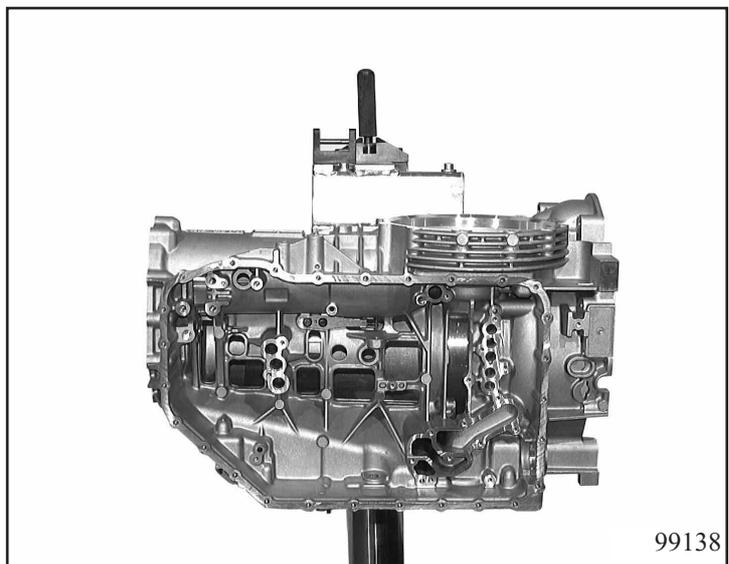
### 3.1.3 Pinion shaft

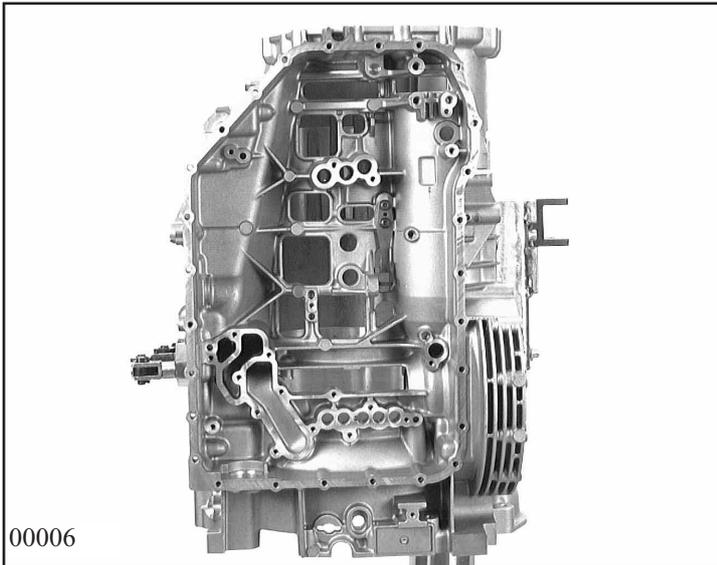
Clamp the transmission housing in holder 5x46 002 165 and suspend from or attach to assembly trolley or workbench mounting with the differential opening upwards.

To do this, screw the eye with M8 thread into the tapped hole in the housing. Use a crane to suspend the holder in the assembly trolley or workbench mounting and secure or fasten it there.

#### **Important:**

For adjusting work, see Chapter 1.4.2





Turn the housing through 90° with the converter bell downwards.

**Important:**

For adjusting work, see Chapter 1.4.6



Place shim washer 35.040 on pinion shaft 35.010/130.

Install inner bearing race 35.020 on the pinion shaft in the mandrel press, using drift 5x46 002 217. Install the bearing spacing washer and outer bearing race. Install the other inner bearing race in the mandrel press, using drift 5x46 002 217.

**Important:**

For adjusting work, see Chapter 1.4.3.1 + 1.4.3.2



Screw locknut 35.030 with fixture 5x46 002 174 on to the pinion shaft and caulk into position.

To do this, clamp retaining fixture 5x46 042 174 horizontally into the vice.

Place wrench 5x46 012 174 on the pinion shaft locknut.

Also pass insertion tool 5x66 000 030 (wrench connected to torque wrench) over the pinion shaft, then push the pinion shaft into the splines of the retaining fixture and tighten the locknut.

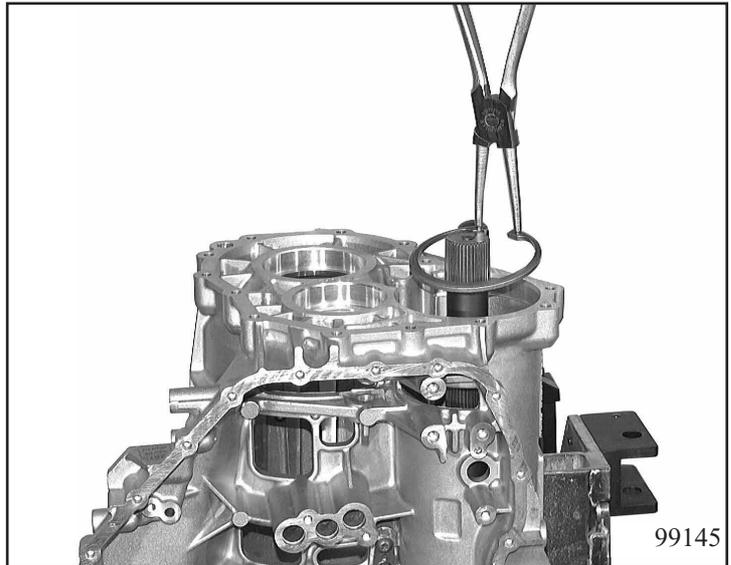
(Tightening torques: see Chapter 1.5)

### 3.1.4 Installing pinion shaft in transmission housing

Heat the transmission housing strongly at the pinion shaft bearing seat with a hot-air blower. Insert the complete pinion shaft into the transmission housing so that the groove in the outer bearing race is precisely aligned with the tapped hole in the transmission housing.

Insert a new countersunk screw 01.440 into the transmission housing. Secure with snap ring 35.050 (tapered face upwards).

(Tightening torques: see Chapter 1.5)



Pinion moment max. 2.5 mm, bearing oiled. Check without differential and shaft sealing ring.

Place adapter 5x66 000 027 on pinion shaft drive splines.

Use connector 52 205 300 to link adapter with torsionmeter 52 205 250.

Turn the torsionmeter uniformly and read off the scale value.

#### **Important:**

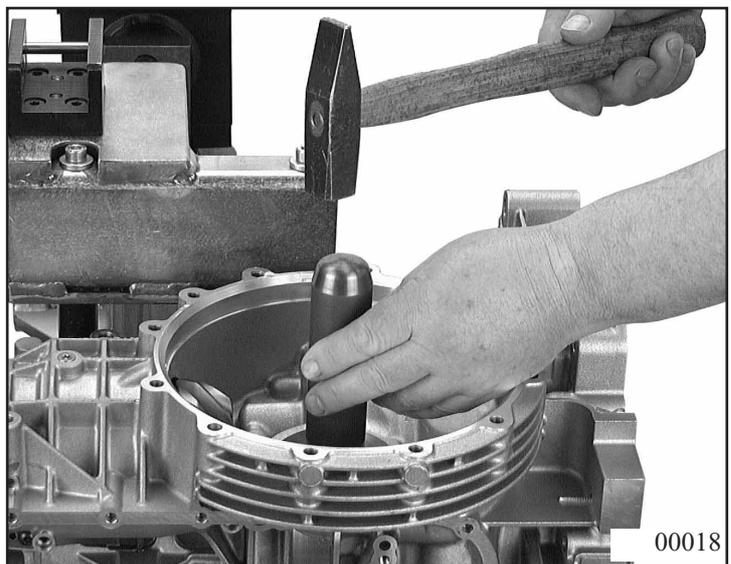
The housing must first have cooled down to room temperature.

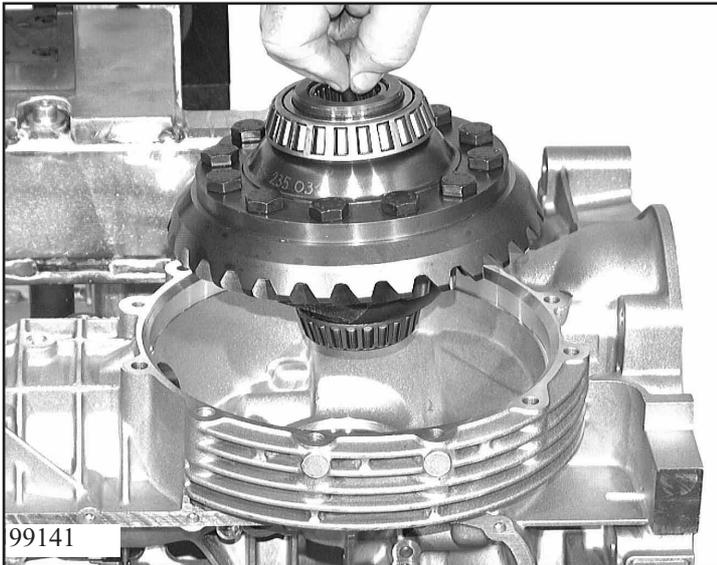


### 3.1.5 Installing differential in transmission housing

Turn the housing through 90° with the differential opening facing down.

Insert shaft sealing ring 35.070 into the transmission housing, using driving-in tool 5x46 002 246.

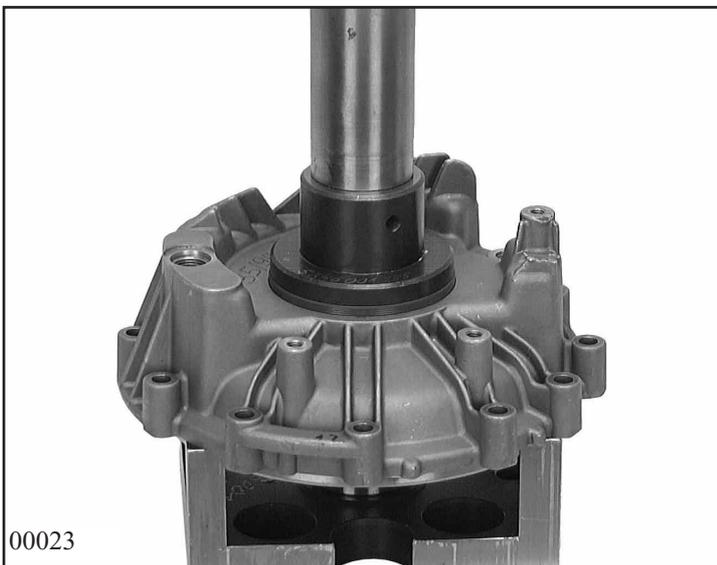




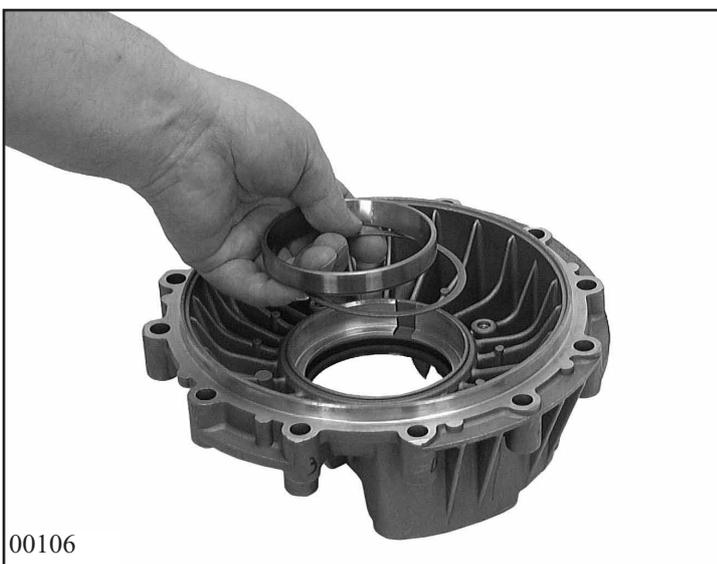
Install the correct washer 35.080 with the outer bearing race in the transmission housing.  
Insert the complete differential.

**Important:**

For adjusting work, see Chapter 1.4.3.3



Place differential cover 35.150/110 on guide plate 5x46 001 255 and press shaft sealing ring 35.150/120 into the cover in the mandrel press, using drift 5x46 001 255.



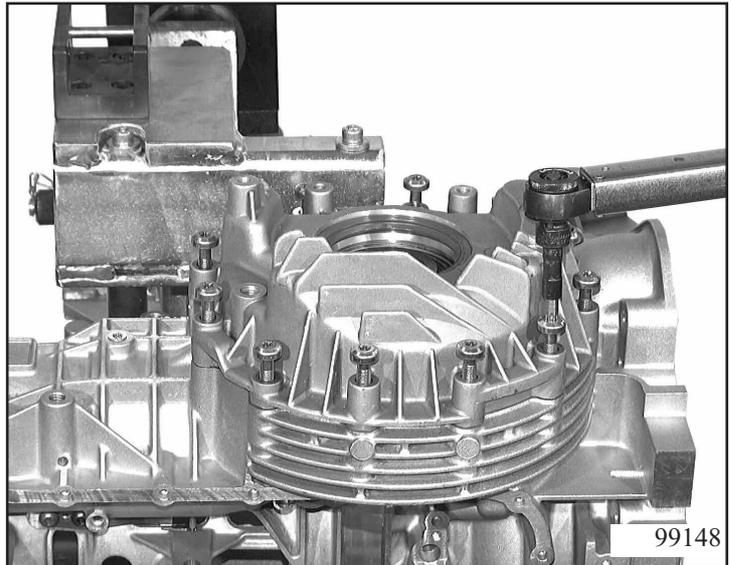
Install the correct washer 35.120 with the outer bearing race in the differential cover.  
Pull O-ring 35.146 on to differential cover.

Attach magnet 35.150/140 to oil dam 35.150/130.  
Secure the oil dam to the differential cover with 3 screws 35.150/150.  
Secure the differential cover with 12 screws 35.184.

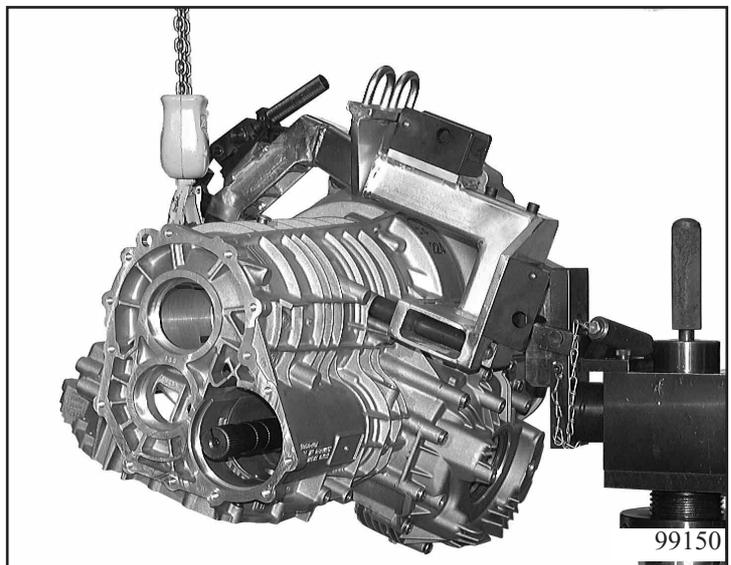
(Tightening torques: see Chapter 1.5)

**Note:**

For screw connection specifications, see Chapter 1.3.1.1

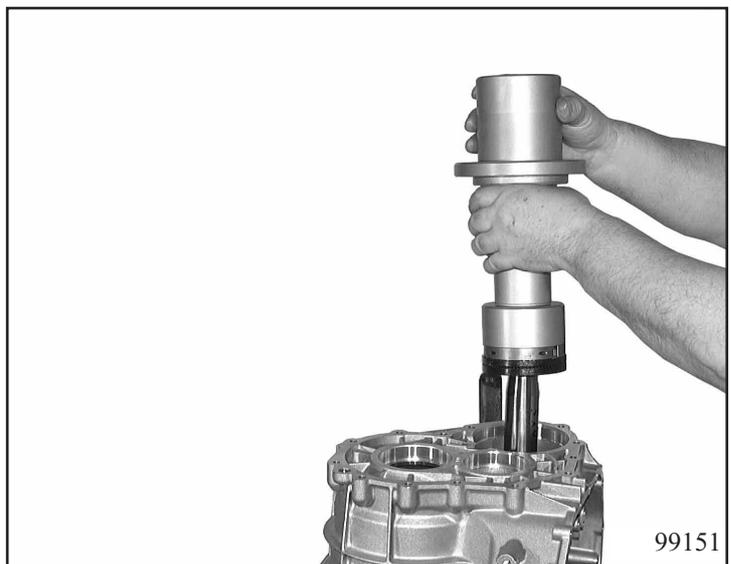


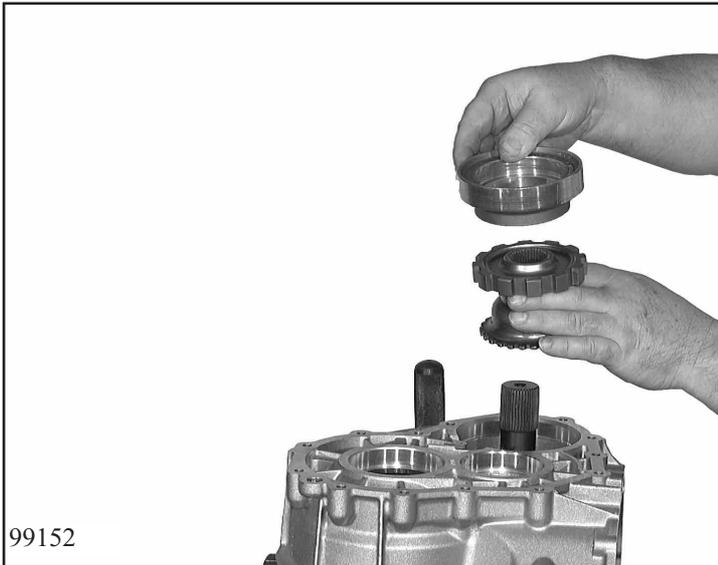
Change the suspended position of the transmission housing by connecting the crane hook to the 5 HP 19 FL eye on the assembly bracket.  
Apply slight tension at the crane and pull the safety locking pin out of the assembly trolley and assembly bracket.  
Raise the transmission with the crane, turn it through 90° round its longitudinal axis, replace it in the assembly bracket and secure with the pin.  
Detach the crane hook from the eye.



**3.1.6 Installing pinion-shaft sealing ring, parking lock gearwheel and bearing race**

Next, turn the transmission through 90° so that the converter bell faces down.  
Place guide sleeve 5x46 001 266 over the pinion shaft. Place shaft sealing ring 35.280 on the pressing-in fixture and drive it fully into the transmission housing over the pinion shaft.





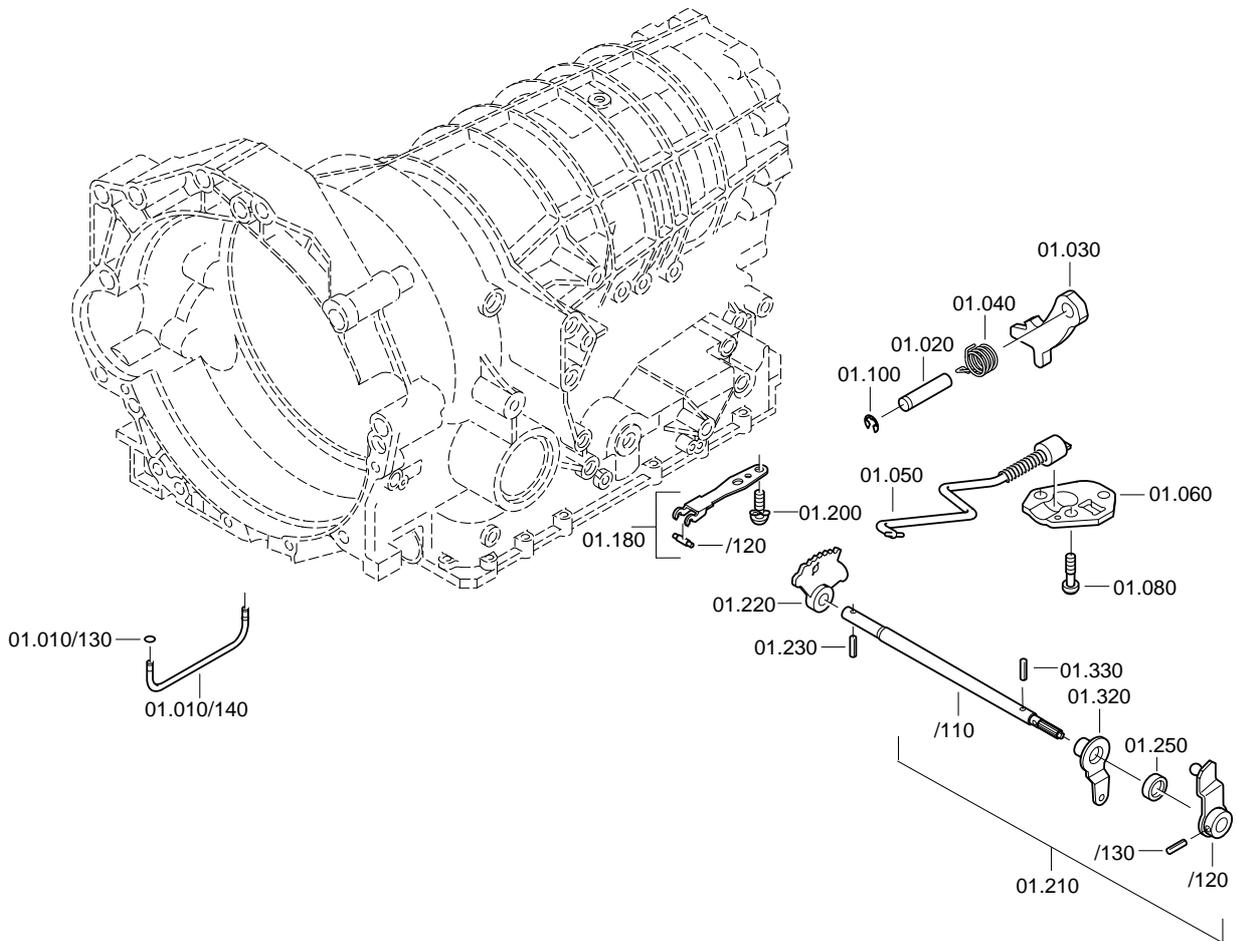
Install parking lock gearwheel 35.300.  
Drive in bearing race 35.190 with a suitable drift.

**Note:**

To prevent the bearing race and parking lock gearwheel from falling out, insert an M8 x 20 screw with washer (external diameter at least 25 mm) into a tapped hole next to the bearing race.



### 3.2 Installing shift and parking lock mechanism

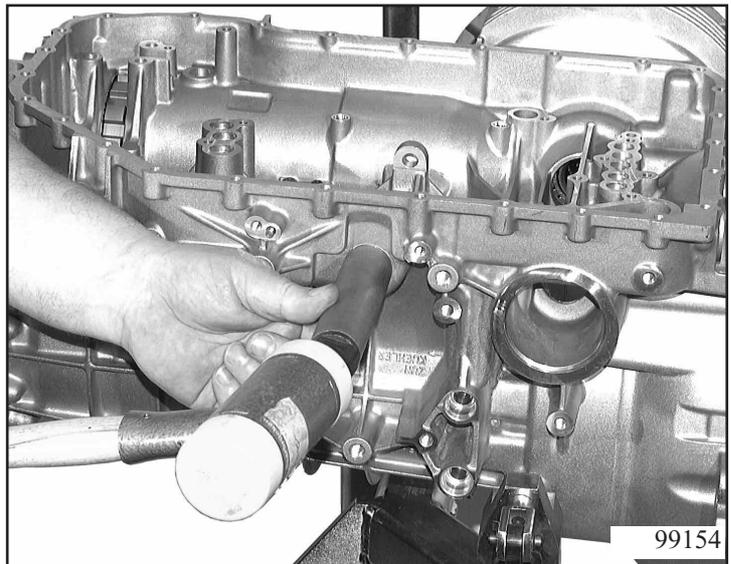


Drive clamping sleeve 01.210/130 through selector lever 01.210/120 into selector shaft 01.210/110 in such a way that the ball pin of the selector lever faces the rear at the flat on the selector shaft (see picture).

**Warning:**  
Risk of incorrect assembly.

00024

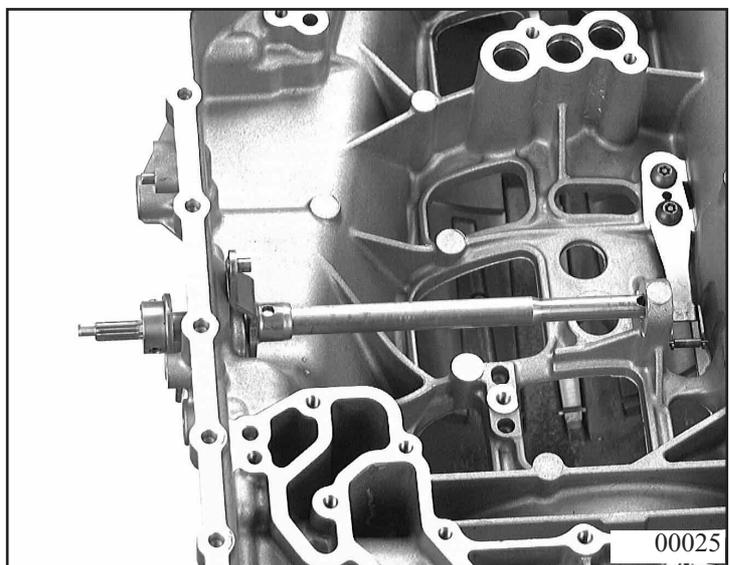
Drive selector shaft sealing ring 01.250 into the transmission housing with drift 5x46 001 134.



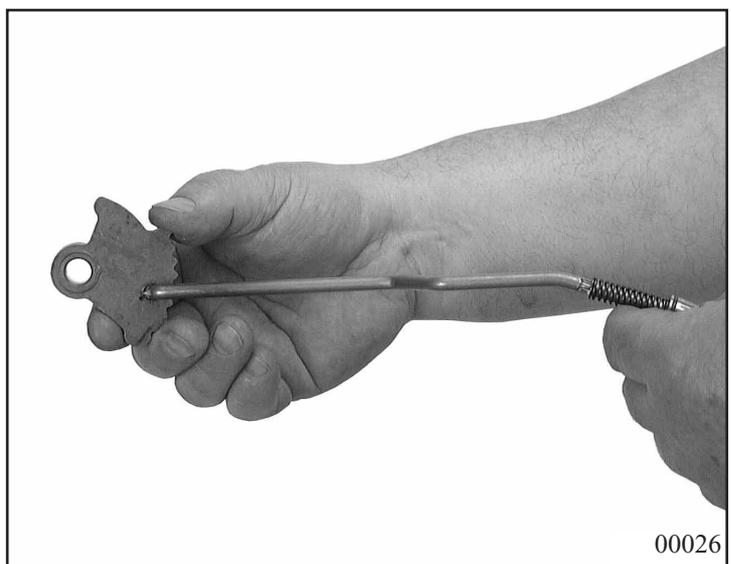
**Important:**

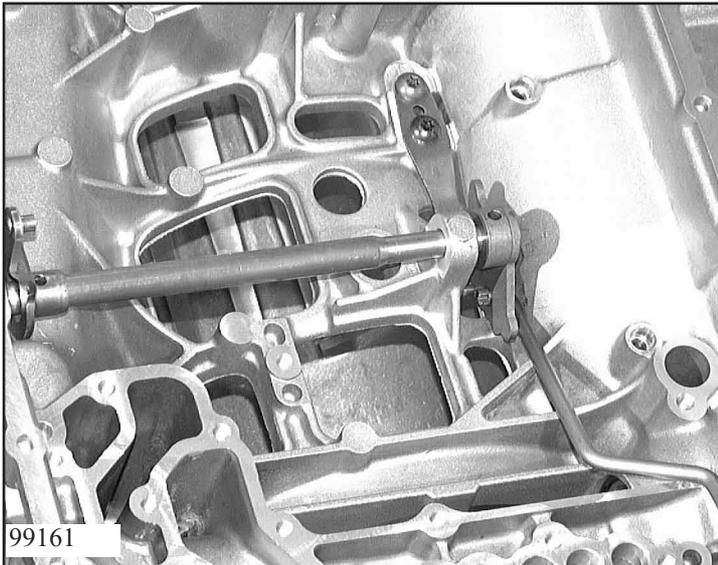
Only if the detent spring or transmission housing was defective: attach detent spring 01.180 loosely with two screws 01.200.

Insert the selector shaft into the transmission housing so that the selector lever is facing away from the oil pan. Push selector lever 01.320 over the selector shaft so that the drive pin for the shift valve faces the valve body. Insert the selector shaft in the guide in the transmission housing.



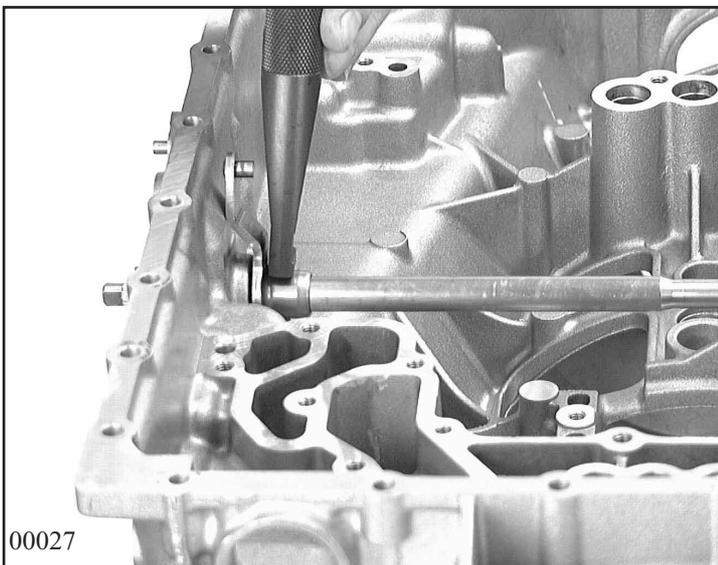
Attach connecting rod 01.050 to detent disc 01.220 and turn it so that it is secured.





Push the detent disc with the connecting rod over the selector shaft. Press the detent spring down and move the detent disc to the correct position.

99161



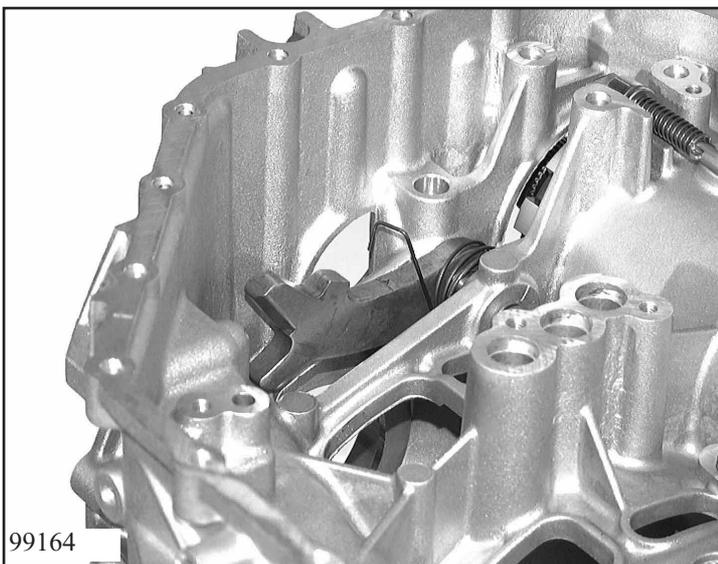
Using drift 5x46 002 033, drive clamping sleeve 01.230 through the detent disc and clamping sleeve 01.330 through the selector lever into the selector shaft.

00027

**Important:**

If transmission housing, detent disc or selector shaft has been renewed or the detent spring detached, the detent spring must be re-adjusted.

Adjusting work: see Chapter 1.4.4



Insert pawl 01.030 with torsion spring 01.040 into the transmission housing and locate with the ring groove towards the converter bell by pressing in pin 01.020. After this, secure the pin with circlip 01.100.

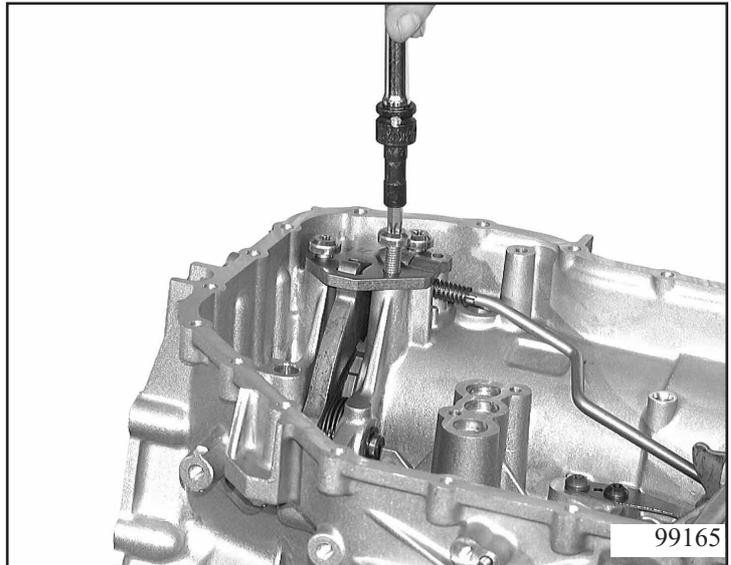
99164

Press the pawl down and attach guide plate 01.060 by means of the 3 machine screws 01.080 .

(Tightening torques: see Chapter 1.5)

**Important:**

On transmissions with serial number < 22216 (FL) or < 7749 (FLA), a new guide plate must be installed (the geometry has been modified). The shim washer has been deleted.



Up to transmission number 22216(FL) or 7749 (FLA) the parking lock has to be adjusted. A washer is normally installed between the pawl and the housing up to these serial numbers. The new guide plate on higher-numbered transmissions avoids the need for this adjustment. (old: 1060 324 039 / new: 1060 324 007)

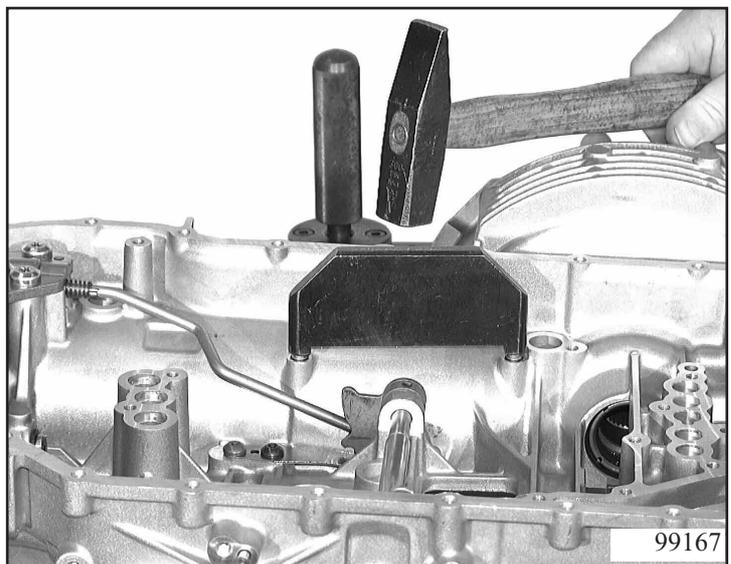
**Recommendation** (to avoid adjustment)

Old transmission housing, old guide plate  
⇒ install the washer again.

Old transmission housing, new guide plate ⇒ washer deleted.

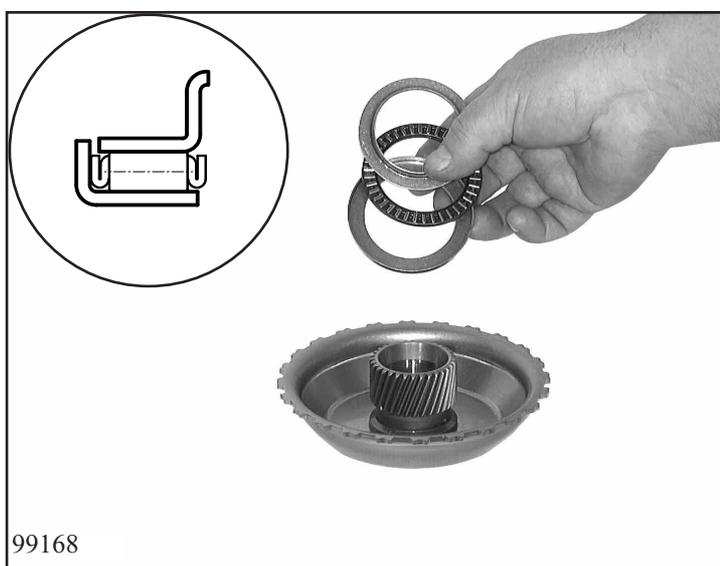
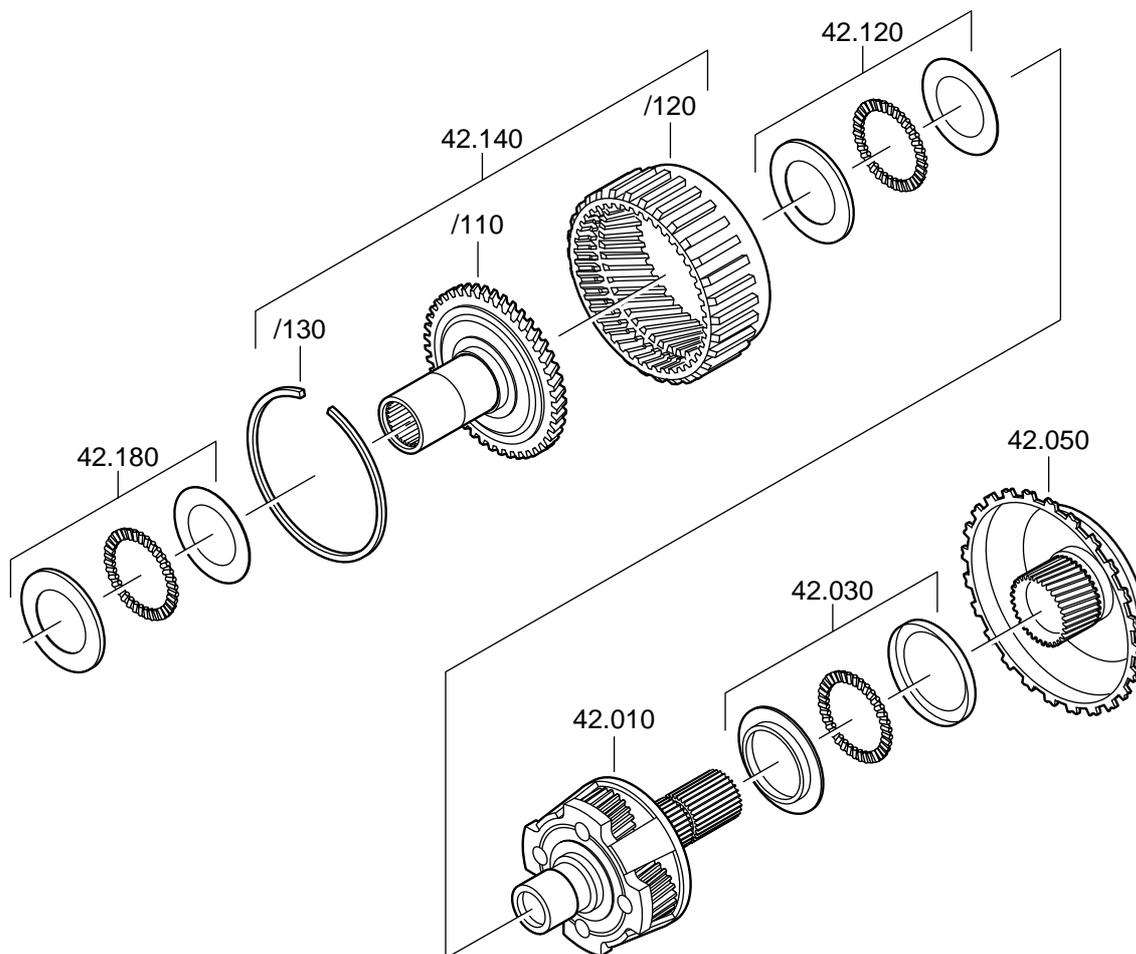
New transmission housing, new guide plate ⇒ washer deleted.

Pull two new O-rings 01.010/130 on to new oil pipe 01.010/140 and press the oil pipe in with driving-in tool 5x46 001 290.



### 3.3 Tower, installing tower

#### 3.3.1 Planetary gear set III



Install angle washer 42.030/110, needle roller thrust bearing 42.030/120 and angle washer 42.030/130 over sun wheel hub 42.050.

**Installed position (see picture)**

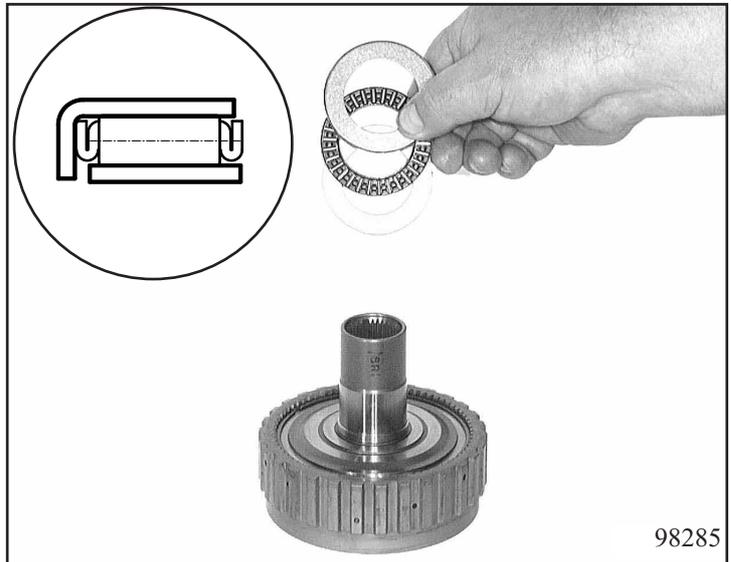
Install planet wheel carrier 42.010.  
Place the complete unit on mounting  
fixture 5x46 002 006.



Insert ring gear carrier 42.140/110 in ring  
gear 42.140/120 and retain with snap ring  
42.140/130.

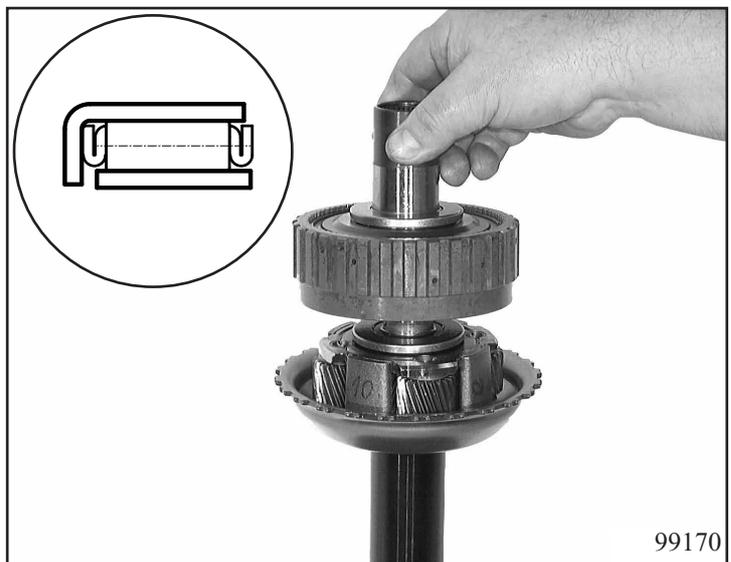
Place thrust washer 42.180/110, needle  
roller thrust bearing 42.180/120 and  
angle washer 42.180/130 on the ring gear  
unit.

**Installed position (see picture)**

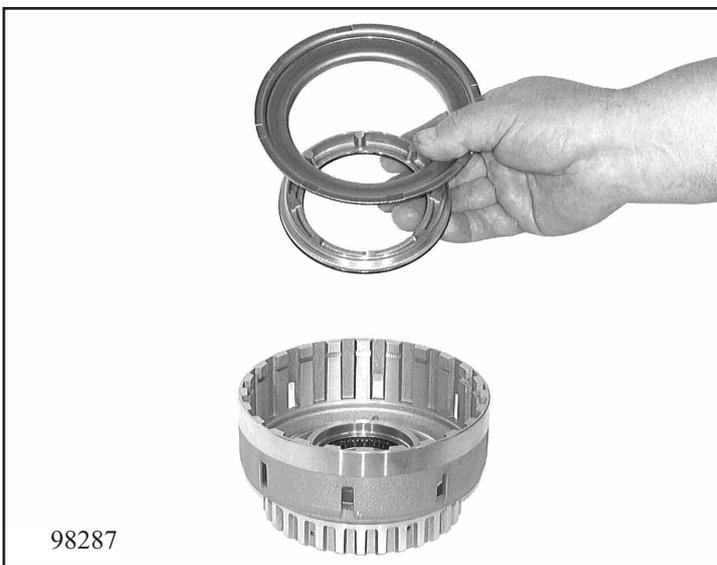
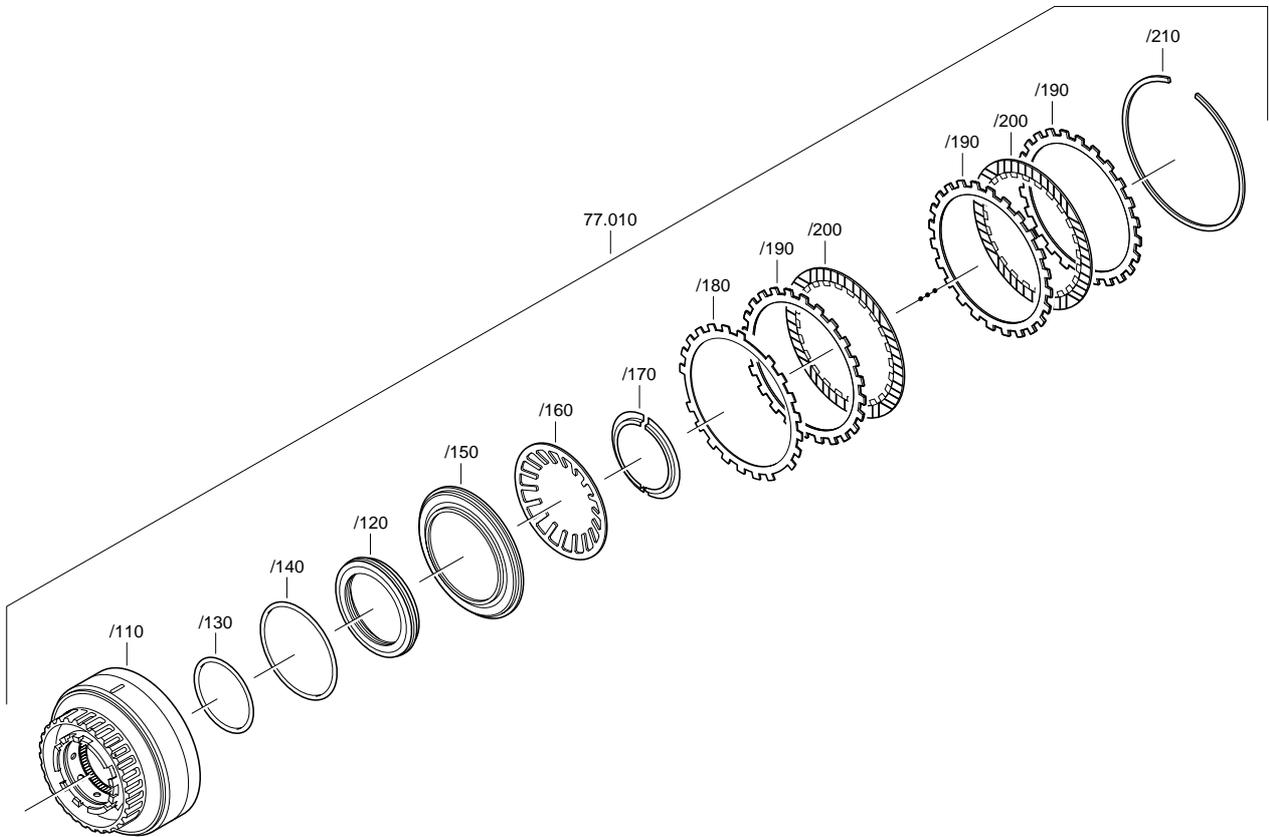


Place thrust washer 42.120/110, needle  
roller thrust bearing 42.120/120 and  
angle washer 42.120/130 on the planet  
wheel carrier and install the complete  
ring gear unit.

**Installed position (see picture)**



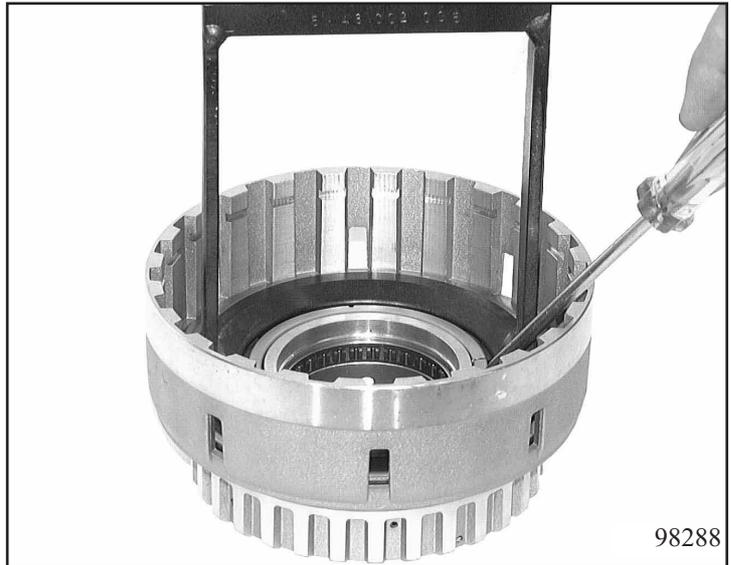
### 3.3.2 Clutch F



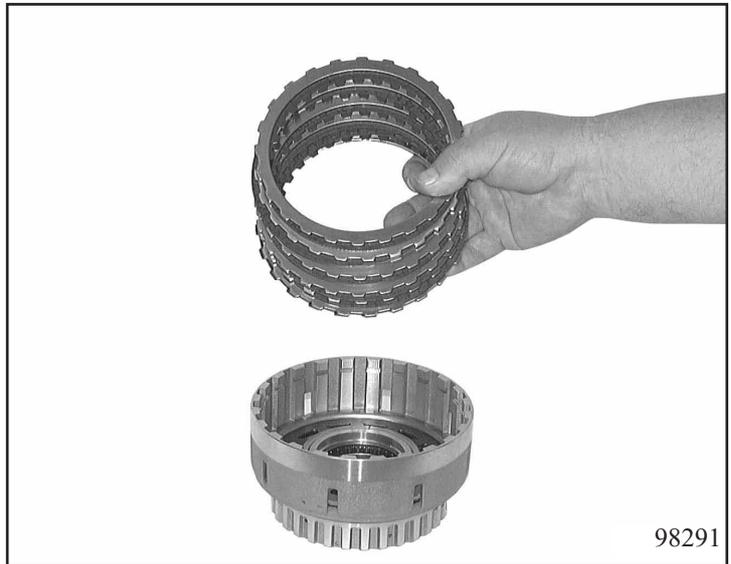
Pull two new O-rings 77.010/130 and 77.010/140 on to piston 77.010/120 and press into cylinder F 77.010/110. Place pressure plate 77.010/150 on the piston.

98287

Install cup spring 77.010/160 press it down under the mandrel press with assembly bracket 5x46 002 005 and install split retaining ring 77.010/170.



Install the complete disc set, starting with spring disc 77.010/180. Follow this with steel plates 77.010/190 and lined plates 77.010/200 alternately. Secure the uppermost steel plate with snap ring 77.010/210.



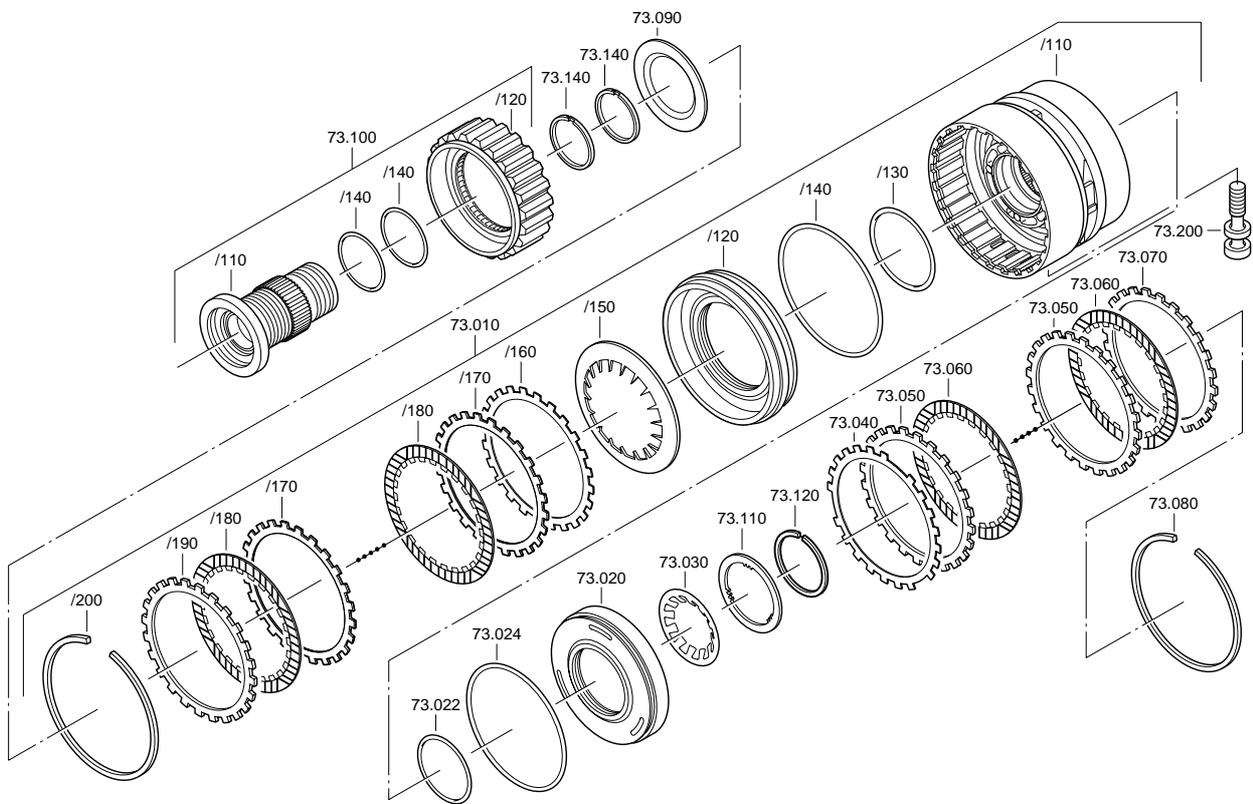
**Note:**  
Adjusting work: see Chapter 1.4.1.1

Place clutch F on the planetary gear set, turning it in either direction until the splines and cutouts on the ring gear and the lined discs are fully engaged.

**Note:**  
Check through the cutouts in the cylinder. The final disc must not be pressed upwards by the lined plates. The gap must be wider at the top than at the bottom.



### 3.3.3 Brake DG with 1st gear freewheel



First determine the air gap at brakes DG. To do this, fit two O-rings 73.010/130/140 to piston D 73.010/120. Install two O-rings 73.022, 73.024 on piston G 73.020. Install both pistons in cylinder DG 73.010/110.

**Important:**

Adjusting work: see Chapters 1.4.1.2, 1.4.1.3.  
The pistons must make full contact in order to avoid incorrect measurements. If necessary press them in fully with a suitable drift.

99172

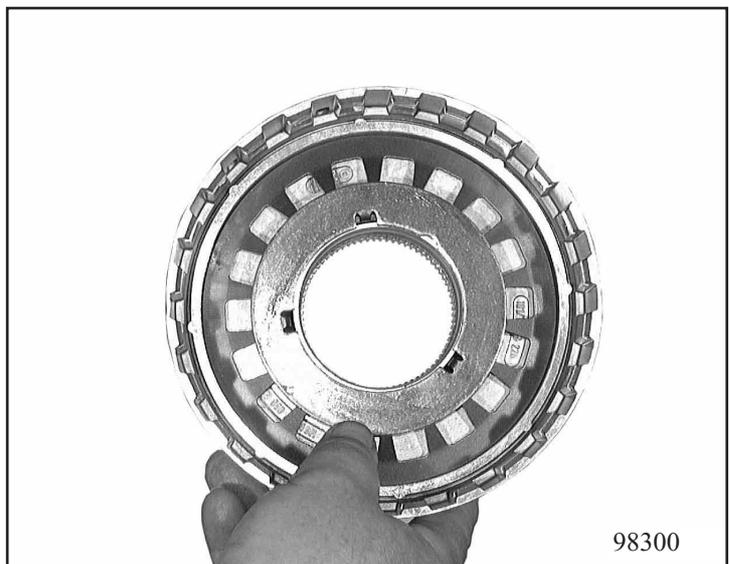
Press carrier (freewheel - inner ring) 73.100/110 into freewheel 73.100/120. To do this, hold the freewheel to prevent it from turning, and turn the carrier clockwise.



Place the complete unit on counter-holding fixture 5x46 000 577 turn until the 3 pins on the fixture engage in the freewheel. Pull on the 2 O-rings 73.100/140.



Insert cup spring 73.010/150 and retaining washer 73.090 into cylinder DG.





99173

Place cylinder DG on a suitable surface and press the complete carrier fully into the cylinder.  
Turn the unit round by 180°.

**Warning:**  
Do not let the components fall apart.



99174

Insert cup spring 73.030 at the G side of cylinder DG.  
Attach thrust washer 73.110.



99176

Place snap ring 73.120 on the taper of assembly fixture 5x46 000 576 and press down slightly with the pressure block. Place the taper on the hub, push the pressure block over it and insert the bracket of the fixture into the cylinder.

**Important:**  
The teeth on the thrust washer must engage in the splines on the carrier.

Install two rectangular-section rings 73.140 on the carrier.  
 Insert disc set G, starting with spring disc 73.040 and continuing alternately with steel discs 73.050 and lined discs 73.060. Insert end disc 73.070 and secure it with snap ring 73.080 .



99177

Turn the complete unit round and remove the counter-holding fixture.  
 Insert disc set D, starting with spring disc 73.010/160 and continuing alternately with steel discs 73.010/170 and lined discs 73.010/180. Insert end disc 73.010/190 and secure with snap ring 73.010/200.



99178

**Important:**  
 If keys 73.012/210 were taken off when dismantling, install them again.

Mount brake DG with first-gear flywheel on clutch F and move in both directions until the teeth and cutouts of the lined plates engage fully with the inner disc carrier.  
 Insert lifting fixture 5x46 000 545 into the planet wheel carrier of the complete planetary gear set (tower). Press down the centre lever.



99179

**Note:**  
 This is not possible if brake DG has been mounted incorrectly on clutch F.

### 3.3.4 Installing the tower

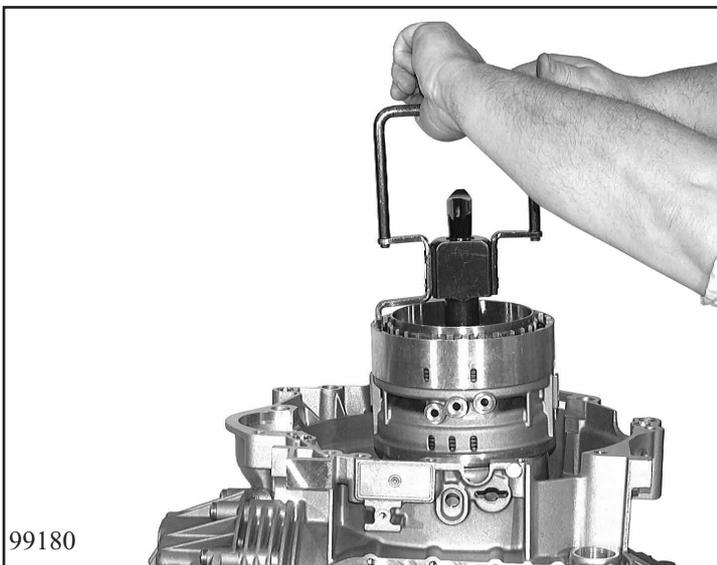
Using a hoist, lift the tower out of the mounting fixture. Support it with the other hand under the sun gear to prevent this from falling out.

Clamp assembly sleeve 5x46 002 164 on the shaft so that the sun wheel cannot fall out.

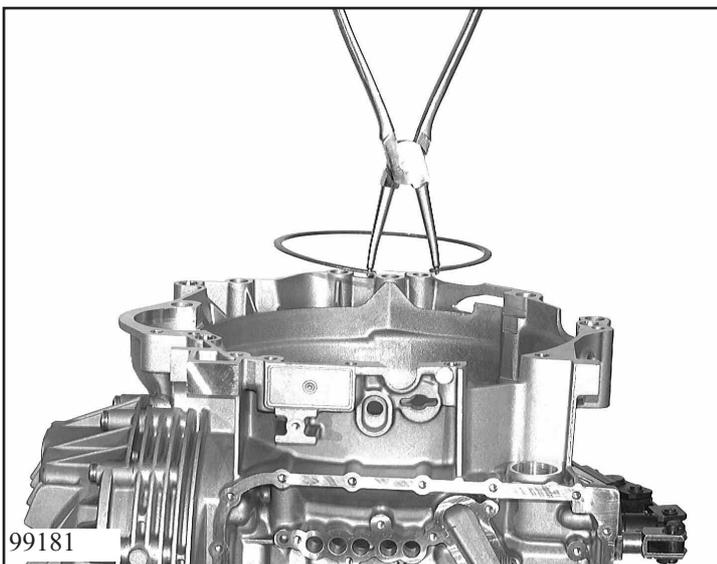


Turn the transmission housing through 90°.

Insert the tower in the transmission housing, aligning the feed bores of the cylinders (D/G/F) with those in the transmission housing.

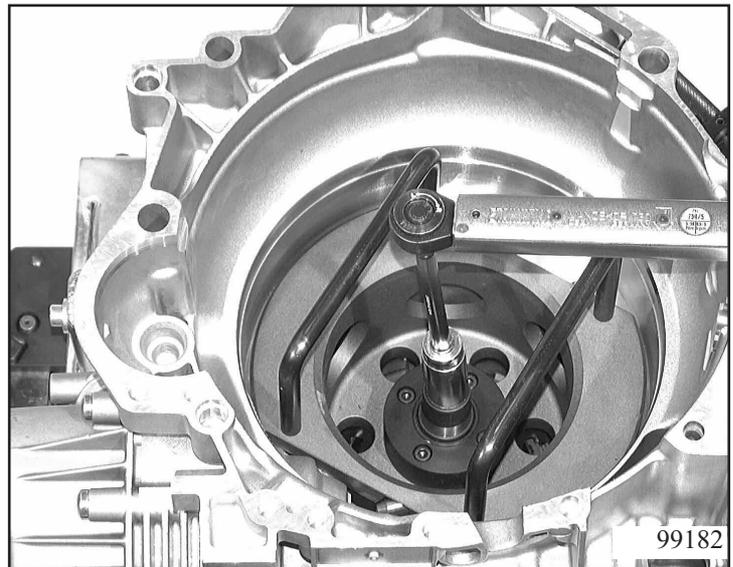


Remove the lifting device and insert snap ring 73.210 into the groove in the transmission housing, using pliers 5x46 001 376.

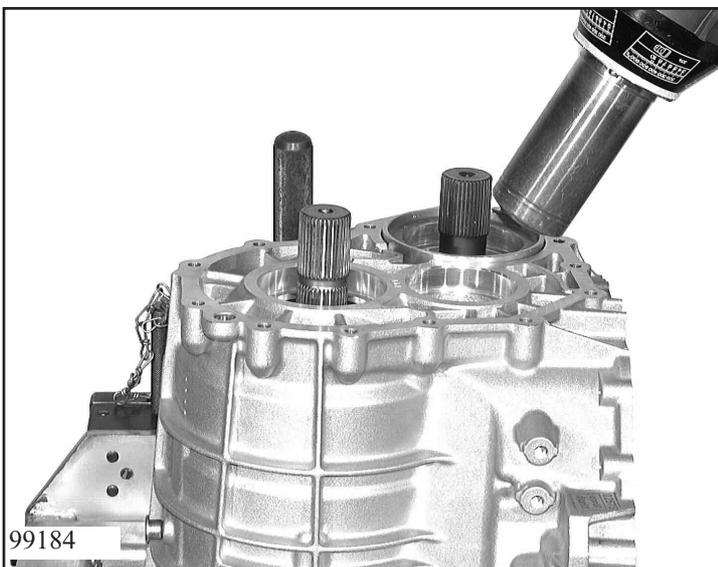
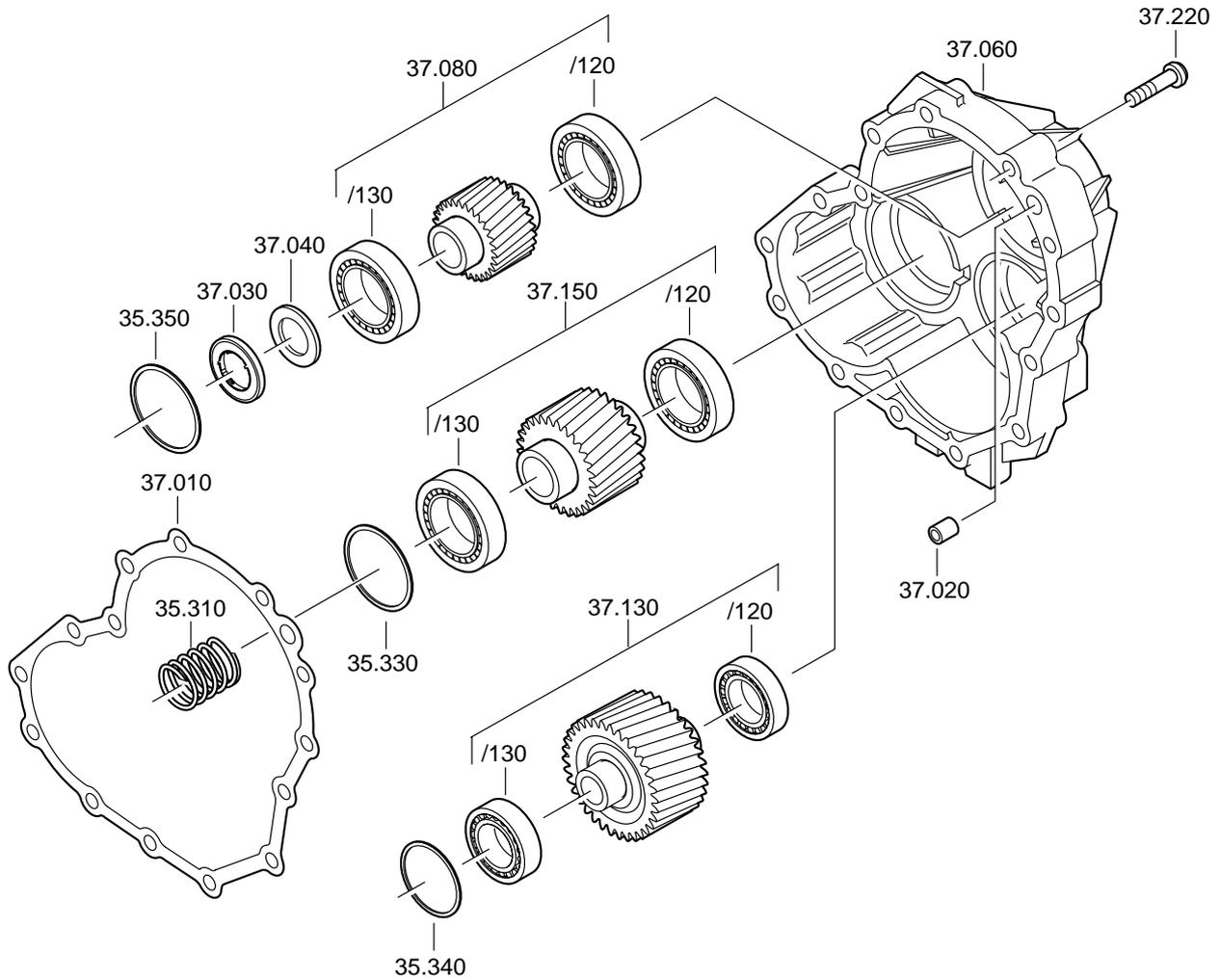


Using fixture 5x46 001 284, press the snap ring fully into the groove in the housing.  
Turn the transmission through 180° and take off the sun gear retaining fixture.

(Fixture tightening torque 22 Nm.)



### 3.4 Installing front axle output



Heat the bearing seats for the pinion and the helical and intermediate gears in the transmission housing thoroughly with the hot-air blower.

Insert the shim washers as follows into the bearing seats: pinion 35.330, helical gear 35.350 and intermediate gear 35.340.

Insert the outer bearing races into the bearing seats: pinion 37.080/130, helical gear 37.150/130, intermediate gear 37.130/130.

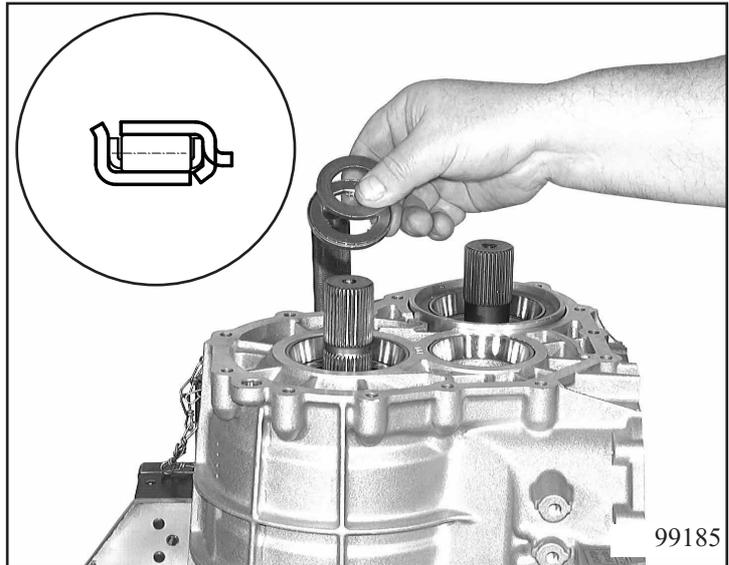
**Important:**

Adjusting work: see Chapters 1.4.5

Insert thrust bearing 37.030 and shim washer 37.040 over the output shaft.

**Installed position (see picture)**

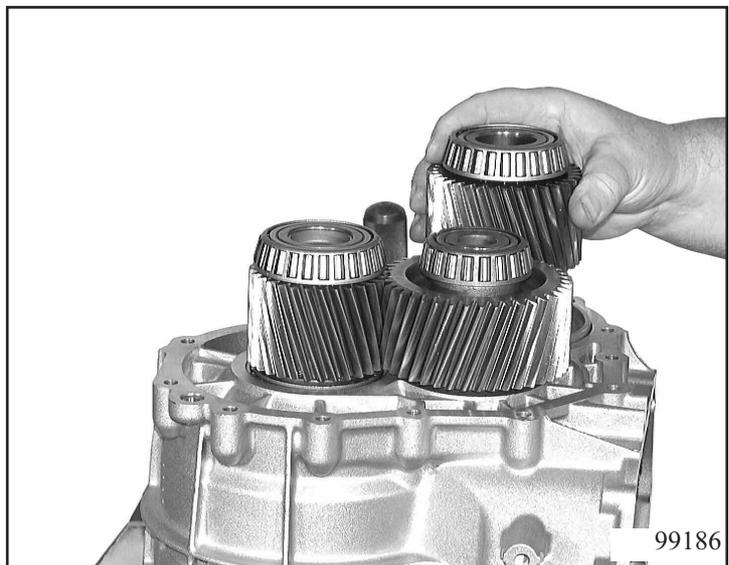
Place spring 35.310 over pinion shaft on parking lock gear.



Install complete pinion and complete intermediate gear together in the transmission housing. Raise the complete intermediate gear slightly when inserting the helical gear. Mesh the helical gear teeth with the intermediate gear and insert both gearwheels together. The projection on the helical gear must face towards the transmission housing.

**Important:**

The figures stamped upon the gears must face upwards.

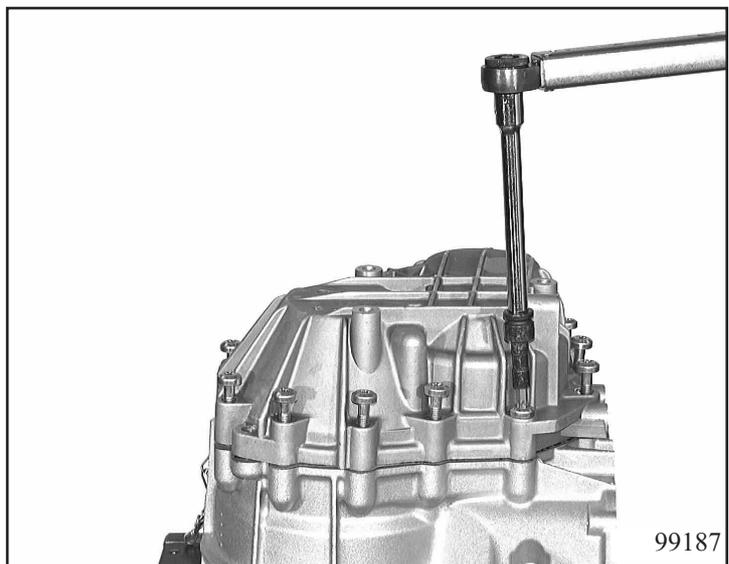


Place gasket 37.010 on the sealing face of the transmission housing and attach front axle housing 37.060, tightening the 14 screws 37.220 in a crosswise pattern.

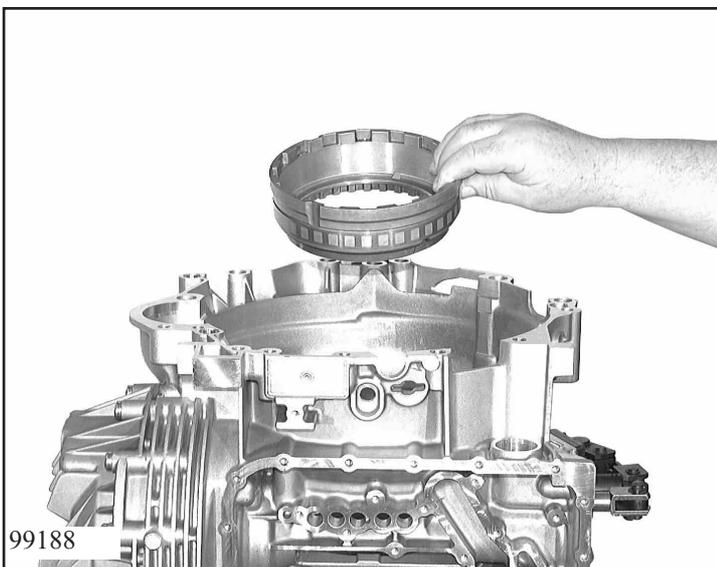
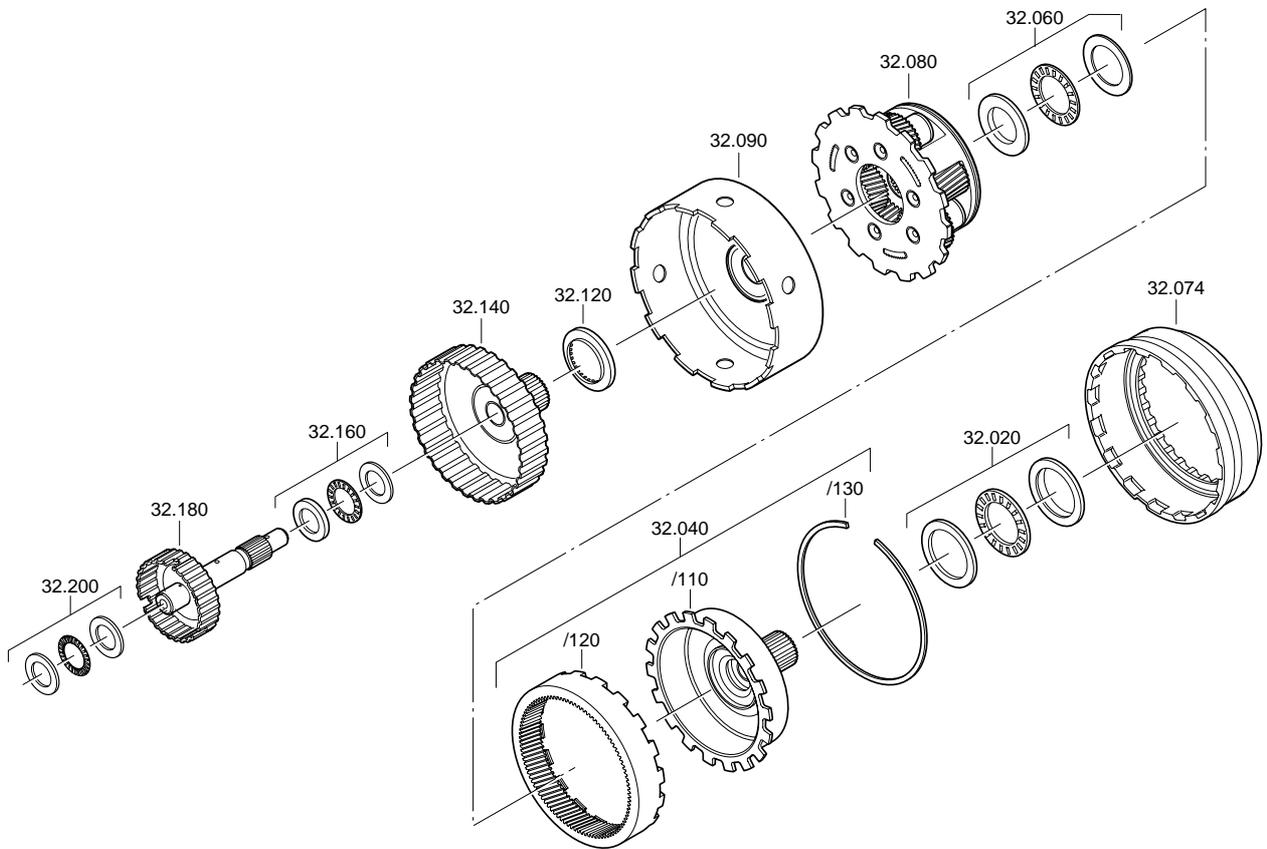
(Tightening torques: see Chapter 1.5)

**Important:**

Sleeve 37.020 must be installed in the front axle housing.



### 3.5 Planetary gear sets I and II



Turn the transmission through 180°.  
Place spider 32.074 on the freewheel.

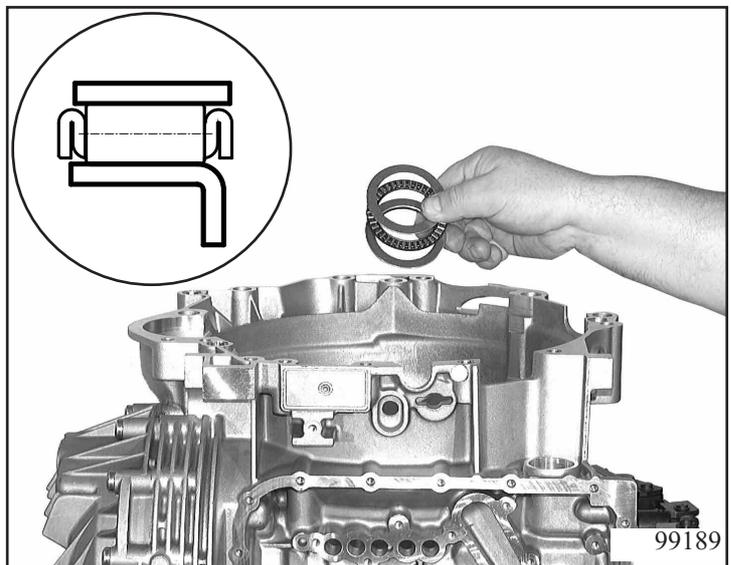
99188

Insert shaft 32.040/110 in ring gear 32.040/120 and secure with snap ring 32.040/130.

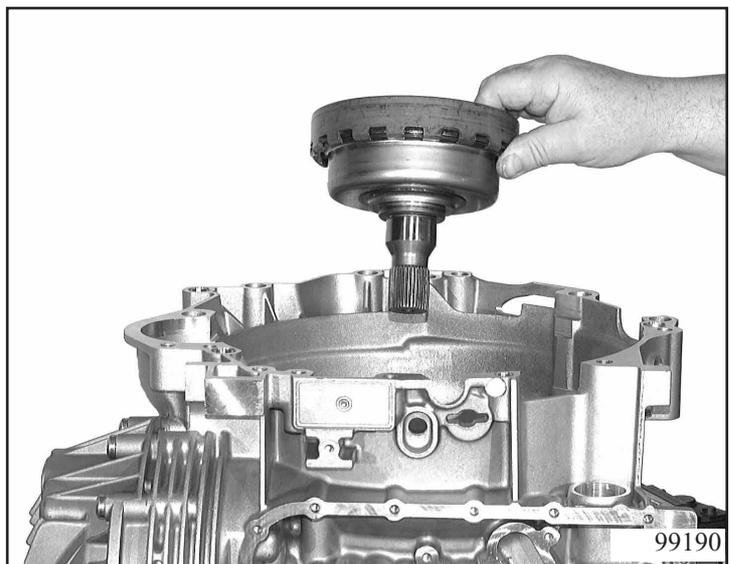


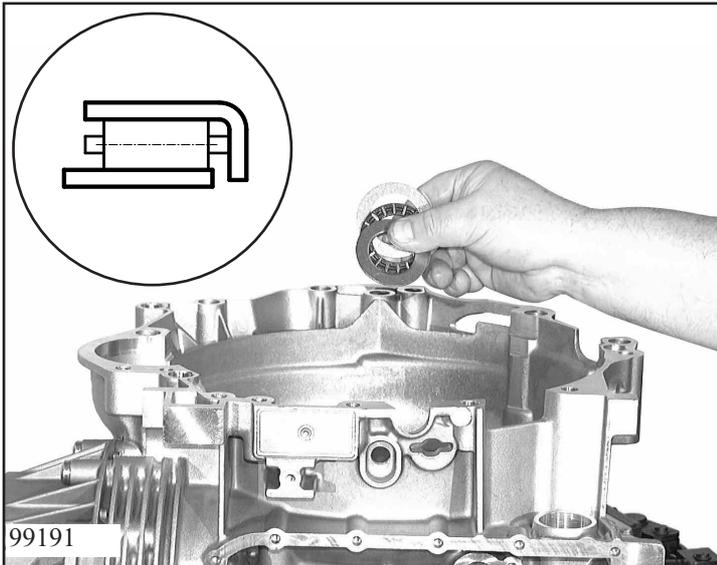
Insert angle washer 32.020/110, needle roller thrust bearing 32.020/120 and thrust washer 32.020/130.

**Installed position (see picture)**



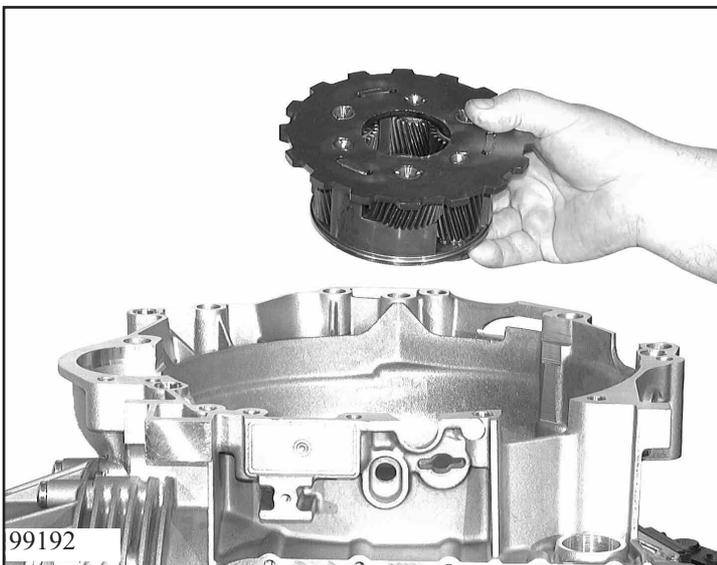
Insert output shaft with ring gear into transmission housing.



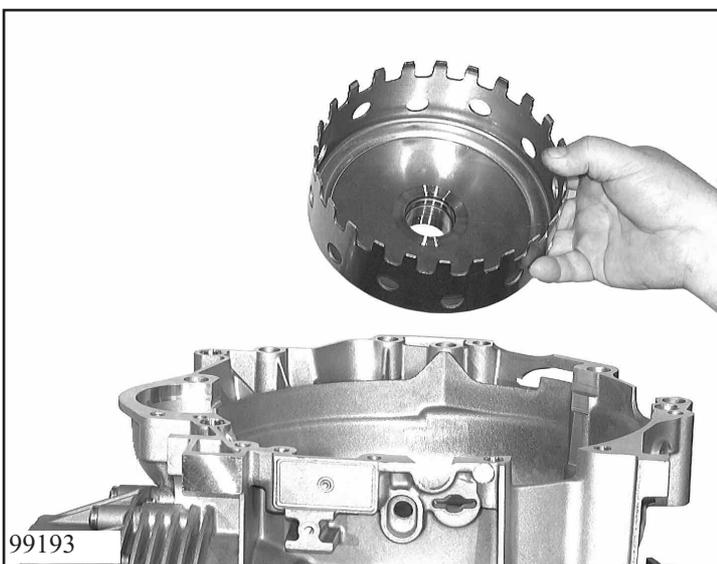


Insert thrust washer 32.060/110, needle roller thrust bearing cage 32.060/120 and angle washer 32.060/130.

**Installed position (see picture)**



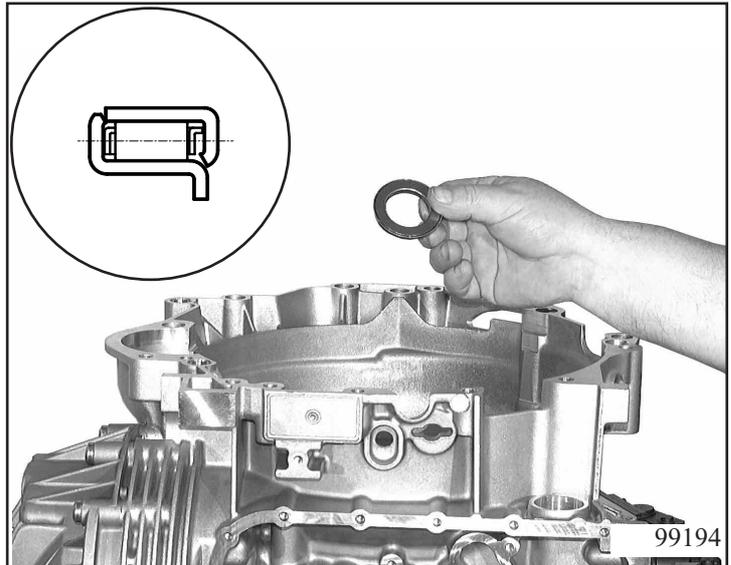
Insert planet carrier 32.080 into transmission housing.



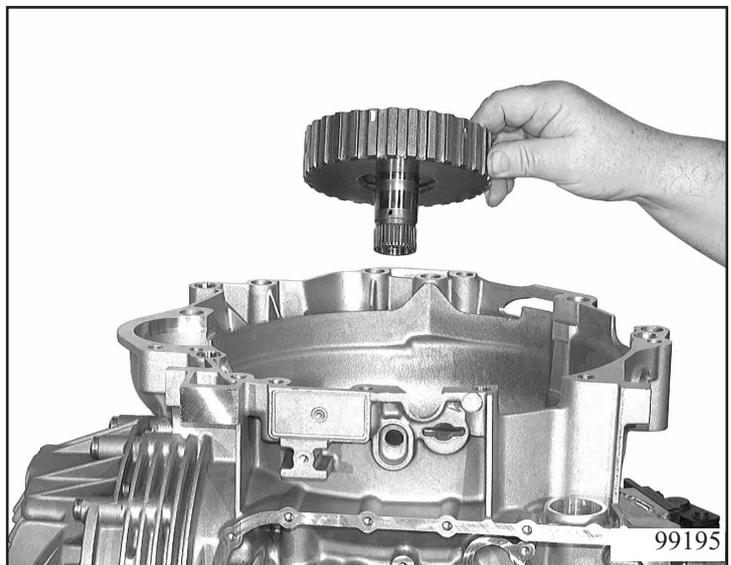
Insert sun gear with spider 32.090 into planet carrier.

Place needle roller thrust bearing 32.120 in spider.

**Installed position (see picture)**

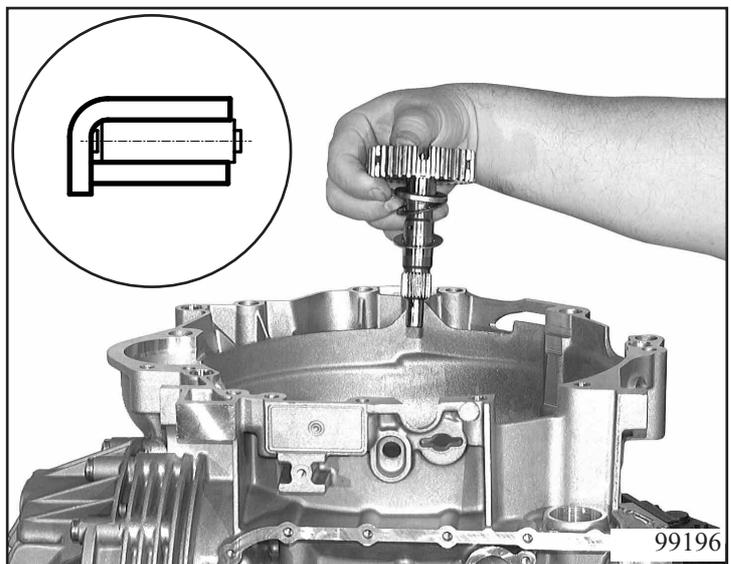


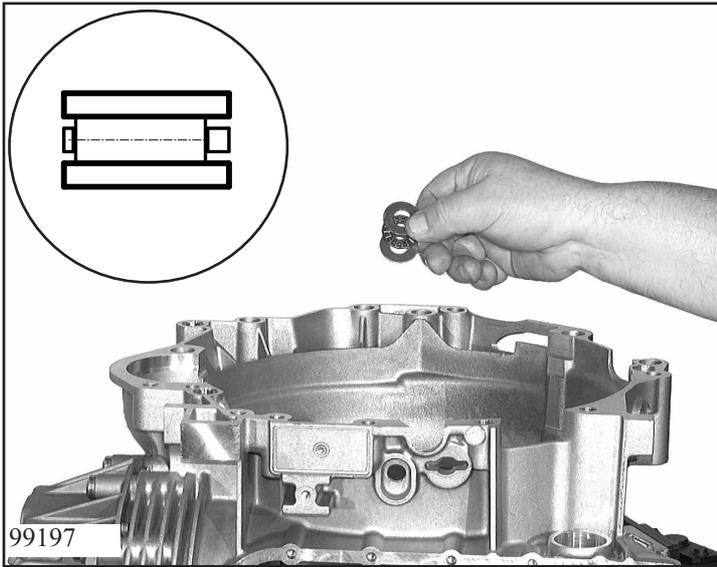
Insert sun gear shaft 32.140 and check for correct operation.  
If installed correctly, the spider rotates in the opposite direction to the sun gear shaft.



Push angle washer 32.160/110, needle roller thrust bearing cage 32.160/120 and thrust washer 32.160/130 over the end of intermediate shaft 32.180 and insert the intermediate shaft.

**Installed position (see picture)**





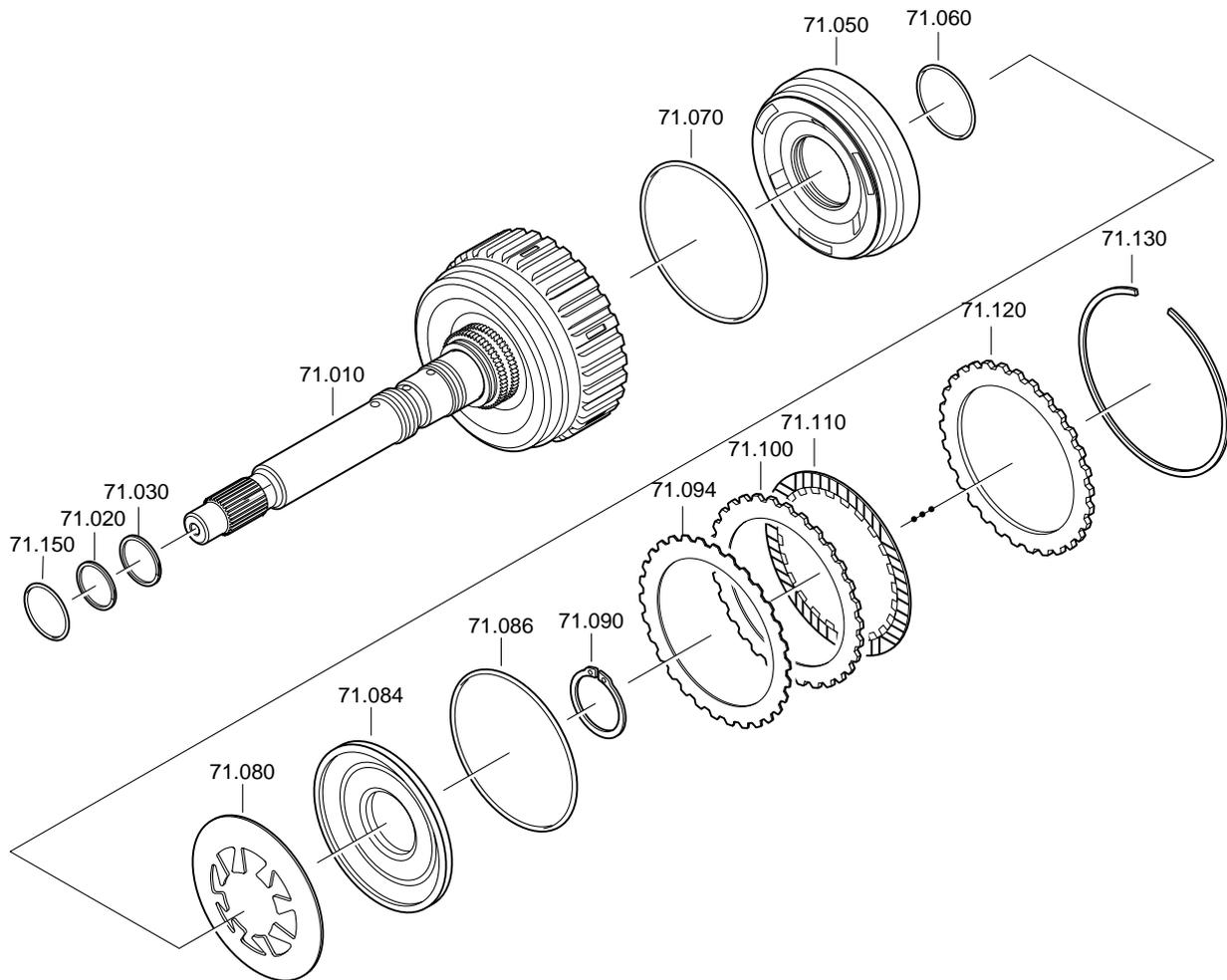
Place thrust washer 32.200/110, needle roller thrust bearing 32.200/120 and thrust washer 32.200/130 over the intermediate shaft journal.

**Installed position (see picture)**



### 3.6 Input and installing

#### 3.6.1 Clutch E



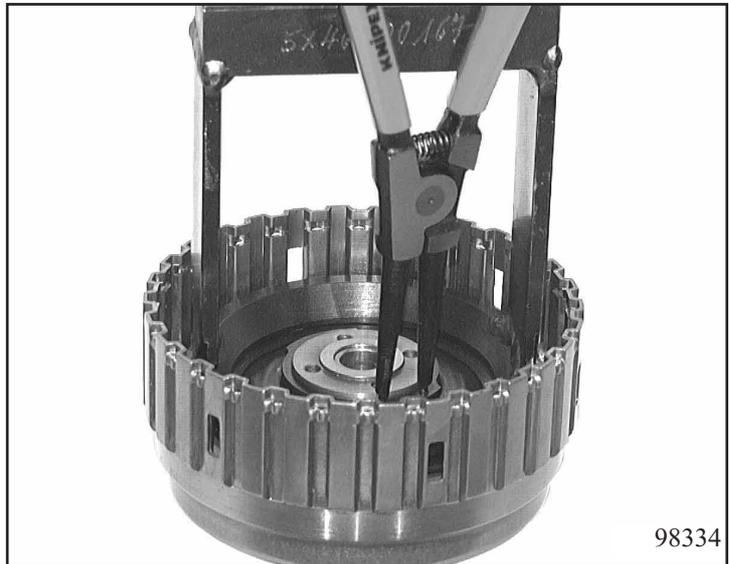
Place input shaft 71.010 in fixture 5x46 002 006.  
Pull new O-ring seals 71.060 and 71.070 on to piston E 71.050 .  
Press piston E into cylinder E on the input shaft.

98332

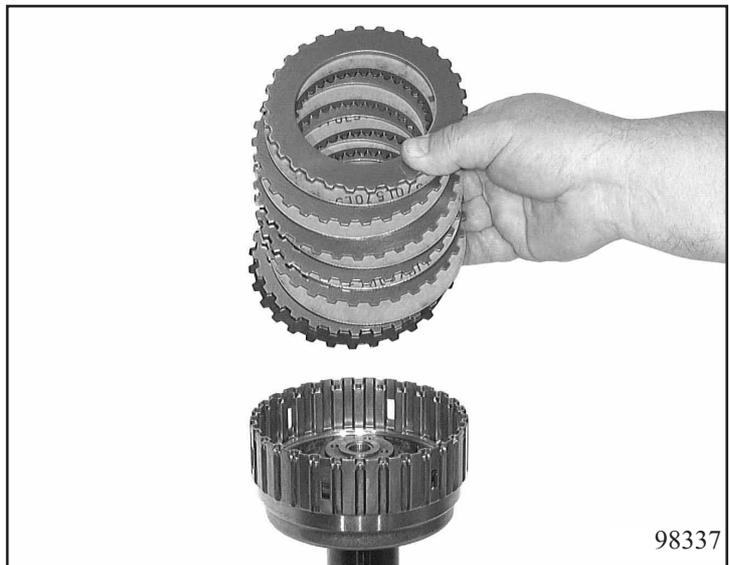
Place cup spring 71.080 on piston E with the edge facing up.  
Pull a new O-ring seal 71.086 on to oil dam 71.084 and insert into piston E.



Take the shaft out of the fixture. Press the oil dam down with assembly bracket 5x46 030 167 in the mandrel press and install non-ground circlip 71.090, using suitable pliers.



Mount the shaft in the fixture again.  
Insert the complete disc set for clutch E, starting with spring disc 71.094.  
Follow this disc with steel disc 71.100 and lined disc 71.110 alternately.  
Install end disc 71.120 and secure it with snap ring 71.130.

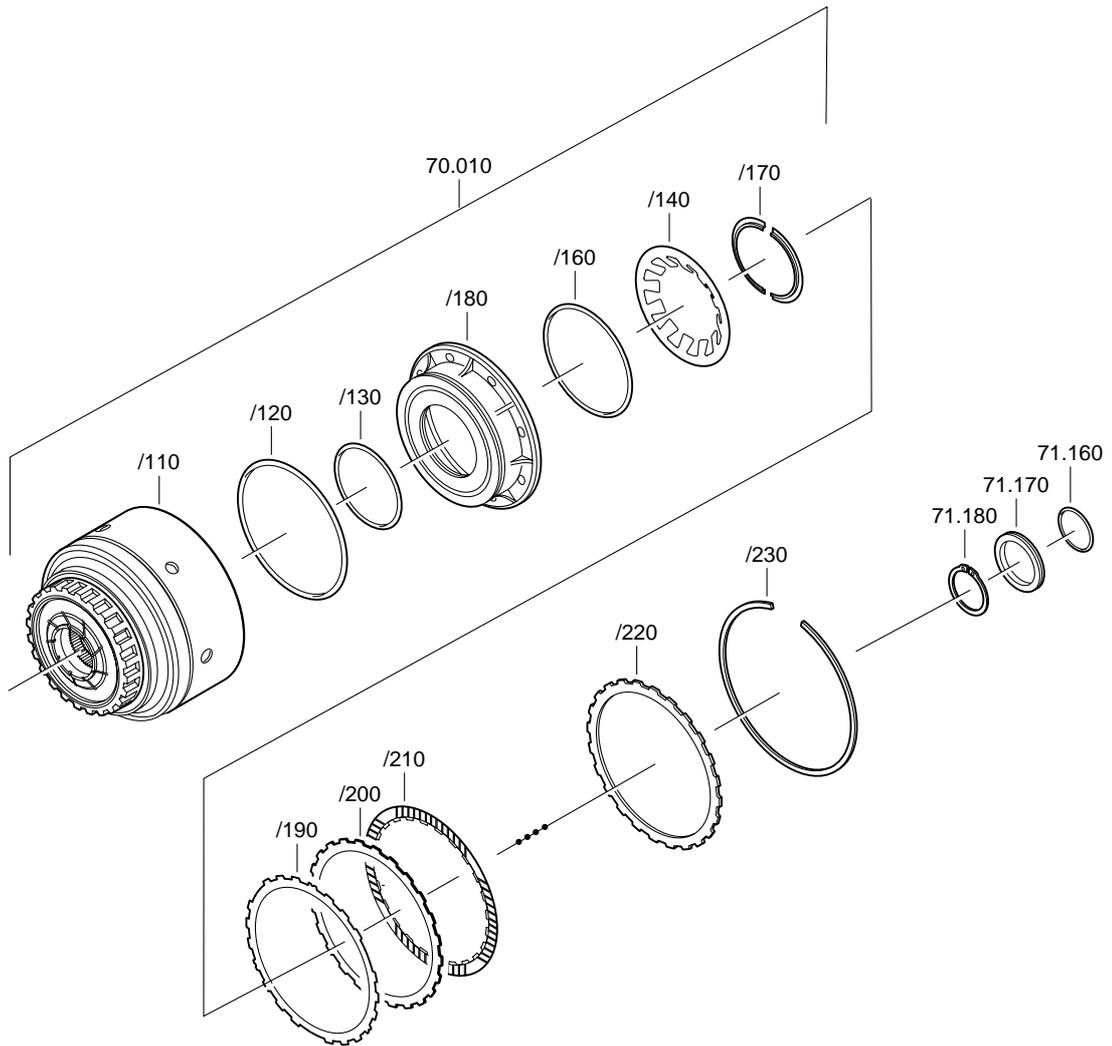


**Important:**  
Adjusting work: see Chapter 1.4.1.4

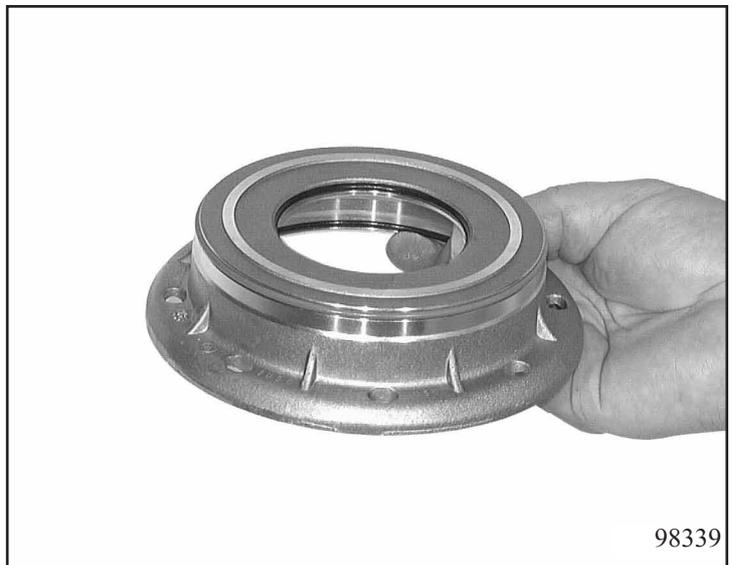


Take the shaft out of the fixture.  
Install two new rectangular-section rings  
71.020 and 71.030 and a new O-ring  
71.150 on the input shaft.

### 3.6.2 Clutch A



Pull new O-ring seals 70.010/120, 70.010/130 and 70.010/160 on to piston A 70.010/180.

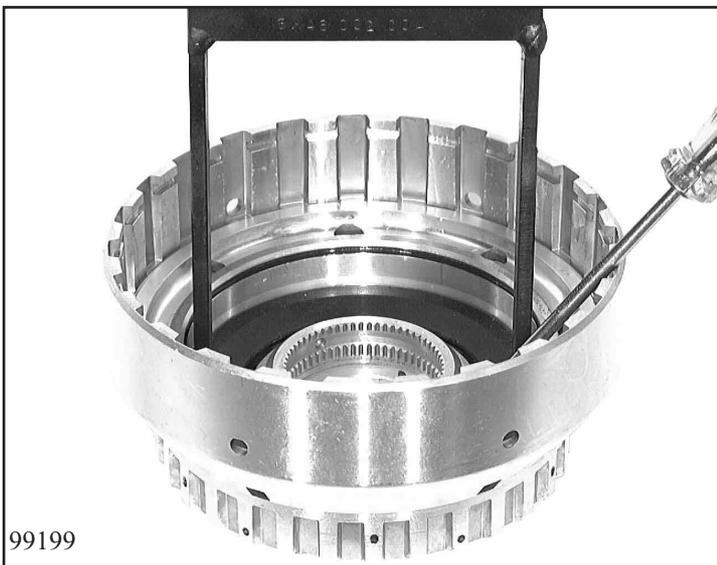


98339



Press piston A into cylinder A 70.010/110 and insert cup spring 70.010/140 with the convex side up.

99198



Using assembly fixture 5x46 002 004, press the cup spring down and retain it with split retaining washer 70.010/170.

99199



Insert the complete disc set for clutch A. Start with spring disc 70.010/190 and continue alternately with outer disc 70.010/200 and lined disc 70.010/210. Finally insert end disc 70.010/220 and secure with snap ring 70.010/230.

99203

**Important:**  
Adjusting work: see Chapter 1.4.1.5

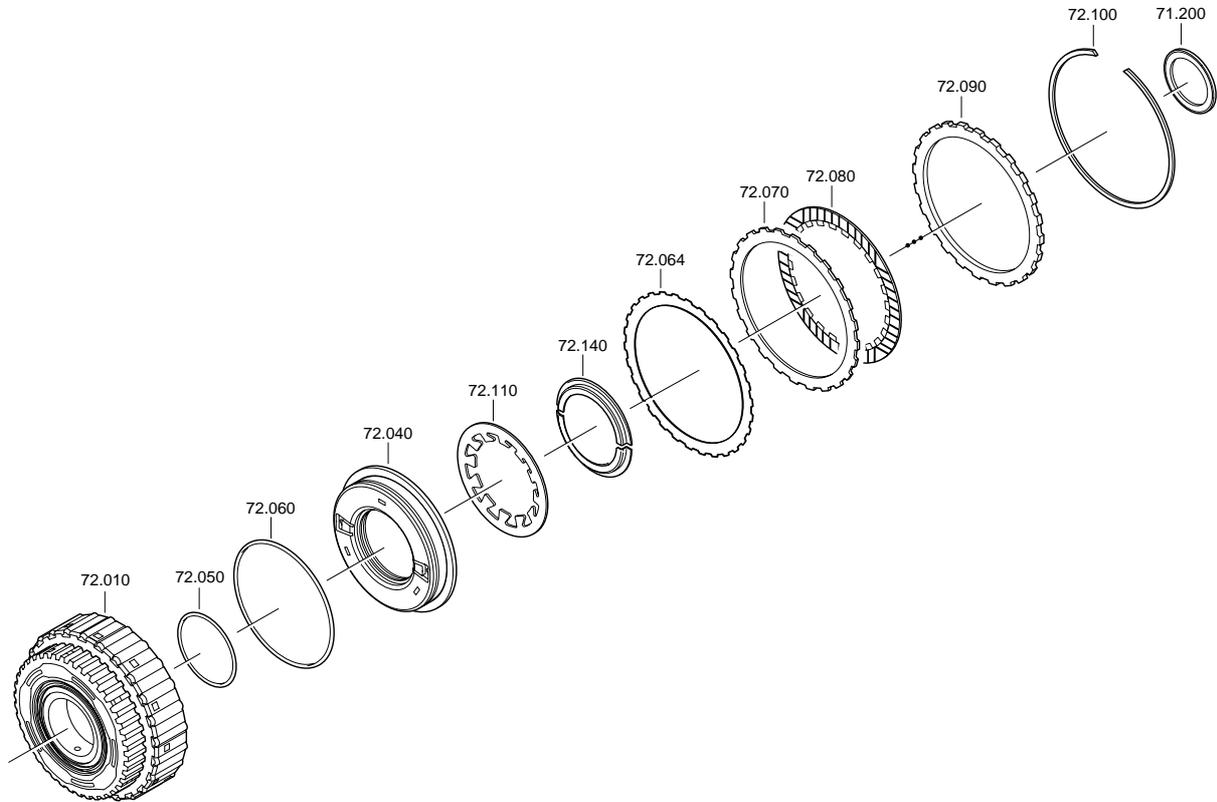
Pull O-ring 71.160 on to ring 71.170, place the ring in the hub of cylinder A and press in fully.



Engage clutch A on the splines of the input shaft and press in fully.  
Press the ring with O-ring seal down fully in the same direction.  
Using pressing-in drift 5x46 001 160 in the mandrel press, force ground circlip 71.180 on to sleeve 5x46 001 160 and press down until the circlip engages in the input shaft.



### 3.6.3 Clutch B



Pull two new O-rings 72.050 and 72.060 on to piston B 72.040 and press into cylinder B 70.010.

98347

Insert cup spring 72.110, press the cup spring down with assembly fixture 5x46 002 005 and secure with split retaining ring 72.140.



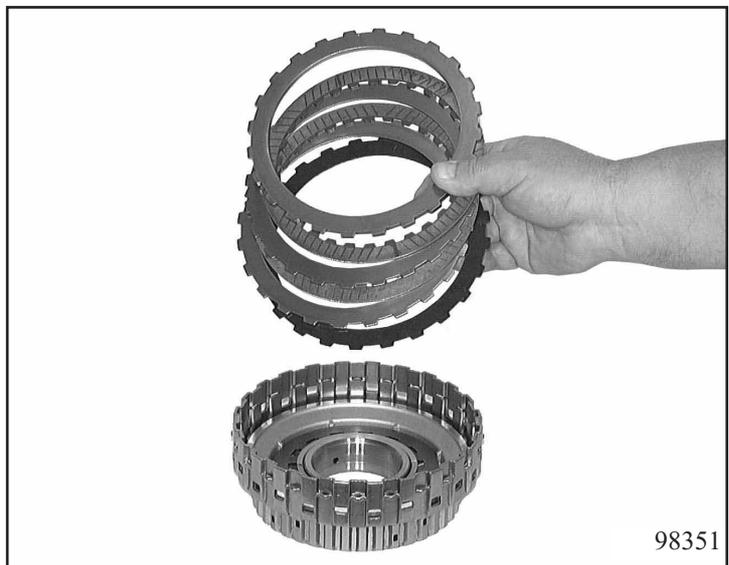
Insert clutch disc set B.  
To do this, insert corrugated spring 72.064 - if fitted -, then steel discs 72.070 and lined discs 72.080 alternately. Add end disc 72.090 and secure with snap ring 72.100.

**Note:**

If according to the parts list the disc set does not include a corrugated disc, adjustment is not necessary: otherwise:

**Important:**

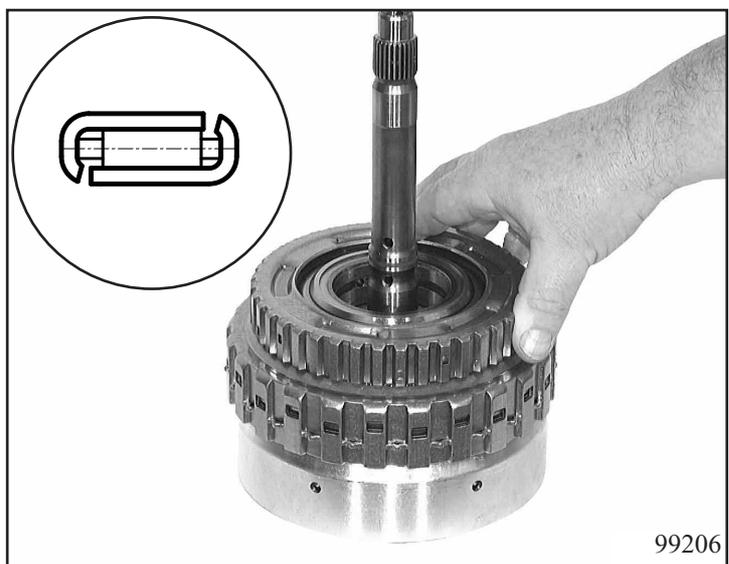
Adjusting work: see Chapter 1.4.1.6



Install thrust bearing 71.200 on cylinder A.

**Installed position (see picture)**

Align the lined discs for clutch B and insert over cylinder A, turning them at the same time.



### 3.6/4 Installing the input

Clamp assembly fixture 5x46 002 010 to the input shaft.



Insert the complete unit into the transmission housing, turning at the same time, until the lined discs for clutches A and E have been inserted completely.

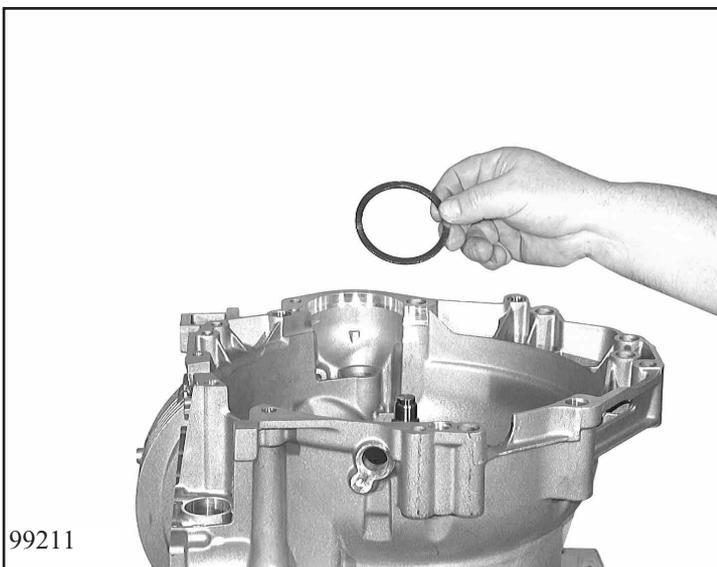
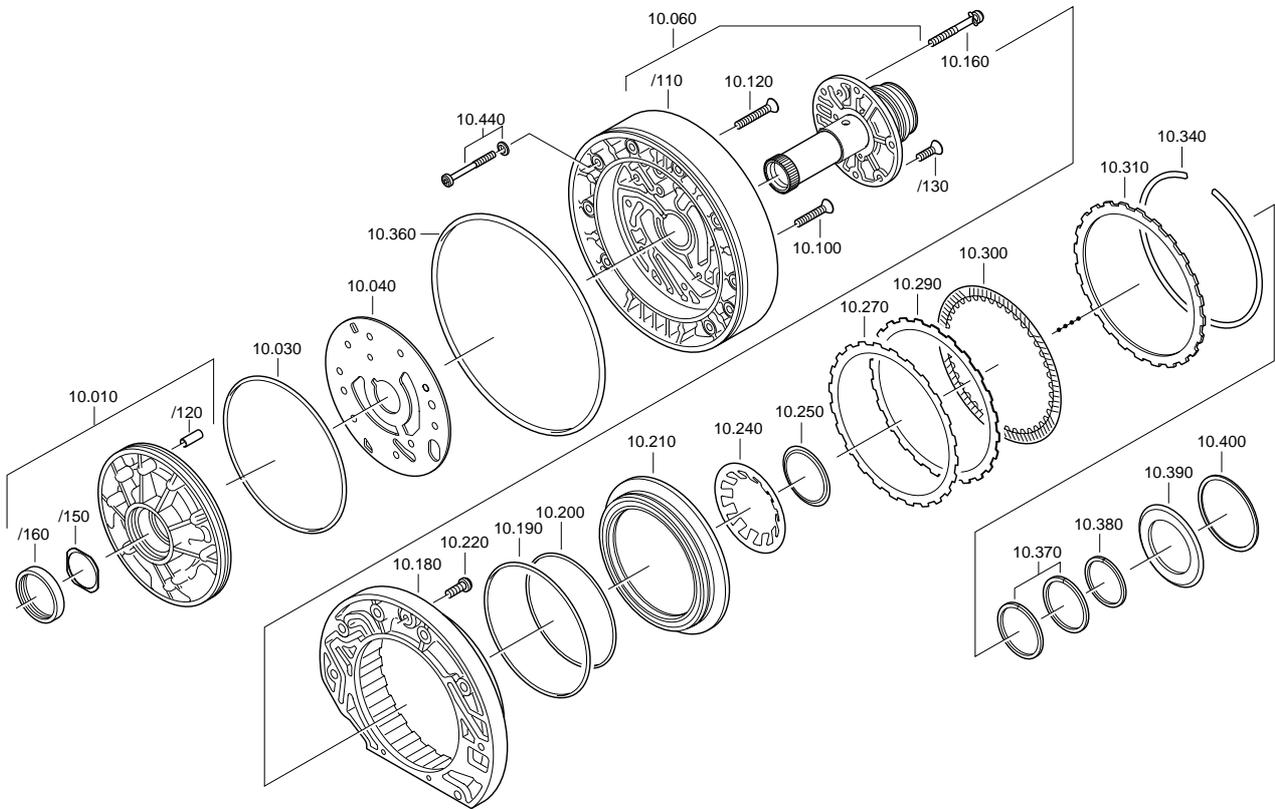


**Important:**

The drive splines on the spider must engage completely in cylinder B. Ensure this by turning the spider and the input shaft.



### 3.7 Oil supply and brake C and installing



Place shim washer 10.400 on cylinder B.

**Important:**

If adjustment is necessary, it is best to start with the thinnest washer from the OTK.

Install the correct shim washer after calculating its thickness.

99211

### 3.7.1 Oil supply

Place washer 10.010/150 in pump housing and install shaft sealing ring 10.010/160 with assembly sleeve 5x46 002 008.

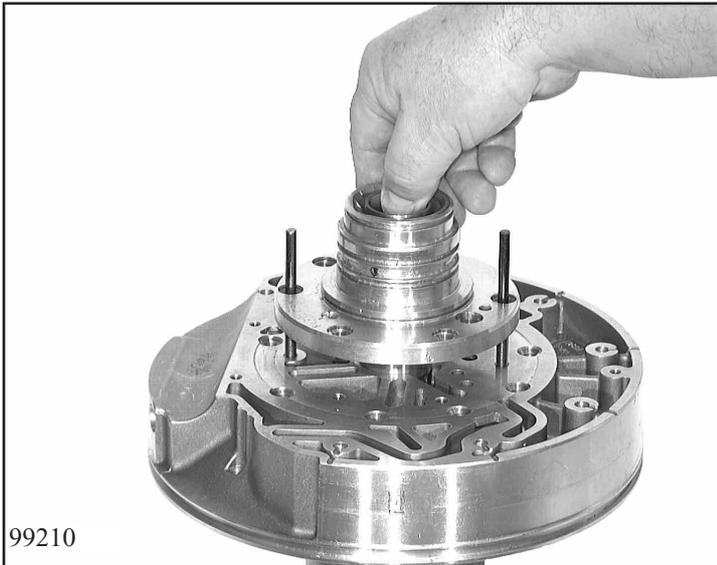


Add parts to pump 10.010 so that the markings on the pump gear and the pump ring gear are at the top.



Insert centring sleeve 10.010/120 into the pump housing and install intermediate plate 10.040.  
After this, pull a new O-ring 10.030 on to the pump housing.





99210

Screw 2 centring pins 5x46 001 007 into intermediate plate 10.060/110.

Heat the intermediate plate to approx. 70 - 80° C at the stator shaft seat and guide the stator shaft into the plate by means of the centring pins (place on a suitable underlay).

Removing the centring pins.

Secure the stator shaft loosely to the intermediate plate with 5 countersunk screws 10.060/130.

**Note:**

Check that the piston of the flow regulating valve can move freely.



99211

Screw 2 centring pins (M6) into the pump, press the intermediate plate over them and press in carefully with a suitable drift in the mandrel press.

Remove the centring pins.

Insert 8 countersunk screws 10.100, 1 countersunk screw 10.120 and 1 machine screw 10.160 loosely.

Pull two new O-ring seals 10.190 and 10.200 on to piston 10.210.

Install cylinder C 10.180 on the oil supply, align it and secure loosely with 3 screws 10.220. Tighten the screws.

**Important:**

Screw tightening specifications: see Chapter 1.3.1.2



99212

**3.7.2 Checking drag torque of pump (oiled)**

Max. drag torque 0.8 Nm.

Insert measuring fixture 5p01 003 033 into pump wheel driver. Connect torsionmeter 5x45 000 103 (H&K 52 205 212) to measuring fixture with connector 5x66 000 029 (H&K 52 205 300).

Turn the torsionmeter uniformly and read off the scale value.

If this is higher than the maximum value the pump must be dismantled again (tooth misalignment, dirt etc.).

### 3.7.3 Brake C

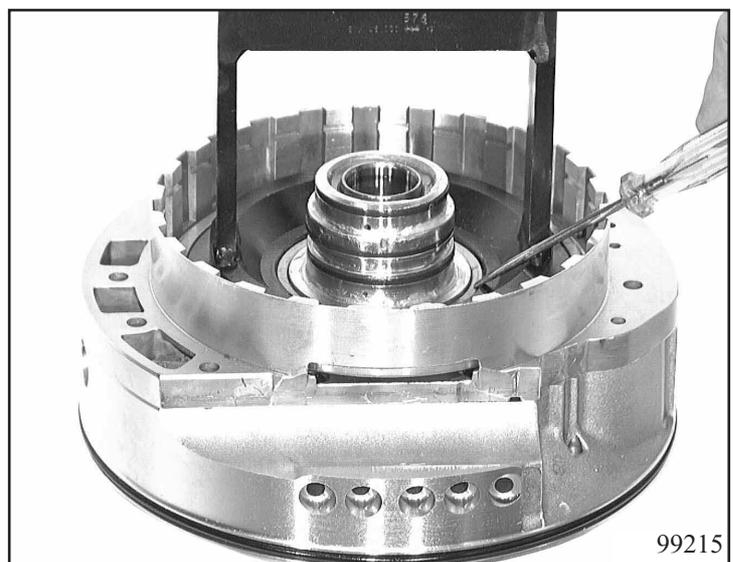
Pull a new O-ring seal 10.360 on to the oil supply and 3 new rectangular-section rings 10.370 and 10.380 on to the stator shaft hub.



Press the piston into cylinder C.



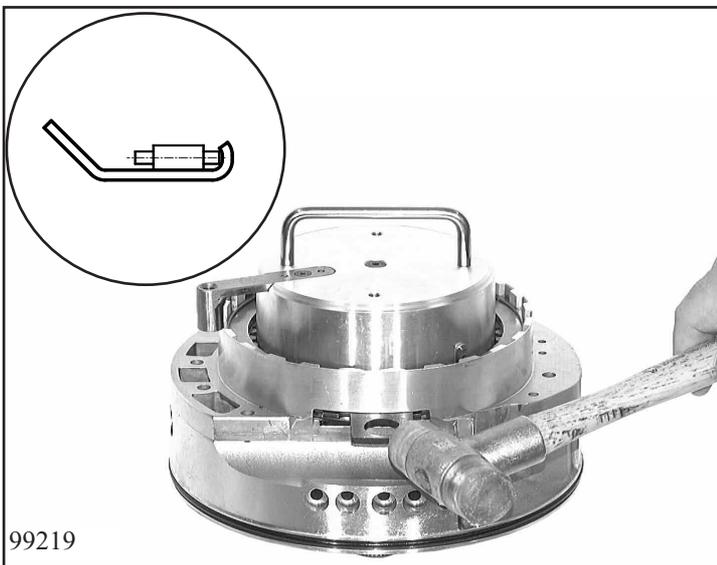
Place cup spring 10.240 on piston C, press down with assembly bracket 5x46 000 576 in the mandrel press and secure with split retaining ring 10.250.





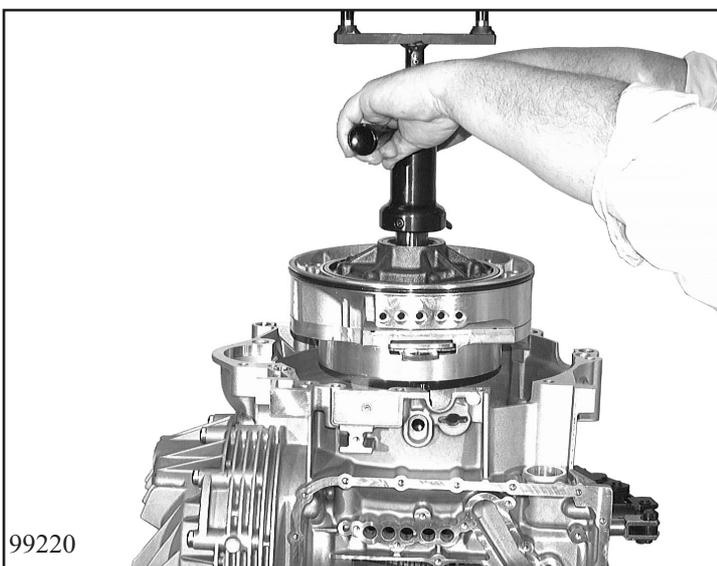
Insert the complete brake C disc set. Start with spring disc 10.270 and continue alternately with steel disc 10.290 and lined disc 10.300; finish with thick outer disc 10.310. Finally, secure with snap ring 10.340.

**Important:**  
Adjusting work: see Chapter 1.4.1.7



Align the lined discs for brake C with centring fixture 5x46 002 007 and clamp them with steel wedge 5x46 002 156. Remove the centring fixture. Use a small amount of Vaseline to attach angle washer / needle roller thrust bearing cage 10.390 to the hub of the stator shaft. Clamp fixture 5x46 002 009 on to the stator shaft.

**Installed position (see picture)**



### 3.7/4 Installing oil supply and brake C

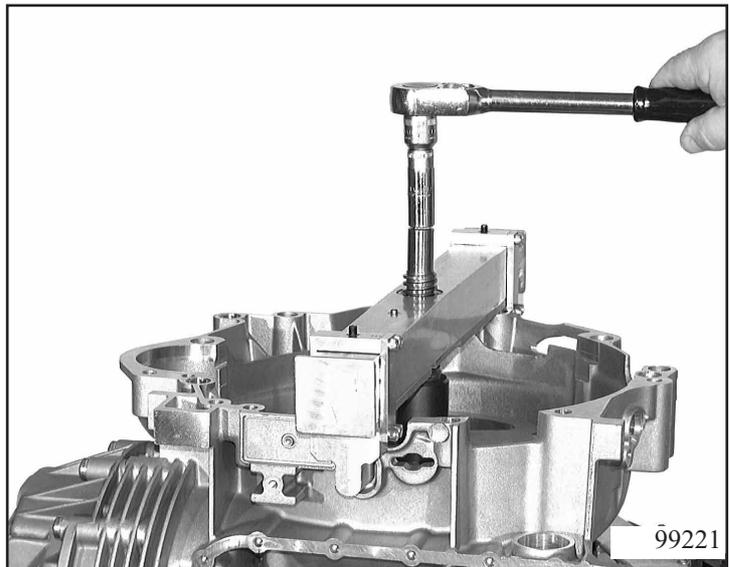
Insert the oil supply into the transmission housing in such a way that the lined discs of brake C enter the disc carrier on cylinder B. At the same time align the oil supply with centring pin 5x46 002 007. Afterwards, remove the fixture.

**Attention!**  
Insert tool with screw twisted on top (otherwise it touches on the housing)

Attach assembly fixture 5x46 001 385 to the oil supply, secure with sliding catch in slots on transmission housing and turn at the thread to force the oil supply into its final position.  
Remove the wedge.

**Important:**

It must be possible to perform these movements without using undue force.

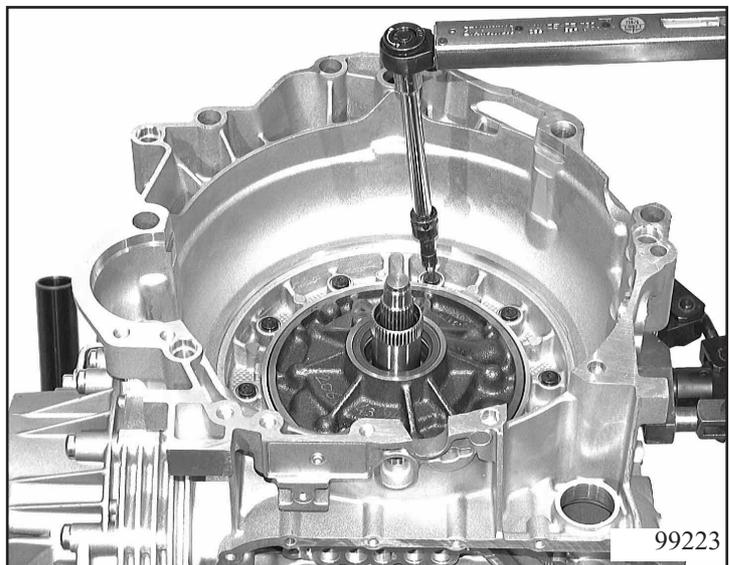


Secure the oil supply with 9 screws 10.440 and new 'Usit' rings.  
Rotate the transmission so that the oil pan is uppermost.

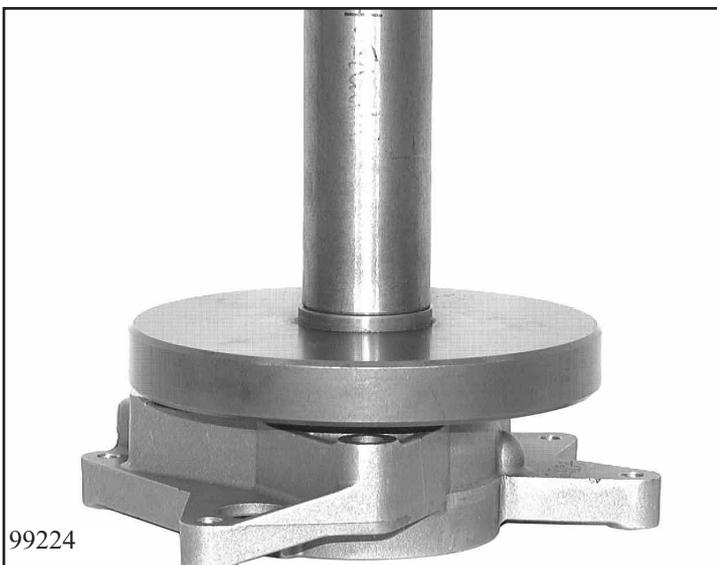
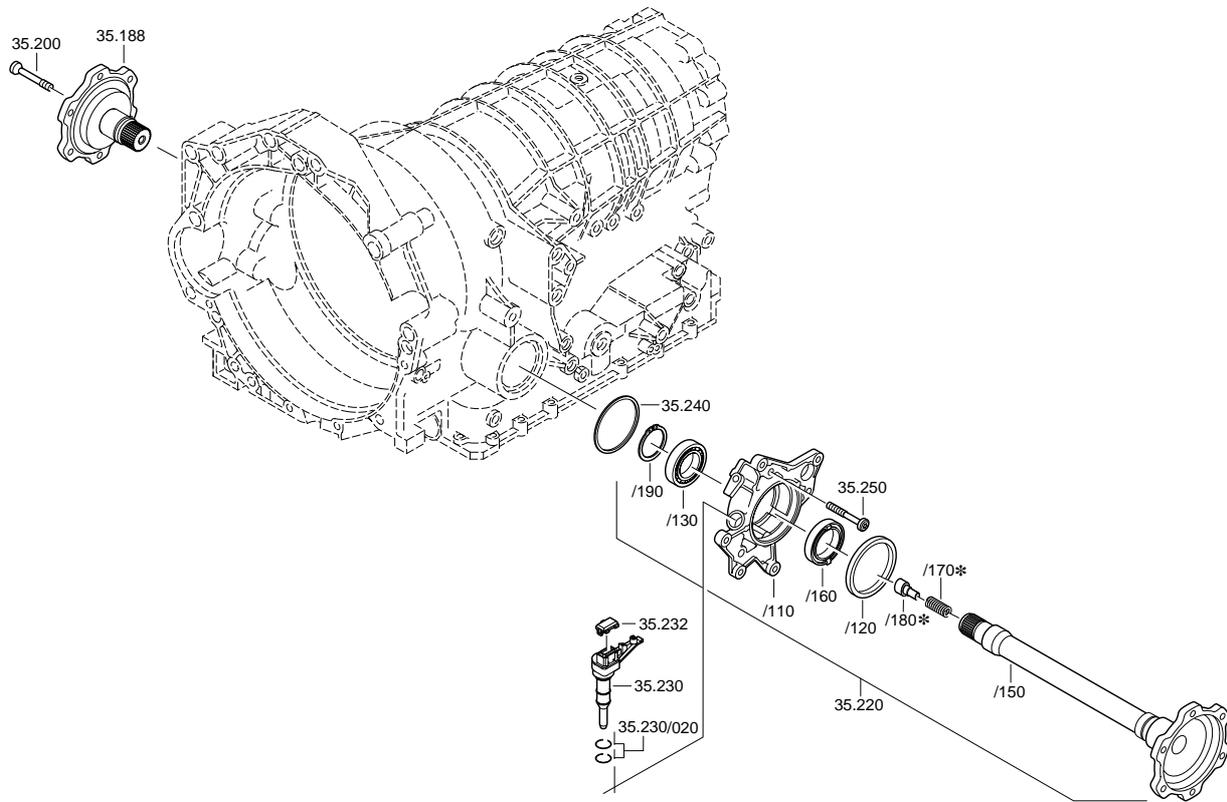
(Tightening torques: see Chapter 1.5)

**Important:**

Adjusting work: see Chapter 1.4.7



### 3.8 Adding parts to flange shaft and installing



Using fixture 5x46 000 182, press bearing 35.220/130 fully into speedometer housing 35.220/110 in the mandrel press.

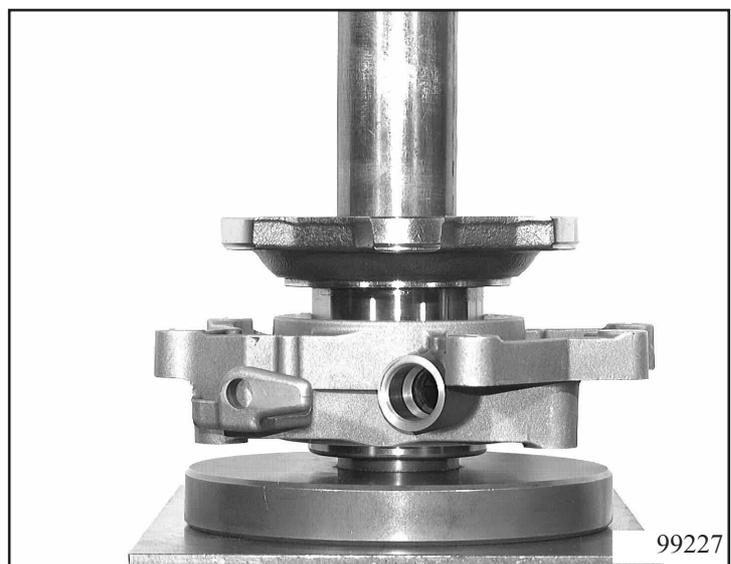
Insert speedometer housing with bearing into fixture 5x46 001 272. Using a mandrel press and pressing-in drift 5x46 001 272, press shaft sealing ring 35.220/120 fully into the speedometer housing.

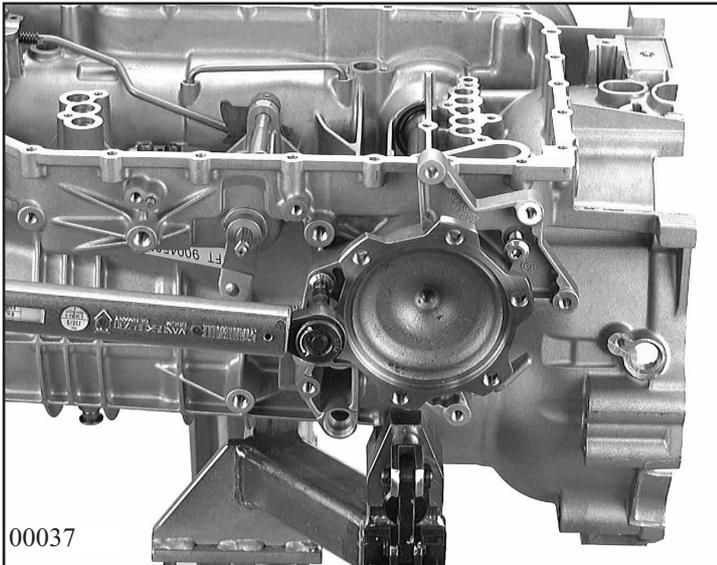


Insert magnet ring 35.220/160 with the journal in the slot in flange shaft 35.220/150.



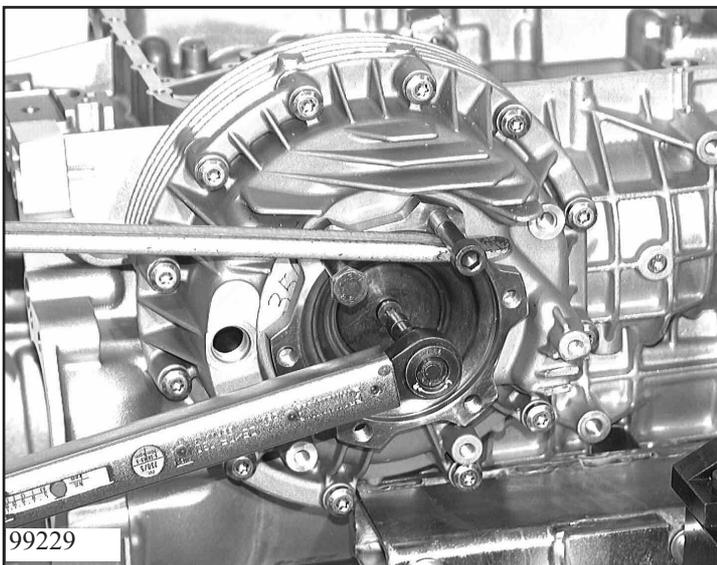
Using assembly fixture 5x46 000 182, press the flange shaft into the speedometer housing in the mandrel press and secure it with the circlip. Insert sealing ring 35.240 into the speedometer housing.





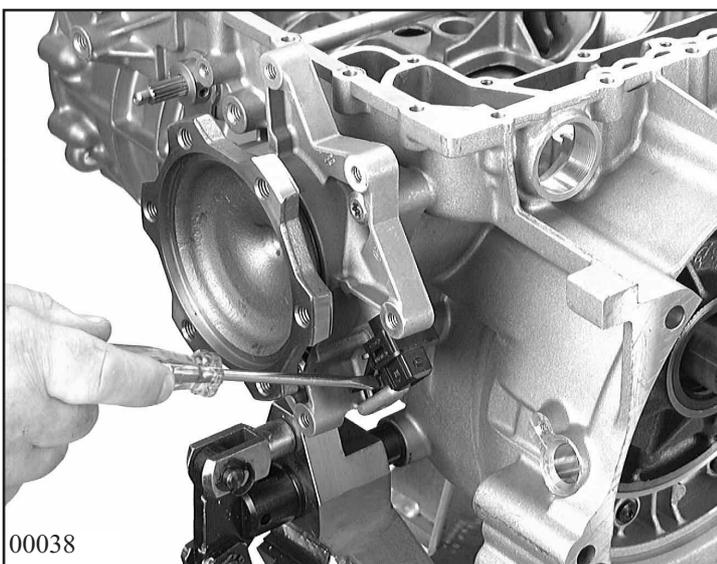
Insert the complete side shaft into the transmission housing and attach with 3 screws 35.250.

(Tightening torques: see Chapter 1.5)



Insert flange 35.188 into the differential. Prevent the flange from turning and secure with expansion bolt 35.200.

(Tightening torques: see Chapter 1.5)

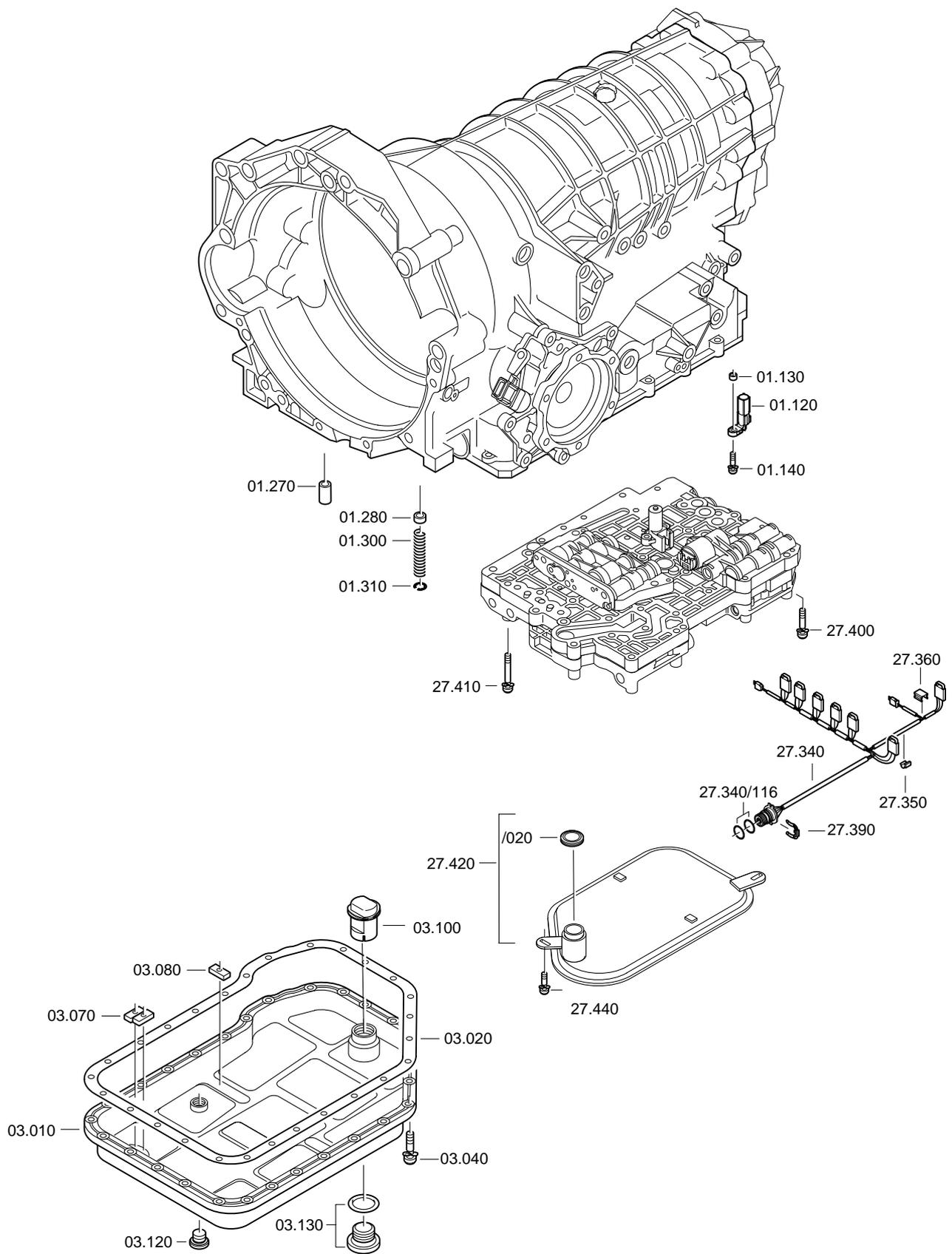


Pull two new O-rings 35.230/020 on to speedometer sensor 35.230 and press this into the speedometer housing so that the arm engages in the housing.

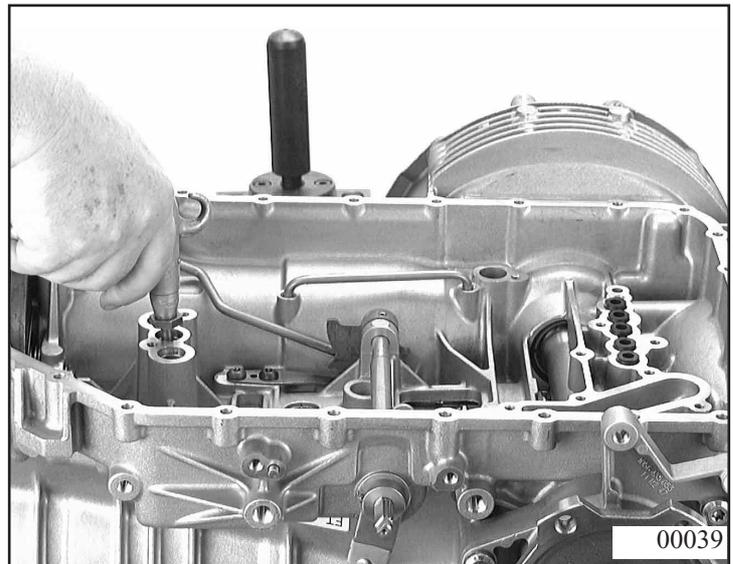


### 3.9 Installing valve body, oil filter and oil pan, position switch, converter

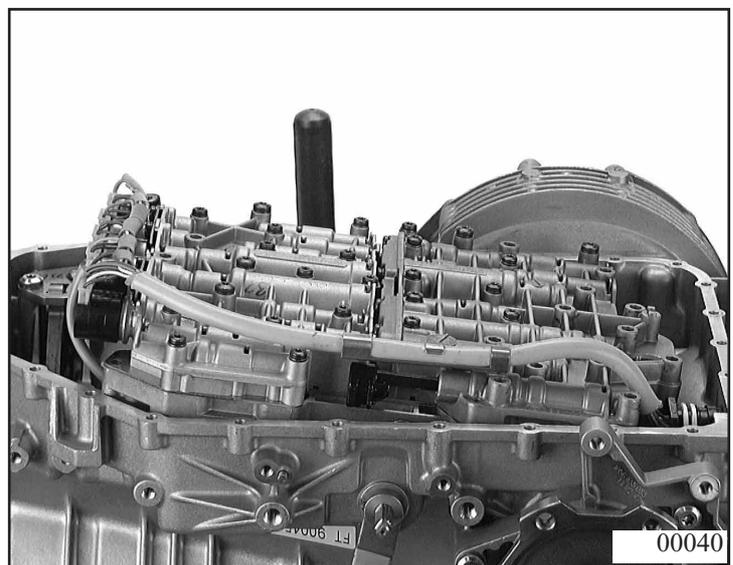
#### 3.9.1 Installing valve body, oil filter and oil pan



Insert 5 sealing sleeves 01.270 into feed holes WKZ, E, B, A, and C.  
 Insert 3 sealing sleeves 01.280 into feed holes D, G and F einsetzen and press in with a suitable drift.  
 Check the function of all clutches and brakes with compressed air. Secure sleeves D, G, F with springs 01.300 and snap rings 01.310 sichern. Press the snap ring in fully.



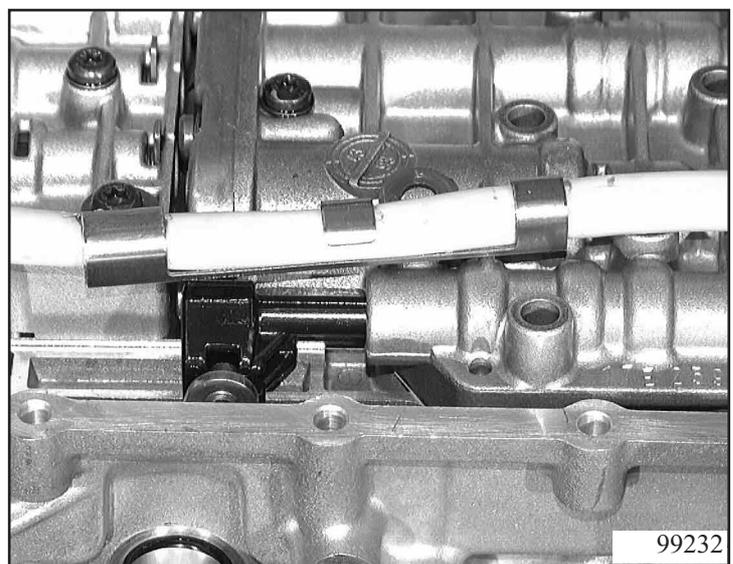
Offer up the complete valve body at a slight angle.  
 Pull two new O-rings 27.340/116 on to wiring harness plug 27.340. Insert the plug into its hole.

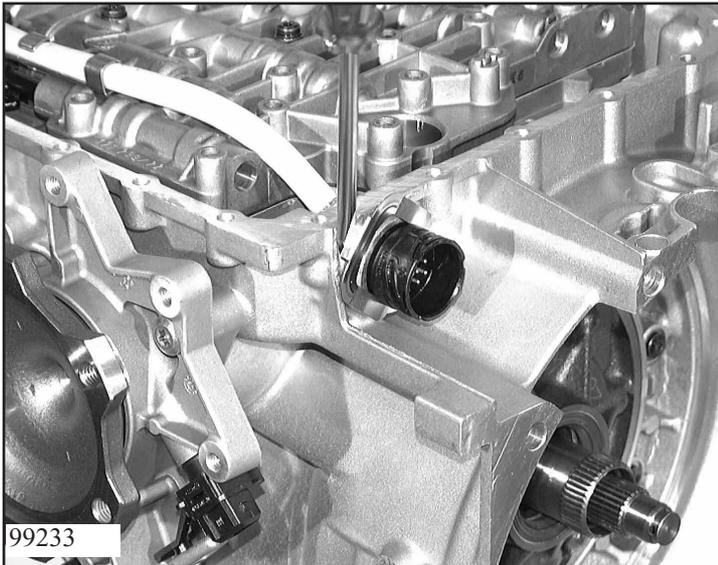


Select position "N".  
 Align the valve body and press it down by hand.

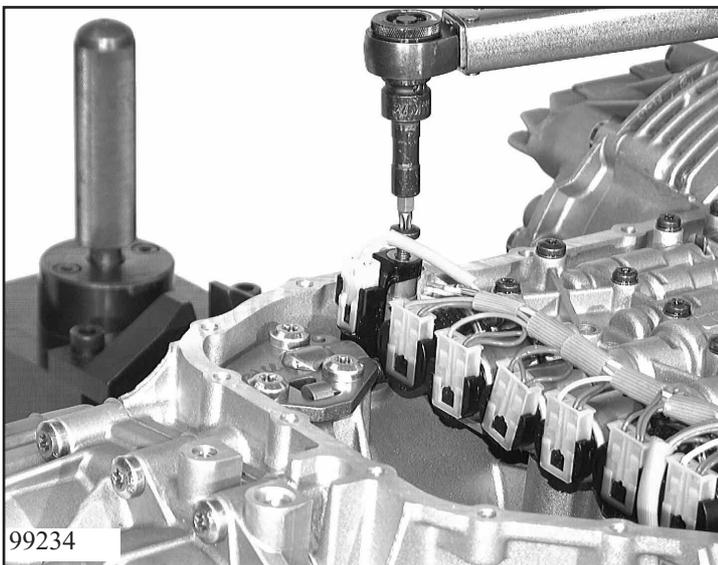
**Important:**

The detent disc journal must be in the slot on the selector valve and the guide pin correctly located in the transmission housing.



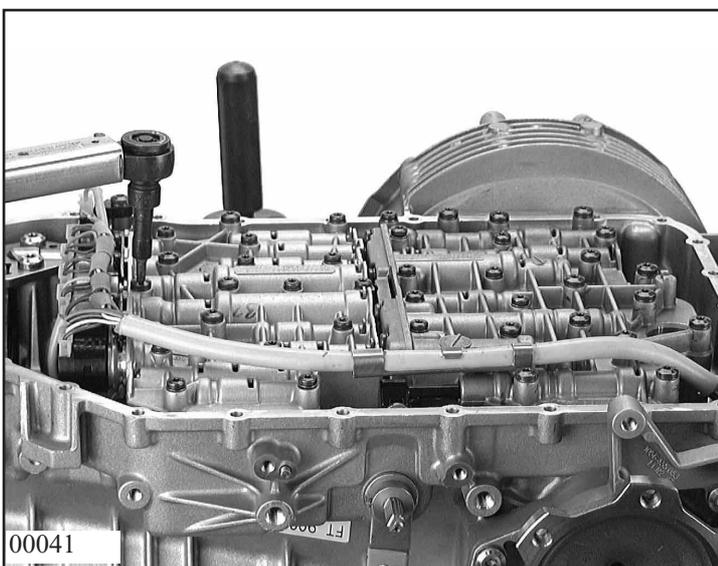


Engage the plug guide journal in the slot and retain with keeper plate 27.390.



Place spacing ring 01.130 on the tapped hole for the inductive sensor. Insert inductive sensor 01.120 in the hole provided, and secure with screw 01.140.

(Tightening torques: see Chapter 1.5)

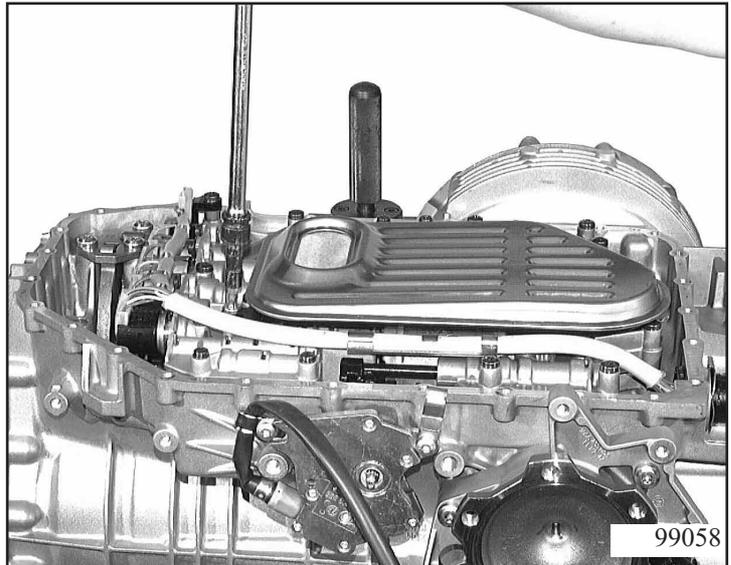


Secure the valve body with 16 screws 27.410 and 1 screw 27.400.

(Tightening torques: see Chapter 1.5)

Attach oil filter 27.420 to the valve body with a new sealing ring 27.420/020 and secure with 2 screws 27.440.

(Tightening torques: see Chapter 1.5)

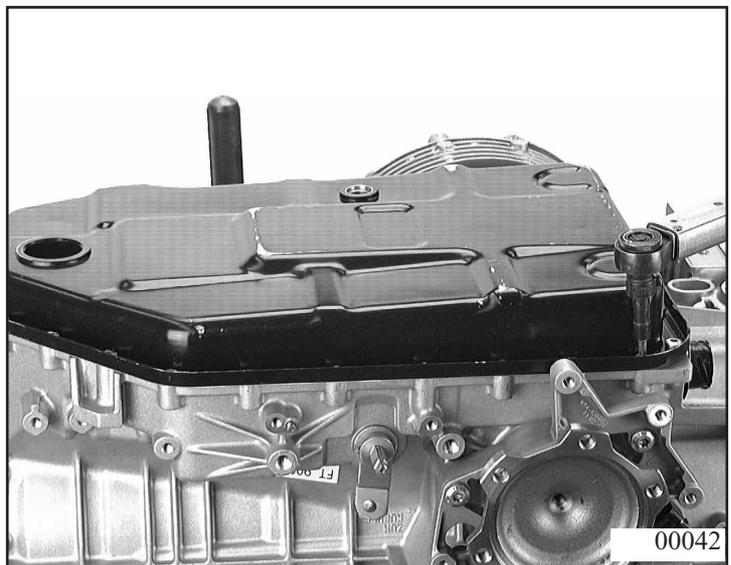


Insert 3 or 6 magnets 03.070 (according to version) in the recesses in oil pan 03.010.

Lightly oil new paper gasket 03.020 and place it on the sealing face of the transmission housing.

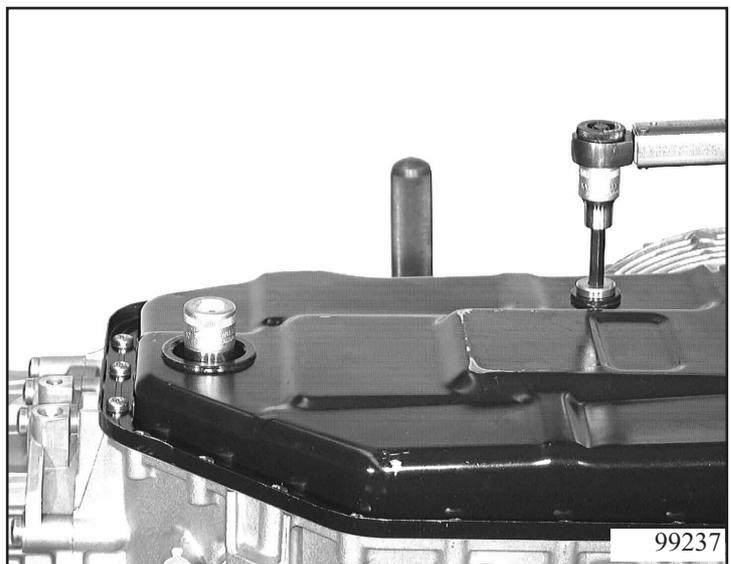
Secure the oil pan with 27 screws 03.040, tightening them in a crosswise pattern.

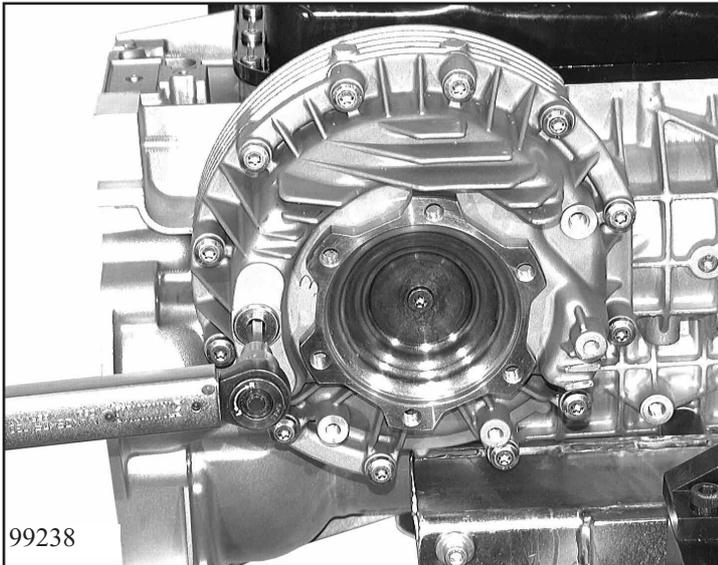
(Tightening torques: see Chapter 1.5)



Screw a new oil filler plug 03.130 with O-ring and a new oil drain plug 03.120 into the oil pan.

(Tightening torques: see Chapter 1.5)

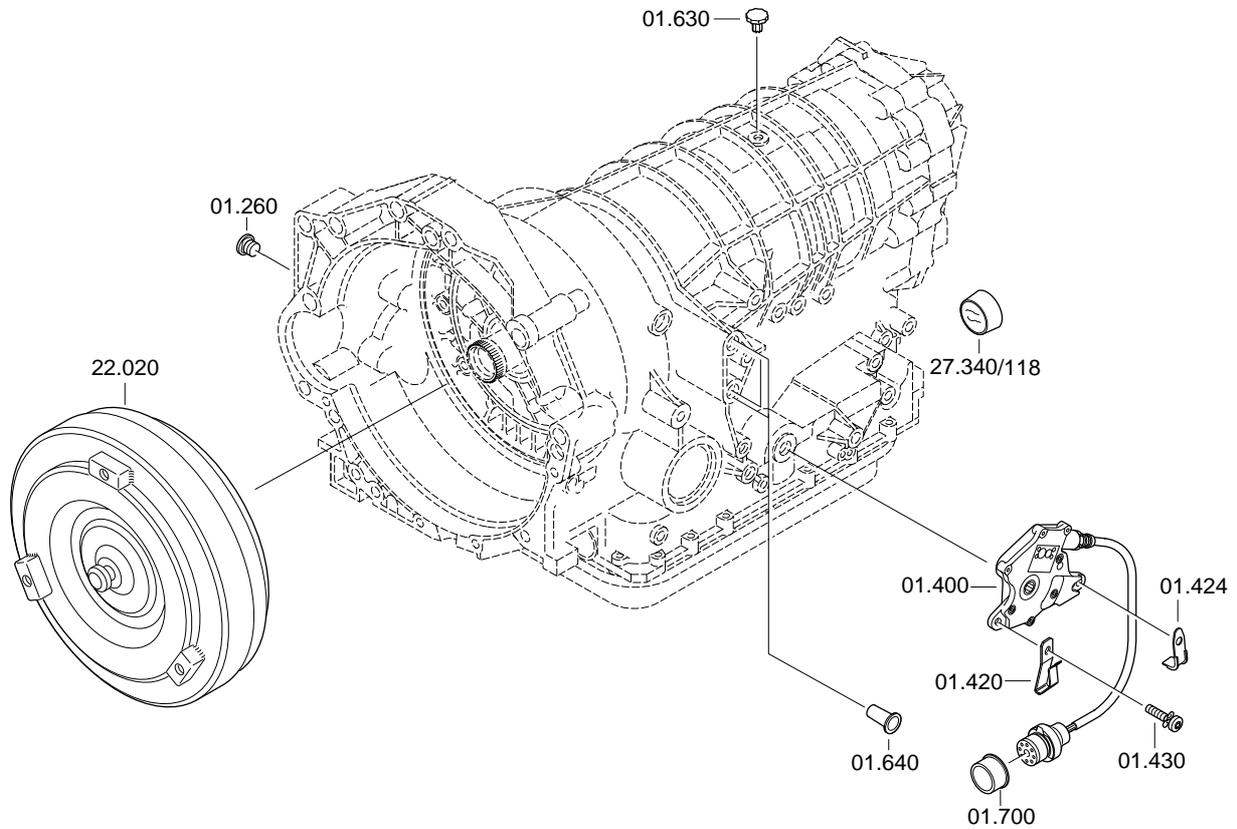




Screw a new oil filler plug 35.370 into the differential cover.  
After adding the oil, secure the plug with lacquer.

(Tightening torques: see Chapter 1.5)

### 3.9.2 Installing position switch and converter

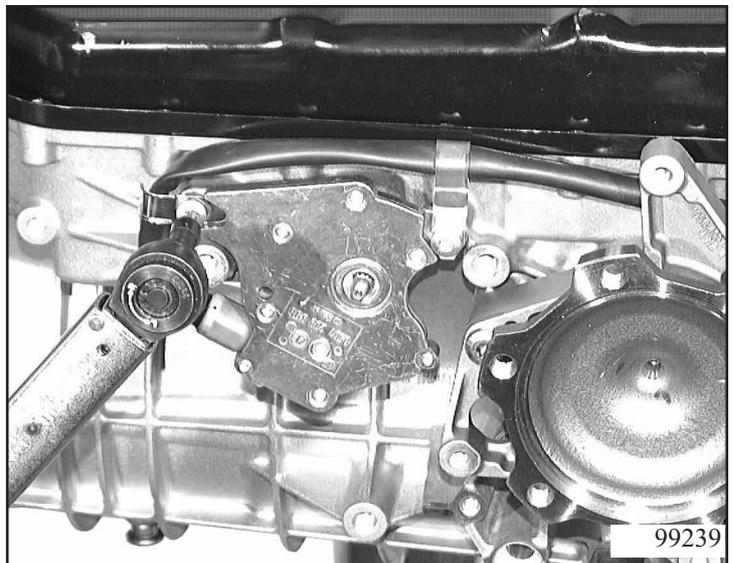


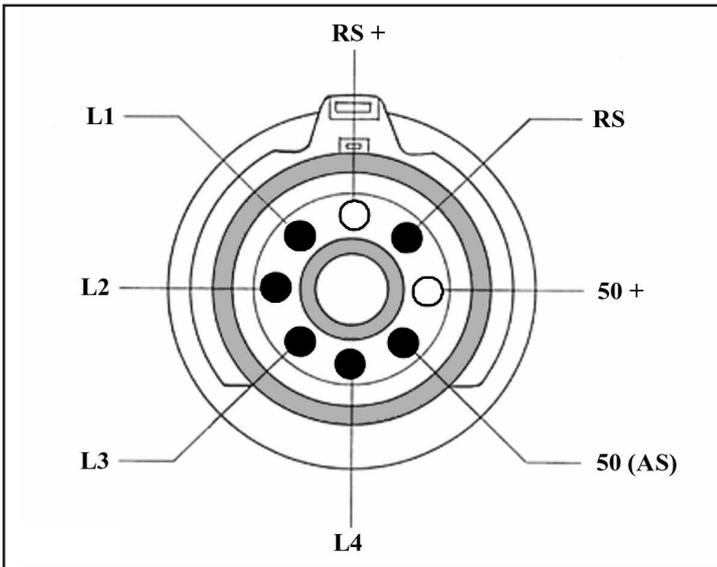
#### 3.9.2.1 Installing and checking position switch

Move the selector shaft to position “N”. Push position switch 01.400 on to the selector shaft so that the pin in the transmission housing enters the hole in the switch.

Using 2 screws 01.430, attach the position switch and terminals 01.420 and 01.424 to the transmission housing and insert the cables into the terminals.

(Tightening torques: see Chapter 1.5)



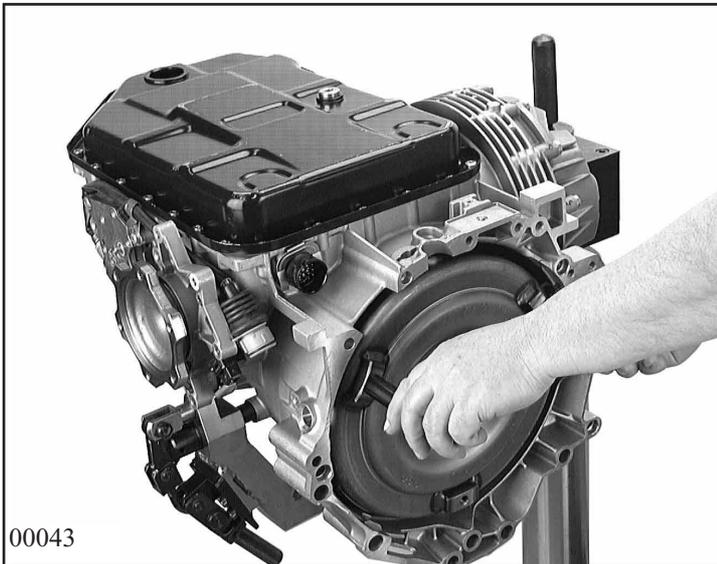


Check the switch resistance values in ohms with the multimeter by reference to the function table.

### Code table

	P	Z1	R	Z1	N	Z2	D	Z3	4	Z4	3	Z4	2
L1	1	1	0	1	1	1	1	1	0	0	0	0	0
L2	0	1	1	1	1	0	0	1	1	0	0	0	0
L3	0	0	0	0	1	1	1	1	1	1	0	1	1
L4	0	0	0	0	0	0	1	1	1	1	1	1	0
AS	1	0	0	0	1	0	0	0	0	0	0	0	0
RS	0	0	1	0	0	0	0	0	0	0	0	0	0

### 3.9.2.1 Installing the converter



Screw two handles 5x46 002 166 into converter 22.020 and insert it carefully.



Turn the transmission through 90° and carefully rotate the converter in either direction until the pump drive journals engage. Remove the handles.

### Note:

Do not allow the converter to fall into the housing, or the driver journals may be damaged.

Fasten converter retaining bracket 22.110 to the converter and transmission housing with 2 screws 22.120 and 22.130.

(Tightening torques: see Chapter 1.5)

**Important:**

The converter retaining screw must not be too long (recommended length 14 mm) or else the converter will be damaged and the converter clutch will malfunction.

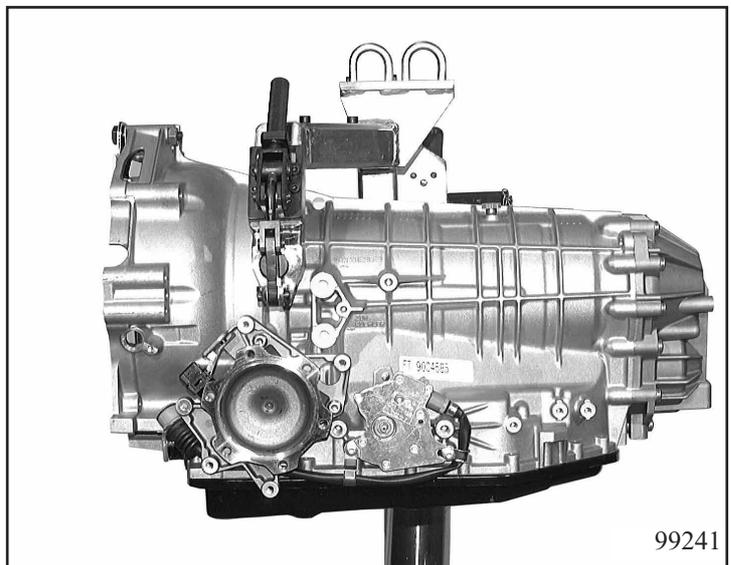


### 3.9.3 Installing breather cover and protective transit caps

Press breather cover 01.630 into the breather.

After this, attach all transit plugs/caps:

- 1 Transit plug for selector shaft
- 1 Plug 27.340/118 on EGS wiring harness
- 2 Plug 01.640 for cooler connection



# REPAIR MANUAL

**(SUPPLEMENT)**

**5 HP- 19 FLA**



**ZF GETRIEBE GMBH SAARBRÜCKEN**

Version 00/08/01  
CD

subject to alterations

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# Preliminary information

The 5HP19FLA repair manual is largely based on the 5HP19FL repair manual, and is identical as far as the end of the automatic section

End of transmission housing including adjustment of bevel gear drive and input and output endplay

For this reason, these sections of the repair manual are not repeated here and only a supplement is provided for repairs to the four-wheel-drive section of the transmission, together with the corresponding changes to the component transmission. It contains:

Supplement - changes compared with 5 HP 19 FL  
Drive to front and rear wheels with Torsen II

Repairs to this section of the transmission must only be carried out by personnel that has received training from ZF Getriebe GmbH.

All removal and assembly work is shown in chronological order. The supplement pages and the differences compared with the 5 HP 19 FL should be included in the 5 HP 19 FL repair manual at the points where the output to the front axle is dealt with.

The photographs are general in nature so that they relate to various installations, and are therefore not always applicable in all details.

Important amendments or modifications for specific applications that have to be taken into account during repair work are issued in the form of *Technical Bulletins* or described during training courses. There is no update service for this manual if it is passed on to third parties.

During all repair work the directives and information in the *Technical Bulletins* must be complied with.

Depending on the fault or damage that has occurred, the repair can be restricted to the work needed to eliminate it.

Please note:

- Seals such as O-rings, shaft sealing rings, gaskets and filters must never be re-used.
- All O-rings, rectangular-section rings and other sealing rings must be coated with Vaseline before installing.
- All bearings should be lightly oiled before installing.

The following preconditions should be satisfied before repair work starts:

- The necessary special tools should be available.  
The complete set of special tools is listed in Chapter 4.7.
- A suitable transmission test rig should be available.  
Please refer to the *Technical Bulletins* for the relevant test values.

**Warning:**

The transmission, differential and transfer box housing must only be delivered after filling with the oil grade and quantity stated in the relevant part list (see ELCAT).

Technical Service

Technical Documentation

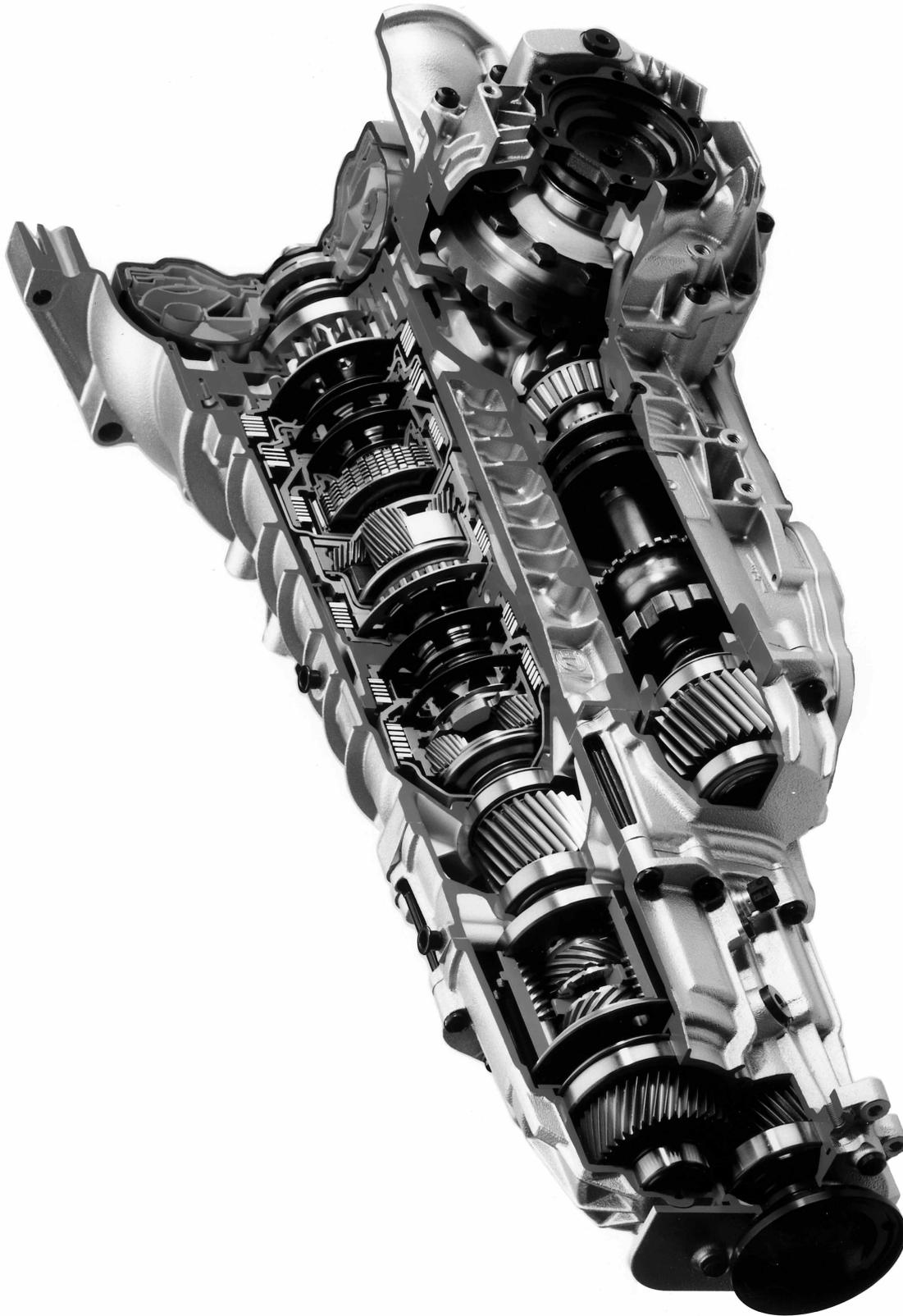
Training Center

Bach

Reus

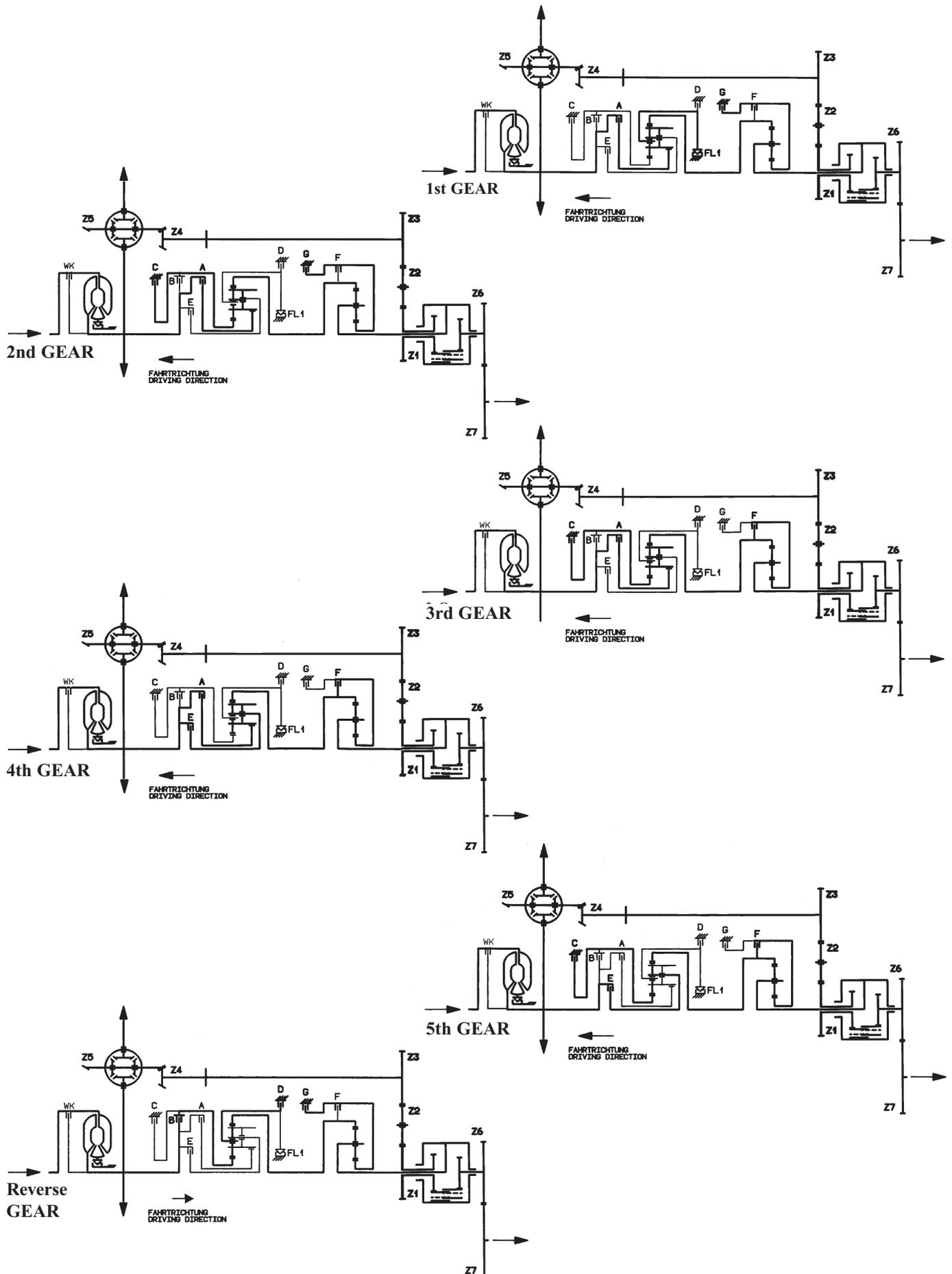
Schultz

4. Allgemeines  
4.1 Abbildung des Getriebes





## 4.2 Power flow diagram

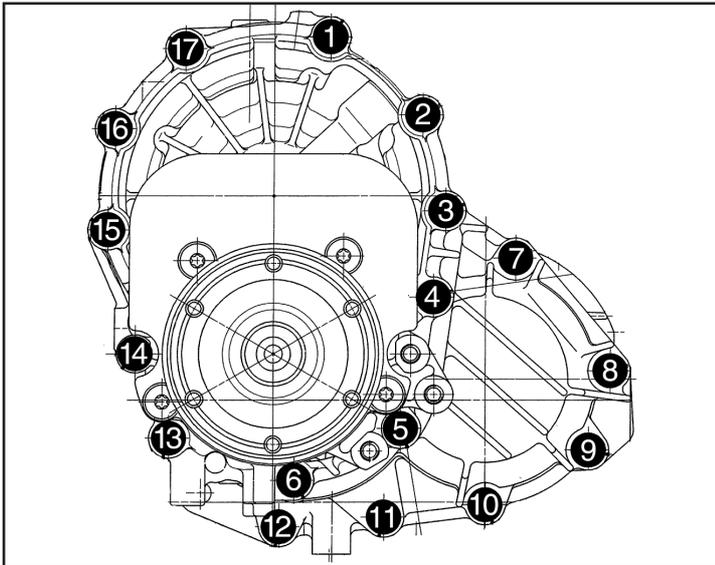




### 4.3 Specifications

#### 4.3.1 Screw connection specifications

##### 4.3.1.1 Transfer box housing



Tighten the screws initially in the following order.

7 ⇨ 12

Then finally tighten the screws in numerical order (see diagram)

1 ⇨ 2 ⇨ 3 ⇨ ... ⇨ 17

**Important:**

The numbers indicate the *actual* order of final tightening.

(Simplification of **specification**

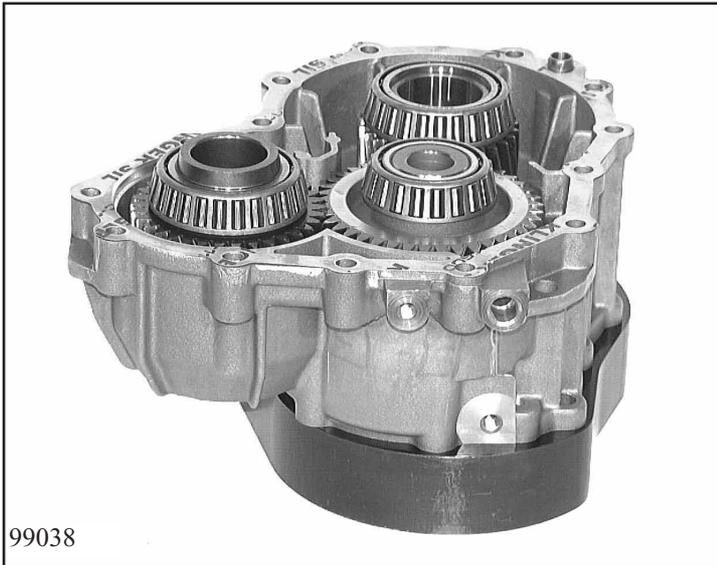
**1060 700 133**)

(Tightening torques: see Chapter 4.5)

When **adjusting the output gear bearings**, omit the screws with the numbers

**4, 5, 6.**





99038

#### 4.4 Output shaft bearing adjustment

##### 4.4.0 Preparations for bearing adjustment (shim washers)

Place the intermediate housing on plate 5p95 002 092 so that the pins enter the holes provided in the plate.  
(The outer bearing races are installed in the intermediate housing without shaft sealing rings.)  
Install the front axle shaft and the intermediate and helical gears in the correct positions in the intermediate housing.  
Place gasket on intermediate housing.

#### **Important:**

This procedure is important to avoid incorrect measurements. The numbers on the teeth face down in the intermediate housing.

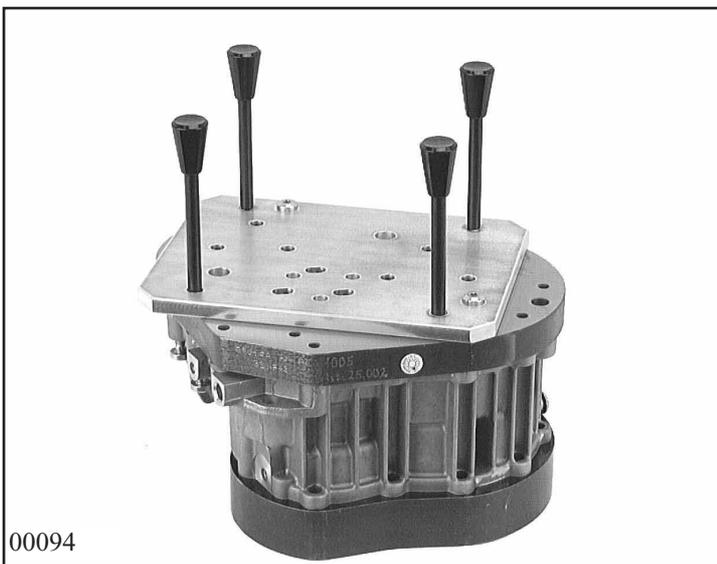


99039

Place measuring plate 5p01 002 704 on the intermediate housing.  
Insert centring ring 5p01 070 357 into the helical gear bore in the measuring plate.  
In the measuring plate, place the outer bearing races on the front axle shaft and the intermediate and helical gears.  
Connect the intermediate housing and the measuring plate together with 6 screws 37.220, tightening only 2 of them at first.

#### **Important:**

Tightening procedure: see Chapter 4.3.1.



00094

Place gear retaining plate 5x46 002 172 on the measuring plate and secure it with 4 M8x25 screws.

(Tightening torque 10 Nm)

Lift the intermediate housing away from the support plate. Use the handles at the gear retaining plate to turn the housing through 180°. Set it down on the handles of the gear retaining plate.

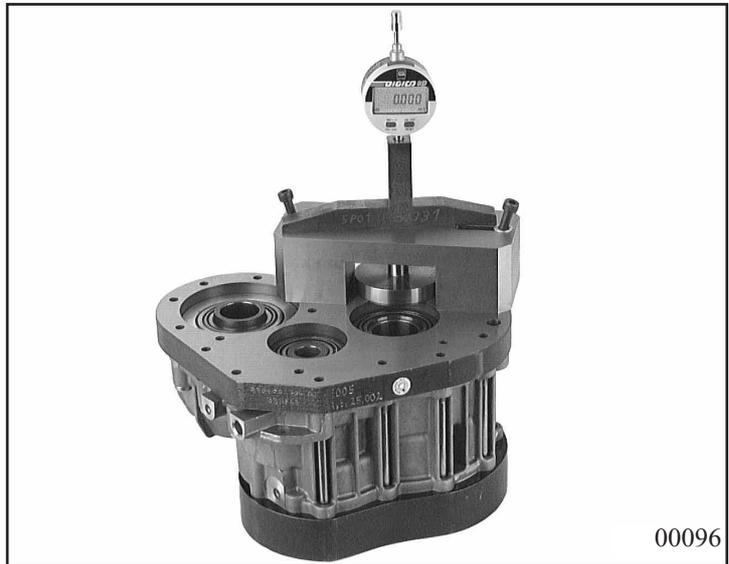
Place the support plate on the intermediate housing.  
 Attach the support plate to the measuring plate with 6 screws 36.290 (M8 x 140) and the intermediate housing to the measuring plate with 6 screws 37.220 (M8 x 45).  
 Turn the intermediate housing through 180°, place it on the support plate and remove the gear retaining plate.

**Important:**  
 Tightening procedure: see Chapter 4.3.1.



#### 4.4.1 Front axle shaft bearing projection

Place pressure bell 5p01 030 357 on the measuring plate.  
 Place measuring bridge 5p01 010 357 over the pressure bell.  
 Place measuring bar 5p01 150 331 on the measuring bridge and set the dial to “0” at the pressure bell.



Place the pressure bell on the front axle shaft outer bearing race.  
 Place the spring of fixture 5p01 000 357 over the pressure bell and fasten the measuring bridge to the corresponding tapped holes in the measuring plate, using 2 M8x80 screws with washers.

(Tightening torque 10 Nm)





Turn the gears .  
Place the measuring bar on the measuring bridge and measure as far as the pressure bell.  
Read off value  $M_{DV}$ .

#### 4.4.2 Projection at helical/intermediate gear bearings

Repeat the procedure for the front axle shaft bearing. Read off values  $M_{DS}$  (for the helical gear) and  $M_{DZ}$  (for the intermediate gear).

**Important:**

Use pressure bell 5p01 020 357 for the intermediate gear.

After measuring the projection value, dismantle the “measuring package” gears again.

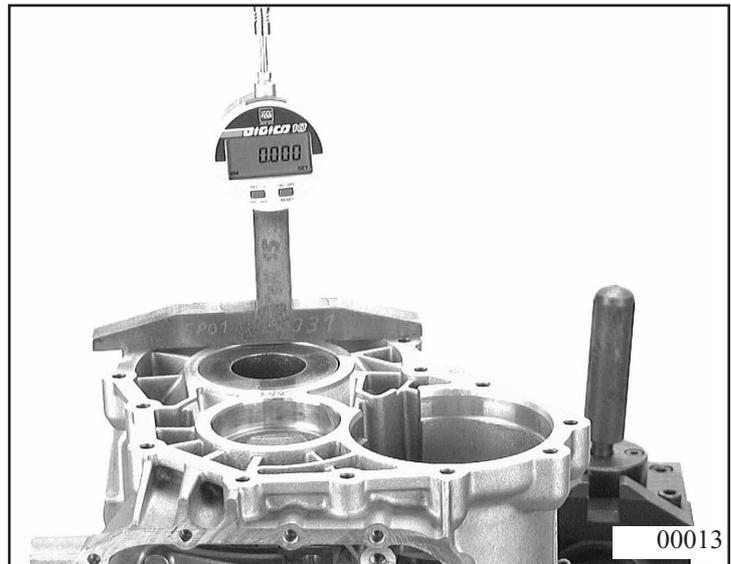
#### 4.4.3 Installation space - front axle shaft

Insert measuring ring 5p01 040 357 into the bore in the front axle shaft bearing. Set the dial to “0” with measuring bar 5p01 150 331 on the transmission housing sealing face.

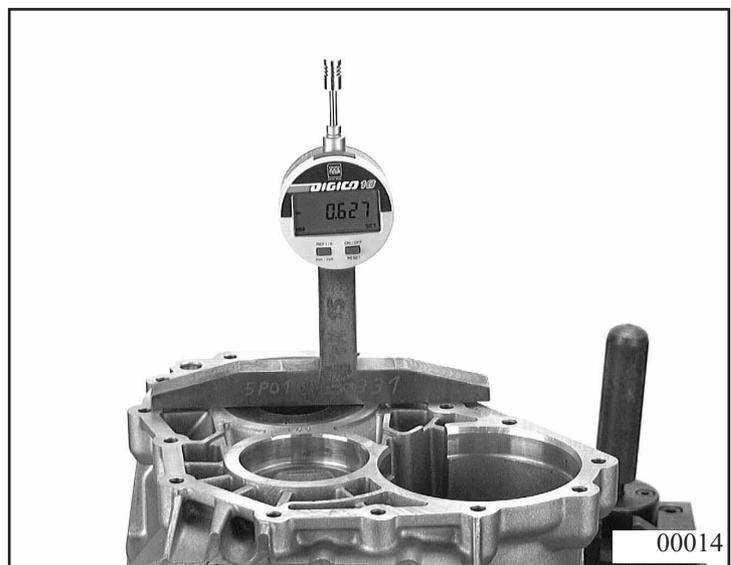
**Note:**

The measuring ring must be properly located in the bore.

*Keep all parts and surrounding areas clean.*



Place the measuring bar on the sealing face of the transmission housing and the dial centrally on the measuring ring, and take reading  $M_{RV} \Rightarrow M_{RV}$



#### 4.4.4 Installation space, intermediate gear

Repeat the procedure for the front axle shaft.

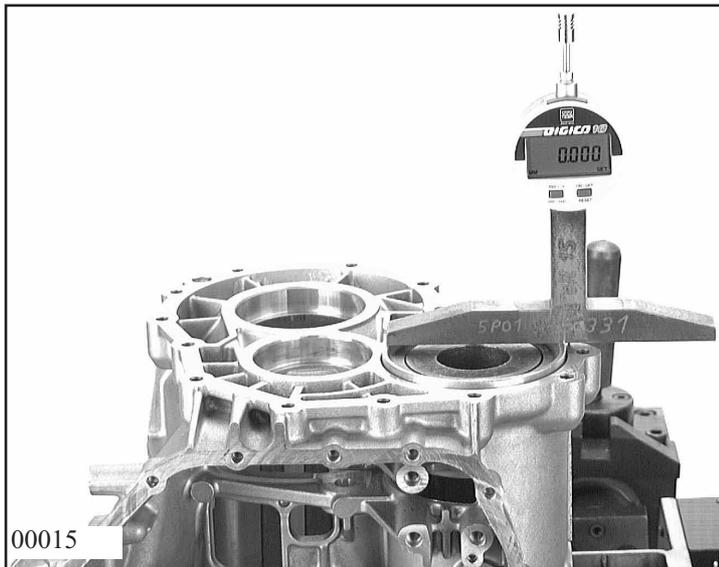
Determine value  $M_{RZ}$ .

$\Rightarrow M_{RZ}$

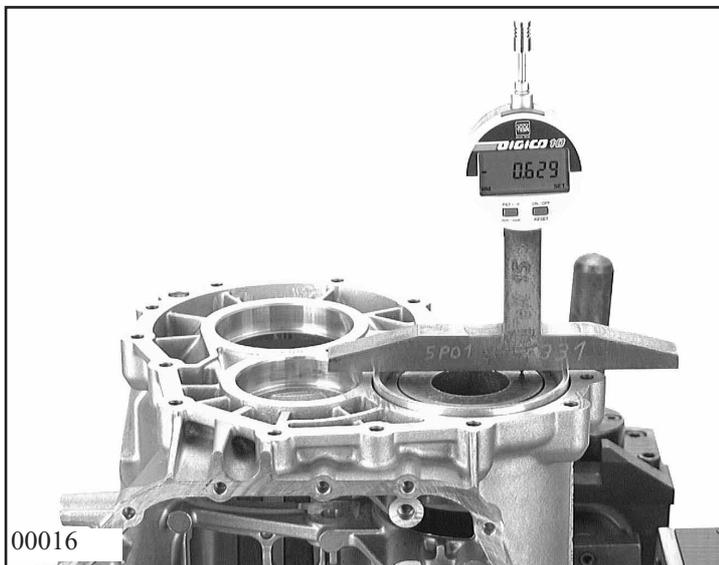
**Important:**

A different measuring ring 5p01 050 357 is used.

#### 4.4.5 Installation space, helical gear



Press bearing race 35.190 into transmission housing.  
Place measuring ring 5p01 040 357 in pinion bearing hole.  
Measure with measuring bar 5p01 150 331 on bearing race against the transmission housing sealing face and set the dial to "0".



Measure down on bearing race and determine value  $M_{RS} \leftrightarrow M_{RS}$

#### Abbreviations:

$K_{RV/RS}$  = meas. ring thickness 5p01 040 357  
 $K_{RZ}$  = measuring ring thickness 5p01 050 357  
 $K_P$  = measuring plate thickness 5p01 002 704

(Front axle shaft, helical/intermediate gears)

$N_V, N_S, N_Z$  = zero line

$B_V, B_S, B_Z$  = installation space

$H_V, H_S, H_Z$  = projection

$M_{RV}, M_{RS}, M_{RZ}$  = installation space  
measured value

$M_{DV}, M_{DS}, M_{DZ}$  = projection measured  
value

$S_V, S_S, S_Z$  = washer thickness

$S_{PV}, S_{PS}$  = play

$V_Z$  = preload

#### 4.4.6 Determining shim thicknesses for front axle shaft and helical and intermediate gears

Use the measured values to determine the desired shim thicknesses.

##### Calculation:

$$B_V = K_{RV} - M_{RV}$$

$$B_S = K_{RS} - M_{RS}$$

$$B_Z = K_{RZ} - M_{RZ}$$

$$H_V = K_P + M_{DV}$$

$$H_S = K_P + M_{DS}$$

$$H_Z = K_P + M_{DZ}$$

$$N_V = B_V - H_V$$

$$N_S = B_S - H_S$$

$$N_Z = B_Z - H_Z$$

$$S_V = N_V - S_{PV}$$

$$S_S = N_S - S_{PS}$$

$$S_Z = N_Z - V_Z$$

##### Important !:

The K values of the measuring rings and measuring plates are engraved on them. Use the K values of your own measuring rings and plates.

##### Adjusting values (acc. to parts list)

Front axle shaft: (play)  $S_{PV}$

Setting: 0 to 0.05 mm

Test value: -0.03 to 0.08 mm

Helical gear: (play)  $S_{PS}$

Setting: 0 to 0.05 mm = play

Test value: -0.03 to 0.08 mm

Intermediate gear: (preload)  $V_Z$

Setting: -0.03 to -0.08 mm =

Test value: 0 to -0.11 mm

##### Important:

For understanding the sign:

+ indicates play ;

- indicates preload

**Example: (for 4.4)****Front axle shaft:**

$$\begin{aligned} K_{RV} &= 15.466 \text{ mm} \\ K_P &= 25.002 \text{ mm} \\ M_{RV} &= -0.627 \text{ mm} \\ M_{DV} &= -10.285 \text{ mm} \\ S_{PV} &= 0 \text{ bis } 0.5 \text{ mm} \end{aligned}$$

$$\begin{aligned} B_V &= 15.466 - (-0.629) \\ &= 16.095 \text{ mm} \\ H_V &= 25.002 + (-10.285) \\ &= 14.717 \text{ mm} \\ N_V &= 16.093 - 14.717 \\ &= 1.378 \text{ mm} \\ S_V &= 1.35 \text{ mm selected} \\ \Rightarrow S_{PV} &= 0.028 \text{ mm (play)} \end{aligned}$$

**Helical gear:**

$$\begin{aligned} K_{RS} &= 15.466 \text{ mm} \\ K_P &= 25.002 \text{ mm} \\ M_{RS} &= -0.624 \text{ mm} \\ M_{DS} &= -10.335 \\ S_{PS} &= 0 \text{ bis } 0.5 \text{ mm} \end{aligned}$$

$$\begin{aligned} B_S &= 15.466 - (-0.624) \\ &= 16.09 \text{ mm} \\ H_S &= 25.002 + (-10.33) \\ &= 14.667 \text{ mm} \\ N_S &= 16.09 - 14.667 \\ &= 1.423 \text{ mm} \\ S_S &= 1.4 \text{ mm selected} \\ \Rightarrow S_{PS} &= 0.023 \text{ mm (play)} \end{aligned}$$

**Intermediate gear:**

$$\begin{aligned} K_{RZ} &= 15.47 \text{ mm} \\ K_P &= 25.002 \text{ mm} \\ M_{RZ} &= -0.622 \text{ mm} \\ M_{DZ} &= -10.135 \text{ mm} \\ V_Z &= -0.03 \text{ bis } -0.08 \text{ mm} \end{aligned}$$

$$\begin{aligned} B_Z &= 15.47 - (-0.622) \\ &= 16.092 \text{ mm} \\ H_Z &= 25.002 + (-10.135) \\ &= 14.867 \text{ mm} \\ N_Z &= 16.092 - 14.867 \\ &= 1.405 \text{ mm} \\ S_Z &= 1.45 \text{ mm selected} \\ \Rightarrow V_Z &= -0.045 \text{ mm (preload)} \end{aligned}$$

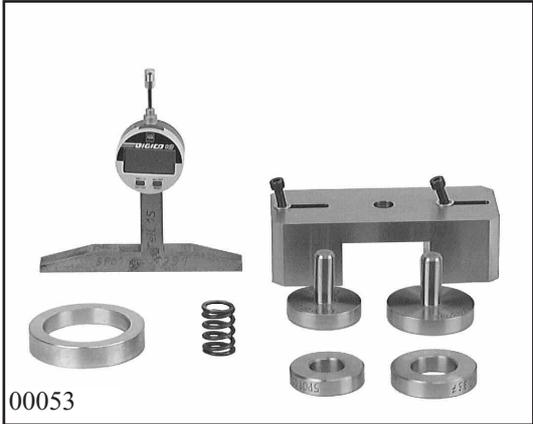


## 1.5 Tightening torques

No.	Designation	Part List- Item-No.	Wrench size No.	Page	Tightening torque [Nm]
1	Hex screw (Torsen II)		Hexagon wrench = 17 mm	6.1/4	62 Nm (± 7 Nm)
2	Machine screw (guide plate)	36.120	TORX - TX 27	6.2/3	10 Nm (± 1 Nm)
3	Machine screw (vibration damper)	36.250	TORX - TX 40	6.2/4	23 Nm (± 2.3 Nm)
4	Machine screw (Setting/initial tightening, intermediate housing)	37.220	TORX - TX 40	4.3/1 4.4/2 6.2/8	10 Nm (± 1 Nm)
	(Final tightening, transfer box interm. housing)	36.290 36.300 37.220		4.3/1 4.4/2 6.2/8	23 Nm (± 2.3 Nm)
5	Expansion bolt (output flange)	36.270	TORX - TX 40	6.2/8	25 Nm (± 2.5 Nm)
6	Drain plug, M12x1.5 (transfer box housing)	36.340	Internal hexagon, 6 mm	6.2/8	20 Nm (± 2 Nm)
7	Filler plug, M18x1,5 (transfer box housing)	36.350	Internal hexagon, 8 mm	6.2/8	35 Nm (± 3.5 Nm)



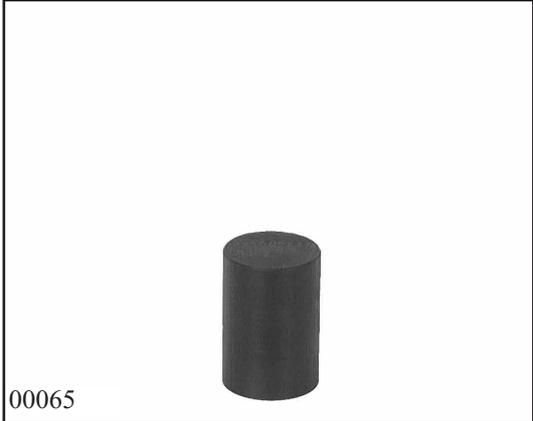
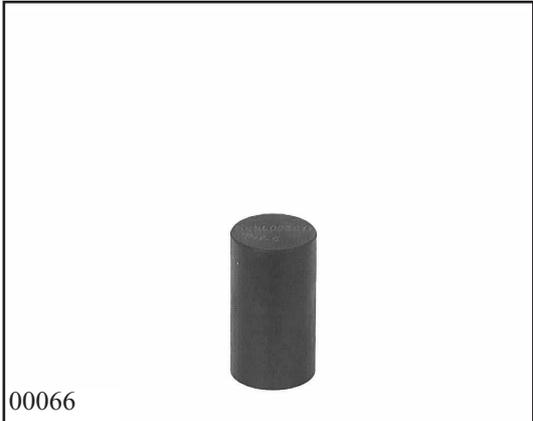
## 4.7 Special tools

OBJECT	Order-No. / Application	Remarks
<p style="text-align: center;">1</p>  <p>00053</p>	<p>5p01 000 357 Measuring plate preload (300N)</p>	<p>Identical 5 HP 19 FL</p>
<p style="text-align: center;">2</p>  <p>99265</p>	<p>5p01 150 331 Measuring bar</p>	<p>Identical 4 HP 20 5 HP 19 FL</p>
<p style="text-align: center;">3</p>  <p>00073</p>	<p>5p95 000 603 Adapter with measuring disc for angle of rotation, Torsen II</p>	

Remarks	Order-No. / Application	OBJECT
	<p>5p95 002 092 Spacing ring support, intermediate housing</p>	<p style="text-align: center;">4</p>  <p style="text-align: right;">99279</p>
	<p>5x46 001 327 Drift, vibration damper shaft sealing ring</p>	<p style="text-align: center;">5</p>  <p style="text-align: right;">99282</p>
	<p>5x46 001 332 Assembly fixture, front axle shaft sealing ring</p>	<p style="text-align: center;">6</p>  <p style="text-align: right;">99278</p>

OBJECT	Order-No. / Application	Remarks
<p style="text-align: center;">7</p> <div style="border: 1px solid black; padding: 10px; text-align: center;">  <p>99276</p> </div>	<p>5x46 001 339 Mounting sleeve, front axle shaft sealing ring</p>	
<p style="text-align: center;">8</p> <div style="border: 1px solid black; padding: 10px; text-align: center;">  <p>99277</p> </div>	<p>5x46 001 535 Mounting sleeve, intermediate housing shaft sealing ring</p>	
<p style="text-align: center;">9</p> <div style="border: 1px solid black; padding: 10px; text-align: center;">  <p>98171</p> </div>	<p>5x46 001 955 Core insert, intermediate gear</p>	<p>Identical  4 HP 20 5 HP 19 FL</p>

Remarks	Order-No. / Application	OBJECT
<p>Identical</p> <p>4 HP 20</p>	<p>5x46 001 956 Core insert, pinion and helical gear</p>	<p style="text-align: center;"><b>10</b></p> <div style="border: 1px solid black; width: 100%; height: 100%; position: relative;">  <p style="text-align: right; margin-top: 10px;">98168</p> </div>
<p>Identical</p> <p>4 HP 20</p>	<p>5x46 002 000 Core insert for ROLLEX puller (front axle shaft)</p>	<p style="text-align: center;"><b>11</b></p> <div style="border: 1px solid black; width: 100%; height: 100%; position: relative;">  <p style="text-align: right; margin-top: 10px;">98169</p> </div>
<p>Identical</p> <p>5 HP 19 FL</p>	<p>5x46 002 165 Transmission mounting bracket</p>	<p style="text-align: center;"><b>12</b></p> <div style="border: 1px solid black; width: 100%; height: 100%; position: relative;">  <p style="text-align: right; margin-top: 10px;">99246</p> </div>

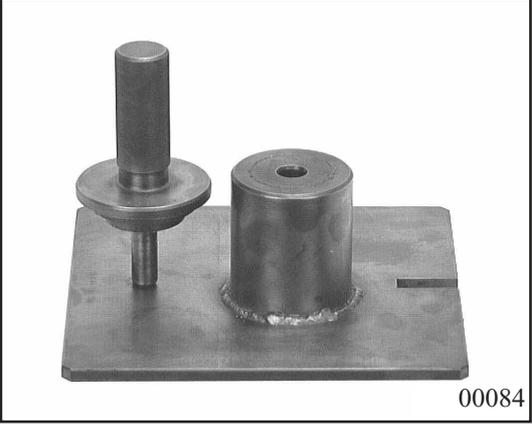
OBJECT	Order-No. / Application	Remarks
<p style="text-align: center;"><b>13</b></p> 	<p>5x46 002 173 Gear retaining plate</p>	<p>Identical  5 HP 19 FL</p>
<p style="text-align: center;"><b>14</b></p> 	<p>5x46 002 218 Drift for inner bearing race, pinion and helical gear</p>	<p>Identical  5 HP 19 FL</p>
<p style="text-align: center;"><b>15</b></p> 	<p>5x46 002 219 Drift for inner bearing race, inter- mediate gear</p>	<p>Identical  5 HP 19 FL</p>

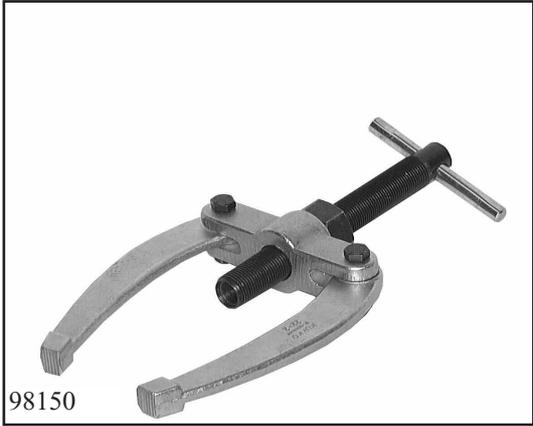
Remarks	Order-No. / Application	OBJECT
	<p>5x46 002 257 Sleeve for roller bearing, front axle shaft</p>	<p style="text-align: center;"><b>16</b></p> <div style="border: 1px solid black; padding: 10px; text-align: center;">  <p style="text-align: right;">00074</p> </div>
	<p>5x46 002 259 Drift for output gear needle roller sleeve, transfer box housing</p>	<p style="text-align: center;"><b>17</b></p> <div style="border: 1px solid black; padding: 10px; text-align: center;">  <p style="text-align: right;">00075</p> </div>
	<p>5x46 002 261 Drift for rear axle shaft needle roller sleeve, transfer box housing</p>	<p style="text-align: center;"><b>18</b></p> <div style="border: 1px solid black; padding: 10px; text-align: center;">  <p style="text-align: right;">00076</p> </div>

OBJECT	Order-No. / Application	Remarks
<p style="text-align: center;"><b>19</b></p> <div style="border: 1px solid black; padding: 10px; text-align: center;">  <p>00077</p> </div>	<p>5x46 002 262 Retaining fixture, Torsen II</p>	
<p style="text-align: center;"><b>20</b></p> <div style="border: 1px solid black; padding: 10px; text-align: center;">  <p>99281</p> </div>	<p>5x46 002 273 Puller for output gear ball bearing, Rillex 6210</p>	
<p style="text-align: center;"><b>21</b></p> <div style="border: 1px solid black; padding: 10px; text-align: center;">  <p>99280</p> </div>	<p>5x46 002 274 Puller for rear axle shaft ball bearing, Rillex 6211</p>	

Remarks	Order-No. / Application	OBJECT
	5x46 002 275 Core insert, rear axle shaft	<p style="text-align: center;"><b>22</b></p> <div style="border: 1px solid black; padding: 10px; text-align: center;">  <p style="text-align: right;">00078</p> </div>
	5x46 002 276 Core insert, output gear	<p style="text-align: center;"><b>23</b></p> <div style="border: 1px solid black; padding: 10px; text-align: center;">  <p style="text-align: right;">00079</p> </div>
	5x46 002 277 Pressing-out drift, output gear, transfer box housing	<p style="text-align: center;"><b>24</b></p> <div style="border: 1px solid black; padding: 10px; text-align: center;">  <p style="text-align: right;">00080</p> </div>

OBJECT	Order-No. / Application	Remarks
<p style="text-align: center;"><b>25</b></p> <div style="border: 1px solid black; padding: 10px; margin-bottom: 10px;">  <p>00081</p> </div>	<p>5x46 002 278 Pressing-out drift, output gear nut</p>	
<p style="text-align: center;"><b>26</b></p> <div style="border: 1px solid black; padding: 10px; margin-bottom: 10px;">  <p>00082</p> </div>	<p>5x46 002 280 Sleeve for rear axle shaft ball bearing</p>	
<p style="text-align: center;"><b>27</b></p> <div style="border: 1px solid black; padding: 10px;">  <p>00083</p> </div>	<p>5x46 002 281 Sleeve for output gear ball bearing</p>	

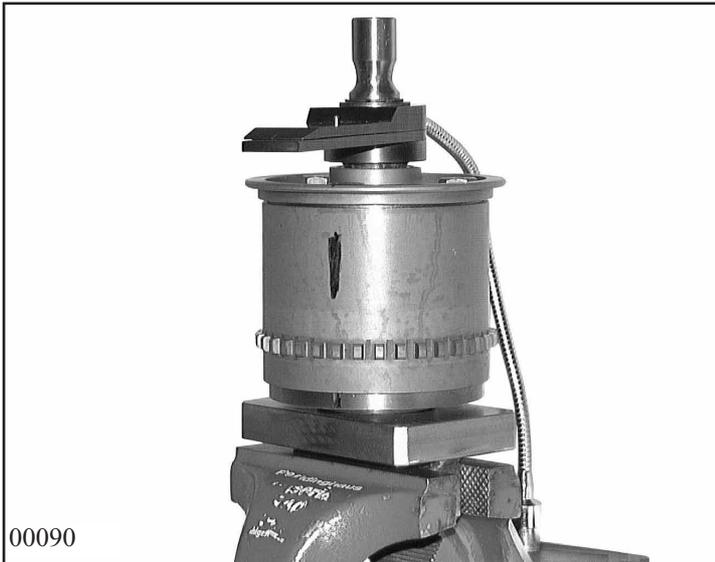
Remarks	Order-No. / Application	OBJECT
	<p>5x46 002 282  Assembly fixture, intermediate housing shaft sealing ring</p>	<p style="text-align: center;"><b>28</b></p>  <p style="text-align: right;">00084</p>
<p>Identical</p> <p>3 HP 22 Q  4 HP 14 Q  4 HP 18 Q  4 HP 20</p>	<p>5x46 010 011  Basic puller unit for inner bearing race, Rollex 10001</p>	<p style="text-align: center;"><b>29</b></p>  <p style="text-align: right;">98152</p>
<p>Identical</p> <p>4 HP 14 Q  4 HP 18 Q  4 HP 20  5 HP 19 FL</p>	<p>5x46 021 007  Kukko 21/7 puller</p> <p>or</p> <p>5x46 021 008  Kukko 21/8 puller</p>	<p style="text-align: center;"><b>30</b></p>  <p style="text-align: right;">98149</p>

OBJECT	Order-No. / Application	Remarks
<p style="text-align: center;"><b>31</b></p>  <p style="text-align: center;"><b>32</b></p>  <p style="text-align: center;"><b>33</b></p> 	<p>5x46 022 002 Kukko 22-2 puller (basic unit)</p> <p>5x46 032 010 Rollex 32010X/1 puller (gears)</p> <p>5x46 485 481 Puller for inner bearing race, Rollex 48548</p>	<p>Identical</p> <p>4 HP 14 Q 4 HP 18 Q 4 HP 20 5 HP 19 FL</p> <p>Identical</p> <p>4 HP 20</p>

Remarks	Order-No. / Application	OBJECT
Identical  4 HP 18 Q 4 HP 20 5 HP 19 FL	5x46 501 349 Puller for inner bearing race, Rollex 501349	<p style="text-align: center;"><b>34</b></p> <div style="border: 1px solid black; padding: 10px; text-align: center;">  <p style="text-align: right; margin-top: 5px;">99269</p> </div>
	5x46 503 491 Rollex puller, size IA (basic unit)	<p style="text-align: center;"><b>35</b></p> <div style="border: 1px solid black; padding: 10px; text-align: center;">  <p style="text-align: right; margin-top: 5px;">98151</p> </div>

## 4.8 Functional check

### 4.8.1 Checking backlash, Torsen II (angle)



Clamp retaining fixture 5x46 002 262 into the vice.

Position Torsen II in retaining fixture with screw heads upwards.

Insert adapted with angle washer 5p95 000 603 into the rear sun gear splines.



Place the torque wrench on the adapter with angle measuring disc and set to "0" while pressing the wrench lightly against the stop in a clockwise direction.

Turn the torque wrench clockwise until a torque of 10 Nm is reached.

Read off the angle  $M_W$  at the scale on the angle measuring disc.

**(Scale: 0.5° between markings)**

Max. angle = 2.8° (bei 10 Nm).

If a higher angle reading is obtained, renew Torsen II.

#### **Important:**

Include play  $S_{PW}$  - if present - between the adapter and the torque wrench in the angle calculation. Determine  $S_{PW}$  by trial and error.

#### **Calculation:**

$$M_{WR} = M_W - S_{PW}$$

**Example:**

$$S_{PW} = 0.2^\circ$$

$$M_W = 1.75^\circ \text{ (angle reading)}$$

$$\begin{aligned} M_{WR} &= 1.75^\circ - 0.2^\circ \\ &= 1.55^\circ \end{aligned}$$

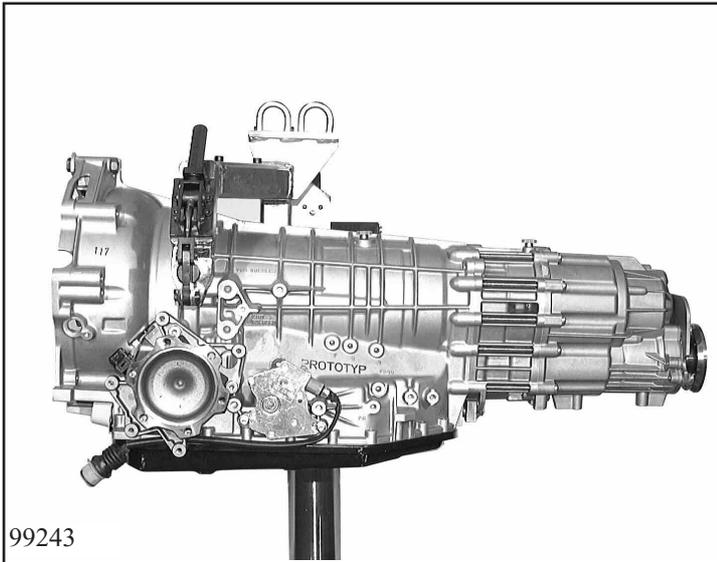
Actual angle:

$$M_{WR} = 1.55^\circ$$

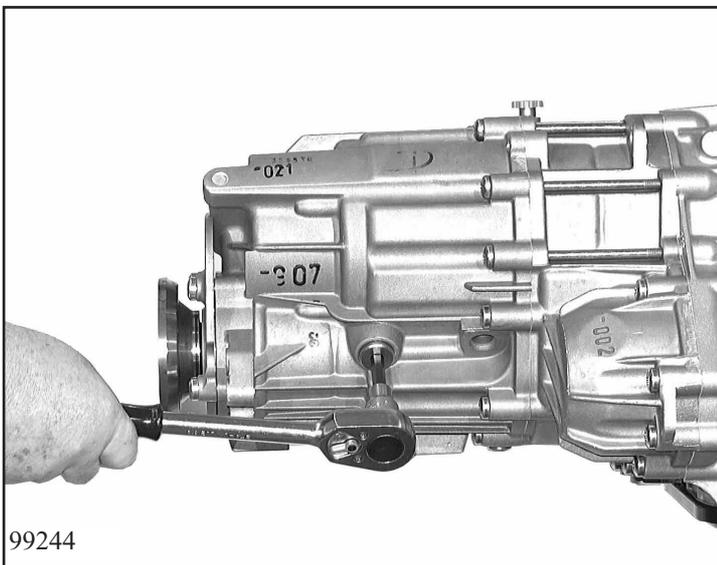
## 5. Removal

### 5.1 Rear axle output with Torsen II

Attach the transmission to assembly bracket 5x46 002 165 and mount on assembly truck or workbench holder 5x46 000 763 with the oil pan at the bottom.



Take out the oil drain and filler plugs so that the oil can be drained out of the transfer box housing.



(Internal hexagon wrench, 6 or 8 mm)

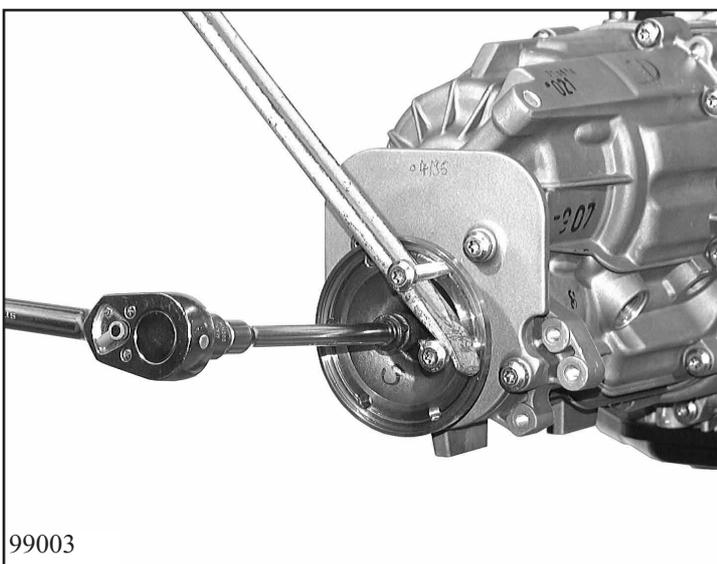
#### **Important:**

The transmission contains three quantities of oil.

Prevent the output flange from rotating and take out the expansion bolt. Take off the output flange. Take out the 4 screws holding the vibration damper and remove it.

Turn the transmission through 90° (transfer box housing at the top).

(Wrench size = Torx TX-40)



Take out the 11 screws holding the transfer box housing and lift it off.  
(The gasket tends to stick and the housing should therefore be struck with a plastic-faced hammer if necessary.)  
Remove the gasket from the housing.  
The cylindrical pins should remain in the intermediate housing. Lift the Torsen II unit away from the output and front axle shafts.

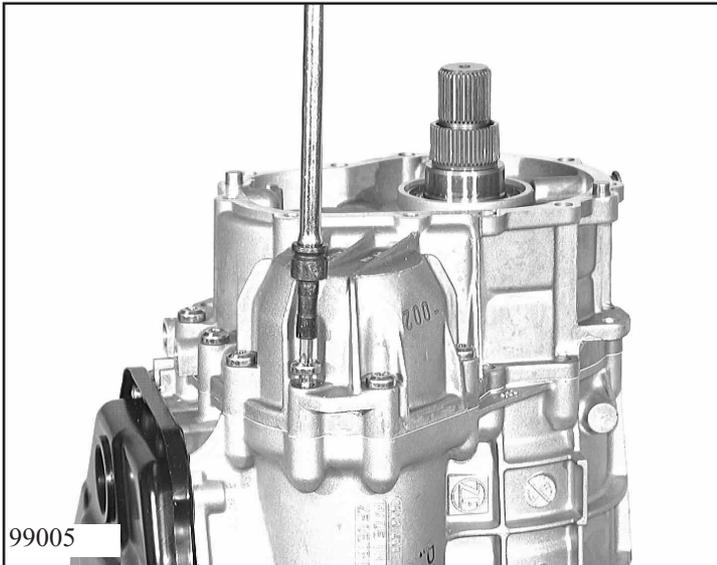
**Warning:**

Oil can run out of the Torsen II unit.  
(Wrench size = Torx TX-40)



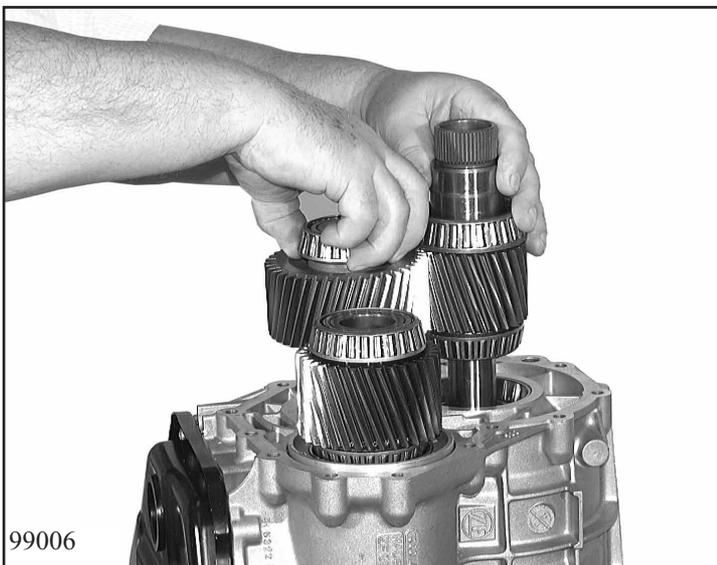
99004

## 5.2 Front axle output



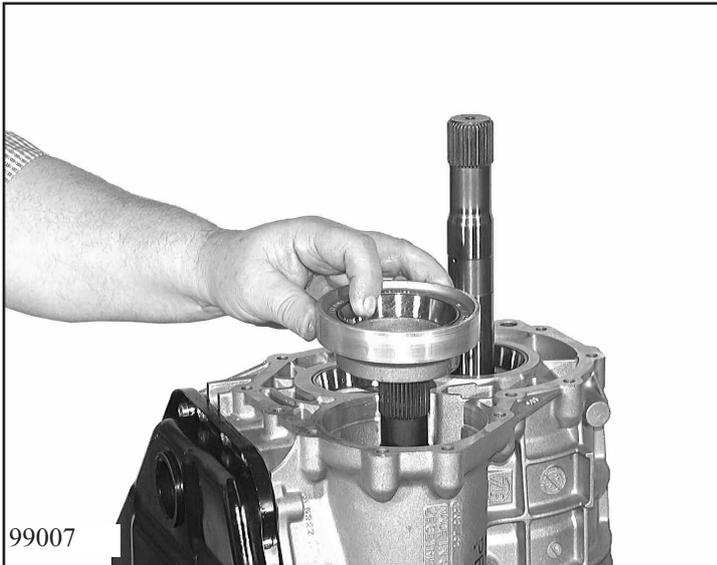
Take off breather cover.  
Remove the 6 screws and lift the intermediate housing away from the transmission housing.  
(The gasket tends to stick and the housing should therefore be struck with a plastic-faced hammer if necessary.)  
The locating sleeve should remain in the intermediate housing.

(Wrench size = Torx TX-40)



Remove the gasket from the housing.  
Take the magnet out of the intermediate housing.  
Lift the intermediate gear and front axle shaft away from the transmission housing together, followed by the helical gear.  
Take the shim washer off the output shaft.





### 5.3 Removing parts from transmission housing

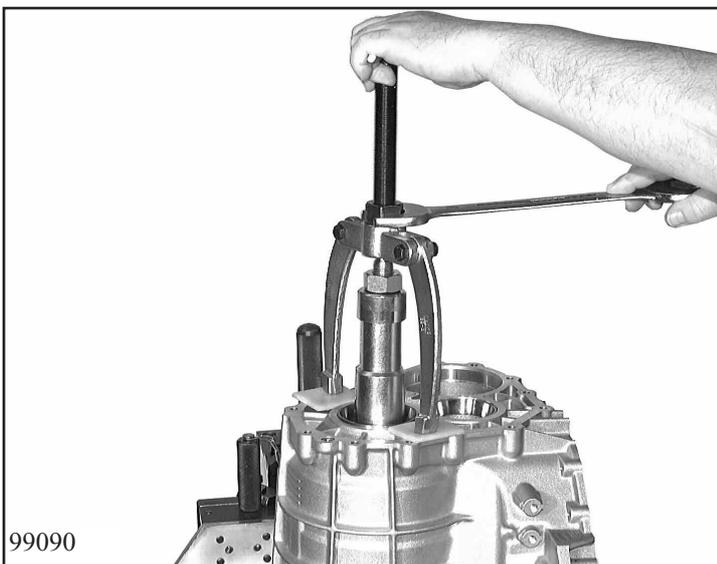
Detach spring from pinion shaft.  
Remove bearing retaining ring by hand or with a 2-arm puller.

Heat the bearing race with a hot air blower and remove the outer bearing race and shim washer. Make sure that the shim washer and outer bearing race are kept with the correct bearing.

**Important:**

Do not damage the sealing face.

Continue removal work as described in the section for the 5HP19 FL.



Remove the outer bearing races from the transmission housing with tool 5x46 022 002 combined with 5x46 021 008 or 5x46 021 007.

**Important:**

A plastic plate must always be placed between the support bracket and the sealing face, or else the sealing face will be damaged beyond repair. Make sure that the outer bearing races and shim washers are kept with the correct bearings.

Do not accidentally interchange them  
⇨ noise problems ⇨ transmission failure



## Dismantling

### 5.4 Helical/intermediate gears and front axle shaft

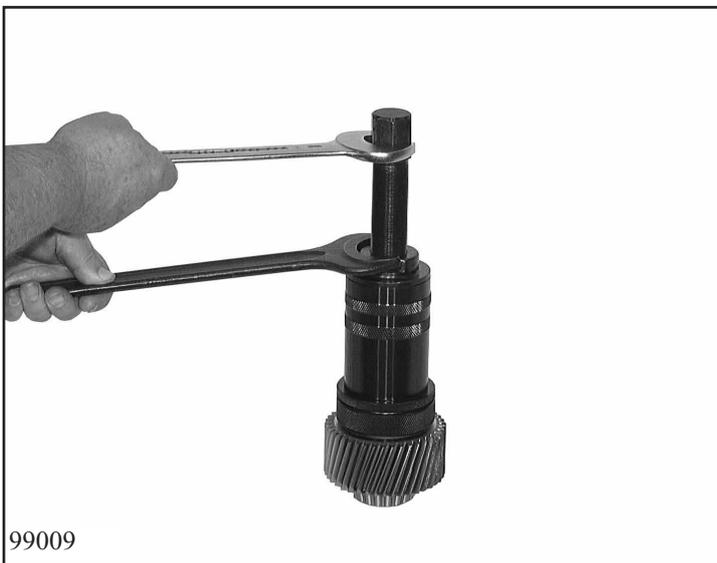
#### 5.4.1 Helical gear

Using puller (Rollex 501349) 5x46 501 349, core insert 5x46 001 956 and basic unit (Rollex 1A) 5x46 503 491, pull off both inner bearing races.



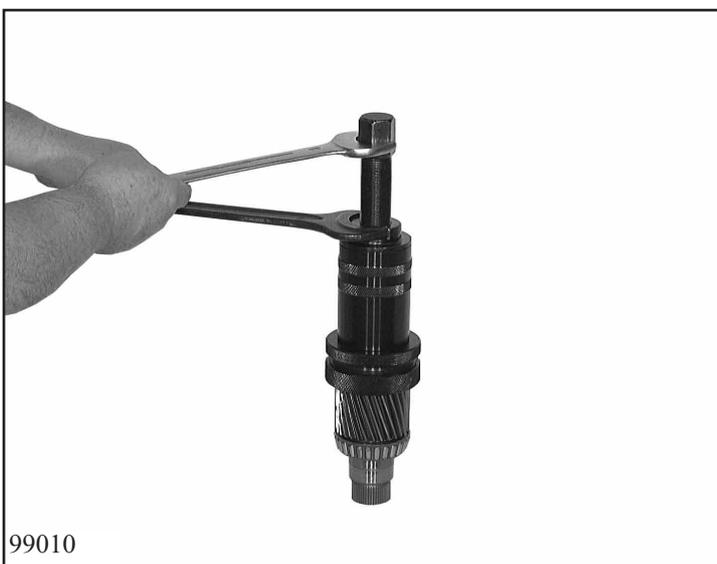
#### 5.4.2 Intermediate gear

Using puller (Rollex 48548) 5x46 485 481, core insert 5x46 001 955 and basic unit (Rollex 1A) 5x46 503 491, pull off both inner bearing races.



#### 5.4.3 Front axle shaft

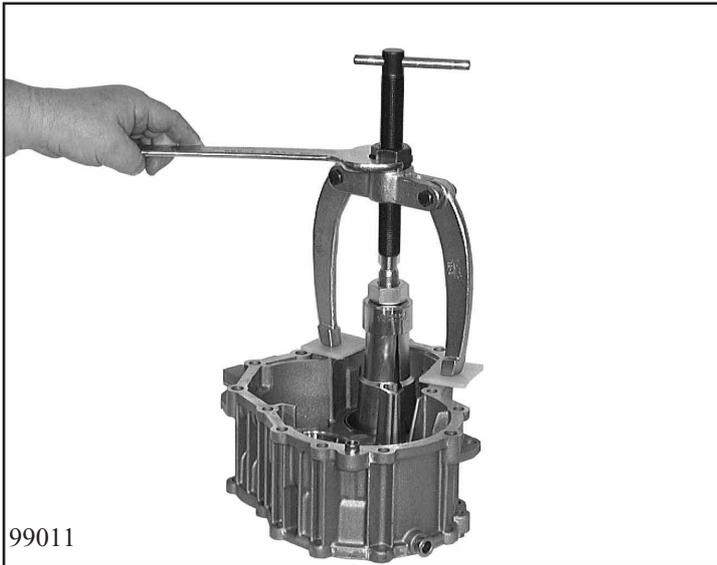
Drive the shaft sealing ring out of the front axle shaft with a suitable tool. Using puller 5x46 032 010 (Rollex 32010x1), core insert 5x46 002 000 and basic unit 5x46 503 491 (Rollex 1A), pull off the large inner bearing race. Using puller 5x46 501 349 (Rollex 501349) and core insert 5x46 001 956, pull off the small inner bearing race.





## 5.5 Housing sections

### 5.5.1 Intermediate housing



Drive the shaft sealing ring out of the intermediate housing with a suitable tool. Remove outer bearing races with tool 5x46 022 002 (Kukko 22-2) combined with 5x46 021 008 (Kukko 21-8) or 5x46 021 007 (Kukko 21-7).

#### **Warning:**

Protect sealing faces against damage with plastic plates. The outer bearing races must remain with the correct bearings, or else noise problems will result. *Do not accidentally confuse them!* The breather remains in the housing unless damaged.

### 5.5.2 Vibration damper



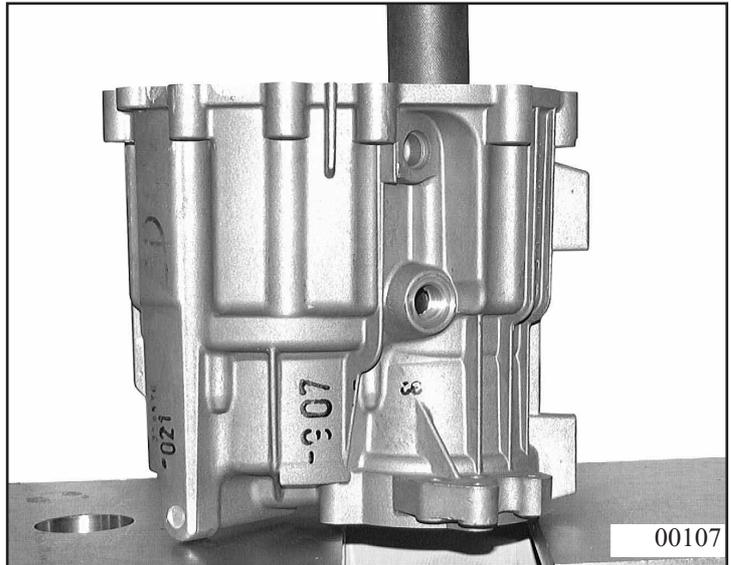
Drive the shaft sealing ring out with a suitable tool, and take it off.

### 5.5.3 Transfer box housing



Using drift 5x46 002 278, press the nut for the expansion bolt (output flange) out of the output gear in the mandrel press.

Using drift 5x46 002 277, force the output gear out in the press.

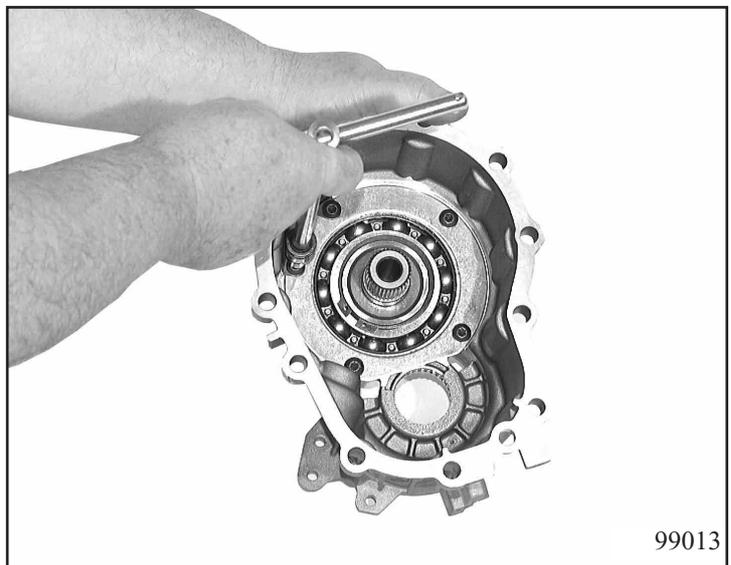


**Important:**

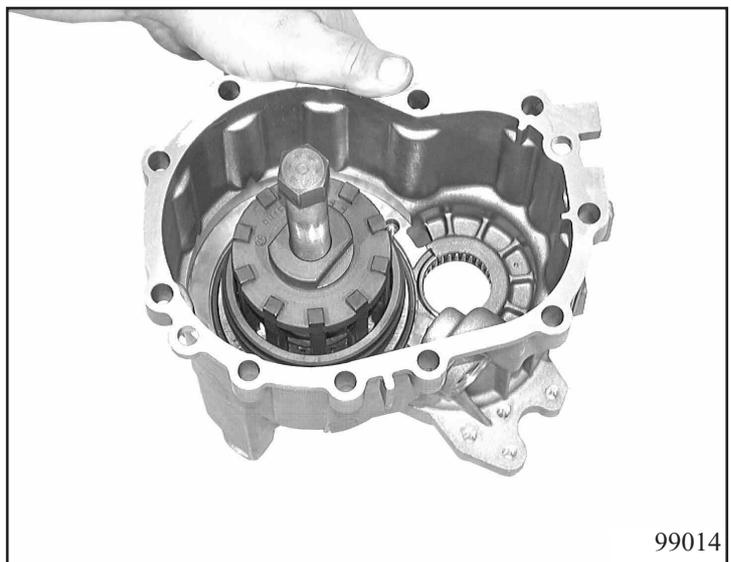
Do not drop the output gear.

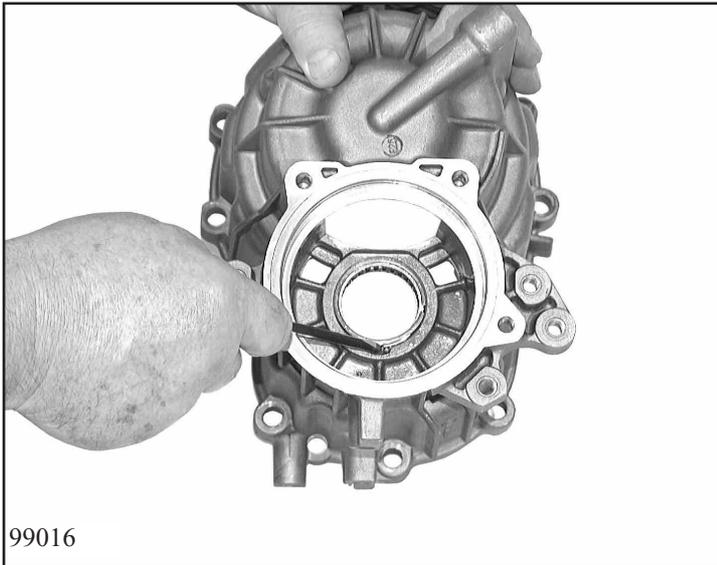
Remove the two screws from the oil dam and take it off.  
Remove the 3 remaining screws from the disc and take it off.

(Wrench size = Torx TX-27)



Mount ball bearing puller 5x46 002 274 on the rear axle shaft ball bearing.  
Tighten the puller spindle firmly until the rear axle shaft moves out.





#### 5.5.4 Removing both needle roller sleeves

Disengage the snap rings with a screwdriver.

**Note:**

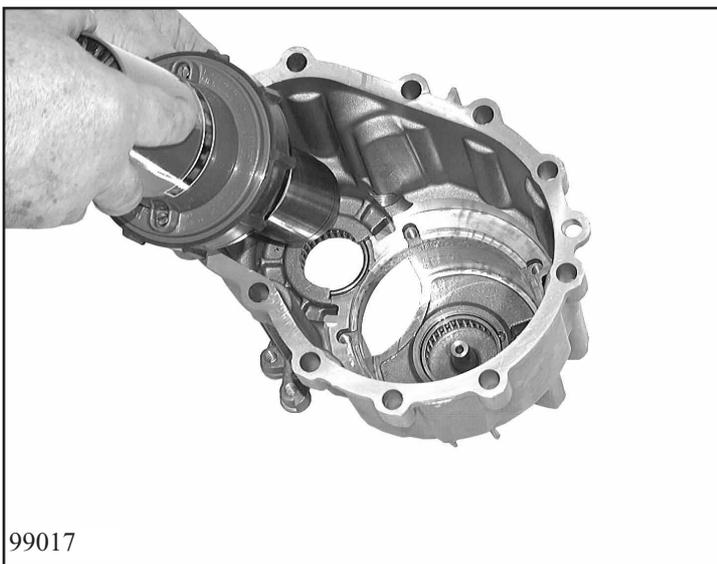
The snap rings may be difficult to remove.

To avoid this difficulty the **following procedures** can be adopted:

- 1) Mill away the groove at the snap ring seat in order to be able to insert the screwdriver blade behind the snap ring. (**Warning:** metal swarf)
- 2) Renew the transfer box housing (order a housing with cutouts at the snap ring seats).

**Note:**

From transmission No. 130 000, date of manufacture 01.04.99, cutouts have been provided at the snap ring seats.



Heat the transfer box housing at the needle roller sleeve seats with a hot air blower and pull the needle roller sleeves out with a suitably bent and pointed piece of welding rod.

(If the surrounding area is heated correctly, the sleeves will fall out easily.)



## 5.6 Rear axle shaft and output gear

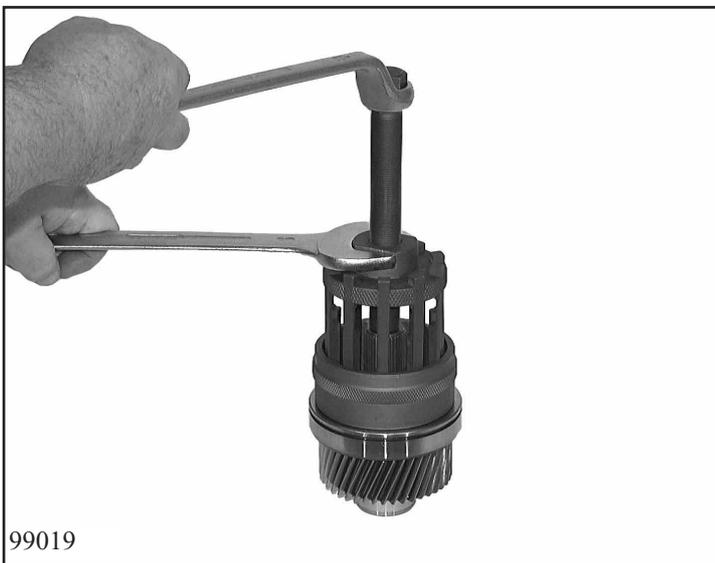
### 5.6.1 Rear axle shaft



Remove the circlip with suitable pliers.  
Remove the snap ring with suitable pliers.

Take off the ball bearing with puller 5x46 002 274 and core insert 5x46 002 275.

### 5.6.2 Output gear



Disengage the circlip with suitable pliers.  
Take off the ball bearing with puller 5x46 002 273 and core insert 5x46 002 276.



## 5.7 Dismantling Torsen II unit

Check Torsen II backlash before dismantling.

(see Functional check chapter 4.8)

### **Important:**

The Torsen II unit must always be re-assembled in exactly the same way as before it was dismantled.

All parts must be used at the same points.

### **Warning:**

Risk of noise, reduced locking action.



Clamp retaining fixture 5x46 002 262 into the vice.

Position the Torsen II unit in the fixture with the screw heads at the top.

Mark the relative positions of the parts with an electric scribe on their covers and housings. Take out the 3 screws and strike the cover lightly on its edge with a plastic-faced hammer to dislodge it. Then lift the Torsen II unit out of the retaining fixture.

(Wrench size = SW 17 mm)



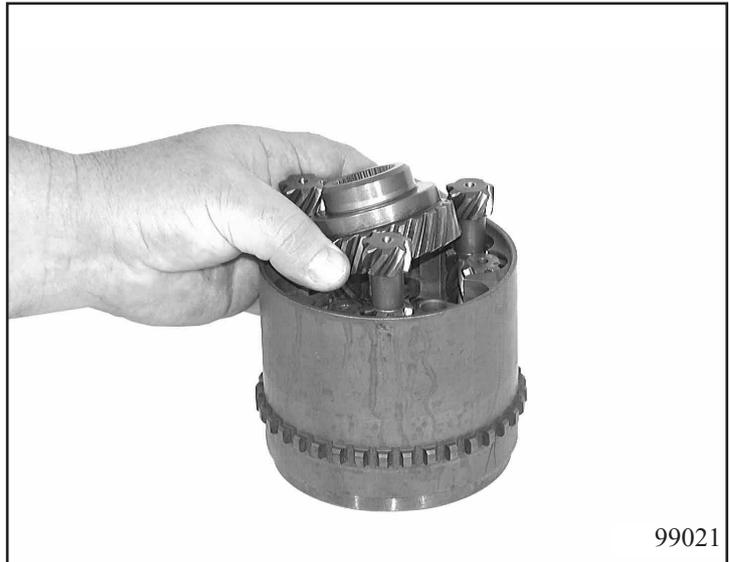
Mark the planet gear pairs with an electric scribe in a similar way, that is to say with circles, crosses or lines on their faces. Mark the meshing teeth and tooth gaps with lines so that they can be identified again later.

Mark the same symbol on the pockets for the pairs of planet wheels on the outside of the housing.

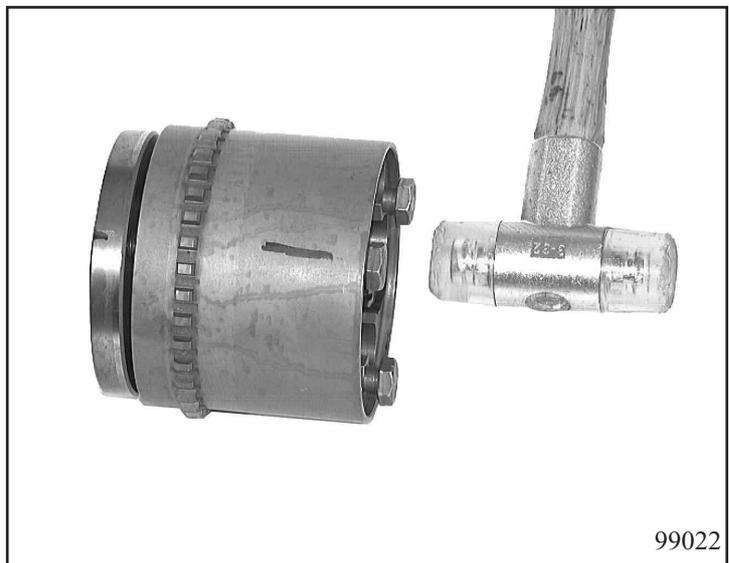
Take off the thrust washer.  
Raise the rear sun gear and with it one planet gear from each pair. Tilt the sun gear until it can be separated from the planet gear and taken out.  
Start to remove the planet gears that are first in sequence, looking clockwise. These have a tooth gap at the top.  
Take off the thrust washer.

**Note:**

One narrow and three identical wide thrust washers are installed.



Insert three screws through the housing into the lower cover and screw them in by at least 5 turns of their threads.  
Place the housing horizontal on the work bench.  
Strike the screw heads lightly with a plastic-faced hammer to drive the cover out of the housing.  
After this, remove the three screws from the cover.  
Remove the cover, thrust washer, the remaining 3 planet gears and the thrust washer.



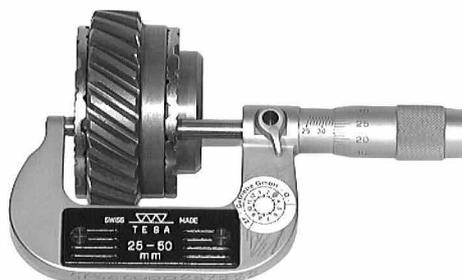
## 6. Installation



99023

### 6.1 Torsen II

Before installing the sun gears, measure the height of the stack comprising the friction disc, sun gear and second friction disc.



99024

#### **Important:**

This dimension must be  $33.255 \text{ mm} \pm 0.025 \text{ mm}$ ; failing this, renew the Torsen II unit.

Place the cover with the larger needle roller sleeve on the workbench with the outside facing down.

Place a narrow thrust washer around the cover bore.

Place the front sun gear on the thrust washer and guide it into the bore in the cover.

Place a broad thrust washer on the sun gear. Place the three pairs of planet gears on the running marks in the cover as indicated by their markings and engage them with the sun gear.



When looking clockwise, the first planet gear of each pair has the tooth gap at the top. Mesh the planet gears together and with the front sun gear.

**Important:**

Looking outwards from the longitudinal axis of the Torsen II unit and towards the pairs of planet gears, their teeth taper towards the top in a manner similar to the appearance of a fir tree.



Place the housing over the planet gears in accordance with the markings and position the front sun gear on the cover.

**Note:**

To check whether the cover and housing are accurately located, insert screws from the top through the housing into the cover.

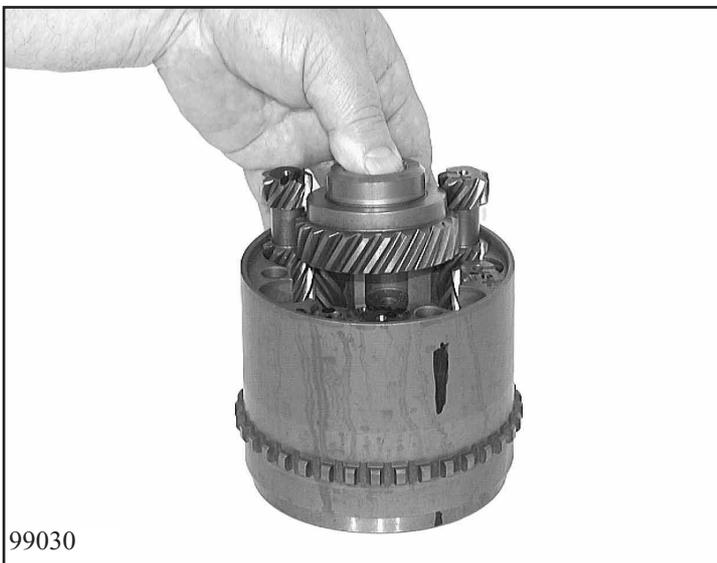
(They must screw in easily by hand.)





Move the housing up evenly until it is in contact with the cover, and press it in with light blows of a plastic-faced hammer. Take out the screws. Turn the planet gear several times. Insert a wide thrust washer into the housing.

99029



Install the rear sun gear.

**Note:**

This is rather difficult the first time and calls for skilled manipulation with the fingers. Is then easier.

Looking clockwise, pull the 2 front planet gears (those with the tooth gap at the top) upwards out of the housing by about 40 mm.

Engage the sun gear teeth in the planet gear tooth gaps.

Tilt the sun gear upwards, away from the third pair of planet gears.

99030



Pull the third planet gear (with the tooth gap at the top) out of the housing.

Tilt the sun gear back so that the sun gear teeth mesh with the teeth gaps in the planet gears.

Guide the sun gear with planet gears slowly downwards.

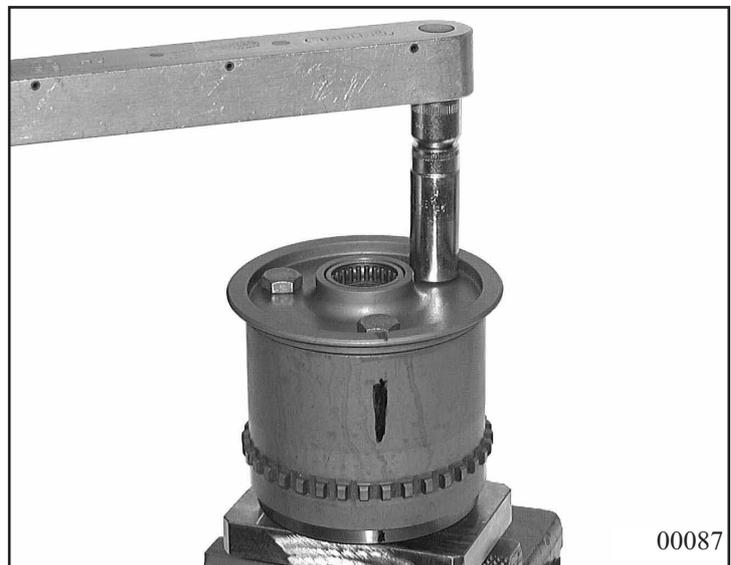
99028

By turning the sun gear in either direction, its teeth can be meshed with those of the planet gears that were not raised. After this has been done, the three raised planet gears will also engage easily with the teeth of the front planet gear. Check that the markings on the planet gears are matched. Place a wide thrust washer on the rear sun gear. Place the cover on the housing as indicated by the markings.



Insert three new screws and tighten them initially by hand. Clamp retaining fixture 5x46 002 262 into the vice. Place the Torsen II unit in the retaining fixture with the screw heads uppermost. Tighten the screws uniformly so that the cover does not tilt. Remove the Torsen II unit from the retaining fixture. Check the Torsen II unit for free rotation by turning the front or rear axle shaft.

(Tightening torques: see Chapter 1.5)





### 6.2.1.1 Output gear

Using sleeve 5x46 002 281 in the mandrel press, force ball bearing 36.180/120 on to the output gear and secure it with circlip 36.180/130.



### 6.2.1.2 Rear axle shaft

Using sleeve 5x46 002 280 in the mandrel press, force ball bearing 36.060/130 on to the rear axle shaft. Install circlip 36.060/150 with suitable pliers. Insert snap ring 36.060/140 into the groove on the ball bearing with suitable pliers.



### 6.2.1.3 Vibration damper

Using drift 5x46 001 327, install shaft sealing ring 36.230/120 in the mandrel press. Install sealing ring 36.250 on the vibration damper.

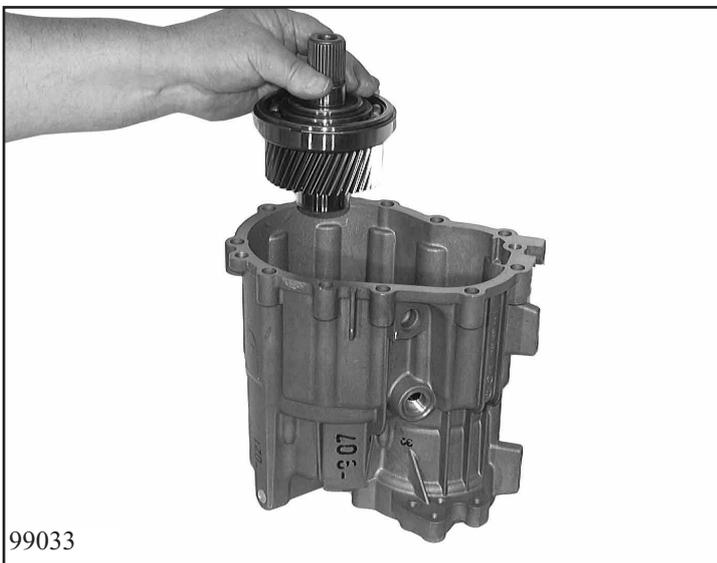


#### 6.2.1.4 Transfer box housing



Using drift 5x46 002 259 in the mandrel press, force needle roller sleeve 36.130 into the transfer box housing and secure with snap ring 36.150.

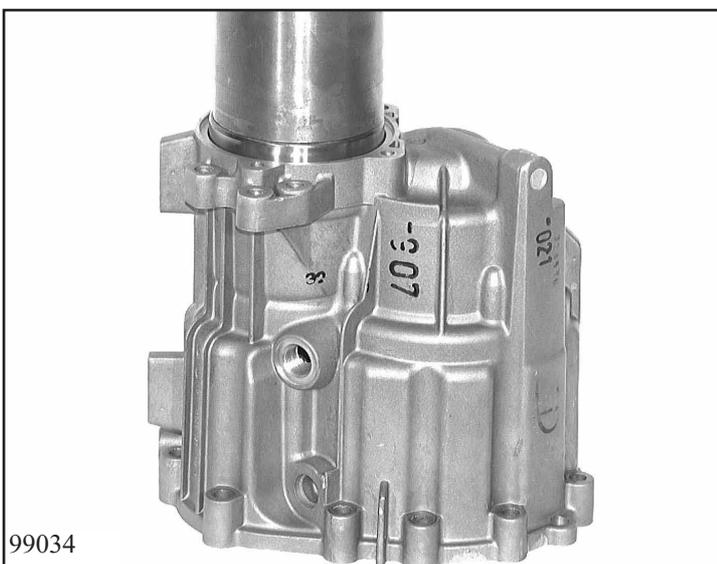
Using drift 5x46 002 261 in the mandrel press, force needle roller sleeve 36.030 into the transfer box housing and secure with snap ring 36.040.



Insert rear axle shaft 36.060 into the transfer box housing, pressing in if necessary with a suitable drift in the mandrel press.

Install disc 36.100 with 3 screws 36.120 and the oil dam with 2 screws 36.120 in the transfer box housing.

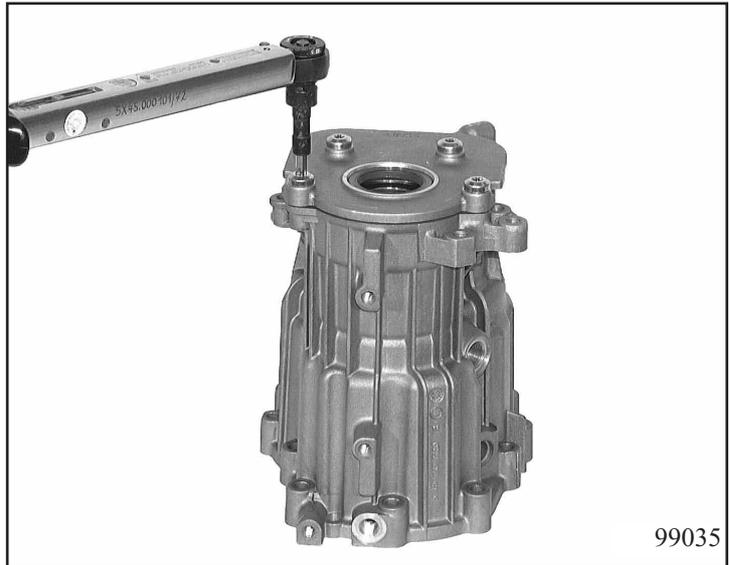
(Tightening torques: see Chapter 1.5)



Insert output gear 36.180 into the needle roller sleeve in the transfer box housing and press in using a suitable drift in the mandrel press.

Install vibration damper 36.230 on the transfer box housing using 4 screws 36.250.

(Tightening torques: see Chapter 1.5)



Press the journal of nut 36.190 into the output gear, using a suitable drift in the mandrel press.

**Important:**

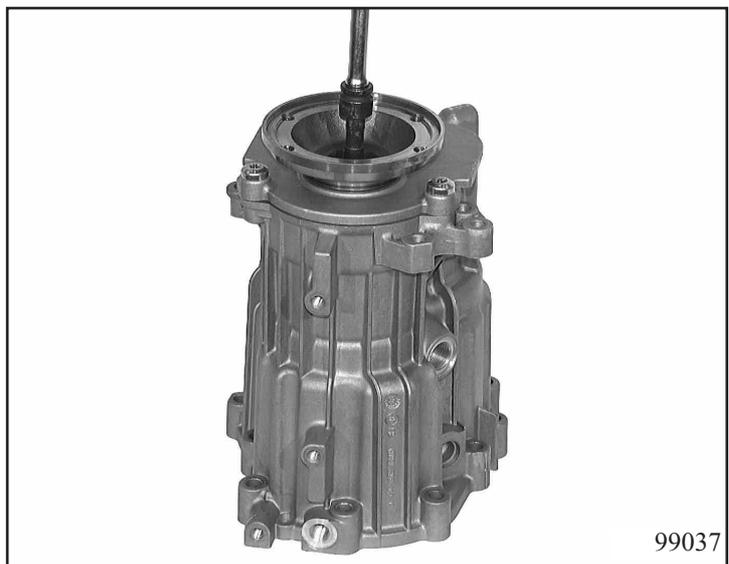
Do not tilt the nut or this will cause problems with the expansion bolt.



Push flange 36.260 into the output gear and secure with expansion bolt 36.270, but without tightening the bolt fully as yet.

**Important:**

The expansion bolt is tightened fully later.





00005

### 6.2.1.5 Intermediate and helical gear

Using sleeve 5x46 002 219, press in roller bearings 37.130/120 and 37.130/130 on intermediate gear, using sleeve 5x46 002 218, press in roller bearings 37.150/120 and 37.150/130 on helical gear.



99040

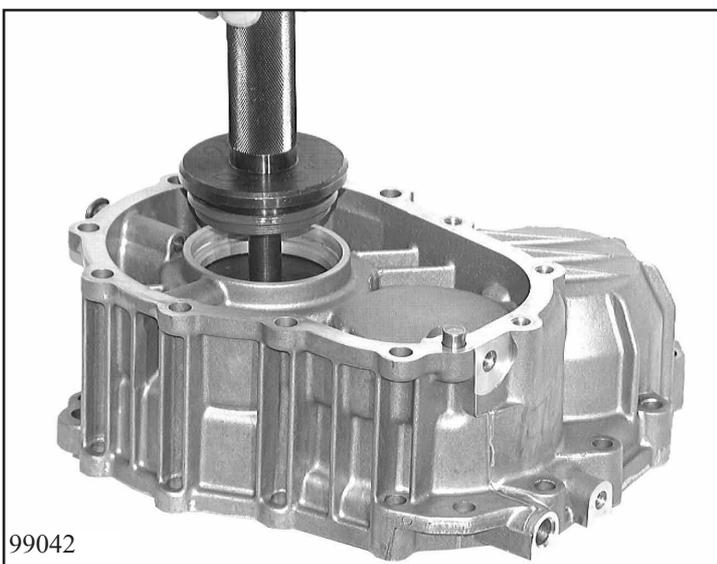
### 6.2.1.6 Front axle shaft

Using sleeves 5x46 002 218 and 5x46 002 257 press on roller bearings 37.080/130 and 37.080/140 in the mandrel press.

Using fixture 5x46 001 332 in the mandrel press, force shaft sealing ring 37.080/120 fully in.

#### **Important:**

For adjusting work, see Chapter 4.4



99042

### 6.2.1.7 Adding remaining parts to intermediate housing

Using fixture 5x46 002 282 in the mandrel press, force shaft sealing ring 37.240 in fully.

Bushing 37.020, 2 cylindrical pins 37.310 and breather 90.480 must already be in the housing.

The same conditions apply to the breather as for the one in the main transmission housing.

The bushing must be pressed in to  $10 \pm 0.5$  mm.

## 6.2.2 Adding parts to transmission housing

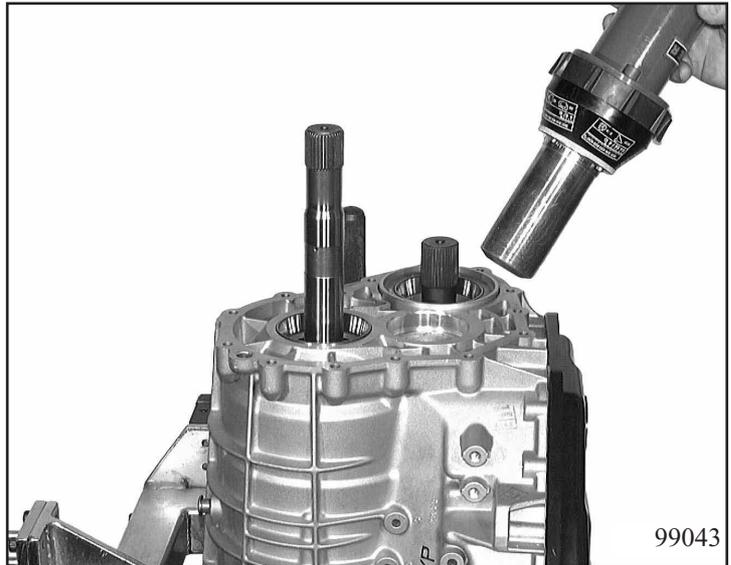
### 6.2.2.1 Inserting helical and intermediate gears and front axle shaft

Heat the bearing seat in the housing slightly with a hot air blower and insert bearing race 35.190.

Heat the outer bearing race seats for the helical and intermediate gears and front axle shaft thoroughly with the blower.

Insert the shim washers for the front axle shaft (35.330), helical gear (35.350) and intermediate gear (35.340) into the bearing seats.

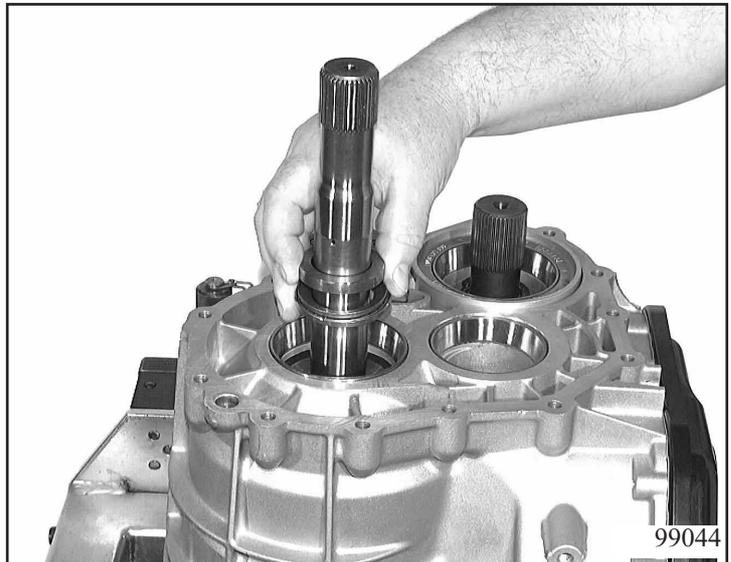
Insert the outer bearing races for the helical gear (37.150/130), intermediate gear (37.130/130) and front axle shaft (37.080/140) into the bearing seats.



Place thrust bearing 37.030 and shim washer 37.040 over the output shaft. Place spring 35.310 over the pinion shaft on the parking lock gear.

#### **Important:**

Adjust endplay as in *1.4.5 Adjusting endplay (output)* in the 5HP19 FL version.



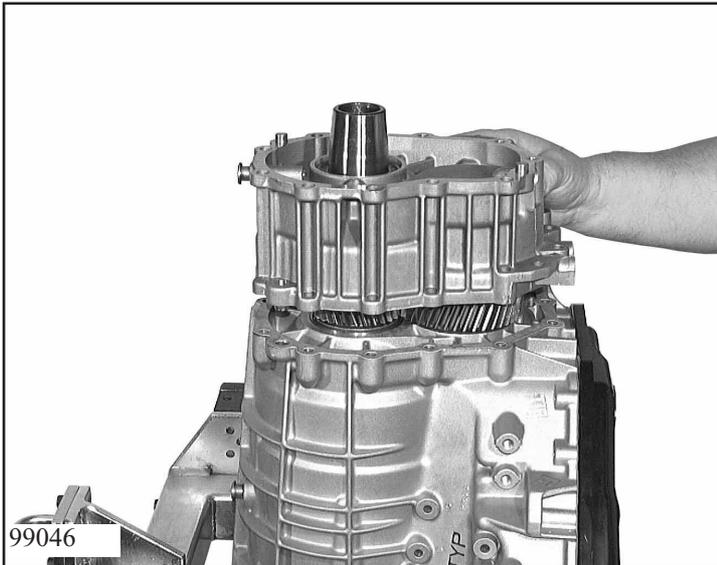
Install guide sleeve 5x46 001 339 for the output shaft sealing ring. Install the front axle shaft and intermediate gear together in the transmission housing. Mesh the helical gear with the intermediate gear and install the helical gear. The projection on the helical gear must be toward the transmission housing. Remove the shaft sealing ring guide sleeve.

#### **Important:**

The numbers stamped on the gears must face up (away from the transmission housing). Do not raise the front axle shaft again after this or the sealing ring may be damaged.



### 6.2.2.2 Installing intermediate housing on transmission housing



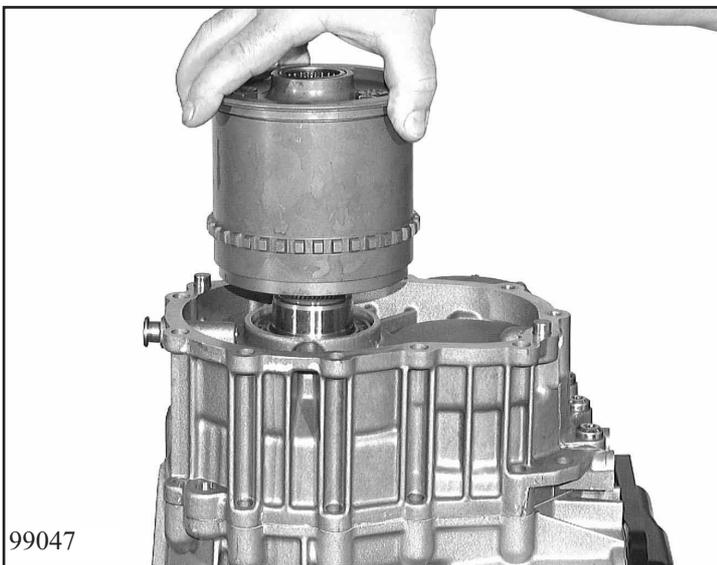
Install guide sleeve 5x46 001 535 for the shaft sealing ring on the output shaft. Place gasket 37.010 on the transmission housing. Place the intermediate housing over the output shaft and the guide sleeve and on to the transmission housing so that the locating sleeve enters the transmission housing.

Insert the 6 screws 37.220 through the intermediate housing into the transmission housing, without tightening them.

#### **Important:**

Tightening procedure: see Chapter 4.3.1

### 6.2.2.3 Installing Torsen II



Install the Torsen II unit in the output and front axle shaft splines.

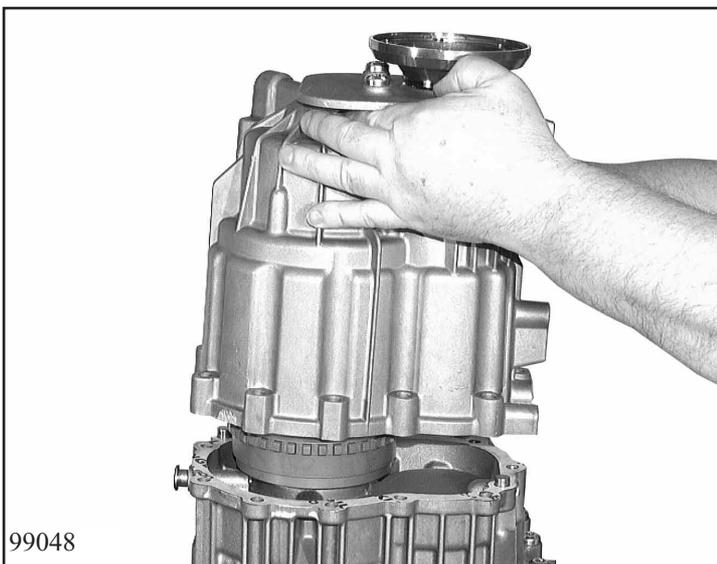
Add 34 cc of oil (Sturaco FM 1992 - KS) to the Torsen II through the hole for the rear axle shaft.

Insert magnet 37.280 into the intermediate shaft.

#### **Important:**

Do not raise the Torsen II unit again after this, or oil will be lost.

### 6.2.2.4 Installing transfer box housing on intermediate housing



Place gasket 36.280 on the intermediate housing.

Place the transfer box housing over the Torsen II unit on to the intermediate housing so that the rear axle shaft enters the Torsen II and then two cylindrical pins in the intermediate housing enter the transfer box housing.

Secure the transfer box housing to the transmission housing with 8 screws 36.290 and to the intermediate housing with 3 screws 36.300. Secure the intermediate housing to the transmission housing with 6 screws 37.220.

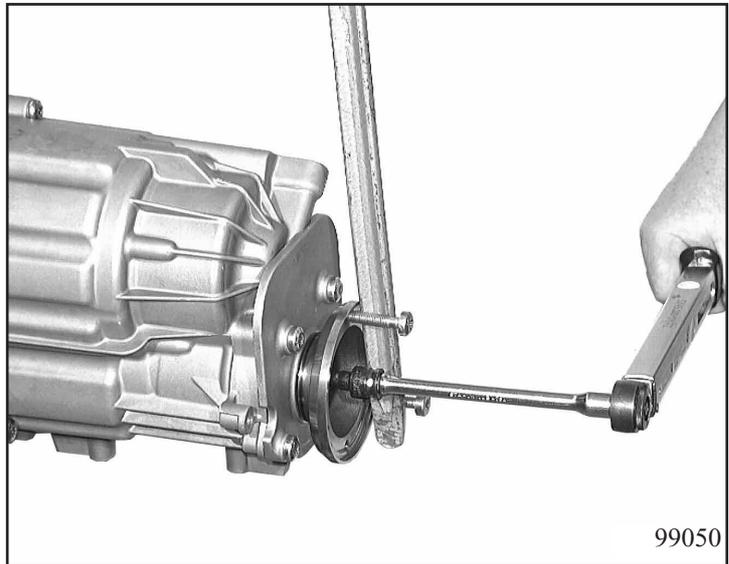
**Important:**

Tightening procedure: see Chapter 4.3.1



Turn the transmission so that the oil pan faces down.  
Prevent the flange from turning; the expansion bolt should now be tightened fully.

(Tightening torques: see Chapter 4.5)



**6.2.2.5 Inserting oil drain and filler plugs**

Screw a new oil drain plug 36.340 and a new oil filler plug 36.350 into the transfer box housing.

Press breather cover 37.340 on to the breather.

(Tightening torques: see Chapter 4.5)

