SCANIA

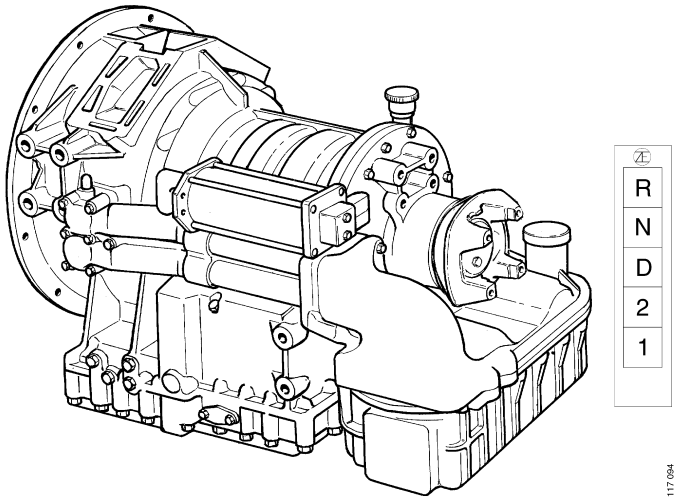
05:08-53

Issue 2 **en**

ZF automatic gearbox

ZF 4/5HP500, 590 and 600

Work description



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Contents

Preface

This booklet contains instructions for simpler mechanical work on automatic gearboxes ZF 4/5HP500, 590 and 600. These are manufactured by ZF. The gearboxes are very similar and those difference that do exist are of little significance for the purposes of this description.

If a fault is suspected in the gearbox, the vehicle should be driven to the nearest Scania workshop. The Scania workshop personnel have the training and appropriate equipment to establish whether the fault lies in the gearbox, its control unit or somewhere else. Once the fault has been accurately located, they can decide on the most suitable course of action.

As Scania does not manufacture these gearboxes, Scania cannot assume complete responsibility for their servicing. This booklet describes the work that falls within Scania's area of responsibility and that can be carried out by most workshops. For major repairs or overhaul, please refer to the ZF service organisation.

Safety directions

The person carrying out the work on the gearbox bears responsibility for ensuring that it is carried out in a safe and correct way.

To avoid injury to persons and damage to products, it is vital to follow the instructions given as well as the applicable safety regulations.

The person carrying out work on the gearbox must first obtain sufficient knowledge on how the work is to be carried out and how potential risks should be avoided.

Neither Scania nor ZF can assume any responsibility for damage or costs incurred due to incorrectly carried-out work or the use of non-original parts.

It is therefore important to read this booklet carefully.

Towing

Disconnect the gearbox electrical connection (Cannon connector)

Use a towing bar when towing.

The vehicle cannot be tow-started.

IMPORTANT! The gearbox is not lubricated when the vehicle is being towed, as the oil pump requires the engine to be running.

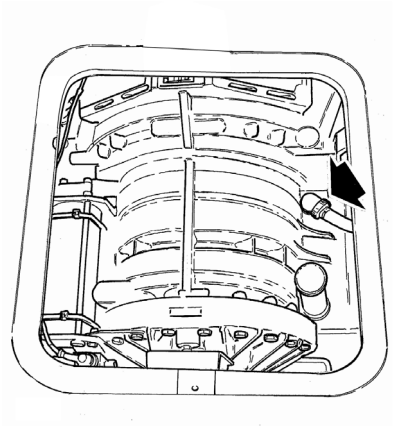
- If the gearbox is intact, the bus can be towed with the engine turned off, the gearbox in neutral and the propeller shaft in place. Towing can be carried out for a maximum of 2 hours at low vehicle speed, 25 km/h.
- If the gearbox is broken, the bus can be towed, but the propeller shaft or both drive shafts must be removed, or the drive wheels lifted.

When towing the vehicle with the engine off, check that the parking brake is not applied.

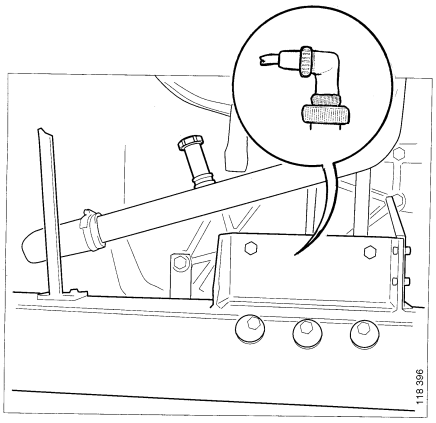
When the engine is not running, there is no steering servo and brake pressure.

Remember that equipment such as fans and lighting use large amounts of power and can drain the battery in one or two hours.

Follow the instructions for towing in the Operator's manual.

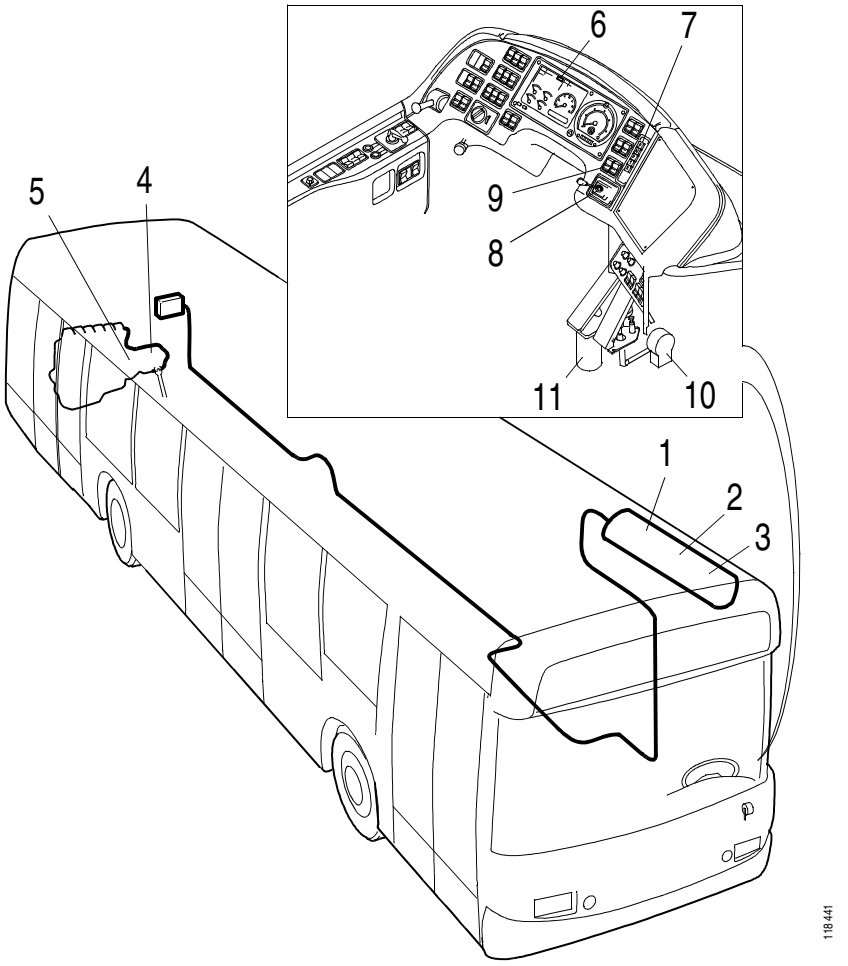


Cannon connector location on K/L buses.



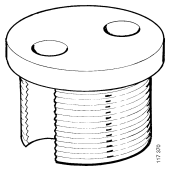
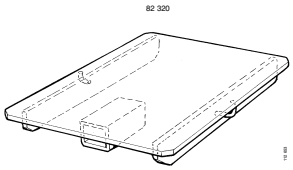
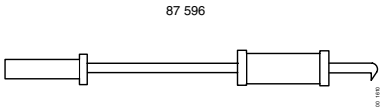
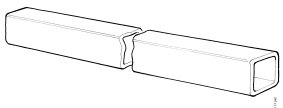
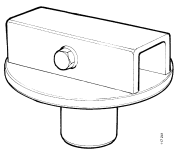
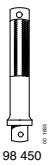
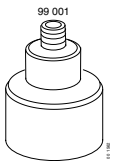
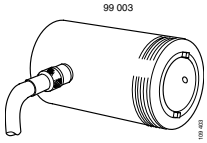
Cannon connector location on N buses.

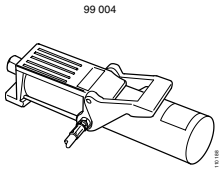
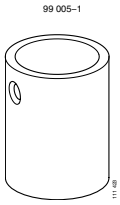
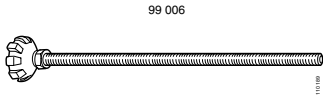
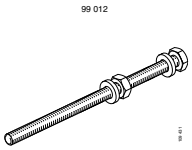
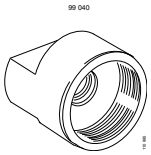
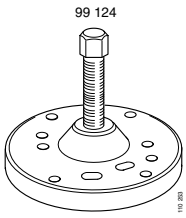
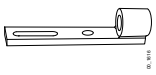
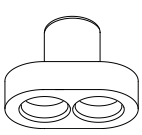
Component location



1 *Gearbox control unit*
2 *ABS control unit*
3 *Retarder control unit*
4 *Gearbox*
5 *Throttle actuation sensor*
6 *Oil temperature warning lamp*
7 *Drive mode selector*
8 *Retarder lever with indicator lamp*
9 *Automatic retarder operation switch. Alternative switch location is in the central electric unit*
10 *Accelerator pedal sensor (under floor)*
11 *Service brake valve (under floor)*

Special tools

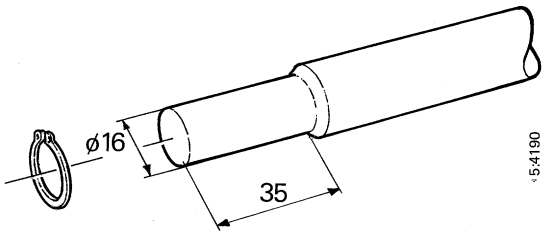
Number	Description	Illustration	Tool board
82 303	Adapter		
82 320	Plate		
87 596	Slide hammer		D2
98 405-1	Fixture part		F1
98 405-2	Fixture part		F1
98 450	Shank		R2, AD2, AM1
99 001	Adapter		AD1
99 003	Hydraulic cylinder		H1

Number	Description	Illustration	Tool board
99 004	Hydraulic pump		H1
99 005-1	Pusher adapter		H1
99 006	Threaded rod		H1
99 012	Threaded rod		H1
99 040	Adapter		
99 124	Puller		
99 129	Counterhold		
99 160	Drift		

Other tools

Number	Description
548 010	Sealing compound
587 084	Torque wrench
587 313	Gearbox jack or component hoist 587 500.
587 538	Temperature gauge
ZF 1P01 137 833	Measuring rod, ZF tool.
ZF 1x56 136 824	Drift, ZF tool

If tool ZF 1P01 137 833 is unavailable, a measuring rod can be manufactured locally by turning a rod to 16 mm diameter for a length of approximately 35 mm and slip on a 15.7 x 1 mm retaining ring.



Renewing sensors and solenoid valves

Preparatory work

For checking solenoid valves and sensors, see Workshop Manual section 05, Automatic Gearbox, ZF 4/5HP500, 590 and 600, Troubleshooting.

IMPORTANT! Always renew O-rings or copper washers before installing components.

Speedometer drive

- When renewing the mechanical drive for the speedometer, the ten-digit number on the gearbox type plate must be stated when ordering spare parts.
- The end play should be 0.1 – 0.3 mm, which is measured with a sliding caliper.
- The backlash should be 0.1 – 0.2 mm, which is checked by hand.

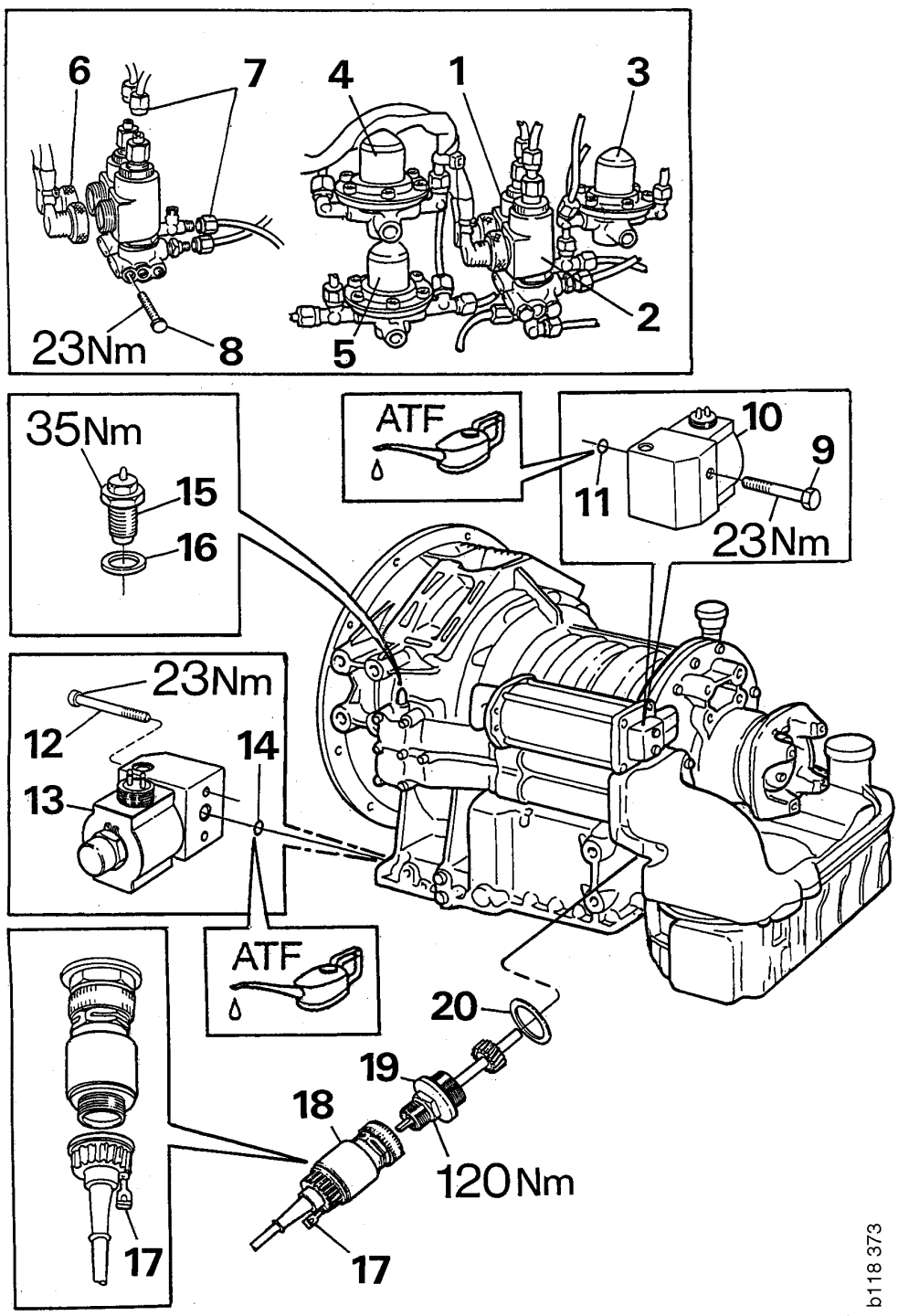
Retarder solenoid valves

IMPORTANT! Depressurise the compressed air system when working on the retarder and accumulator solenoid valves.

Components

Pos.	Description	Remarks
1	Retarder solenoid valve V503	Mark up the electrical and pneumatic connections of the solenoid valve.
2	Retarder solenoid valve V504	Mark up the electrical and pneumatic connections of the solenoid valve.
3	Pressure regulator for retarder setting 1	-
4	Pressure regulator for retarder setting 2	-
5	Pressure regulator for retarder setting 3	-
6	Electrical connections	-
7	Pneumatic connections	-
8	Bolt	Tightening torque 23 Nm.
9	Bolt	Tightening torque 23 Nm.
10	Accumulator solenoid valve V502	-
11	O-ring	**IMPORTANT!** Renew the O-ring. Lubricate the O-ring with automatic transmission fluid.
12	Bolt	Tightening torque 23 Nm.
13	Retarder solenoid valve V501	-
14	O-ring	**IMPORTANT!** Renew the O-ring. Lubricate the O-ring with automatic transmission fluid.
15	Temperature sensor T505	Tightening torque 35 Nm.
16	Copper washer	**IMPORTANT!** Renew the copper washer.
17	Electrical connection catch	Pull out the catch before disconnecting the electrical connection.
18	Speedometer sensor T20	-
19	Speedometer mechanical drive.	Remove the speedometer electrical connection and sensor. Ensure that the copper washer is also removed. Tightening torque 120 Nm. Refer to Preparatory Work.
20	Copper washer	**IMPORTANT!** Renew the copper washer.

Gearbox sensors and valves



Renewing frequency sensors

Output shaft or turbine frequency sensor

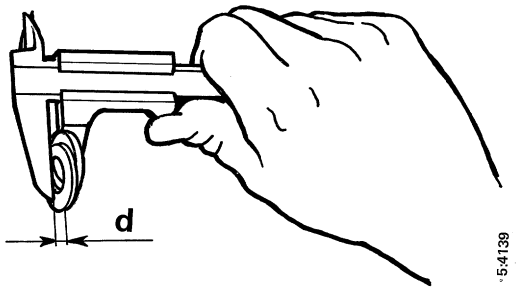
Note: When renewing the turbine frequency sensor. Drain the oil from the gearbox and remove the oil sump.

- When working on the output shaft frequency sensor or the turbine frequency sensor, remove the propeller shaft. Refer to Workshop Manual group 6. This is in order to allow the output shaft to be turned by means of the driver.
- The distance between the frequency sensors and the pulse wheels should be 0.6 - 0.8 mm, which is measured using a sliding caliper or ZF measuring rod 1P01 137 833.
- When installing the sensor, turn the driver until the pulse wheel in question is in the correct position.

IMPORTANT! After installing the output shaft frequency sensor nAB or turbine frequency sensor nT, rotate the pulse wheel 2-3 revolutions in order to check that the frequency sensor does not touch the pulse wheel.

Frequency sensor shims

To calculate the appropriate thickness, measurement 'D' on the shim or a combination of shims, use the formula D = (A + C) -B. Then select the appropriate shim or combination of shims.



Size	ZF part number
0.6 mm	0730 003 049
0.8 mm	0730 003 050
1.0 mm	0730 003 069
1.2 mm	0730 003 068
1.4 mm	0730 003 067
1.8 mm	0730 003 066
2.0 mm	0730 003 065
2.2 mm	0730 003 064
2.4 mm	0730 003 063
2.6 mm	0730 003 062
2.8 mm	0730 003 061
3.0 mm	0730 003 300

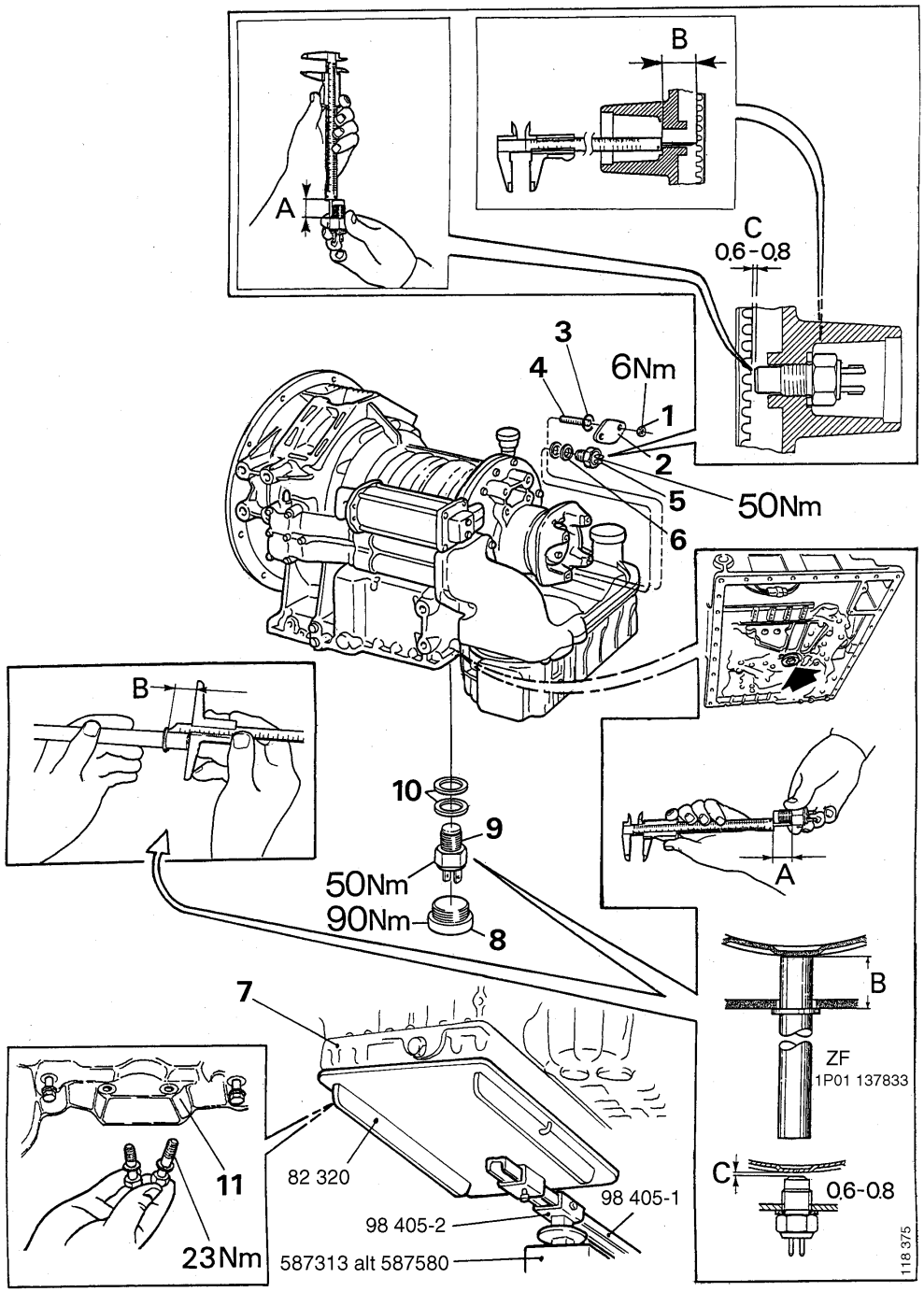
Place the shims on the frequency sensor. If necessary, apply high-temperature oil (part no. 33 243) sparingly on the shims to keep them in place on the sensor during installation.

IMPORTANT! Grease must never be used inside automatic gearboxes.

Components

Pos.	Description	Remarks
1	Nut	Tightening torque 6 Nm.
2	Cover plate	-
3	O-ring	**IMPORTANT!** Renew the O-ring. Lubricate the O-ring with automatic transmission fluid.
4	Stud	-
5	Output shaft frequency sensor	**IMPORTANT!** Ensure that all shims are also removed. Tightening torque 50 Nm.
6	Shims	During installation, check the dimensions; refer to Frequency sensor shims
7	Gearbox oil sump.	Remove the tray by means of component hoist 587 500 or gearbox jack 587 313 and 98 405-1, 98 405-2 and hoist plate 82 320. Tightening torque 23 Nm.
8	Plug	Tightening torque 90 Nm.
9	Turbine frequency sensor	**IMPORTANT!** Ensure that all shims are also removed. When fitting, measure dimension B using tool ZF 1P01 137 833; refer to Other Tools and Frequency Sensor Shims. Tightening torque 50 Nm.
10	Shims	During installation, check the dimensions; refer to Frequency Sensor Shims.
11	Bolt	2 bolts for the oil sump nearest the engine are fitted with copper washers and must be renewed during installation. The remaining bolts are fitted with steel washers. Tightening torque 23 Nm.

Renewing frequency sensors



Renewing end yoke seal

Removal

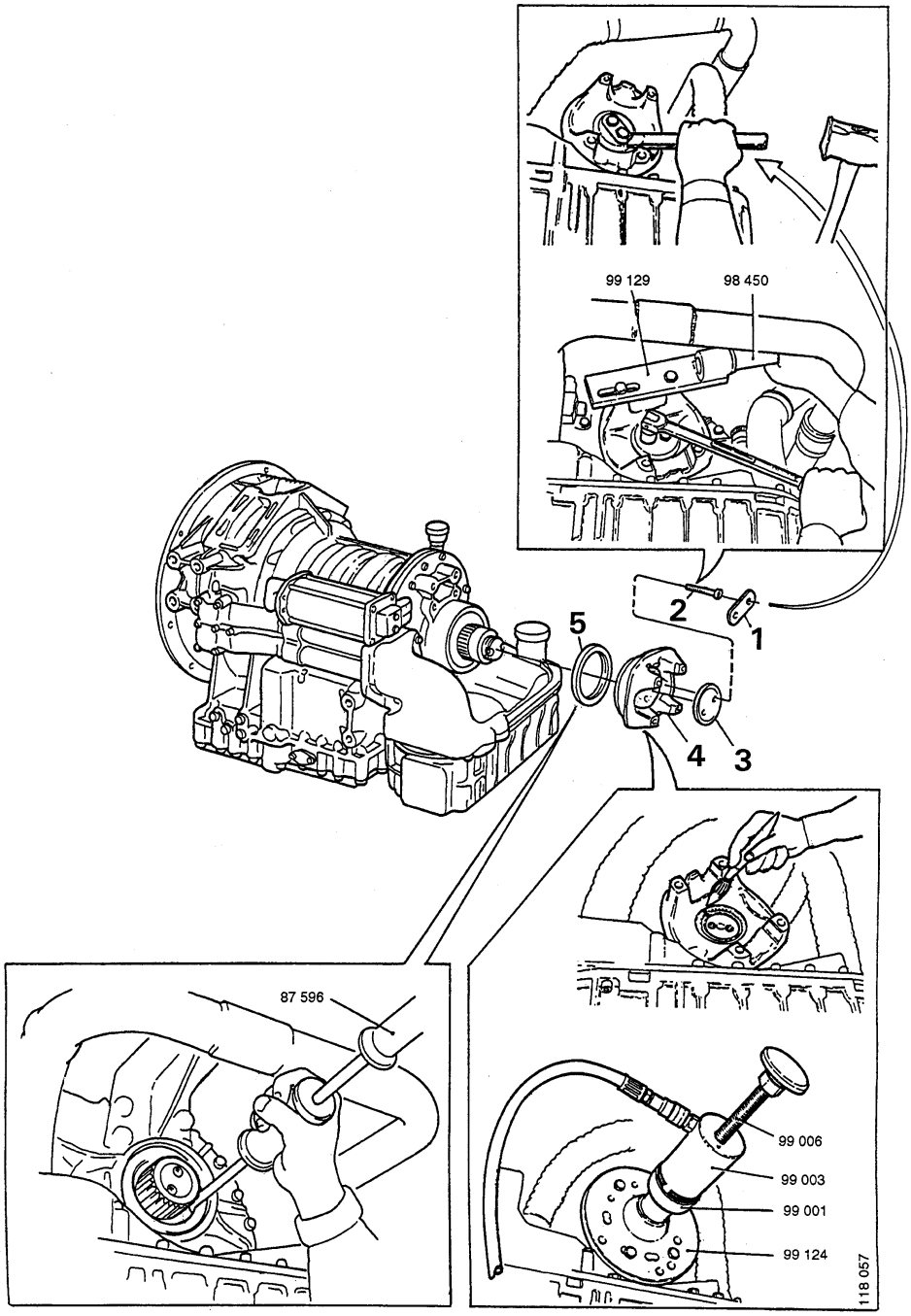
- Remove the propeller shaft. Refer to Workshop Manual group 6.

IMPORTANT! Take care not to damage the splines of the output shaft or driver.

Components

Pos.	Description	Remarks
1	Lock washer	Use a cold chisel to remove the lock washer.
2	Bolt	Use 98 450 and 99 129 as a counterhold.
3	Pressure plate	Tap out the pressure plate using a plastic mallet.
4	End yoke	Mark up the position of the end yoke in relation to the output shaft. Use tools 99 001, 99 003, 99 006, 99 124 and hydraulic pump 99 004.
5	Sealing ring	Use tool 87 596. **IMPORTANT!** Take care not to damage the surface where the sealing ring is situated.

Removing the driver and seal



Fitting

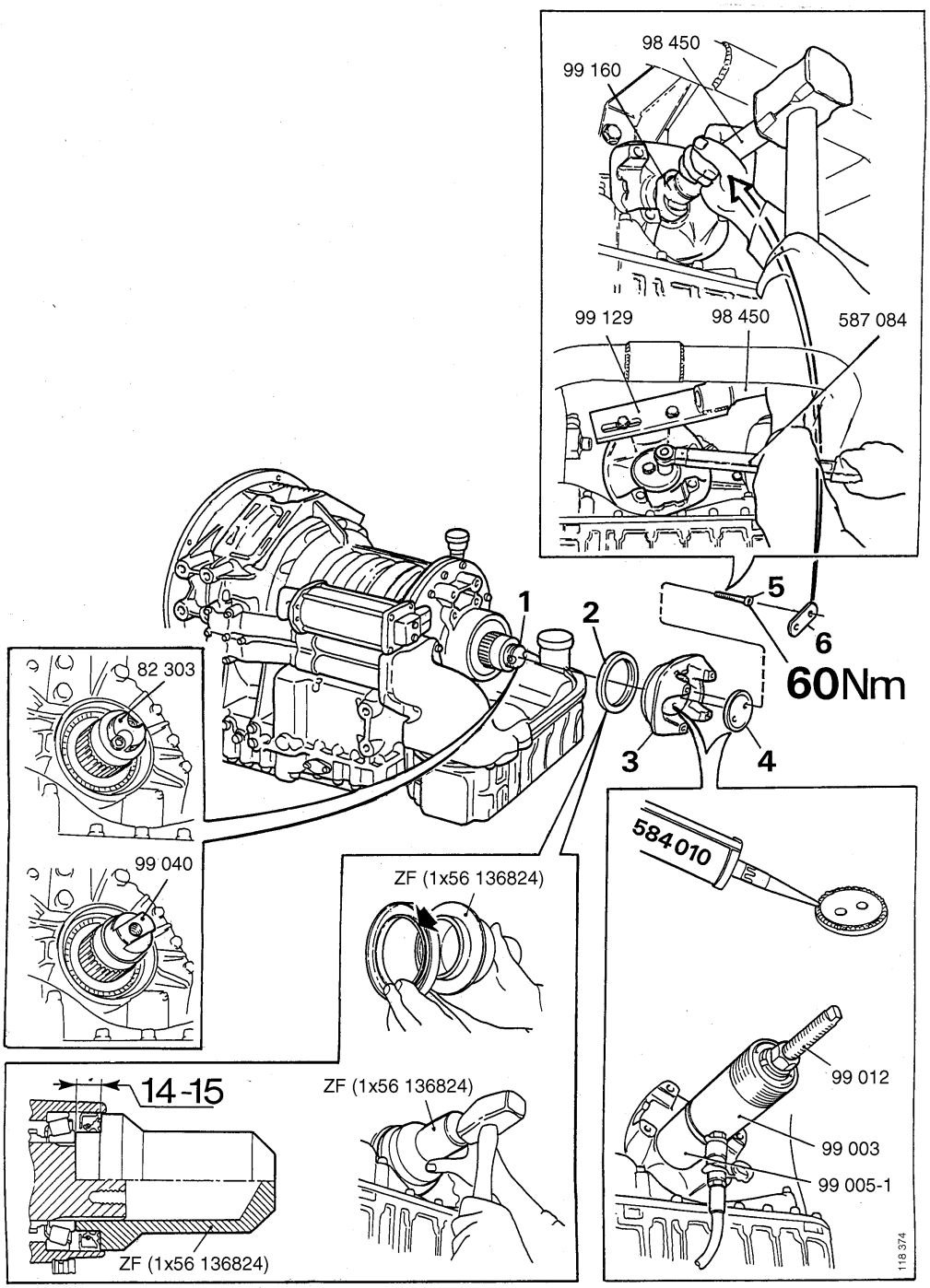
IMPORTANT! Take care not to damage the splines of the output shaft or driver.

- Warm the end yoke to 100-110°C. Check the temperature using temperature gauge 587 538. Do not heat the end yoke further as this would damage the sealing ring.

Components

Pos.	Description	Remarks
1	Output shaft	Fit the adapters 82 303 and 99 040.
2	Sealing ring	**IMPORTANT!** Do not lubricate the sealing ring with grease or oil, as this could result in leakage. Use tool ZF 1x56 136 824. The distance from the bearing to the outer edge of the sealing ring should be 14 - 15 mm.
3	End yoke	Warm the end yoke to 100-110°C. Apply oil to the splines. Install the end yoke using 99 003, 99 004, 99 005-1 and 99 012.
4	Pressure plate	Apply sealing compound 584 010.
5	Bolt	**IMPORTANT!** Renew the bolts. Use 99 129 and 98 450 as a counterhold. Tightening torque 60 Nm; use torque wrench 587 084.
6	Lock washer	**IMPORTANT!** Renew the lock washer. Tap the lock washer into place using drift 99 160 and shank 98 450.

Fitting the seal and driver



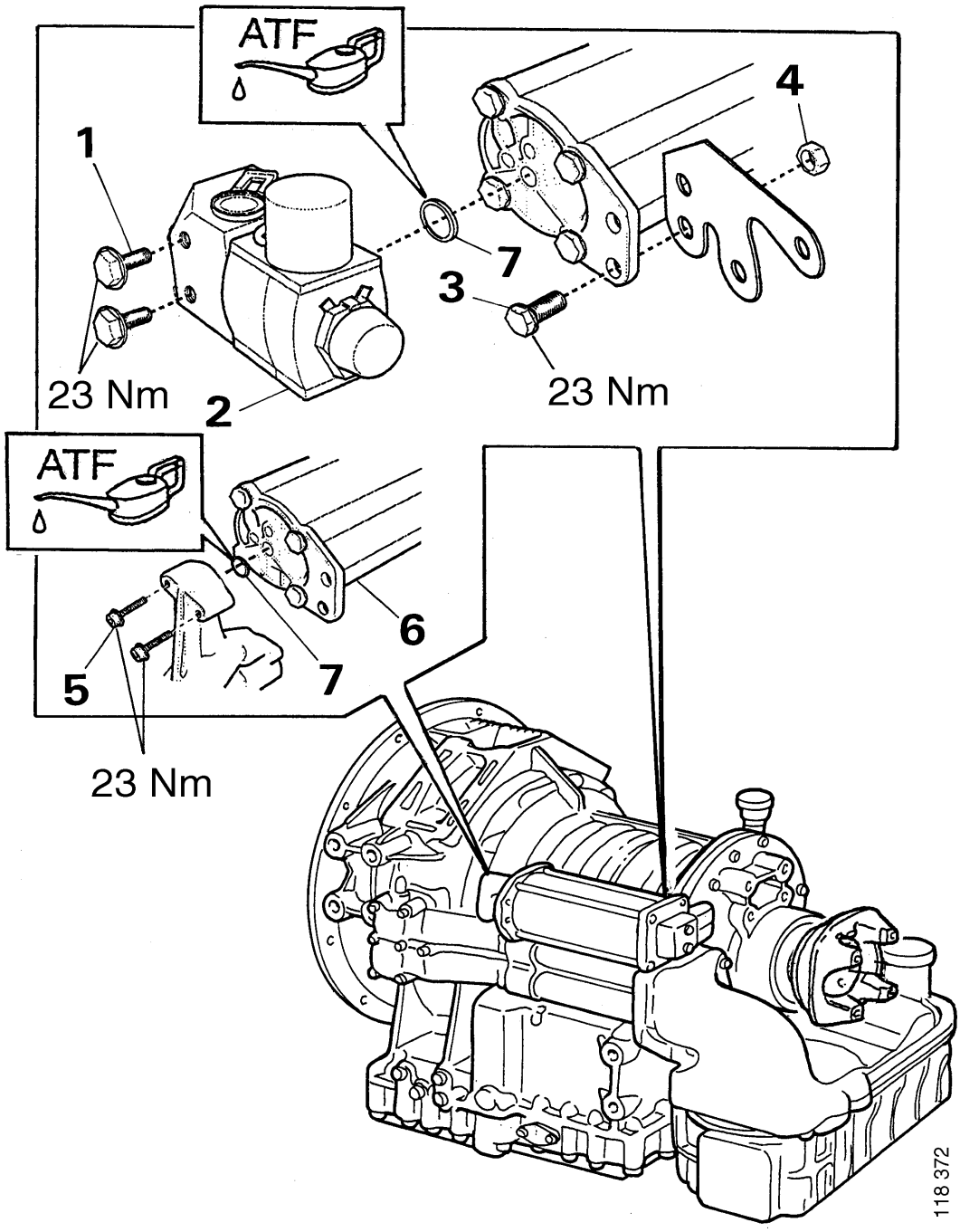
Renewing the accumulator

IMPORTANT! Depressurise the compressed air system before working on the retarder and accumulator solenoid valves.

IMPORTANT! Always renew O-rings or copper washers before installing components.

Pos.	Description	Remarks
1	Bolt	Tightening torque 23 Nm.
2	Accumulator solenoid valve V502	Mark up the electrical and pneumatic connections of the solenoid valve.
3	Bolt	Tightening torque 23 Nm.
4	Nut	Tightening torque 23 Nm.
5	Internal hexagon bolt	Tightening torque 23 Nm.
6	Accumulator	-
7	O-ring	**IMPORTANT!** Renew the O-rings Lubricate the O-rings with automatic transmission fluid.

Renewing the accumulator



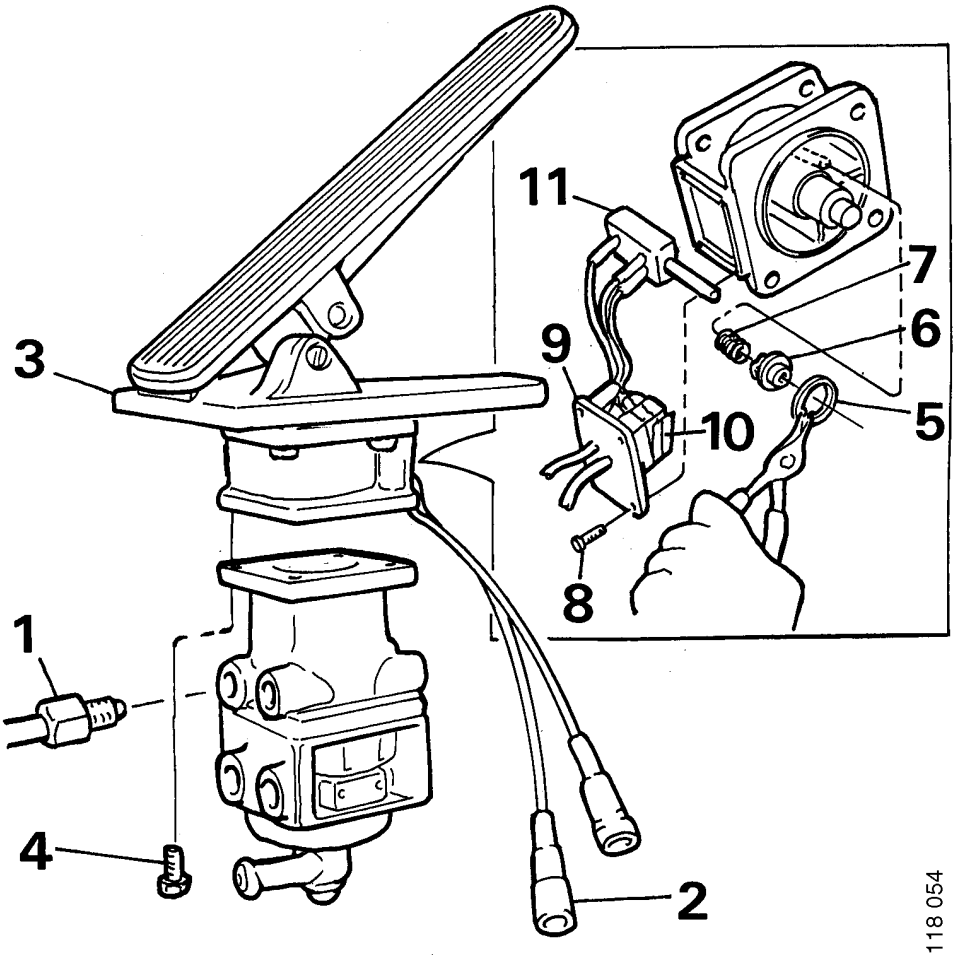
Renewing service brake valve potentiometer

The potentiometer is located in the micro switch housing on top of the service brake valve housing.

Depressurise the compressed air system.

Pos.	Description	Remarks
1	Pneumatic connections	Mark the respective pipes.
2	Connector	-
3	Bottom plate	Lift out the brake pedal and service brake valve as one unit.
4	Bolt	-
5	Retaining ring	-
6	Cover	-
7	Spring	-
8	Screw	-
9	Cable connection	**IMPORTANT!** The micro switches are on the inside. Take care not to break off their tabs.
10	Micro switches	
11	Potentiometer	Note the colour of the cables and how they are connected.

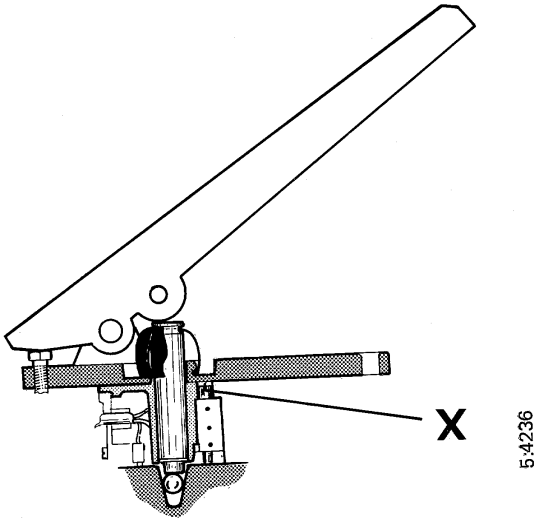
Renewing service brake valve potentiometer



Basic setting of service brake valve potentiometer

The potentiometer is located in the micro switch housing on top of the service brake valve housing.

Adjust the potentiometer by means of the adjustment screw that affects the position of the potentiometer in the valve housing.



IMPORTANT! In order to access the adjusting screw, the brake pedal and service brake valve must be removed as one unit, and then the brake pedal bottom plate must be removed from the micro switch housing.

After adjustment, check the brake signals. Refer to group 5, Automatic Gearbox, ZF 4/5HP500, 590 and 600, Troubleshooting.

Conditions:

- The potentiometer must be connected to the retarder control unit.
- The brake pedal must be fully released.
- The brake valve must be supplied with full air pressure.

Adjustment

1 Connect a voltmeter between pin 9 on the retarder control unit and earth.

2 The output signal of the potentiometer should be 0.12-0.5 V. Adjust if necessary.

Checking and adjusting the throttle actuation sensor

Note: Applies only to vehicle with mechanical throttle control.

IMPORTANT! If the throttle actuation sensor is set incorrectly, the gearbox may be damaged.

The throttle actuation sensor setting should be checked:

- following servicing or repair work to the engine or gearbox.
- in the event of hard gear changing or too long slip times.

Conditions

1 Engine and gearbox must be at operating temperature.

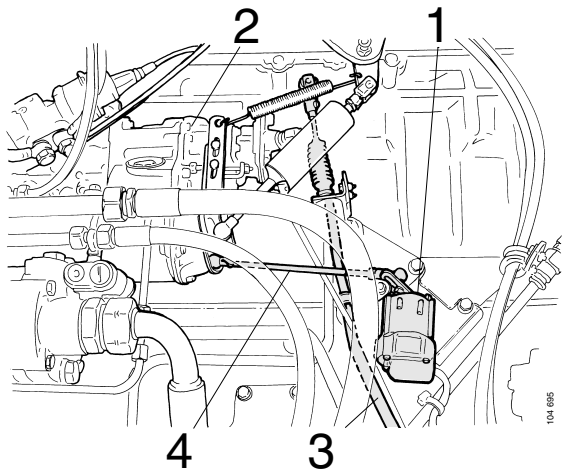
2 Engine idle and full throttle speeds must be correctly set. Refer to Workshop Manual group 14, Mechanical Throttle Control, Function and Work Description.

3 The throttle control must be correctly set. When the pedal is in released position, the pump arm must rest on the idling stop and when the pedal is completely depressed, but not in kick-down position, the pump arm must rest against the full throttle stop.

WARNING!

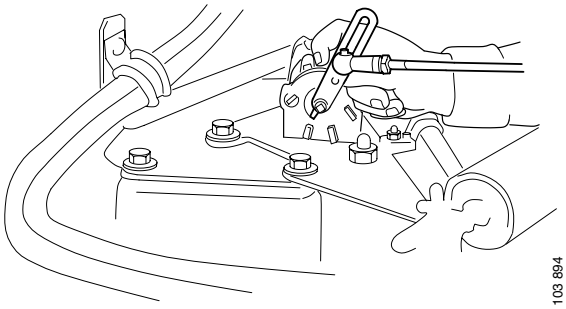
Turn off the main power switch or there will be risk of electric shocks as the throttle actuation sensor is located close to the electrical connections on the starter motor.

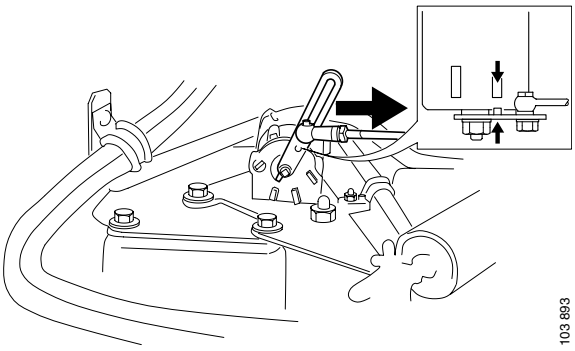
4 Turn off the main power switch.



1 Throttle actuation sensor
2 Injection pump
3 Throttle cable
4 Link

5 Feel with your fingers to check that the mark on the back of the load sensor arm is aligned with the idling mark on the housing.

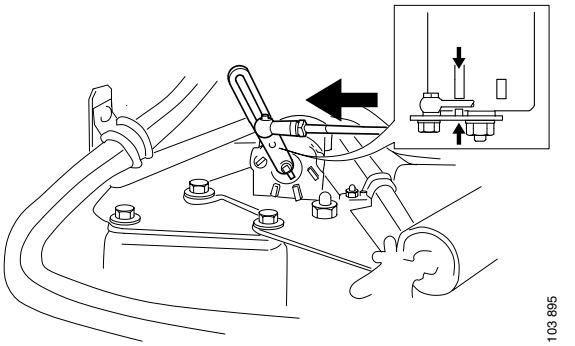




Throttle actuation sensor, idle speed position

Requires two persons

6 Press the pump arm towards the full throttle stop and hold it there. Alternatively, ask a colleague to press the accelerator pedal to full throttle position, but not to kick-down, and keep it there.



Throttle actuation sensor, full throttle position

7 Check that the mark on the arm is aligned with the full throttle mark on the housing.

8 Adjust if necessary.

Using the ZF 55-pin connector box, part no. 1P01 137 834, the values for idle speed and full throttle can be measured by means of a multimeter.

Connect the ZF 55-pin connector box according to the section 'Test Instructions' in Workshop Manual group 5, Automatic Gearbox. ZF, ZF 4/5HP500, 590 and 600, Troubleshooting.

- Measure between connection 24 (+) and 18 (-) in the ZF 55-pin connector box.

Idle speed:

- With idle speed and accelerator pedal fully released.
- The value should be 1.1 - 1.2 V.

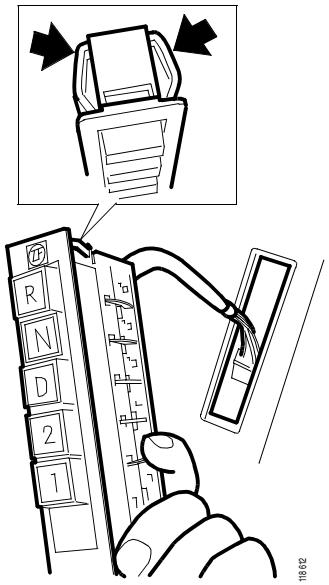
Full throttle

- With full throttle.
- The value should be 3.8 - 4.2 V.

Renewing the drive mode selector

The drive mode selector is fitted with catches securing it to the instrument panel.

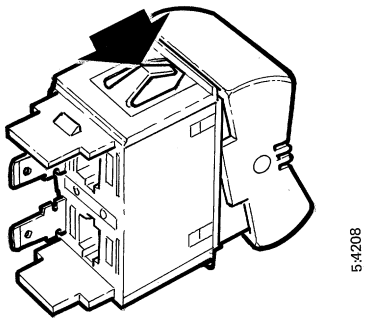
- Press in the catches and press out the drive mode selector from the back of the instrument panel.



Renewing the retarder switch

The switches are fitted with a catch to secure them to the instrument panel.

- Push down the catch so that the switch can be pressed out.



Checking oil level

Both a too high and a too low oil level can damage the gearbox. If the oil level is too low, the discs in the clutches will start to slip, whereby they will rapidly be worn out. If the oil level is too high, it will start to froth and overheat.

Methods of checking

The oil level in the gearbox must be checked at least once a week. The check can be carried under three different conditions:

1 At operating temperature with the engine at idle speed (oil temperature 80 - 90°C).

2 When the oil is cold and with the engine idling (fluid temperature 20 - 30°C).

3 The level will be higher when the engine is stopped than when it is running, as the oil pump is not operating. This can be used as a rough check after a long stationary period or after changing oil to make sure there is oil in the gearbox so that the engine can be started without any risk.

When checking the oil level at operating temperature, the bus should first be driven for approx 30 minutes, repeatedly changing gear up and down. The gearbox will then have attained operating temperature even when the outdoor temperature is well below 0°C.

IMPORTANT! It is the oil level at operating temperature that applies. If the oil level is checked with the oil cold, e.g. after a long stationary period or after changing oil, a final check must be made at operating temperature. The oil level can only be checked correctly at operating temperature.

Dipstick

The dipstick is located in the oil filler pipe. To access the oil filler, open the rear hatch or remove the cover in the floor, depending on the type of bus.

IMPORTANT! Observe strict cleanliness. The gearbox is very sensitive to contaminants. Clean the dipstick and the area around it.

Always check the oil level under the following basic conditions:

- The bus must be on a level surface.
- The parking brake must be applied.

Pull out the dipstick and wipe it dry. Reinsert the dipstick, pull it out and read off the oil level.

Checking at operating temperature

- Oil temperature 80 - 90°C.
- The engine must be idling.
- The drive position selector must be in position N.

The oil level must be between the two upper marks, "hot" or "85°C". The oil level should be close to the top mark after filling.

Top up or drain off oil as necessary. 1 litre of oil corresponds to approximately 10 mm on the dipstick.

Checking with cold oil

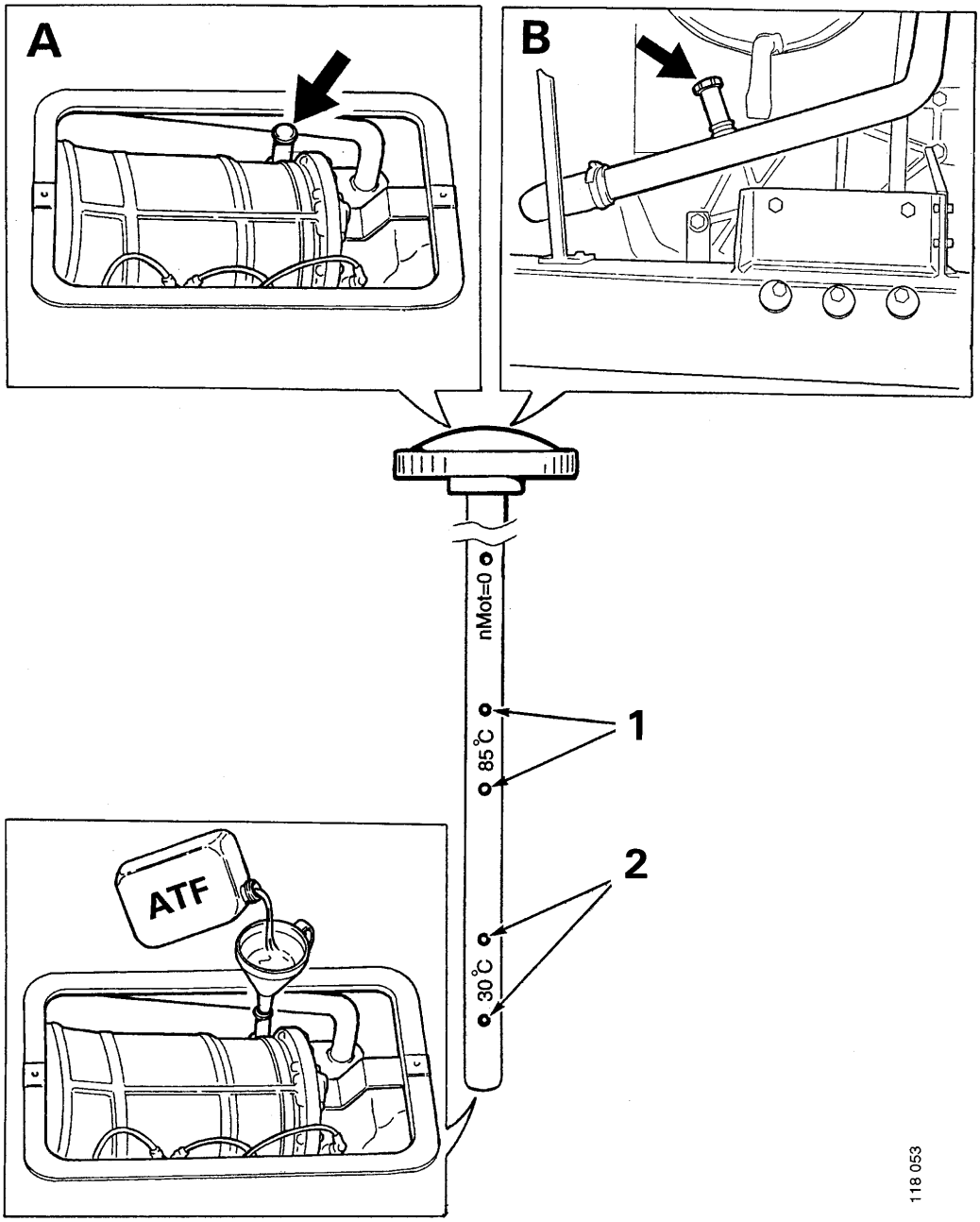
- Oil temperature 20 - 30°C.
- The drive mode selector must be in position N.

Start the engine and run it at idling speed for 3 - 5 minutes.

The oil level must be between the two lower marks, "cold" or "30°C".

If the oil does not reach up to the bottom mark, the oil must be topped up immediately.

Check the oil level at operating temperature as described above.



A Dipstick location on K/L buses

B Dipstick location on N buses

1 Marks for checking at operating temperature

2 Marks for checking with cold oil

Changing oil and filter

The automatic transmission fluid should be changed at the intervals recommended in the inspection programme in Workshop Manual group 0.

Oil grade:

- ATF Dexron II D.
- Or according to ZF recommendations.

The filter must be renewed at every oil change. Change the oil whilst at operating temperature.

IMPORTANT! Observe strict cleanliness. The gearbox is very sensitive to contaminants.

1 Clean around the oil plug and oil filter cover.

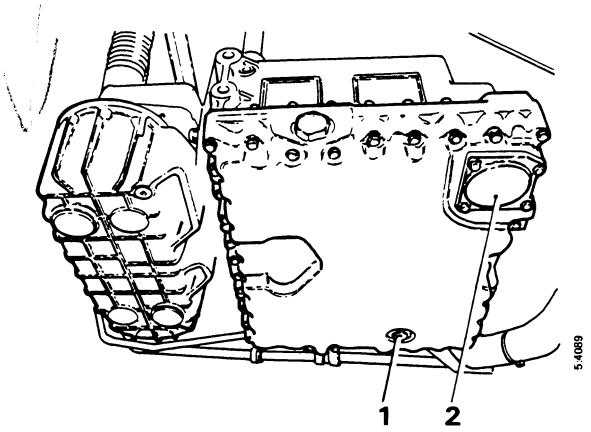
VIKTIGT! Help protect the environment. Use a suitable container when changing the oil.

1 Place a suitable container below. Unscrew the oil plug, making sure the copper washer is also removed.
Allow all the oil to drain out.

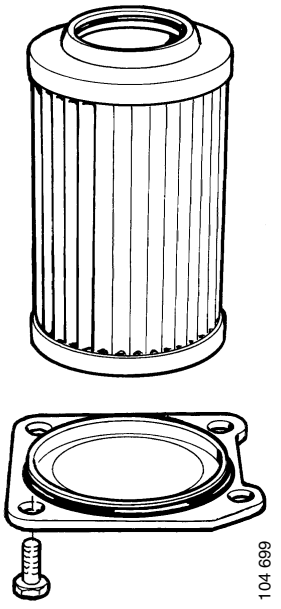
WARNING!

Beware of hot oil. Wear protective gloves and goggles during oil change.

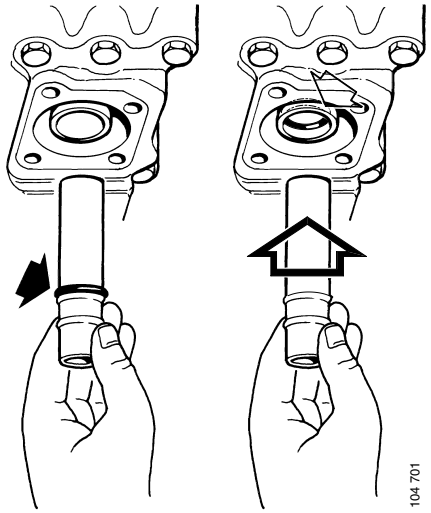
2 Remove the cover.
Remove the old filter and discard it.



1 Oil plug
2 Oil filter cover

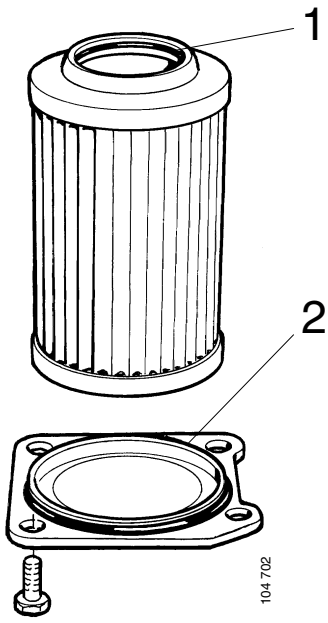


3 If the suction pipe comes out with the filter, the O-ring on the suction pipe must be discarded. If this is the case, fit a new O-ring in the seat in the gearbox and then refit the suction pipe.



4 Check that the O-ring on the new oil filter is in place and not damaged. Check that the contact surfaces are clean and not damaged. Apply automatic transmission fluid sparingly on the O-ring and fit the filter.

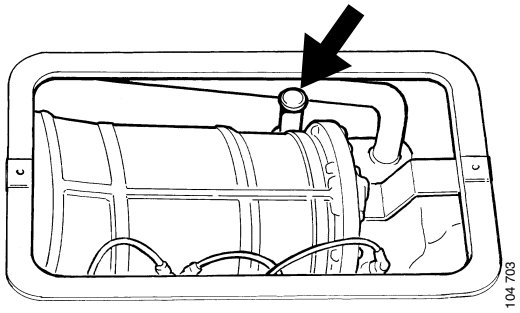
5 Renew the O-ring in the cover.
Fit the cover and tighten the bolts to 23 Nm.
Fit the oil plug together with a new copper washer.
Tighten to 50 Nm.



1 Filter O-ring
2 Cover O-ring

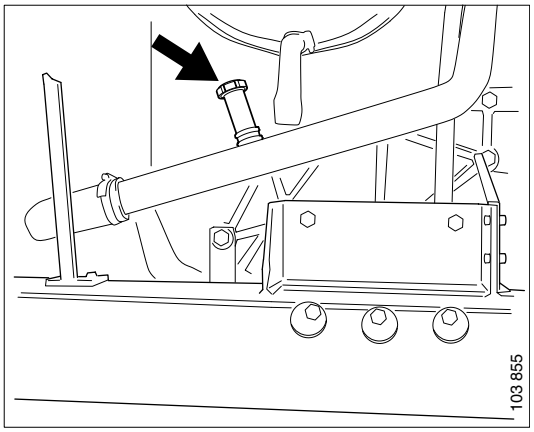
6 Remove the cover in the floor over the gearbox on K/L buses.
Open the rear hatch on N buses.
Clean the dipstick and the area around it.

Oil capacity	**approximately 15 litres**



Dipstick location on K/L buses

IMPORTANT! Observe strict cleanliness. The gearbox is very sensitive to contaminants.



Dipstick location on N buses

7 Remove the dipstick.
Pour in maximum 10 litres of automatic transmission fluid.

8 Start the engine and run it at idle speed. Immediately start slowly to pour in approximately 4 litres of ATF.

9 Check the oil level with cold oil as described in the section "Checking With Cold Oil".

10 Drive the bus until the gearbox has reached operating temperature and check the oil level according to the section "Checking With Warm Oil".