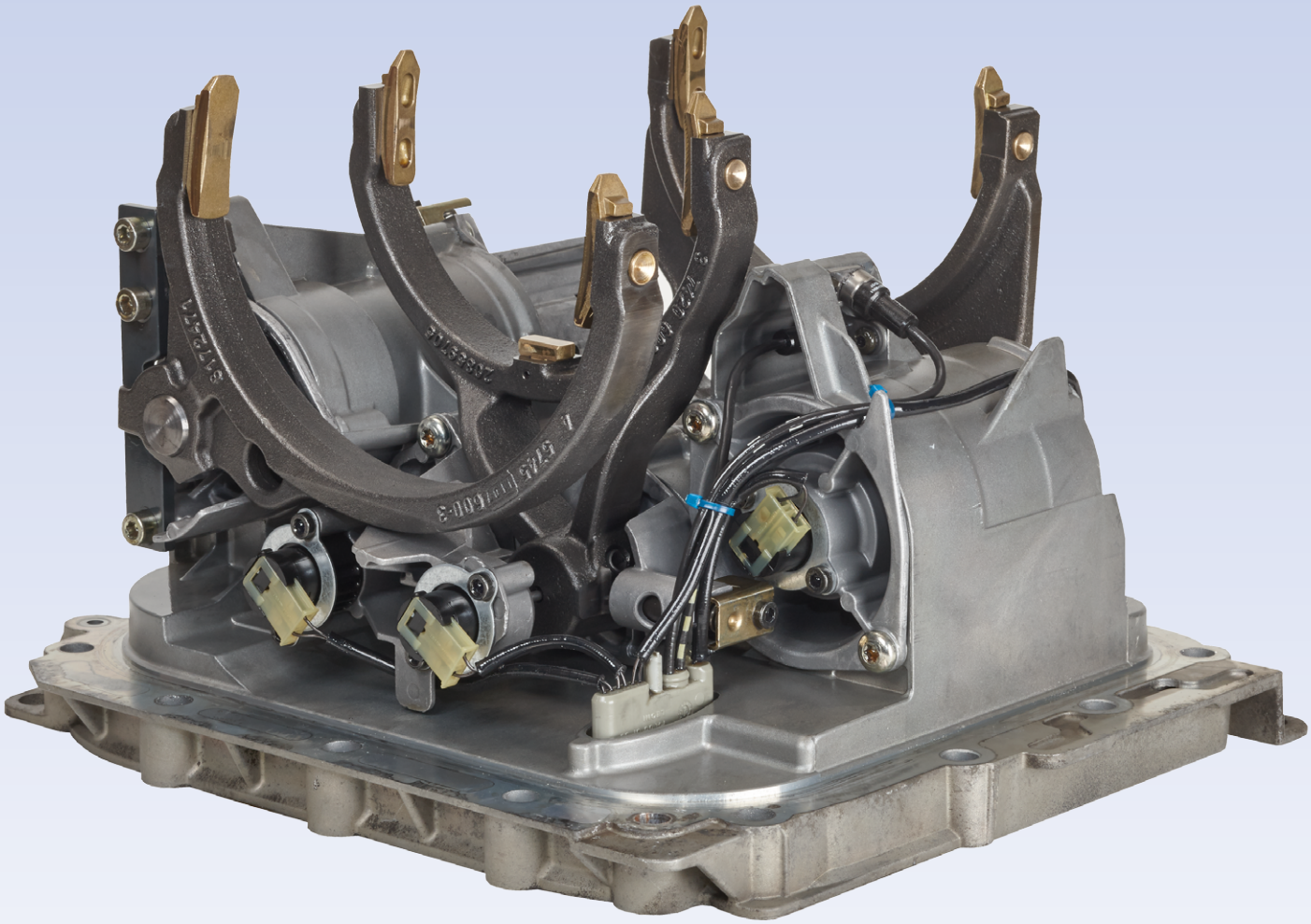
VOLVO GEARBOX ACTUATOR

STRUCTURE • FUNCTION • OVERHAUL



WABCO ACADEMY

VOLVO GEARBOX ACTUATOR

STRUCTURE • FUNCTION • OVERHAUL

1st Edition

WABCO
ACADEMY

The right of amendment is reserved.
Version 2 / 12.2016(en)
815 010 227 3

Table of contents

Table of contents

1 General information

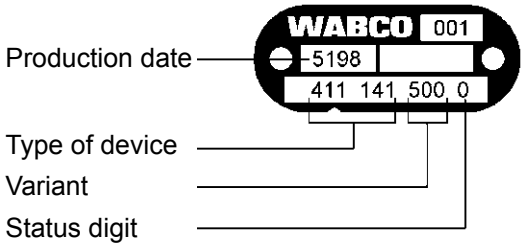
Copyright and trademark notice

The content, particularly technical information, descriptions and figures, corresponds to the state current at the time of printing and is subject to change without notice.

Any brand names, even if not indicated as such, are subject to the rules of the trademark and labelling rights.

Structure of the WABCO product number

WABCO product numbers consist of 10 digits.



0 = New device (complete device)
1 = New device (subassembly)
2 = Repair kit or subassembly
4 = Component part
7 = Replacement device

2 Introduction

Volvo Gearbox Actuator is an AMT type of transmission for commercial vehicles. AMT is an acronym for “Automated Manual Transmission”. The shifting processes are essentially automated by a gear changing system that is installed in the transmission.

This gear changing system – particularly its mechanical components – is subject to normal wear. An indication of advanced wear could be that a particular gear can no longer be engaged, for example. Or an internally installed, defective sensor no longer supplies measured values.

Benefits for you: cost reduction

In the event of a fault, the entire gear changing system is often replaced, but this involves high costs. A significant part of these costs could be saved by replacing only the defective component instead of the complete gear changing system. Even a complete overhaul of the gear changing system, where all moving parts and all sensors are replaced, is significantly more economical than a complete replacement despite the higher labour input.

All the repair kits required for this purpose are available from WABCO. Only the transmission control unit that is integrated into the gear changing system cannot be replaced separately. If this component fails, a complete replacement is the only option.

In this workshop you will learn all the essentials about the structure and operating principle of the Gearbox Actuator gear changing system so that you will be in a position to disassemble it for a complete overhaul. The initial theoretical section is followed by a practical section in which you can apply, check and complement what you have learned.

Scope of application: Volvo Gearbox Actuator up to generation D and Renault Optidriver

You can apply the knowledge and skills acquired in this workshop to transmissions up to Gearbox Actuator generation D, which are installed the following Volvo model series: FH (after 2000), FM 7, FM 10, FM 12, FMX (after 2000) as well as certain variants of the VN, VT and VHD series.

You can apply the learning content of these workshops directly to the D generation, but also to the predecessor generations A,B and C without or only with only minor modifications.

In addition, these statements also apply to corresponding transmissions from Volvo that can be installed in the following Renault model series as an option: Magnum, Premium, Lander and Kerax. At Renault, these transmissions are called “Optidriver”. The sections below refer explicitly only to the corresponding Gearbox Actuator transmissions from Volvo, but, as we have seen, most statements can also be applied to the gear changing systems of the corresponding “Optidriver” transmissions.

3 General information about the Gearbox Actuator transmissions

The basic design is, with respect to the installed shafts and the gear wheel sets, similar to standard manual transmissions. The shift linkage and the manual gear control lever are replaced by an electronically controlled and electro-pneumatically operated gear changing system.

The transmission has 12 forward gears and four reverse gears.

3.1 Gearbox Actuator generations

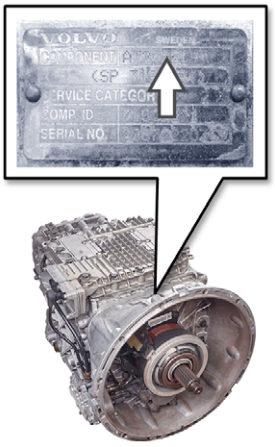
The Gearbox Actuator generations A to D differ only slightly:

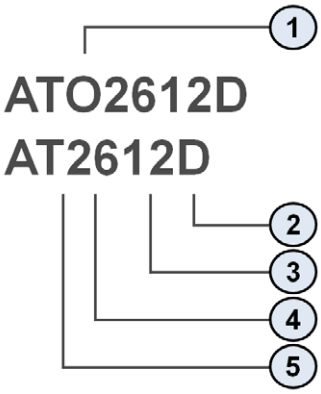
- Generations A and B still have an external clutch cylinder installed on the outside.
- From generation C, an internal clutch cylinder is installed. This is arranged concentrically around the drive shaft.
- In comparison to the C generation, the D generation is equipped with a modified rotational speed sensor.

3.2 Transmission variants: Direct drive and overdrive

Gearbox Actuator is available in direct drive transmission and overdrive models. The glossary at the end of this document explains what these terms mean specifically in relation to Gearbox Actuator. Section 3.5 also explains what distinguishes the design of these two transmission variants.

Labelling of the transmission





The type plate is located at the top of the transmission bell housing. The type description provides the following information:

1 The “O” represents “Overdrive”.

2 The “D” designates the generation.

3 The 12 stands for the number of gears.

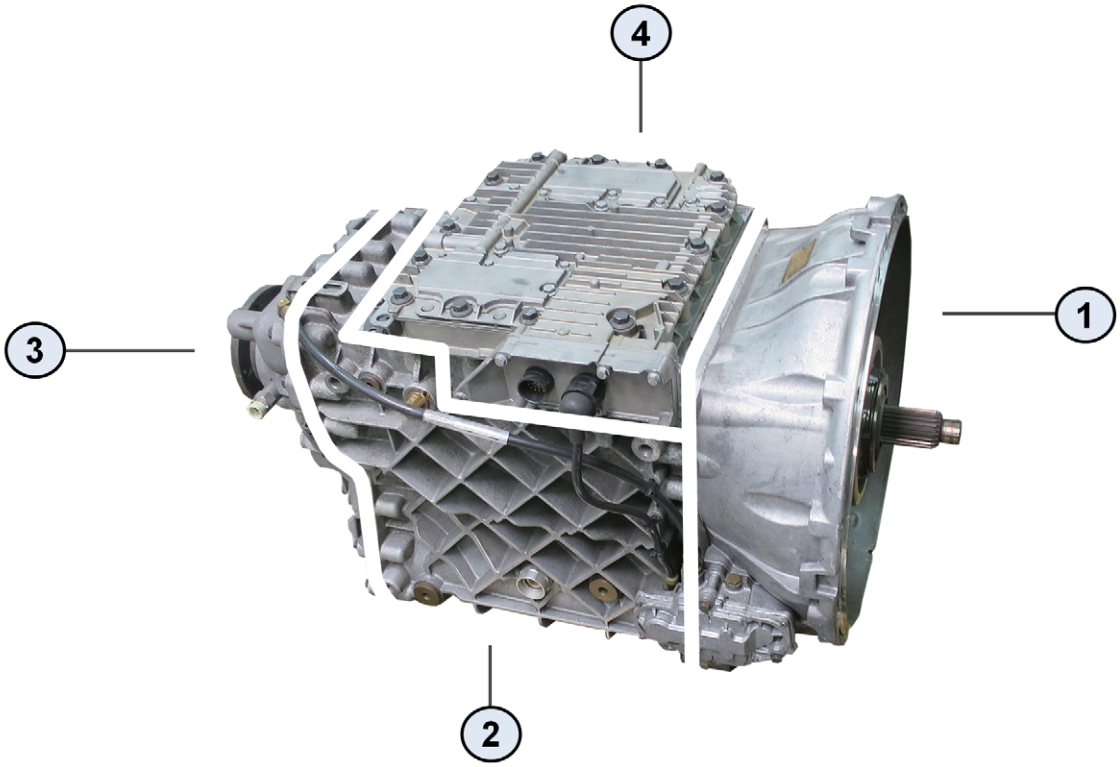
4 The 26 specifies the maximum torque, in this case 2,600 Nm.

5 The missing “O” means that in this case it is a direct drive transmission.

4 Mechanics of the transmission

4.1 Basic structure of the transmission

Gearbox Actuator transmissions have the following basic structure:



1 Clutch housing with transmission bell housing

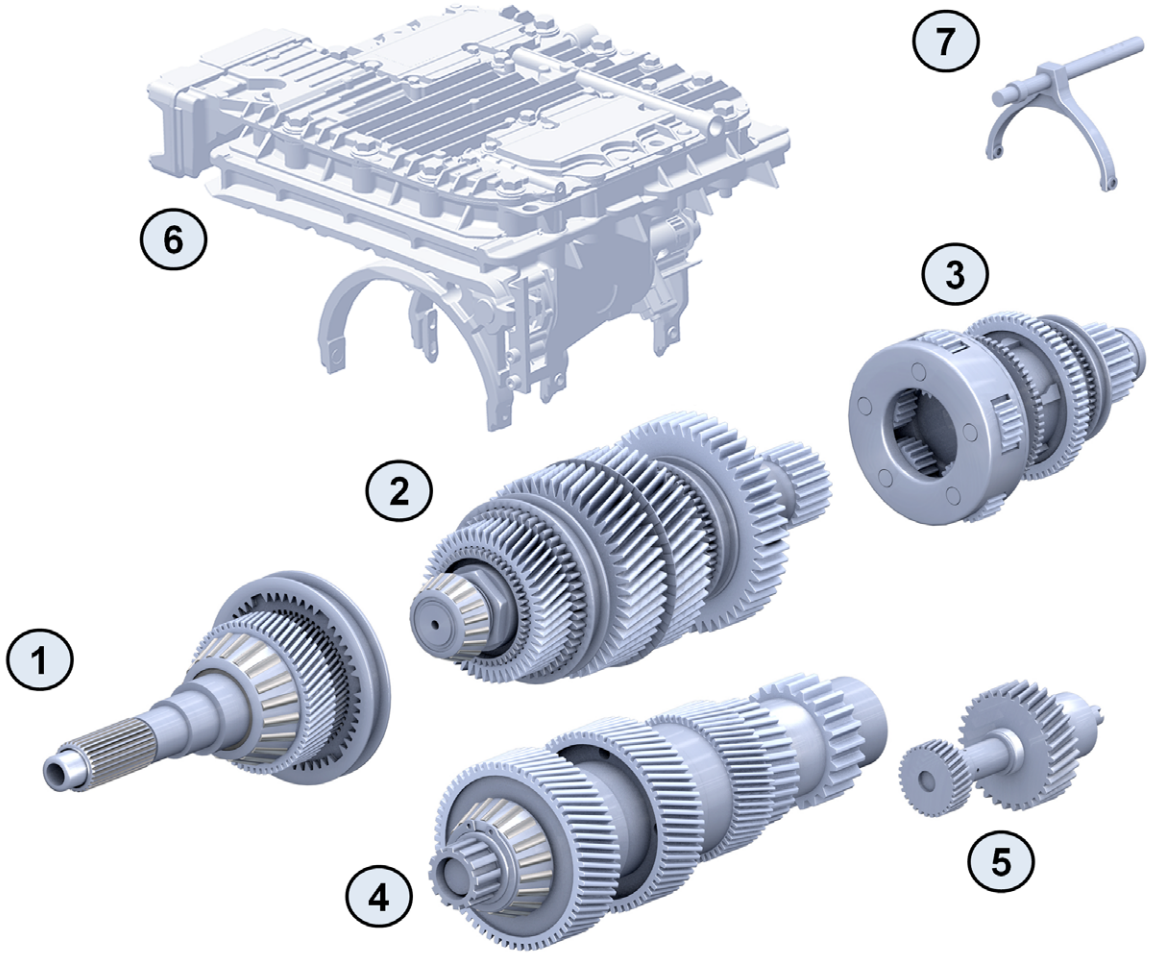
2 Basic housing in which the splitter group and the main group are installed

3 Range housing in which the range group is installed.

4 The gear changing system is arranged at the top side of the basic housing.

4.2 Shafts and gear wheel sets

Internally Gearbox Actuator transmissions are constructed as follows:



1 Drive shaft

2 Main shaft

3 Range group with drive shaft The range group is equipped with a planetary gear at the front.

4 Countershaft

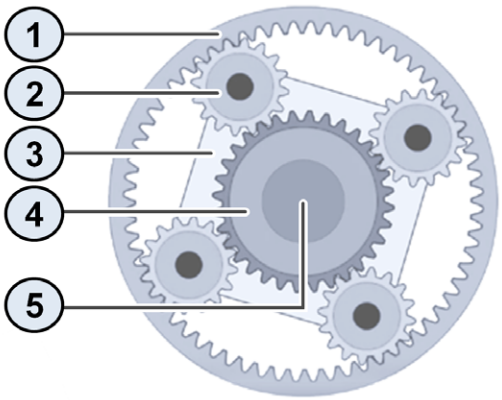
5 Reverse gear shaft

6 The gear changing system has three shift forks which are moved forward and back by pneumatic cylinders. The front shift fork moves the sliding sleeve on the drive shaft. The other two shift forks move the two sliding sleeves on the main shaft.

7 This separate shift fork is actuated by the range cylinder and the fork's shift rod. The shift fork operates the range group sliding sleeve.

4.3 Planetary gear: Operating principle

A planetary gear is installed in the range group of Gearbox Actuator transmissions. Planetary gears are basically constructed as follows:



1 Ring gear

2 Planet wheel (four in this case)

3 Planet carrier

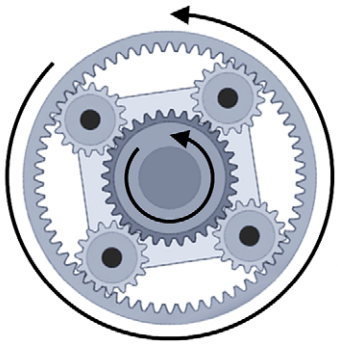
4 Sun wheel

5 Main shaft

The sun wheel is located at the end of the main shaft to which it is firmly connected. The planet wheels rotate around axles that are attached to the planet carrier. The planet carrier for its part is firmly connected to the drive shaft. The planet wheels with external gear teeth also mesh with the internal gearing of the ring gear.

4.3.1 Shift position: Range High

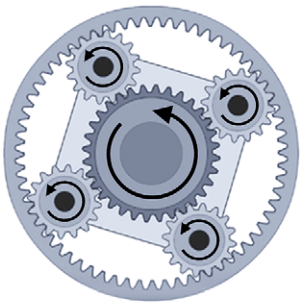
In In this shift position the planet carrier is firmly connected to the ring gear. This means that all gear wheels are locked against each other. Planet carrier and drive shaft rotate 1 : 1 with the main shaft.



4.3.2 Shift position: Range Low

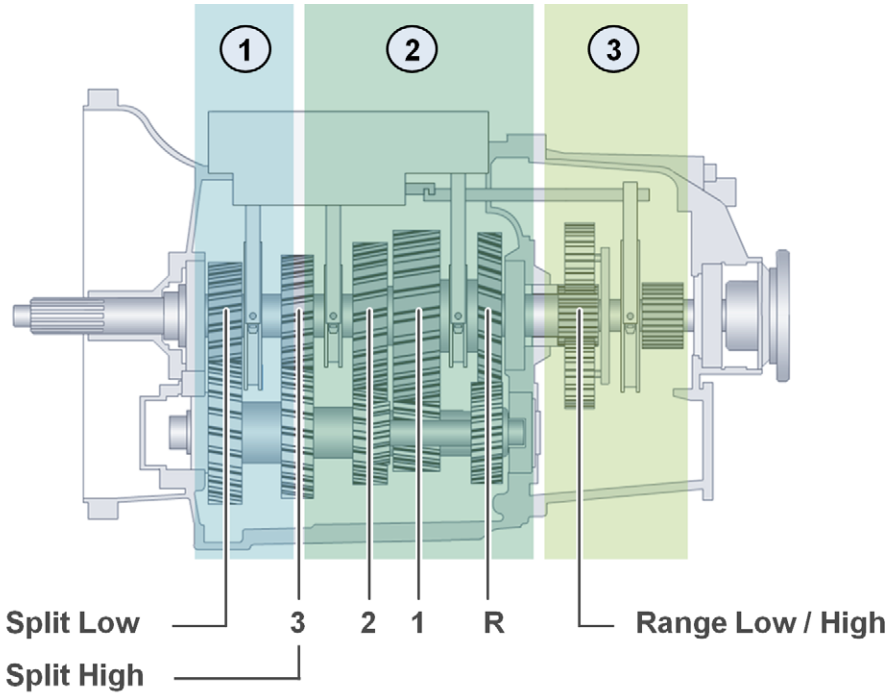
In this shift position the planet carrier is not connected to the ring gear.

The planet wheels therefore roll off in the ring gear. The transmission ratio between main shaft and drive shaft is now around 4.35 : 1.



4.4 Splitter group, main group and range group

The illustration shows these three groups using the example of a direct drive transmission:

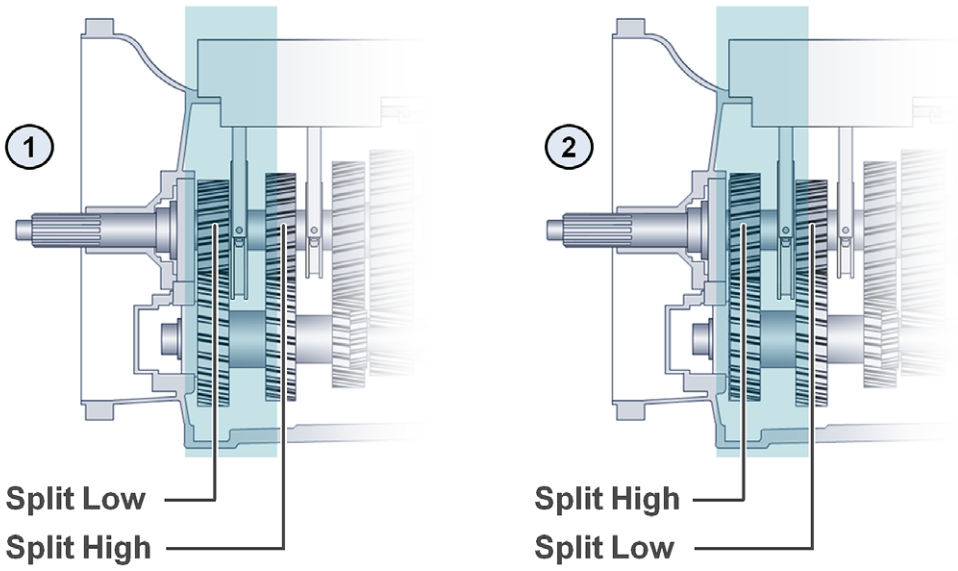


1 Splitter group: The two marked gear wheels enable shifting between two transmission ratios: Split low and Split High. The splitter group is synchronised.

2 Main group: The four marked gear wheels enable shifting between gears 1, 2 and 3 as well as the reverse gear. The main group is not synchronised.

3 Range group: The planetary gear in the range group enables shifting between range low and range high. The range group is synchronised.

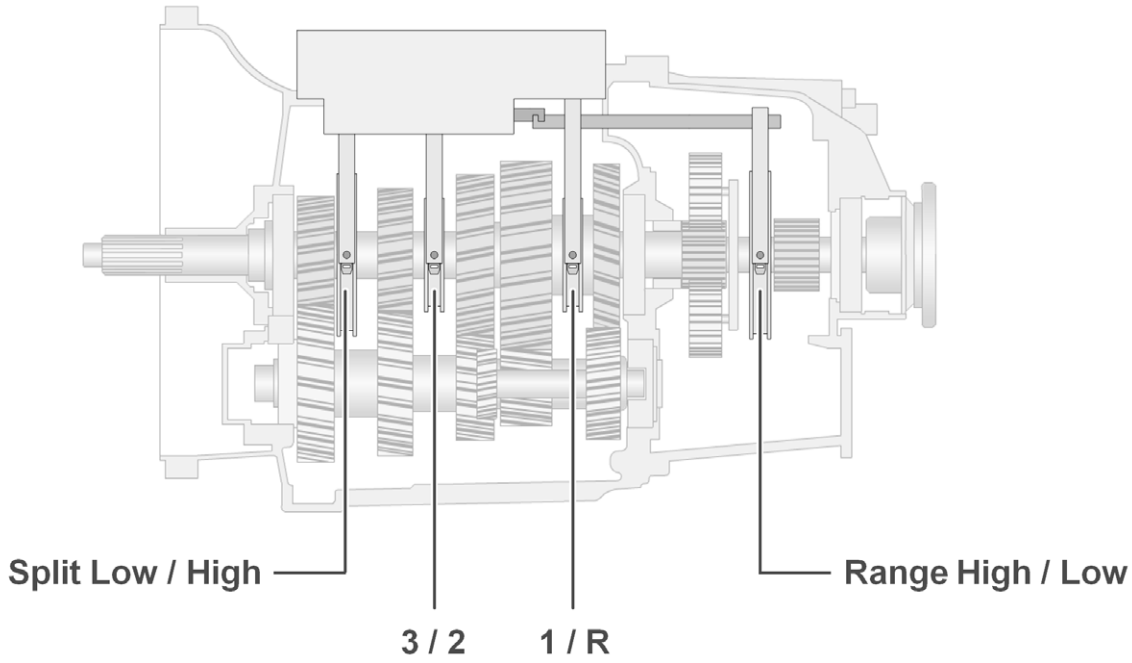
4.5 Direct drive transmission and overdrive in comparison



In contrast to the direct drive transmission (1) the overdrive variant (2) differs in that the Split Low and Split High shifting positions are interchanged and that different transmission ratios apply for both shifting positions.

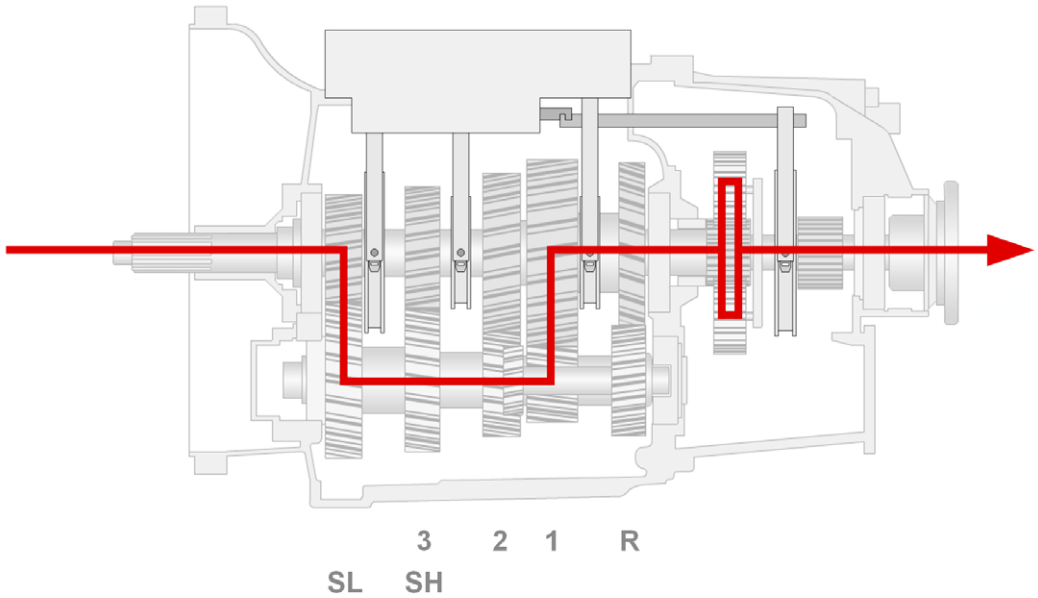
4.6 Sliding sleeves and shift forks

Gearbox Actuator transmissions are equipped with four sliding sleeves:



The sliding sleeves for shifting the splitter group, shifting between gear 1 and the reverse gear as well as between gear 2 and 3 are moved by shift forks that are integrated in the gear changing system. The shift fork for operating the sliding sleeve in the range group, on the other hand, is located outside of the gear changing system. The range cylinder in the gear changing system operates them by means of an external shift rod.

4.7 The flow of force in 1st gear (using the direct drive transmission as an example)

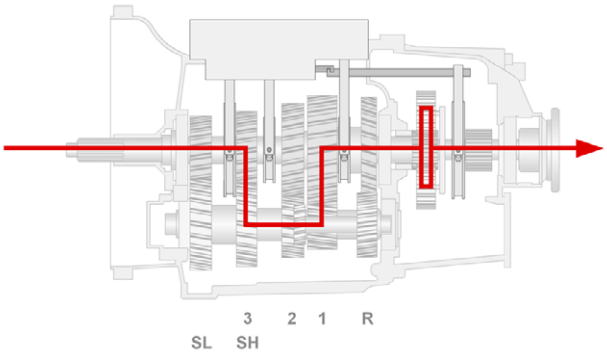


Here the example of the flow of force in 1st gear: The splitter group is engaged to Split Low. In the main group, the idler (see glossary) for the 1st gear is engaged positively locked with the main shaft through the intervention of the sliding sleeve. The sliding sleeve for the 2nd and 3rd gear is in neutral position. The range group is set to Range Low due to the corresponding engagement of the planetary gear.

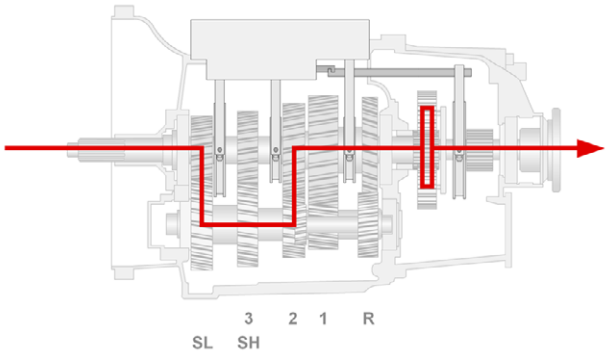
4.8 The flow of force in gears 1 to 12 (direct drive transmission)

1st gear:

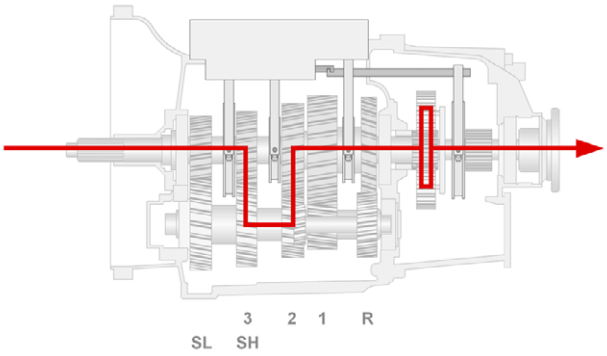
2nd gear:



3rd gear:



4th gear:



5th gear:

6th gear:

7th gear:

8th gear:

9th gear:

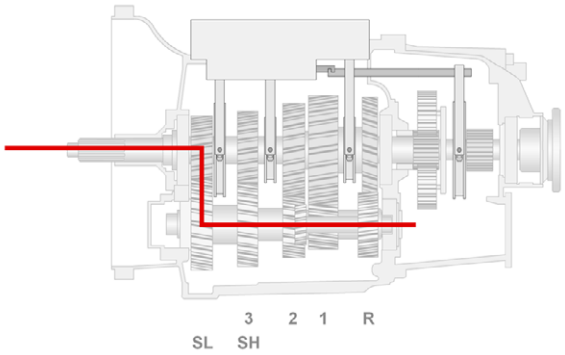
10th gear:

11th gear:

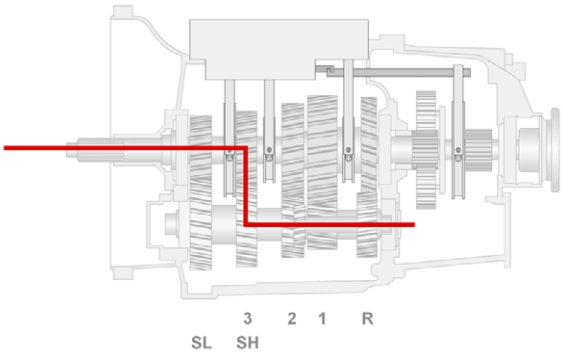
12th gear:

4.9 The flow of force in neutral position (direct drive transmission)

Neutral N1:



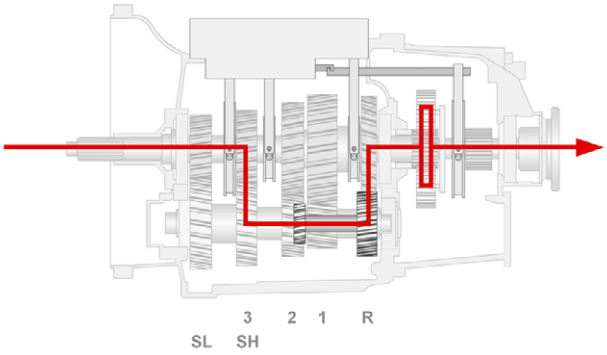
Neutral N2:



4.10 The flow of force in the reverse gears (direct drive transmission)

R1:

R2:



R3:

R4:

4.11 Postition of the shift forks in forward and reverse gears

	Split	3/2	1/R	Range
1	Low	Neutral	1	Low
2	High	Neutral	1	Low
3	Low	2	Neutral	Low
4	High	2	Neutral	Low
5	Low	3	Neutral	Low
6	High	3	Neutral	Low
7	Low	Neutral	1	High
8	High	Neutral	1	High
9	Low	2	Neutral	High
10	High	2	Neutral	High
11	Low	3	Neutral	High
12	High	3	Neutral	High
R1	Low	Neutral	R	Low
R2	High	Neutral	R	Low
R3	Low	Neutral	R	High
R4	High	Neutral	R	High

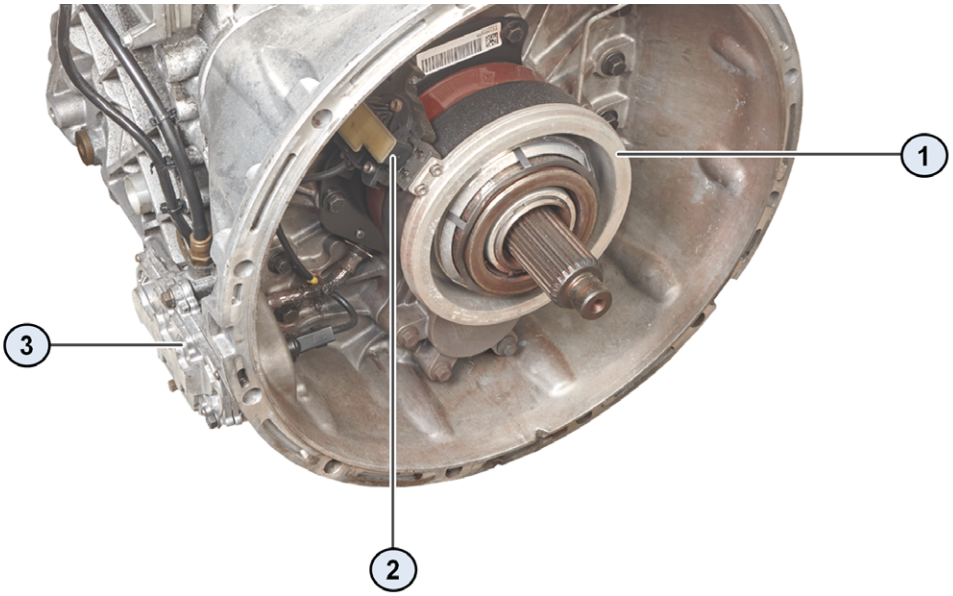
This table shows the positions of the sliding sleeves and shift forks in the different gears using the example of a direct drive transmission. The perspective on the transmission is here also from the side so that the drive side is on the left.

Let us examine the 8th gear for example: Here the following can be noted:

- The shift fork for split is in the position to the right.
- The shift fork for 3 / 2 is in the central position.
- The shift fork for 1 / R is on the left.
- The shift fork for range is on the right.

With overdrive transmissions the position of the shift fork split is exactly the opposite in all gears. The other shift forks, on the other hand, are in exactly the same position as with the direct drive transmission.

4.12 Clutch

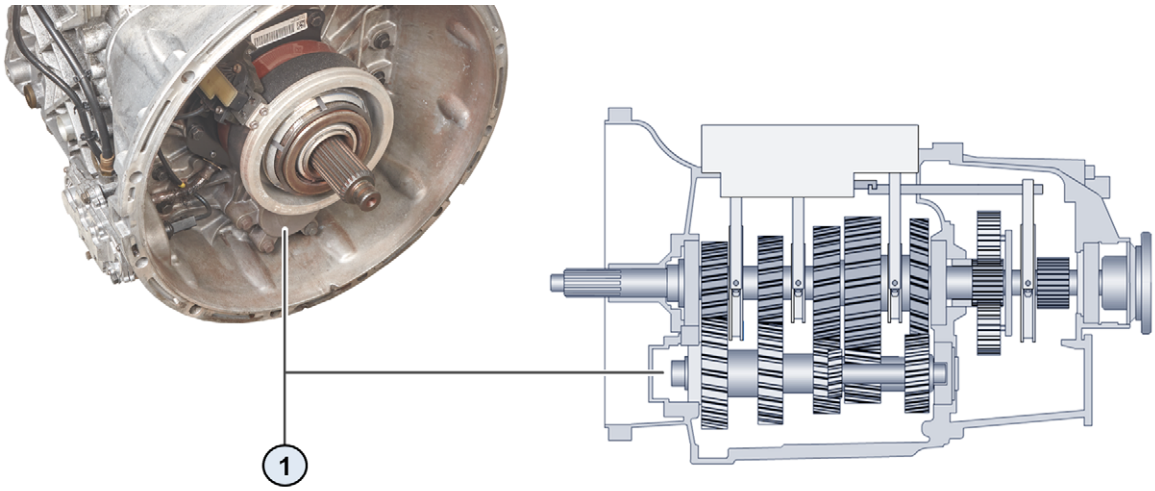


As of Gearbox Actuator generation C, the pneumatic cylinder for operating the clutch (1) is installed – concentrically around the drive shaft – in the transmission bell housing.

A position sensor (2) measures the clutch wear.

The valve package for clutch operation (3) is arranged on the outside of the clutch housing.

4.13 Countershaft brake

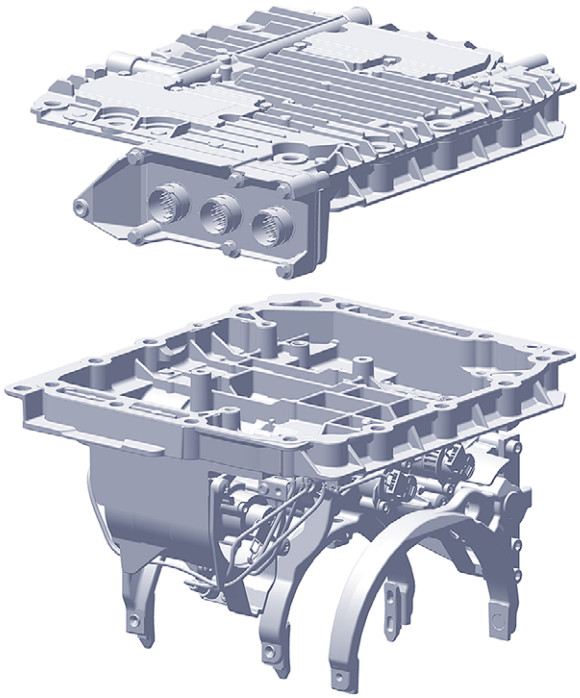


The countershaft brake (1) is arranged below the clutch cylinders. A pneumatic cylinder installed in a multi-disc brake operates this brake for stepless braking of the countershaft. All rotating parts of the transmission are thereby braked as well. This replaces the mechanical synchronisation in the main group, i.e. no synchroniser ring is installed in this group. The respective sliding sleeve is only operated when the main shaft and the idler of the selected gear rotate approximately synchronous with one another or when both are at a stop. To achieve this, the idler is braked accordingly via the countershaft.

The countershaft brake is used when engaging the start gear and when upshifting.

5 Structure of the gear changing system

The gear changing system consists of a cover and a bottom section.



The cover contains

- the transmission control unit,
- the solenoid valve for controlling the air cylinders in the bottom section
- as well as a pressure sensor for monitoring the supply pressure.
- In addition, the cover is equipped with the pneumatic and electrical connections for the gear changing system

The bottom section contains

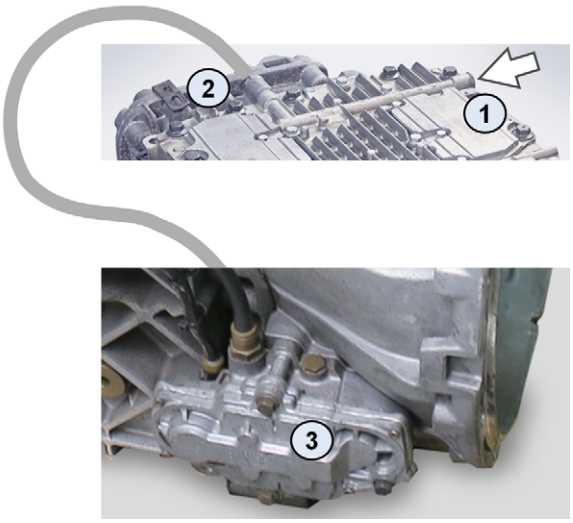
- three of the four shift forks,
- the pneumatic cylinders for moving the shift forks
- and the locking mechanisms which allow the shift forks to engage in the last shifted position.
- In addition, one position sensor for every shift fork
- as well as rotary encoders for the main and counter-shaft are installed in the bottom section.

5.1 Air ports and connections

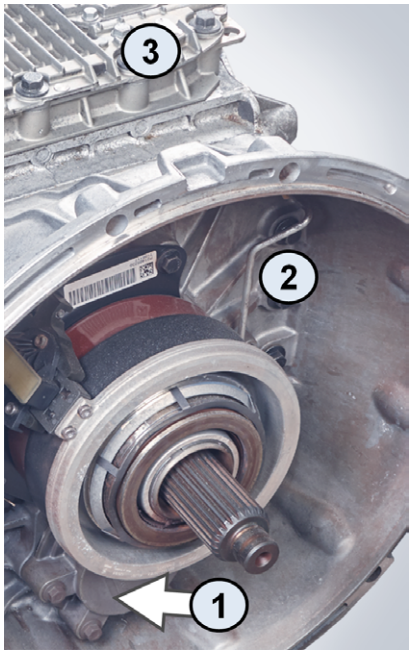
The gear changing system is supplied with compressed air by means of the port (1) at the side of the cover.

Part of this air is conducted to the valve package for clutch operation (3) via an output at the rear of the cover (2) to provide these valves with supply pressure.

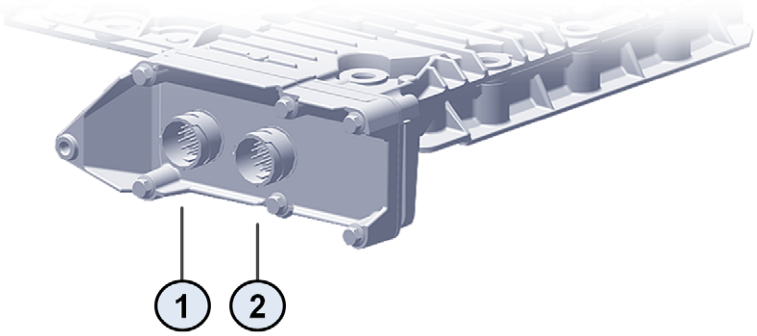
A pressure sensor in the cover monitors the supply pressure for both gear changing system and valve package.



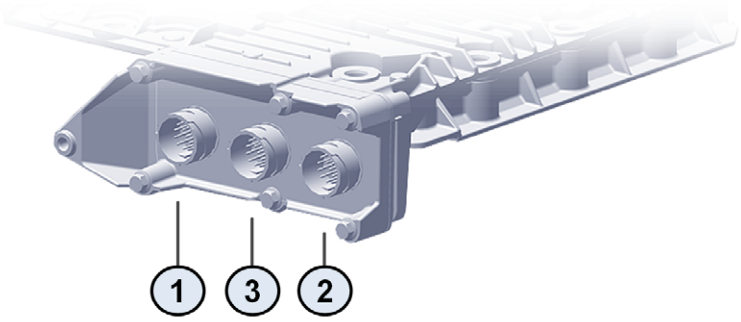
Compressed air is applied to the pneumatic cylinder of the countershaft brake (1) via an internal line (2). A hole connects this air line to the cover of the gear changing system (3) so that the countershaft brake can be controlled by means of an electromagnetically actuated valve.



5.2 Electrical connections



Gearbox Actuator transmissions without a retarder have two electrical connections on the cover of the gear changing system:
one connection (1) for the power supply and for connecting to the vehicle network, the other (2) for connecting the valve package to operate the clutch, which is controlled by these valves.

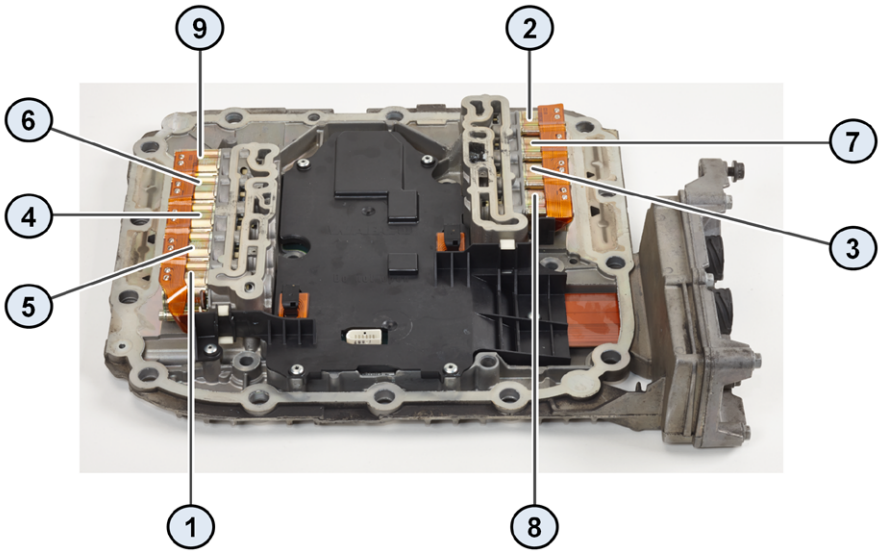


In the case of Gearbox Actuator transmissions with retarder the gear changing system is electrically connected to the retarder control unit via a third connection (3) at the centre.

5.3 Components in the cover of the gear changing system

5.3.1 Solenoid valves

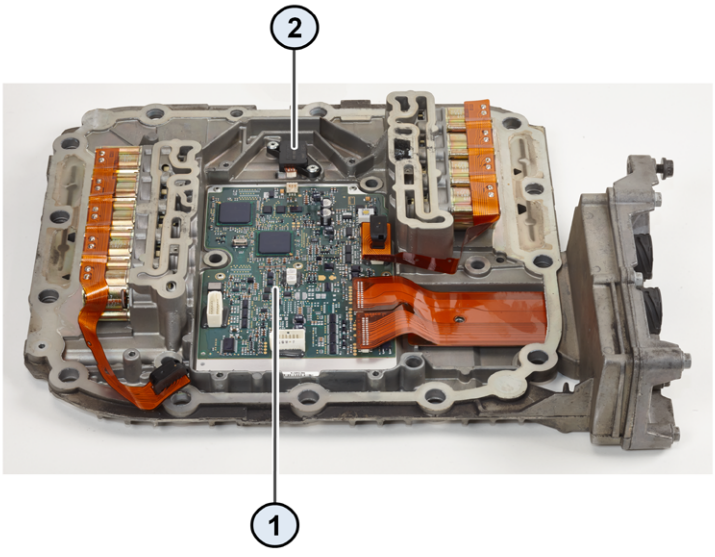
The cover of the gear changing system houses the solenoid valves for controlling the shift fork positions and for operating the countershaft brake. These tasks are distributed as follows:



1 1st gear
2 2nd gear
3 3rd gear
4 Reverse gear
5 Split Low
6 Split High
7 Range Low
8 Range High
9 Countershaft brake

5.3.2 Transmission control unit (TECU) and pressure sensor

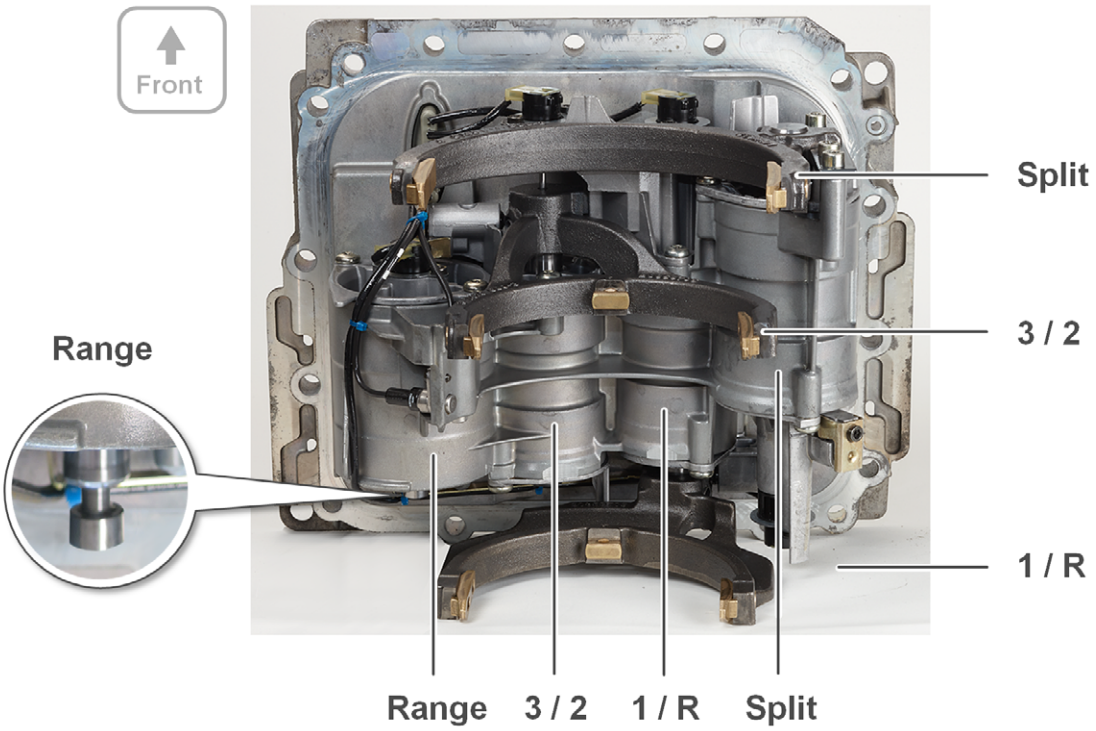
The cover also houses the circuit board of the transmission control unit (1) underneath an additional cover. It is also called TECU (see glossary). The pressure sensor (2) monitoring the supply pressure is also installed here.



5.4 Components in the bottom section of the gear changing system

5.4.1 Cylinders and shift forks

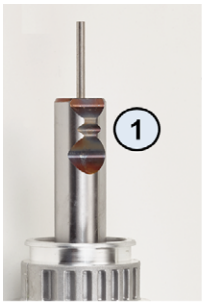
The sequence of shift forks (from the drive side (“Front”) to the driven side) arises from the construction of the transmission: Split, 3/2 and 1/R.

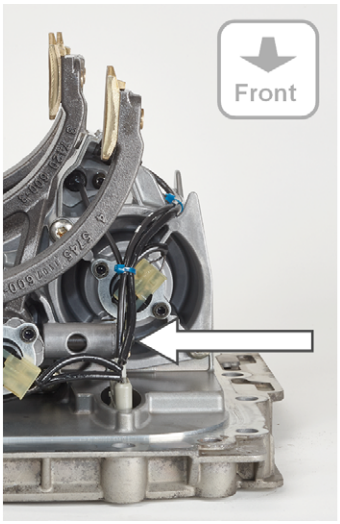


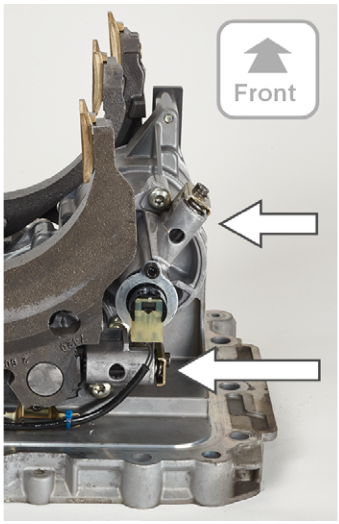
The corresponding cylinders are accompanied on the lift side by the range cylinder. The thickening at the end of its piston rod is mounted into the external shift rod of the range group.

5.4.2 Locking mechanisms

They are used to retain the shift forks exactly in their shift positions. To this end, the locking pins extend into the depressions (1) in the piston rods. Three locking mechanisms are installed in the gear changing system. The range locking mechanism, on the other hand, is located in the range housing (not accessible).

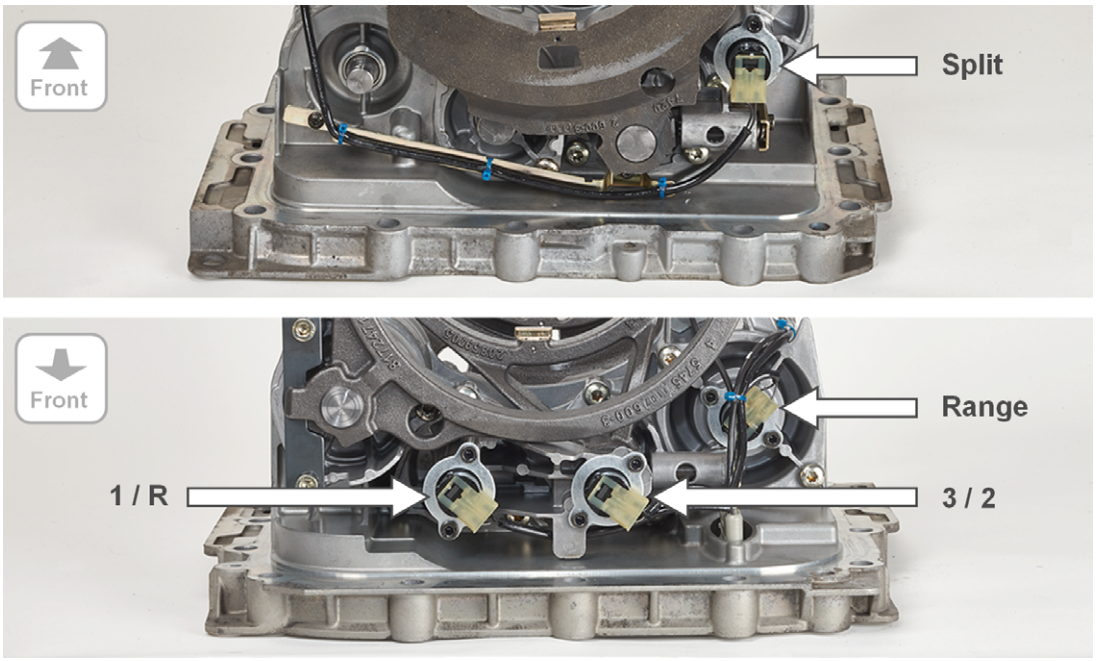




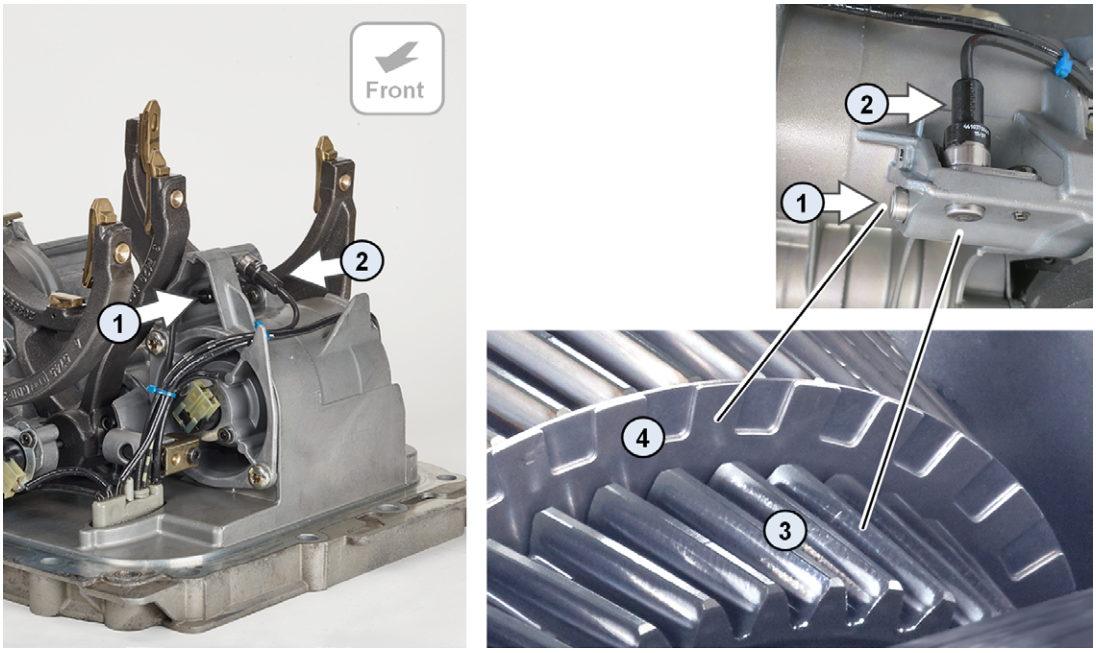


5.4.3 Position sensor

The current positions of the four piston rods and thus the shift forks are captured by four positions sensors. These are located at one end of the respective piston rod. This enables detection of whether a new shift position has actually been reached.



5.4.4 Rotary encoder



The current rotational speed of the main shaft is captured by a horizontally arranged rotational speed sensor (1) by means of a pulse disc (4) that is connected torque-proof to the main shaft.

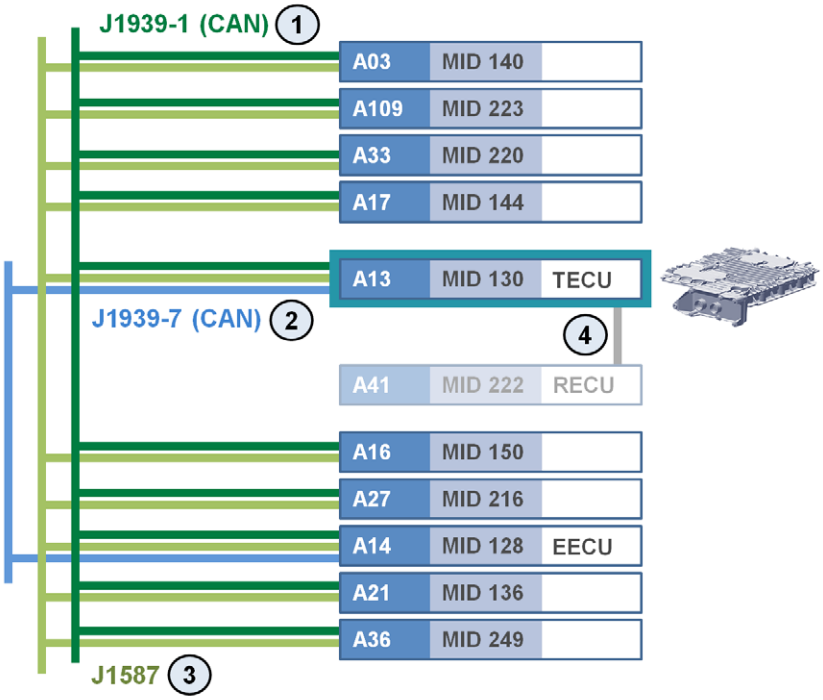
A second, vertically arranged rotational speed sensor (2) captures the countershaft's rotational speed via the rotational speed of the idler (3) for the 2nd gear.

6 Network integration of the transmission control unit

6.1 Bus connections

The transmission control unit (TECU) in the gear changing system of the Gearbox Actuator transmission is networked with numerous other control units in the vehicle through several busses.

Here the network integration of a transmission control unit in the Volvo FH as an example.



A03 Central instrument

A109 Gear select lever control unit

A33 Trip recorder

A17 Vehicle control unit

A13 Transmission control unit (TECU)

A41 Retarder control unit (RECU)

A16 ECS control unit (air suspension)

A27 Control unit for outside lighting

A14 Engine control unit (EECU)

A21 EBS control unit

A36 Body builder module

The transmission control unit A13 (TECU) is first networked with the other control units shown here via a CAN-Bus (1) in accordance with the J1939 standard. A wide range of control and status information is exchanged with the other control units over this Highspeed CAN bus.

The transmission control unit is additionally networked with the engine control unit A14 (EECU) via a further Highspeed CAN bus (2) because in this case the data exchange is particularly extensive and must occur as promptly as possible.

There is another bus (3) that is mainly used for diagnosis. With the FH model series a bus in accordance with the J1587 standard is used for this purpose. In the event of a CAN bus failure, this bus can also be used as an alternative to transmit other data. Its data transmission rate is significantly lower however.

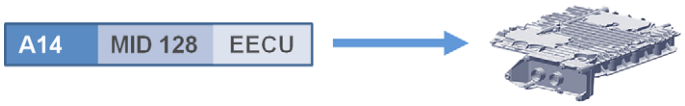
If an Gearbox Actuator transmission with retarder is installed, there is another bus connection (4) to the A41 control unit for the retarder (RECU).

6.2 Examples of CAN messages

The transmission control unit exchanges numerous messages with the other control units via the two CAN busses. Here are a few examples:

Gear select lever control unit:

- Current select lever position



Engine control unit (EECU):

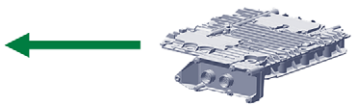
- Engine speed
- Engine torque
- Engine configuration

Vehicle control unit:

- Accelerator pedal position, including kickdown
- Brake pedal position
- Parking brake position
- Control of the retarder

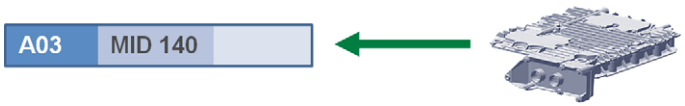
EBS control unit:

- Wheel speeds
- Wheel slip
- ABS intervention
- ESC intervention



- Launch control: prior to shifting between a forward and a reverse gear: automatic activation of the service brake

Network integration of the transmission control unit



Central instrument:

- Currently selected gear
- Currently possible gears
- Currently selected driving program

ECS control unit (air suspension):

- Vehicle weight

Outside lighting control unit:

- Trailer coupled or uncoupled
  (affects the choice of moving-off gear)

Body builder module:

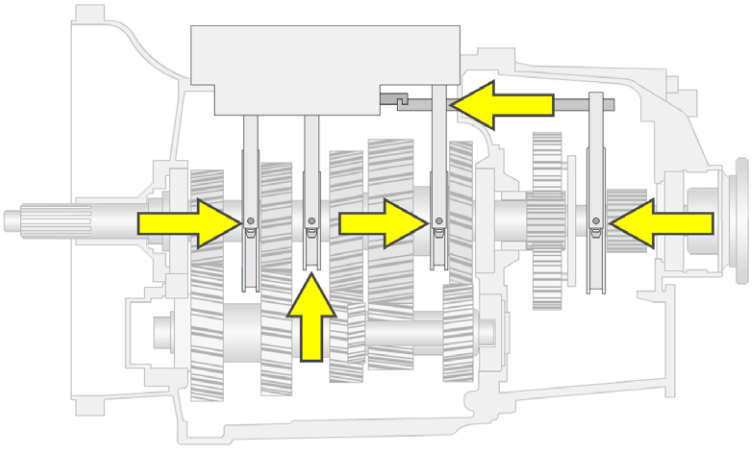
- Activation of the auxiliary drive
- Shifting the auxiliary drive

7 Disassembly of the gear changing system

7.1 Prior to disassembly

The bottom section of the gear changing system can only be removed if the splitter and range groups have the following shift positions:

- Range in High position
- with direct drive transmissions: Split in High position
- with overdrive transmissions: Split in Low position

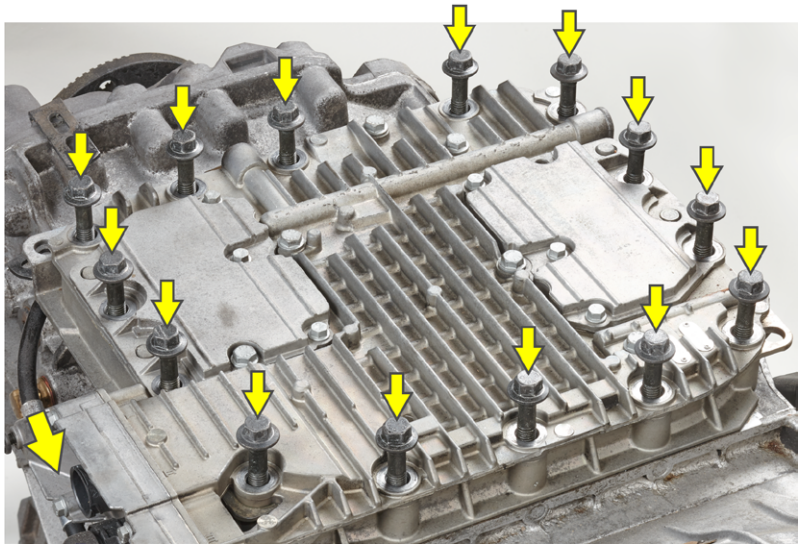


In addition, the shift fork for 1 / R must be in reverse gear position. These positions should be established before beginning disassembly of the gear changing system.

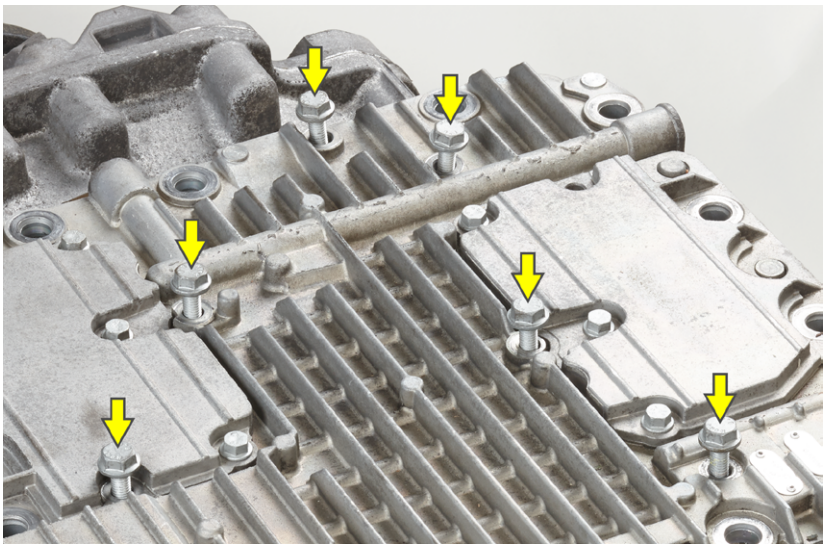
This is most easily done by selecting the corresponding gear. With direct drive transmissions the fourth reverse gear is most suitable for this purpose, with overdrive transmissions the third. If it is not possible to engage this gear due to the defect to be remedied, the attempt can be made to achieve this by means of the diagnostic tools, which is required towards the end of the repair in any case (see section 7.4.6).

7.2 Removing the cover of the gear changing system

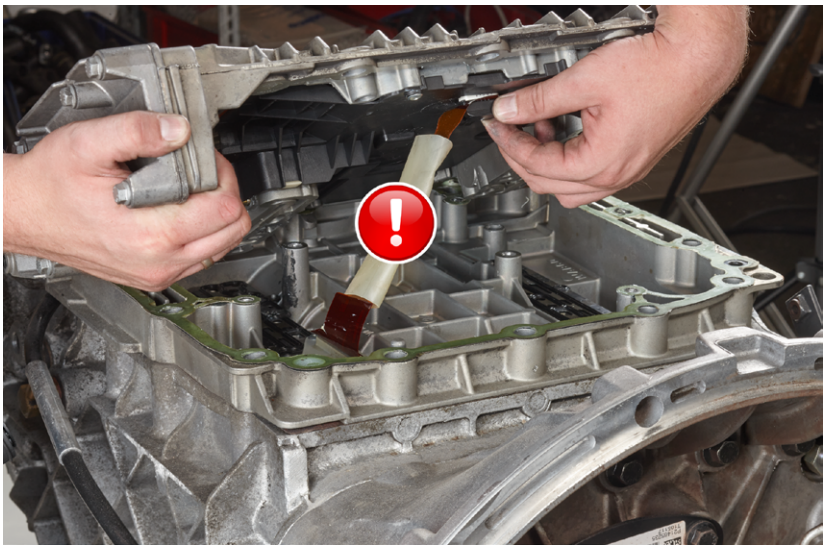
- Unscrew the electrical connectors from the gear changing system's cover to disconnect them.
- Unscrew and remove the size 15 screws at the edge of the cover:



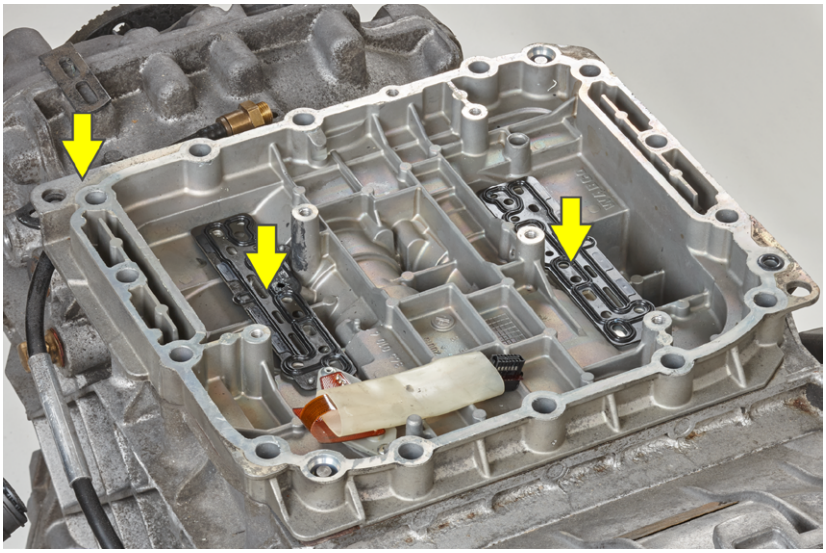
- Unscrew and remove the six size 13 screws:



- Lift the cover a little at the engine side. **Attention: Lift the cover only so far as not to strain or even tear off the connecting cable between the cover and the bottom section!**
- Pull the connecting cable plug connection from the cover:

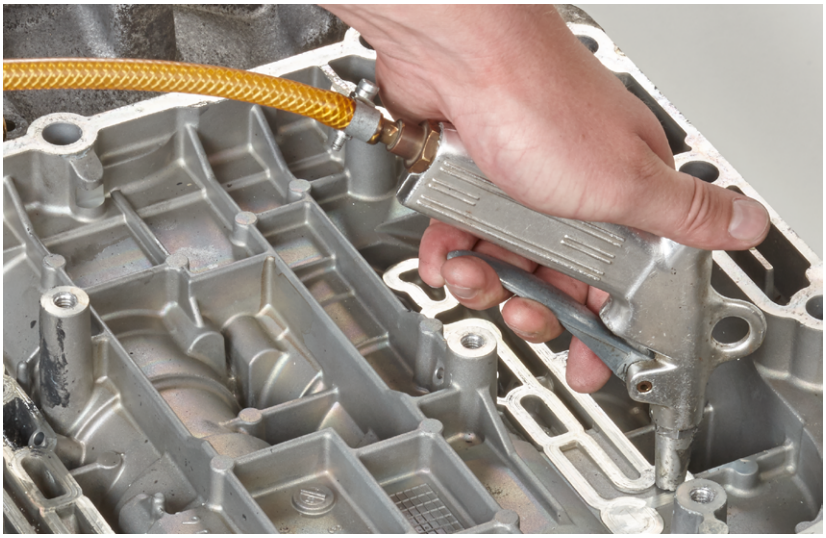


- Remove the cover.
- Remove the cover seal and the two black seals in the bottom section of the gear changing system:



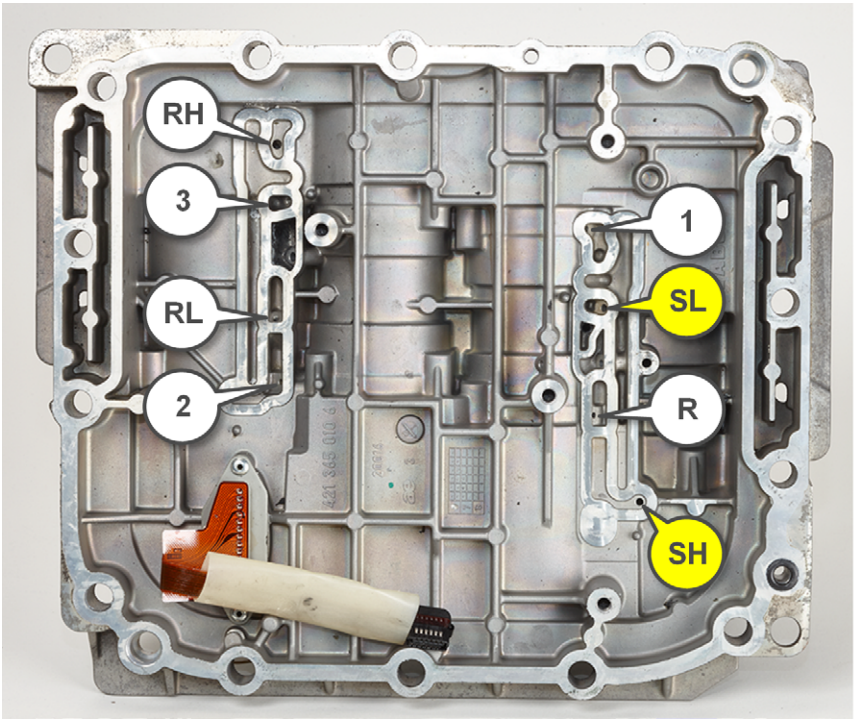
7.3 Move the shift forks into the required position

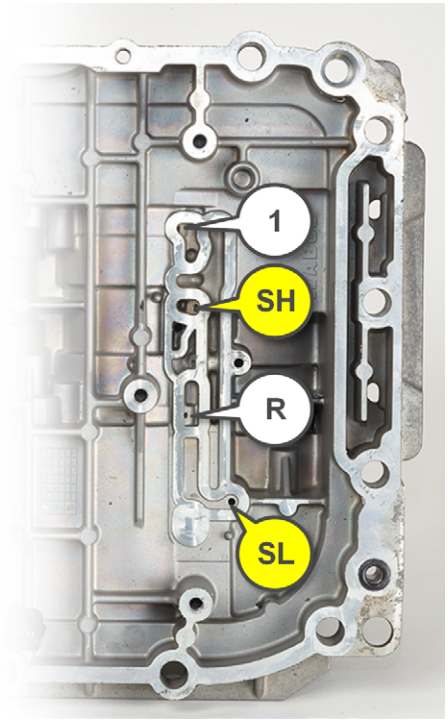
If you were unable to move the cylinders with the shift forks into the required positions by selecting the corresponding gear or by means of the diagnostic tool (see section 6.1), you must to this now manually. For this purpose, compressed air is applied to the corresponding air channels in the bottom section.



Disassembly of the gear changing system

You will find the air channels for operating the shift rod at the locations shown below. On the left hand side the situation for a direct drive transmission, on the right hand side the reverse assignments in relation to split High and split Low for an overdrive transmission:





These are the required steps:

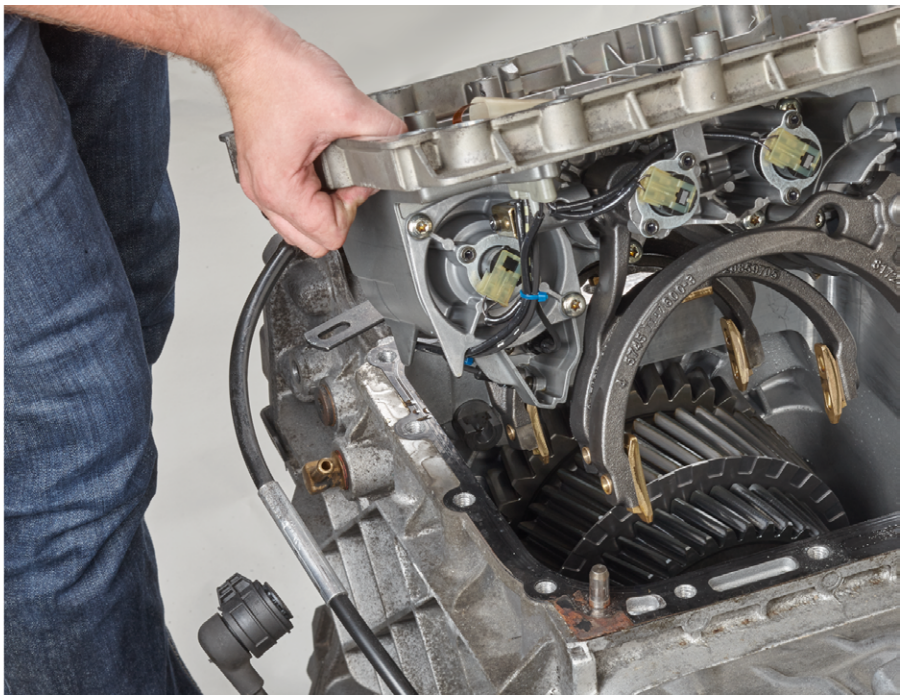
- Temporarily screw in four of the size 15 screws at the edge of the gear changing system's bottom section (one on each side) to fix it in position on the transmission housing. This prevents the gear changing system's bottom section from moving and damaging the pulse disc on the main shaft during the following procedure. Do not tighten the screws too firmly to avoid damaging the sealing surface.
- First move the shift fork split to the "back" position:
  - To ensure that the split shift fork moves correctly, channel 1 (1st gear) must be pressurised first.
  - With direct drive transmissions, the SH channel (Split High) must then be pressurised, with overdrive transmissions, the SL channel (Split Low).
- Then move the range transmission to the "front" position:
  - To ensure that the split shift fork moves correctly, channel R (reverse gear) must be pressurised first.
  - Then pressurise the RH channel (Range High).
- Finally, shift into the reverse gear:
  - A mechanical device in the gear changing system prevents engagement of the reverse gear while the shift fork 3 / 2 is not in neutral position. It must therefore first be checked if the main transmission is in neutral position. For this purpose rotate the drive shaft by hand.
    - If this is possible, the transmission is in neutral position.

  - If this is not possible, the neutral position needs to be established first. For this purpose, carefully pressurise channel 2 (2nd gear) or channel 3 (3rd gear), alternately if necessary, while a second person constantly attempts to rotate the drive shaft. As soon as this becomes possible, the shift fork 3 / 2 has reached the neutral position.
- Then pressurise channel R (reverse gear).

■ Unscrew the size 15 screws used to fix the bottom section in position.

7.4 Remove bottom section

Use screwdrivers to lift the gear changing system from the transmission housing. If the gear changing system has not been removed for some time, use a crowbar instead to lift the bottom section a little.



Then carefully pull the bottom section out upwards so that the pulse disc and the gear wheels in the transmission are not damaged by the shift forks.

7.5 Important note regarding the following descriptions

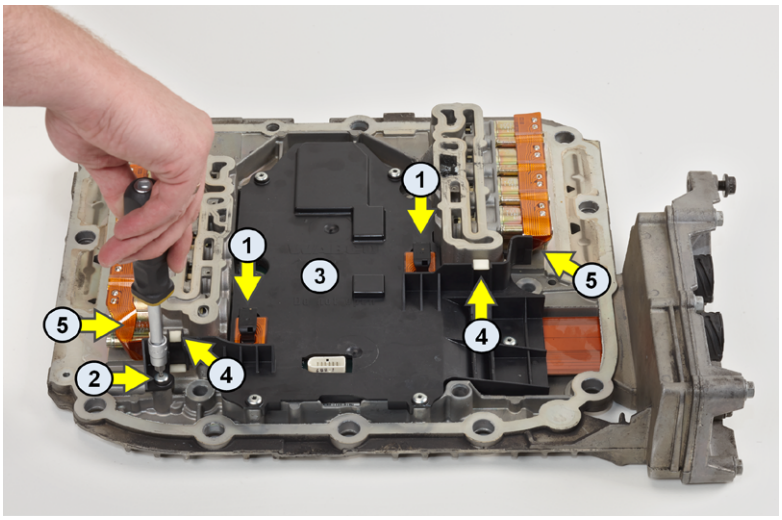
The following descriptions of how to recondition the gear changing system can only provided as an overview here. When replacing parts, always follow all the specifications and repair notes in the documents included in the respective repair kit. Only these documents are binding in terms of liability.

You can also find the technical documentation for each repair kit under its product number in WABCO INFORM (http://inform.wabco-auto.com).

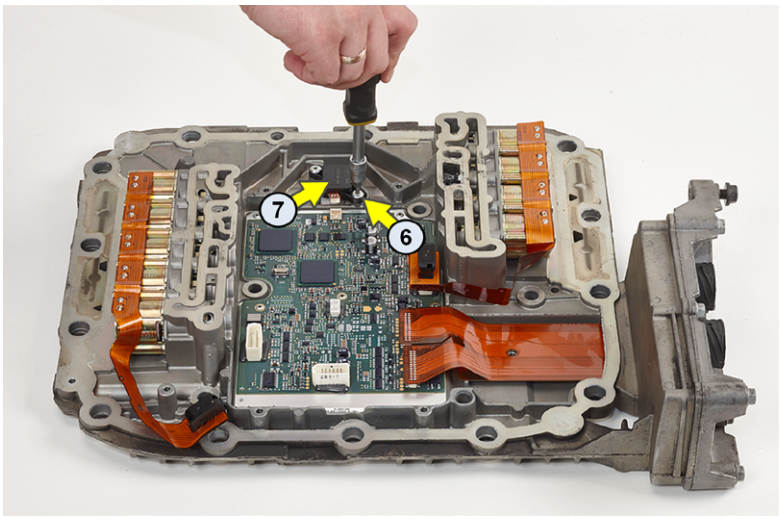
8 General overhaul of the gear changing system

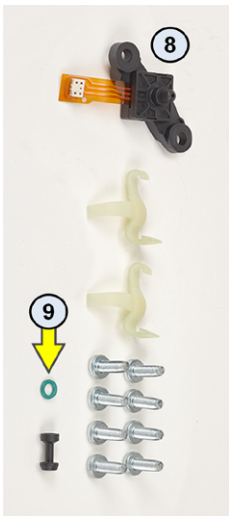
8.1 Replacing the pressure sensor

The pressure sensor for monitoring the supply pressure is installed in the gear changing system cover. When replacing the sensor, follow the detailed instructions included in the corresponding repair kit (WABCO order number 421 365 947 2). Here is a brief overview of the procedure:



- Remove both connectors (1).
- Use an Allen key (SW 2.5) to remove the six self-tapping screws (2) that retain the black cover of the TECU (3) in position.
- Remove the two white plastic clips (4), lift the flex-coil cable (5) from the black cover (3) and remove the cover.

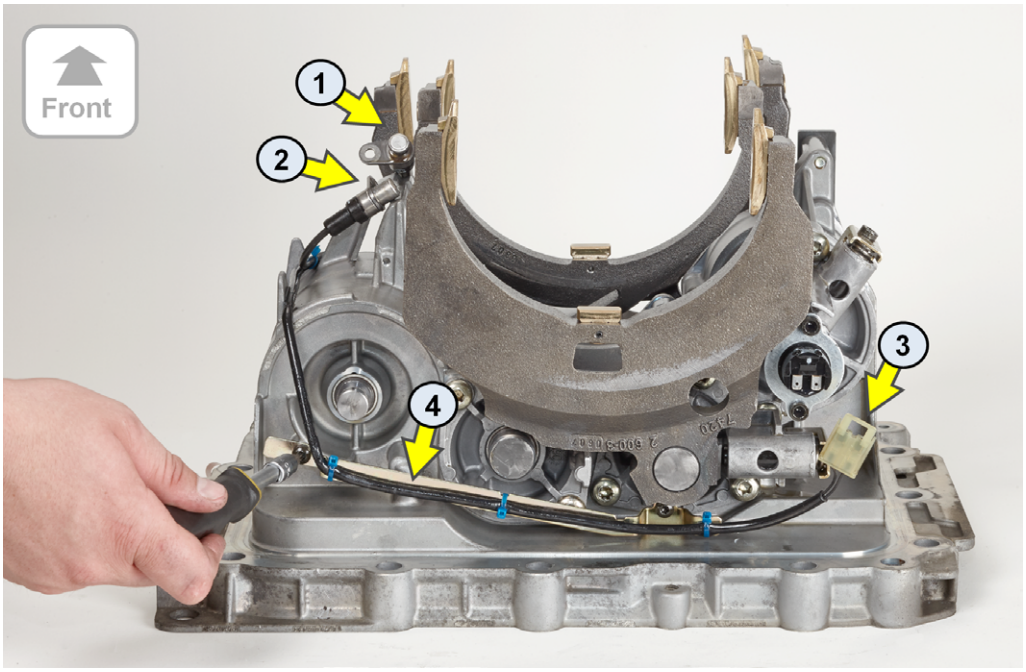




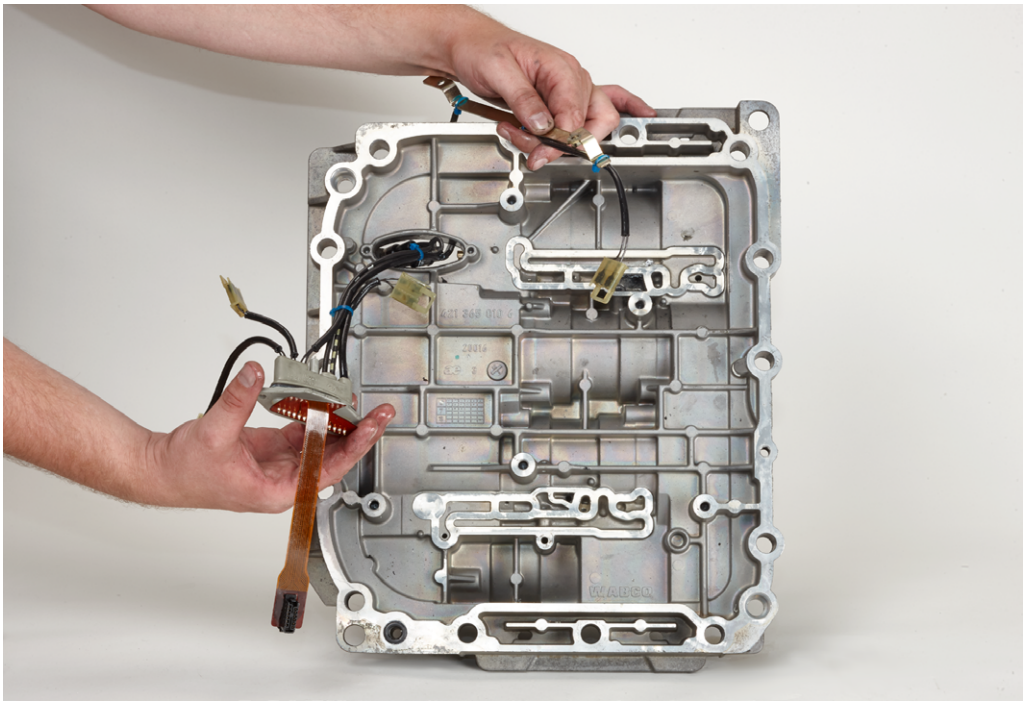
- Remove the two self-tapping screws (6) (SW 2.5) on the pressure sensor.
- Remove the pressure sensor (7) together with the O-ring (see 9) on its air connection.
- Use all the new parts included in the repair kit to install the new pressure sensor (8). (see figure on the right).

8.2 Removing the rotary encoder and cable harness

- Remove the two rotary encoders (1 and 2).
- Disconnect all plug connections (3) including those on the opposite side of the gear changing system.
- Remove the cable bridge (4) on the driven side.

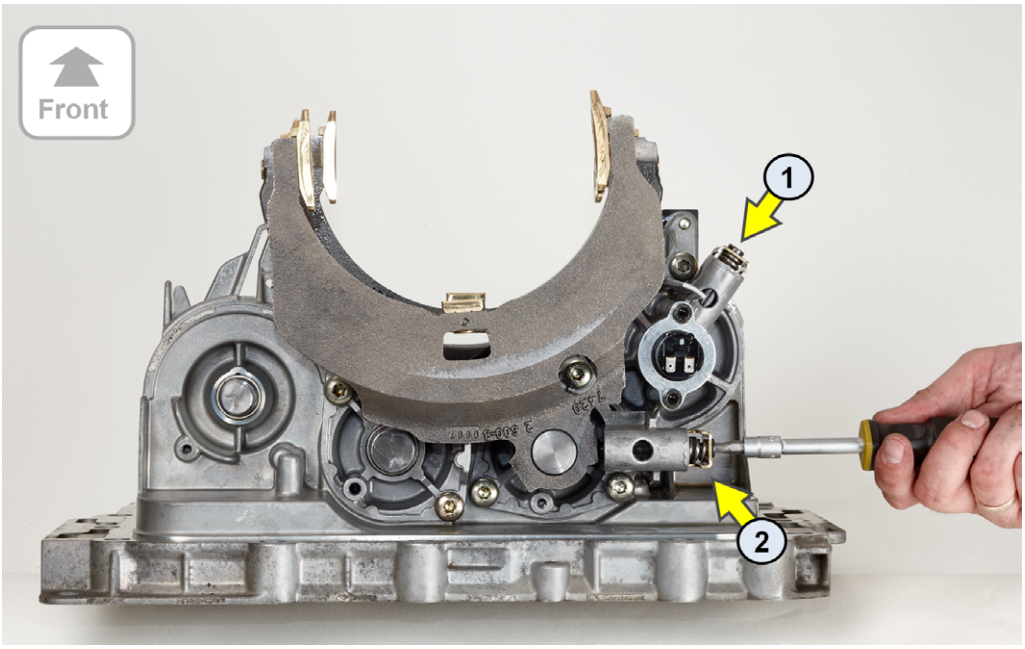


- Remove the entire cable harness:

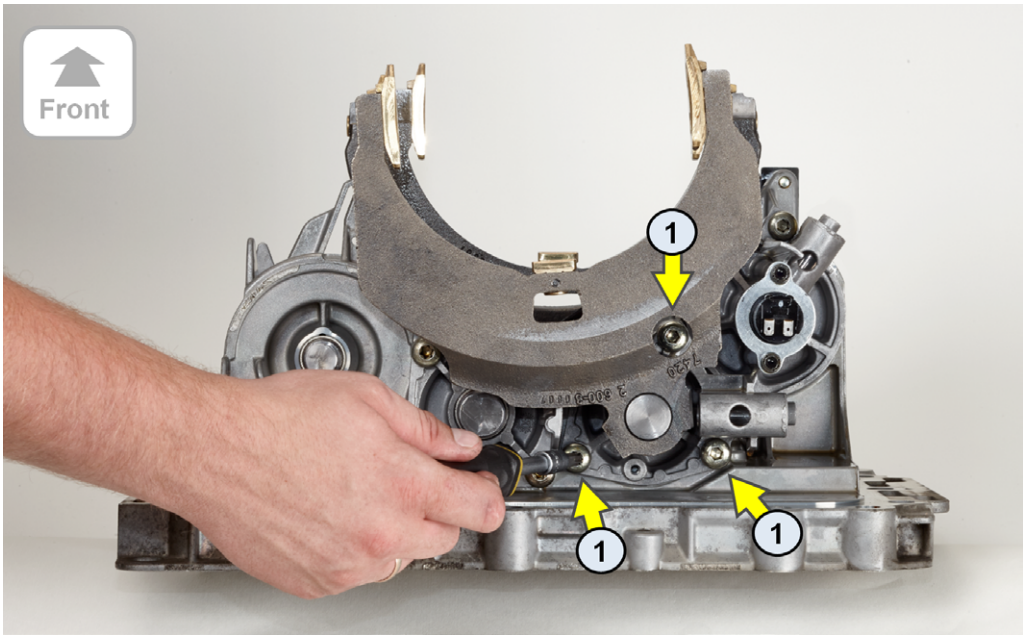


8.3 Removing the locking mechanisms, cylinder covers and piston rods

- On the driven side, remove the locking mechanism for split (1) and 1 / R (2):



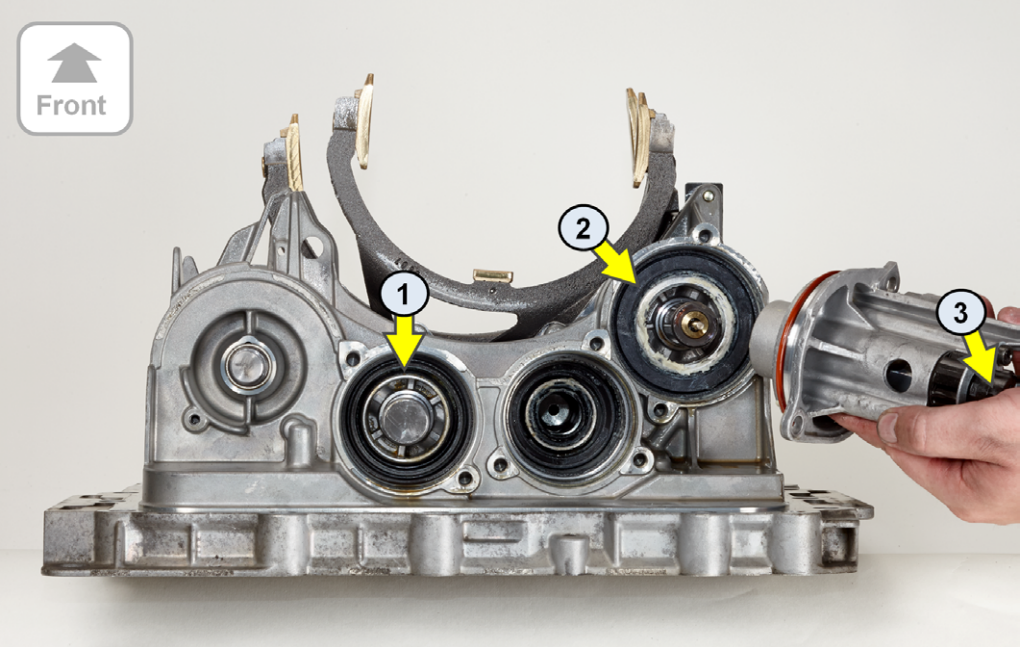
- Unscrew the three screws (1) on the cylinder cover 1 / R:



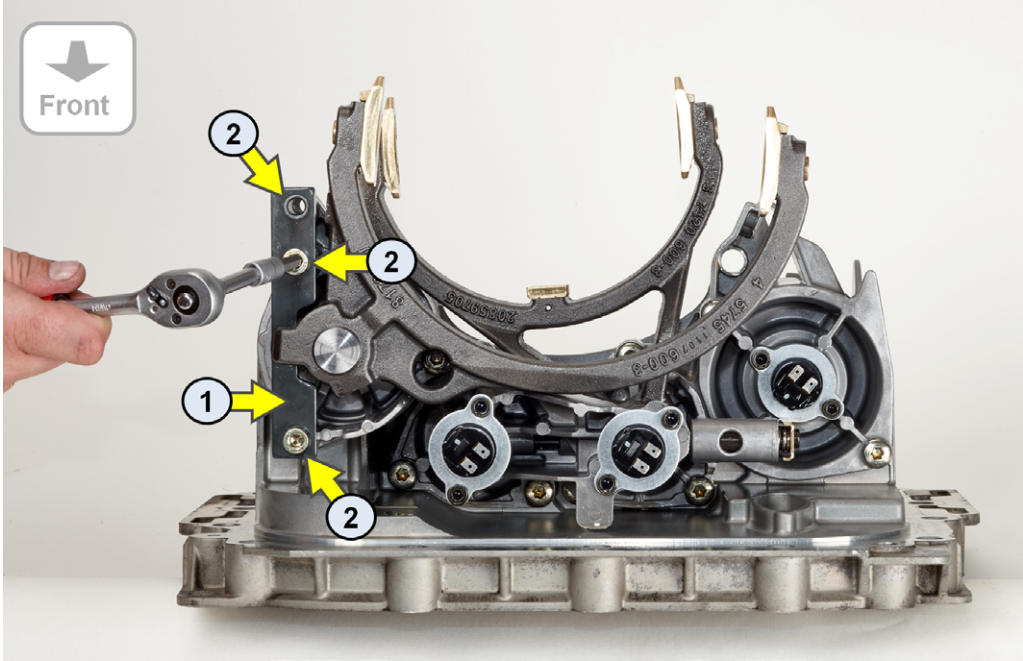
- Remove the cylinder cover and the piston rods including the shift fork.

General overhaul of the gear changing system

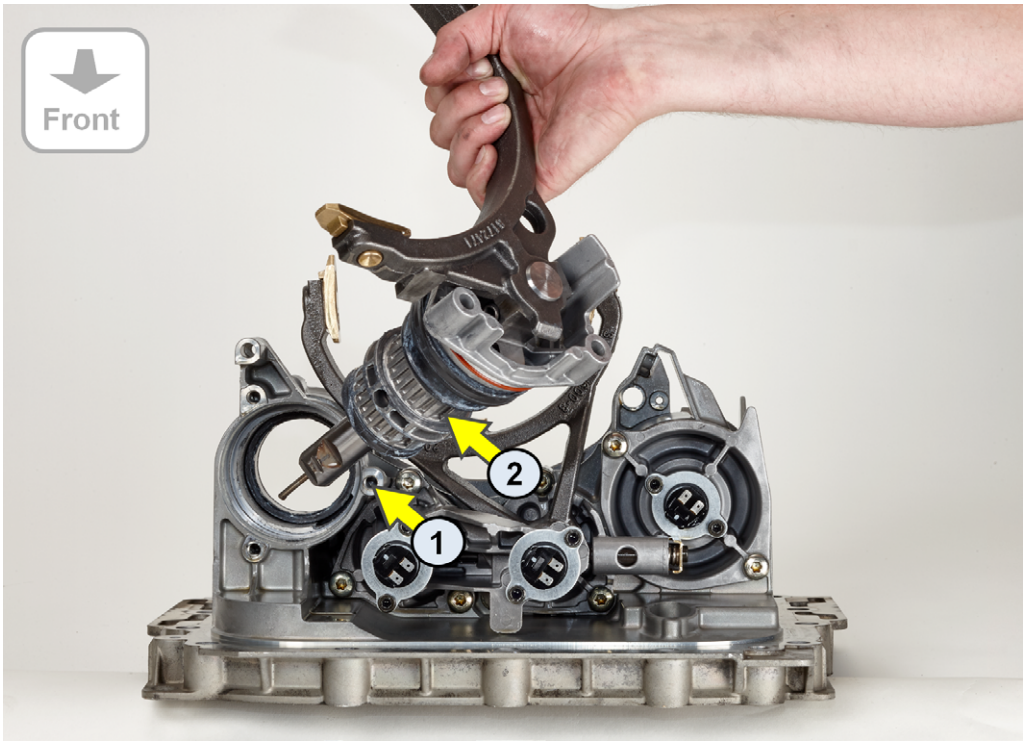
- Unscrew the screws on the covers for the cylinders for 3 / 2 (1) and for split (2).
- Remove both cylinder covers including the split position sensor (3):



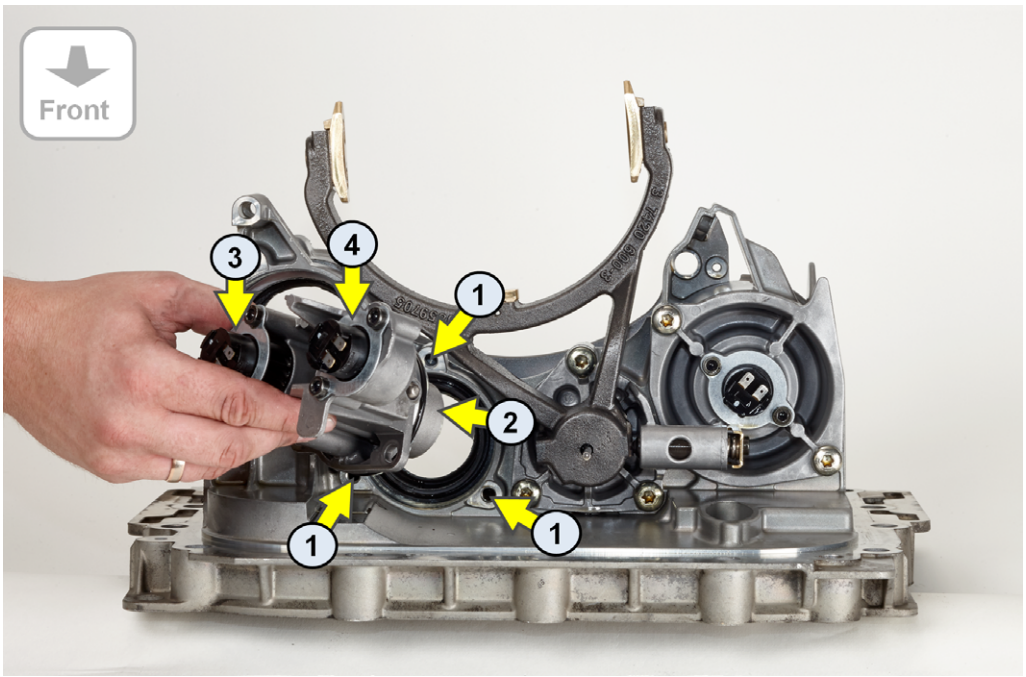
- On the front side of the gear changing system, remove the stop (1) for the shift fork for the shift fork after unscrewing the three screws (2):



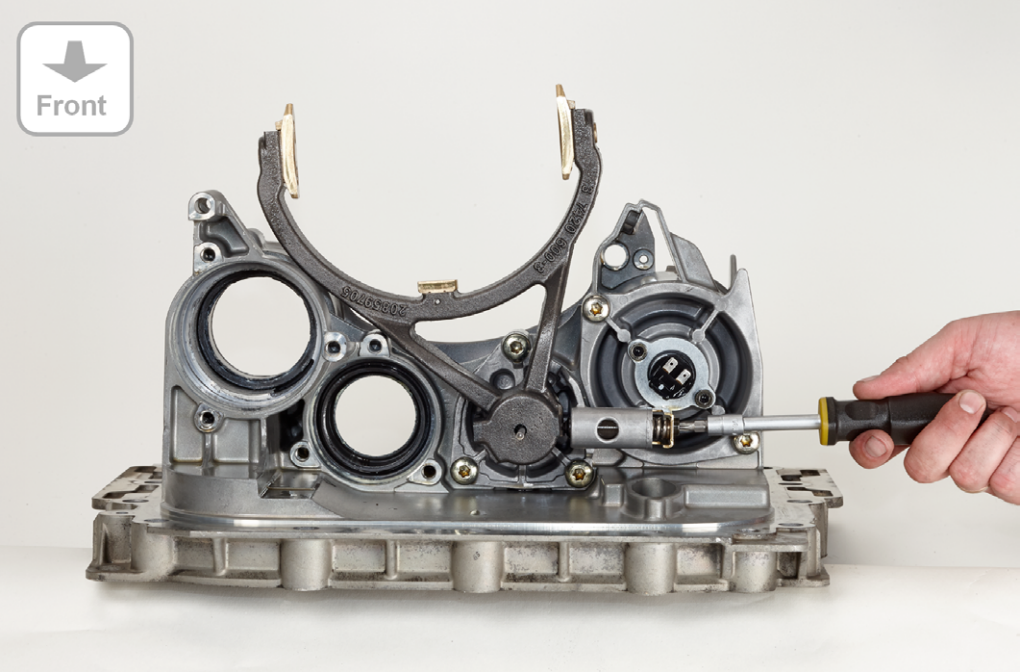
- Unscrew and remove the last screw of the cylinder cover split (1).
- Remove the cylinder cover and the piston rod split (2) including the shift fork



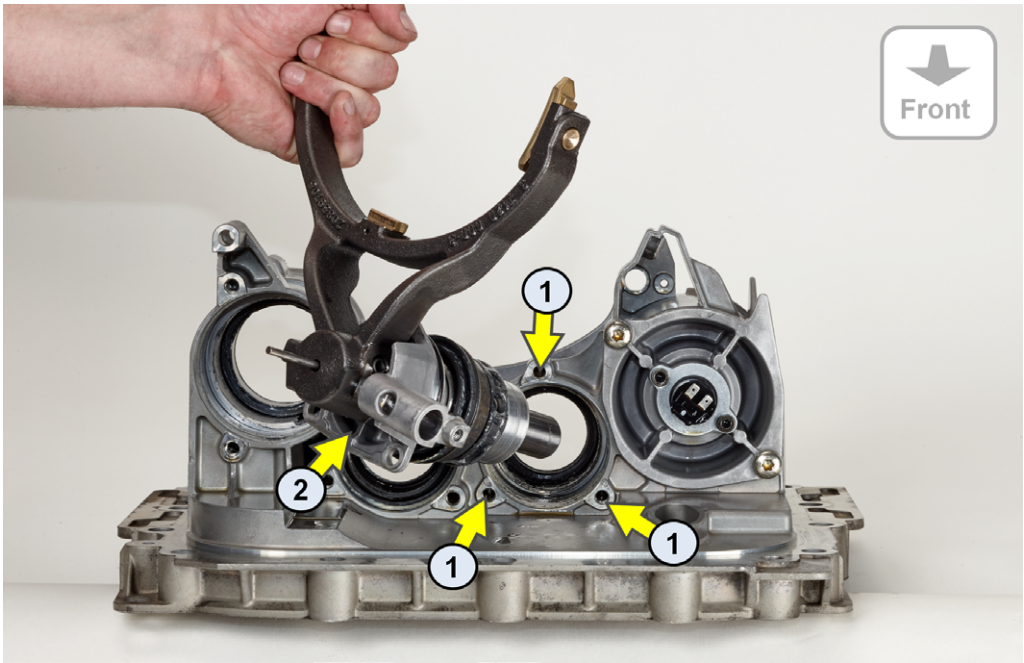
- Remove the three screws on the cylinder cover 1 / R (1).
- Remove the cylinder cover 1 / R (2) including the position sensor for 1 / R (3) and 3 / 2 (4):



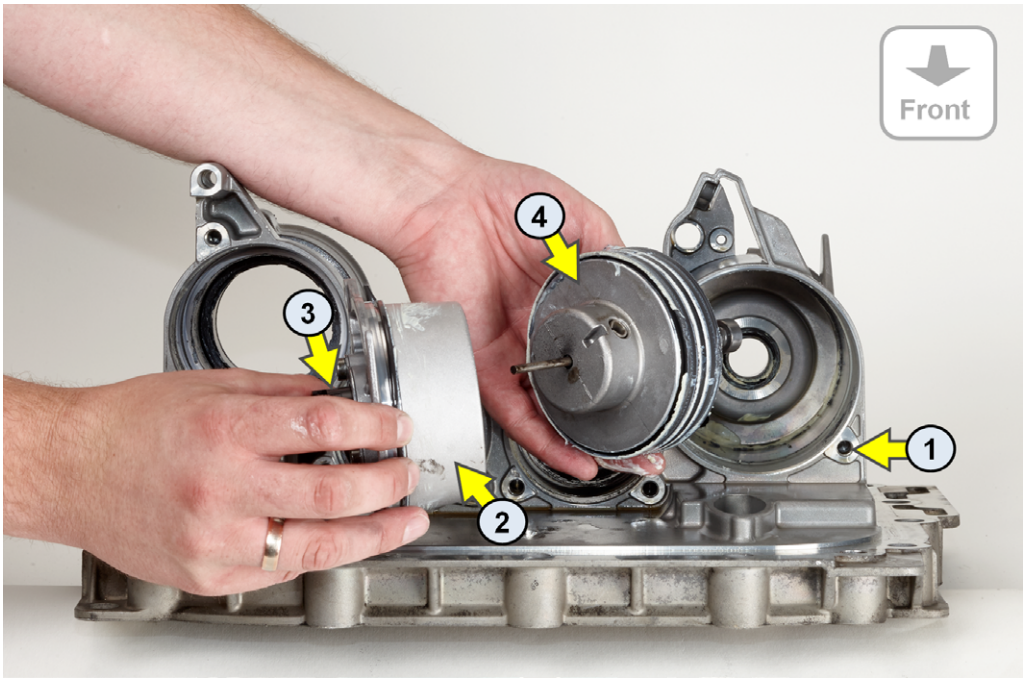
- Remove the locking mechanism for the shift rod of cylinder 3 / 2:



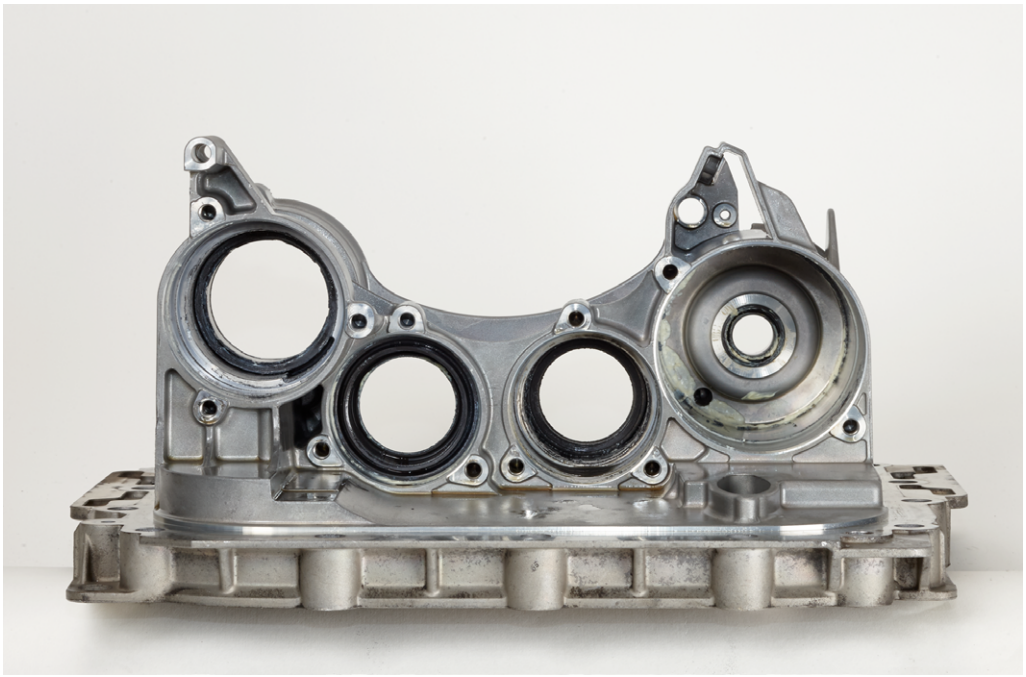
- Remove the three screws on the cylinder cover 3 / 2 (1).
- Remove the cylinder cover (2) and the piston rod 3 / 2 including the shift fork:



- Remove the screw (1) as well as the screw on the opposite side (here concealed) on the range cylinder cover.
- Remove the cylinder cover (2) including the position sensor (3) as well as the piston rod (4):



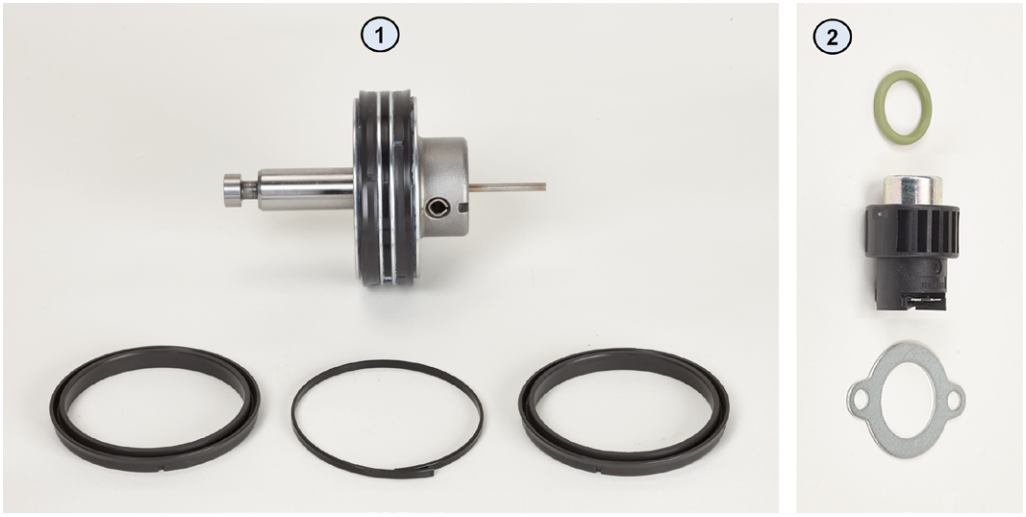
Here the bottom section of the gear changing system where all cylinder covers, piston rods and shift forks have been removed:



8.4 Renewing the components

8.4.1 Range cylinder

- Renew the three piston seals (1).
- Renew the position sensor for range including O-ring and holder (2):



8.4.2 Cylinder 3/2

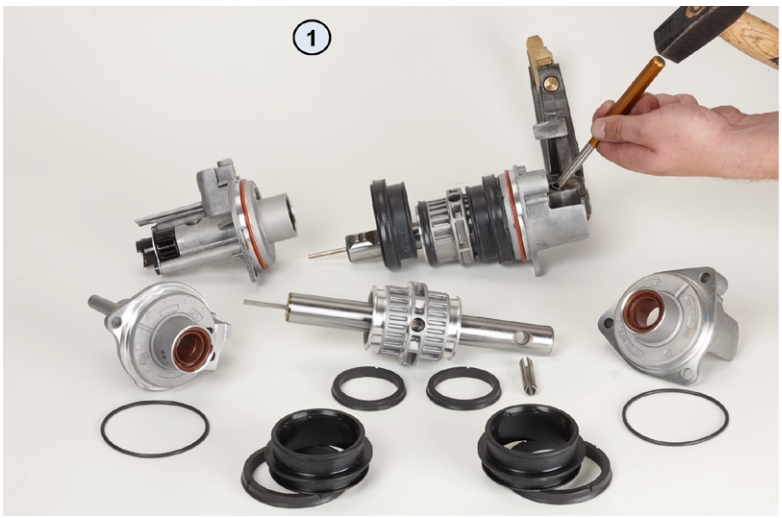
- Renew the piston rod, piston seals as well as the two piston covers including seals.
- Only the shift fork 3 / 2 is disassembled and reused:

8.4.3 Cylinder 1/R

- Renew the piston rod, piston seals as well as the two piston covers including seals (1).
- Only the shift fork 3 / 2 is disassembled and reused.
- Renew the position for 1 / R and 3 / 2 including O-rings and holders (2):

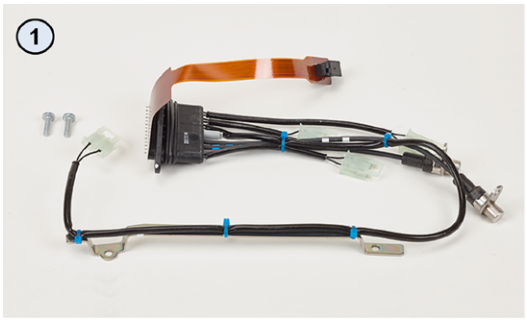
8.4.4 Split cylinder

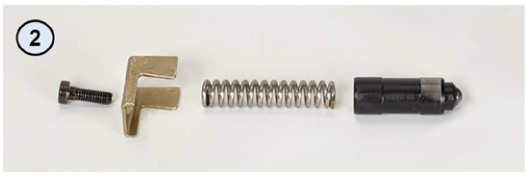
- Renew the piston rod, piston seals as well as the two piston covers including seals (1).
- Only the shift fork split is disassembled and reused.
- Renew the position sensor for split including the O-ring and holder (2):



8.4.5 Other renewable components

- The cable harness with cable bridge and the two rotary encoders (1)
- The other seals, such as the cover seals for the gear changing system (not shown here)
- The three gear locking mechanisms (2)
- The stop for the shift fork split including screws (3)





8.4.6 Finally: Learning the transmission control unit

After the gear changing system has been assembled and reinstalled, the integrated transmission control unit (TECU) must be learned. The multi-brand diagnosis W.EASY from WABCOWÜRTH can be used for this purpose, for example:

9 Appendix: the repair kits

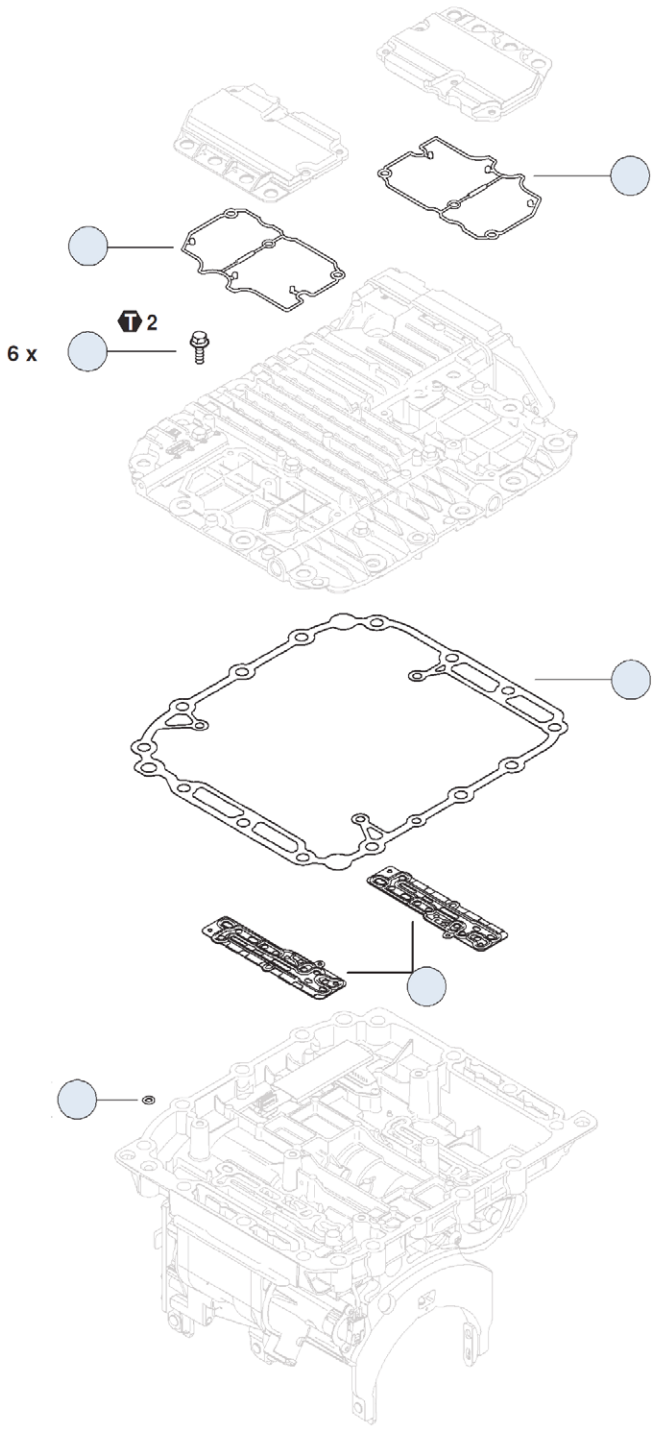
9.1 Overview

REPAIR KIT WABCO PRODUCT NUMBER	VOLVO REFERENCE	RENAULT REFERENCE	DESCRIPTION	GEARBOX ACTUATOR GEAR CHANGING SYSTEM WABCO PRODUCT NUMBER
421 365 9**20** 2	20785252 20562626	7420785252	Seal set; all static seals	421 365 0**00** 0
421 365 9**21** 2	20562627 21911587	7420562627	Cable set with cable bridge and rotary encoders	421 365 0**00** 0
421 365 9**22** 2	20562629	7420562629	1 locking mechanism (kit)	421 365 0**00** 0
421 365 9**23** 2	20562630	7420562630	Lip seals (set)	421 365 0**00** 0
421 365 9**24** 2	20562631	7420562631	Cylinder cover for the split cylinder	421 365 0**00** 0
421 365 9**25** 2	20562633	7420562633	Cylinder cover for the 1/R cylinder	421 365 0**00** 0
421 365 9**26** 2	20562635	7420562635	Cylinder cover for the 3/2 cylinder	421 365 0**00** 0
421 365 9**29** 2	20562642	7420562642	1 position sensor (kit)	421 365 0**00** 0
421 365 9**32** 2	20562105 21786063 21302091	7420562105 7421786063	Piston rod of the split cylinder	421 365 0**00** 0
421 365 9**33** 2	20562107 21302092	7420562107	Piston rod of the 1/R cylinder	421 365 0**00** 0
421 365 9**34** 2	20562109 21302093	7420562109	Piston rod of the 3/2 cylinder	421 365 0**00** 0
421 365 9**38** 2	20775027	7420775027	Cable set with cable bridge and rotary encoders	421 365 0**02** 0 421 365 0**04** 0
421 365 9**39** 2	20845917	7420845917	Stop for the shift fork split	421 365 0**00** 0
421 365 9**46** 2	21068284	7421068284	Cable set with cable bridge and rotary encoders	421 365 0**05** 0 421 365 0**06** 0 421 365 0**08** 0 421 365 0**09** 0
421 365 9**47** 2	21068286	7421068286 7421353473	Pressure sensor repair kit	421 364 0**02** 0 421 364 0**03** 0 421 365 0**00** 0 421 365 0**05** 0 421 365 0**06** 0 421 365 0**08** 0 421 365 0**09** 0 421 365 0**10** 0 421 365 0**11** 0 421 365 0**12** 0 421 365 0**13** 0

Appendix: the repair kits

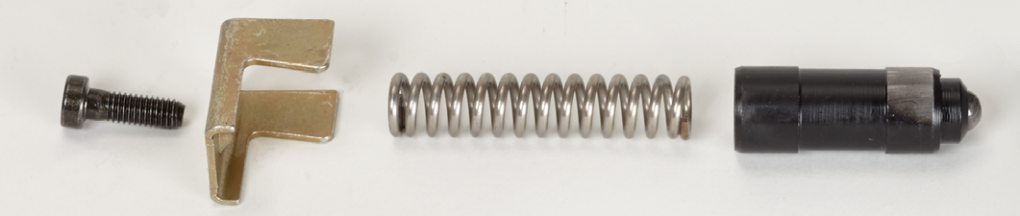
REPAIR KIT WABCO PRODUCT NUMBER	VOLVO REFERENCE	RENAULT REFERENCE	DESCRIPTION	GEARBOX ACTUATOR GEAR CHANGING SYSTEM WABCO PRODUCT NUMBER
421 365 9**45** 2	20785252 20562626	21571890 21244590	Complete bottom section of the gear changing system Generation D	421 364 0**02** 0 421 364 0**03** 0 421 365 0**05** 0 421 365 0**06** 0 421 365 0**07** 0 421 365 0**08** 0 421 365 0**09** 0 421 365 0**10** 0 421 365 0**11** 0 421 365 0**12** 0

9.2 Seal set: static seals (421 365 920 2)



9.3 Cable set with cable bridge and rotary encoders (421 365 921 2, ... 938 2, ... 946 2)

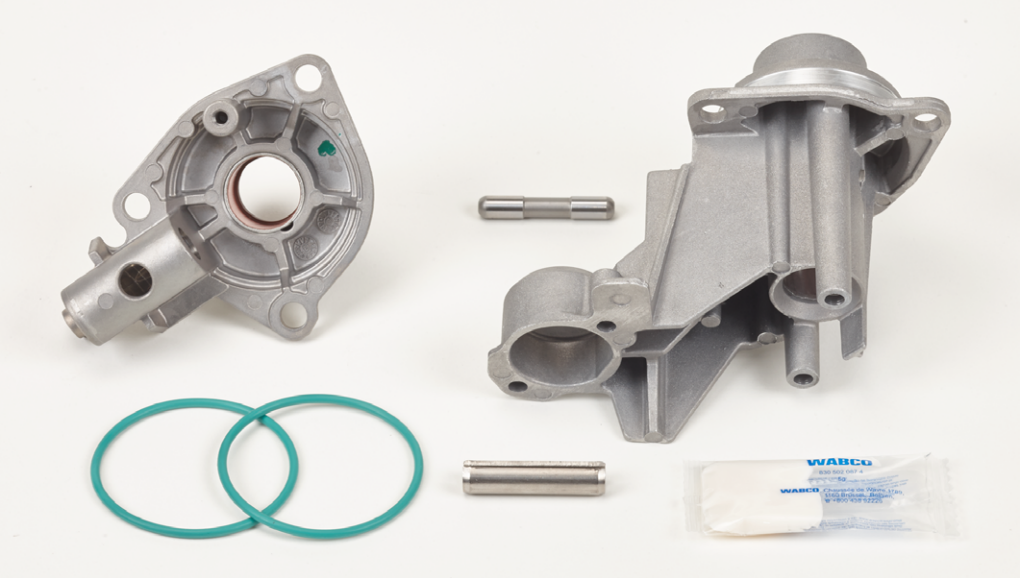
9.4 Locking mechanism (kit) (421 365 922 2)



9.5 Lip seals (set) (421 365 923 2)

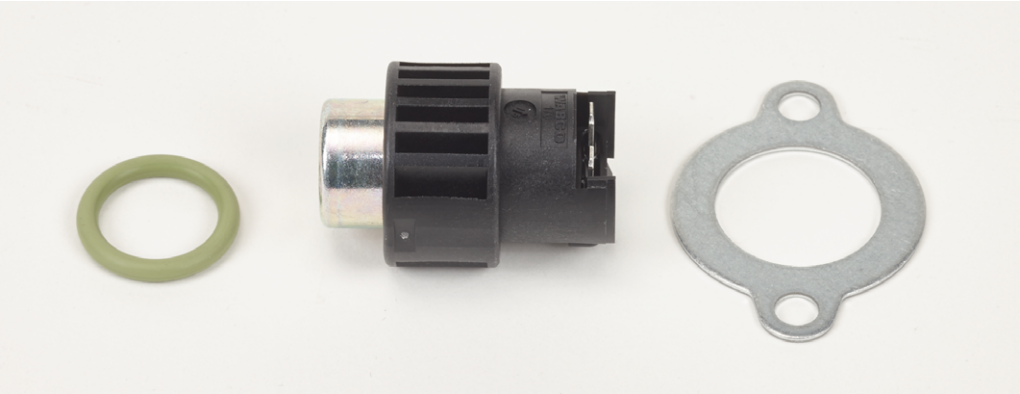
9.6 Cylinder cover for the split cylinder (421 365 924 2)

9.7 Cylinder cover for the 1/R cylinder (421 365 925 2)



9.8 Cylinder cover for the 3/2 cylinder (421 365 926 2)

9.9 Position sensor (kit) (421 365 929 2)

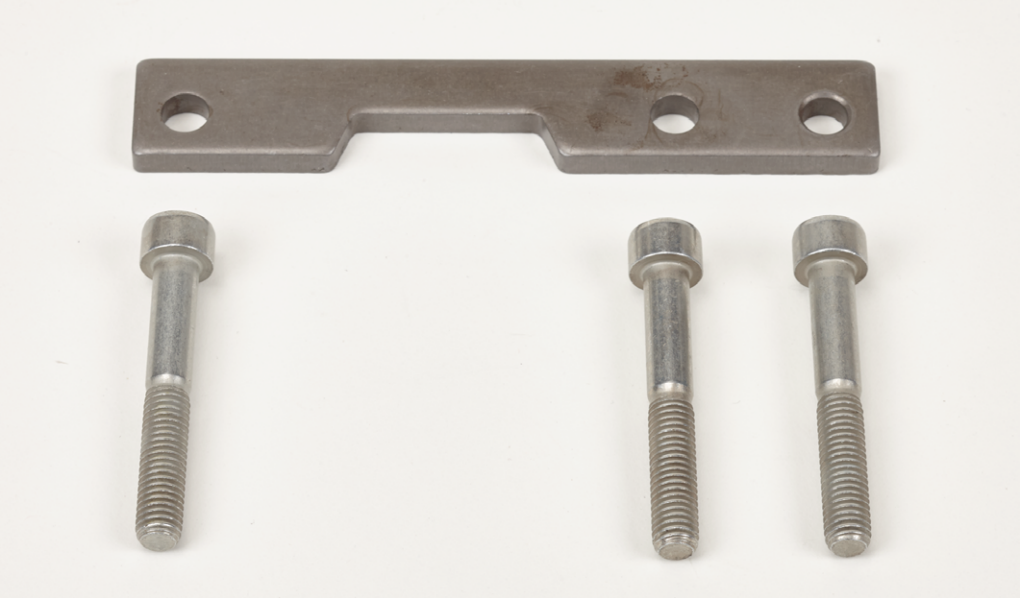


9.10 Cylinder cover for the split cylinder (421 365 932 2)

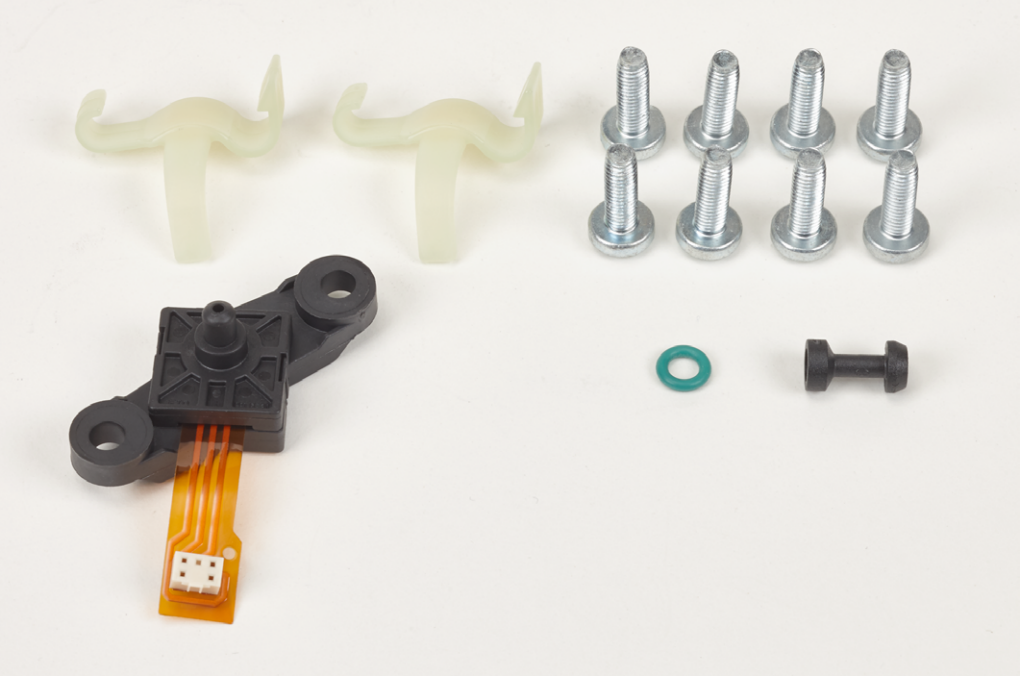
9.11 Piston rod for the 1/R cylinder (421 365 933 2)

9.12 Piston rod for the 3/2 cylinder (421 365 934 2)

9.13 Stop for the shift fork split (421 365 939 2)



9.14 Pressure sensor repair kit (421 365 947 2)



10 Glossary

Direct drive transmission	One of the two Gearbox Actuator transmission variants (next to the overdrive variant). The transmission ratio in the highest, namely the 12th gear, is here 1:1. The input torque is here transferred to the drive shaft unchanged.
EECU	Acronym for “Engine Electronic Control Unit”.
Idler	The gear wheels on the main shaft for the first, the second and the reverse gear are idlers. This means that they are not firmly connected with the main shaft but can rotate freely. Only with the temporary intervention of the respectively adjacent sliding sleeve is an idler positively locked with the main shaft.
Overdrive transmission	One of the two Gearbox Actuator transmission variants (next to the direct drive variant). The transmission ratio is here already 1:1 in the 11th gear. In 12th gear the transmission ratio is longer than with the direct drive transmission, namely 0,79:1. In this gear the engine speed is therefore less than that of the direct drive transmission at the same vehicle speed. This can reduce the fuel consumption, for instance.
Range High	Designates the higher of the two transmission ratios that are provided by the range group.
Range Low	Designates the lower of the two transmission ratios that are provided by the range group.
RECU	Acronym for “Retarder Electronic Control Unit”.
Split High	Designates the higher of the two transmission ratios that are provided by the splitter group.
Split Low	Designates the lower of the two transmission ratios that are provided by the splitter group.
TECU	Acronym for “Transmission Electronic Control Unit”.

Notes

Notes

Notes

WABCO

a WORLD of DIFFERENCE

WABCO (NYSE: WBC) is a leading global supplier of technologies and services that improve the safety, efficiency and connectivity of commercial vehicles. Founded nearly 150 years ago, WABCO continues to pioneer breakthrough innovations for advanced driver assistance, braking, stability control, suspension, transmission automation and aerodynamics. Partnering with the transportation industry as it maps a route towards autonomous driving, WABCO also uniquely connects trucks, trailers, drivers, cargo, and fleet operators through telematics, as well as advanced fleet management and mobile solutions. WABCO reported sales of $2.6 billion in 2015. Headquartered in Brussels, Belgium, WABCO has 12,000 employees in 39 countries. For more information, visit

www.wabco-auto.com

WABCO