

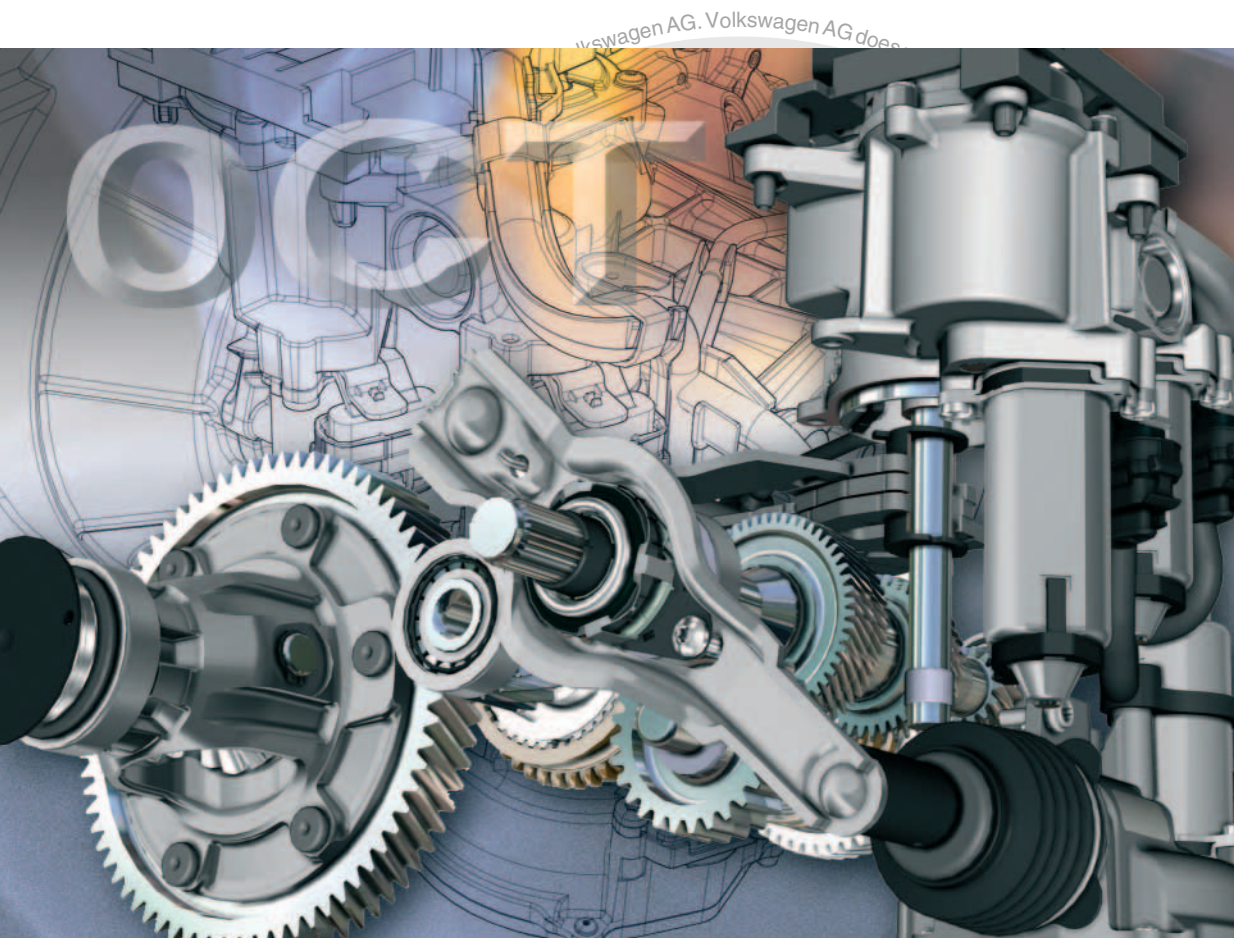
Service Training



Self-study programme 512

Automated 5-speed Manual Gearbox OCT

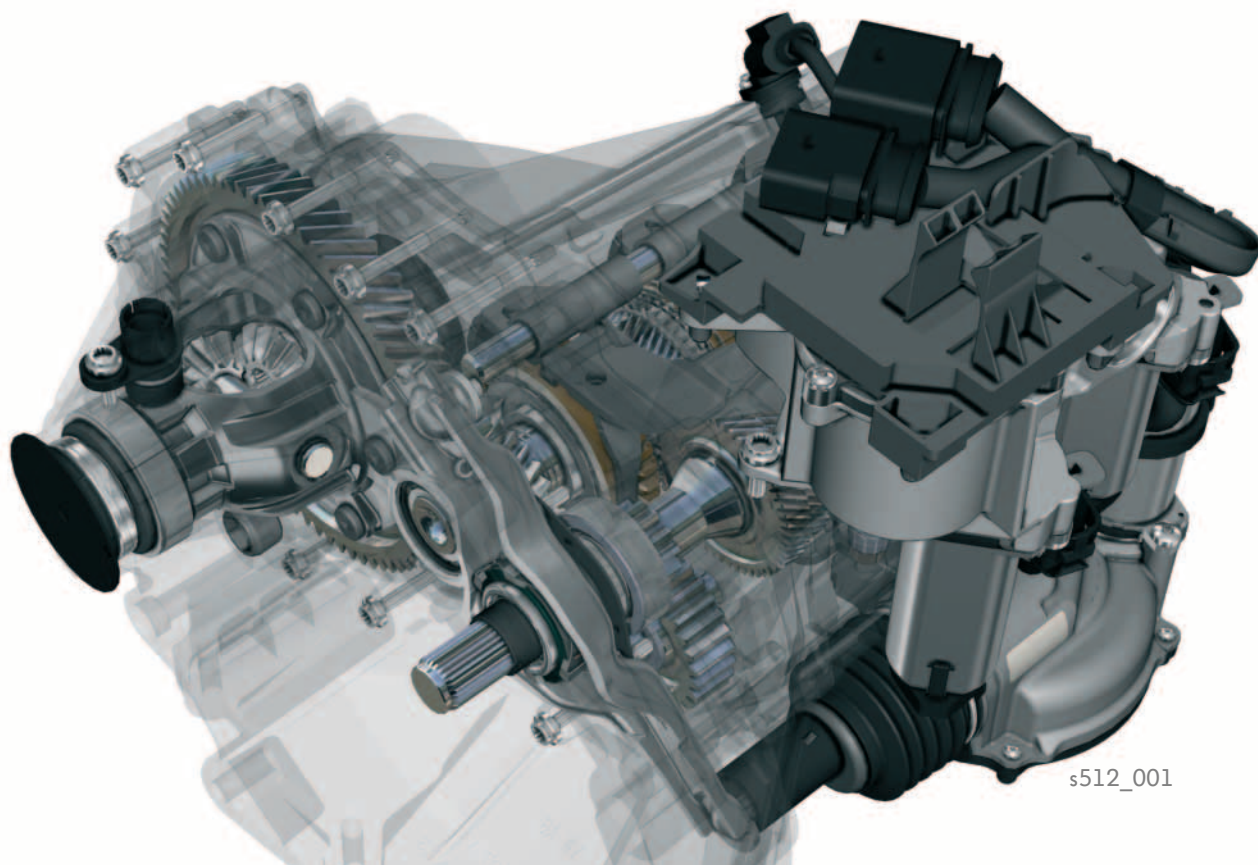
Design and function



The idea of automating a manual gearbox is not new for Volkswagen. A 5-speed manual gearbox has already been turned into an electronic manual gearbox with automatic shift function for the Lupo 3L by using electrohydraulic actuators. Electromechanical actuators are used with the automated manual gearbox OCT. The automated manual gearbox OCT is based on the manual gearbox OCF.

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**The self-study programme presents the design and function of new developments!
The content will not be updated.**

Current testing, setting and repair instructions can be found in the provided service literature.



**Important
note**



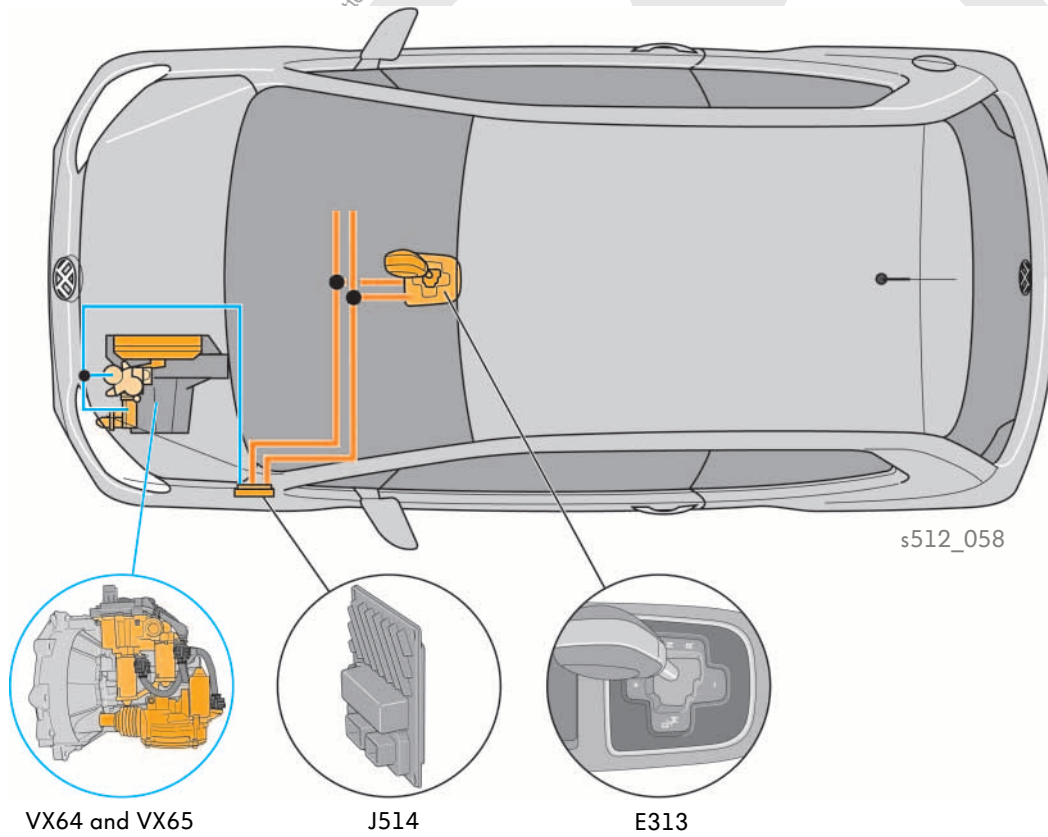
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Introduction

Overview of system components



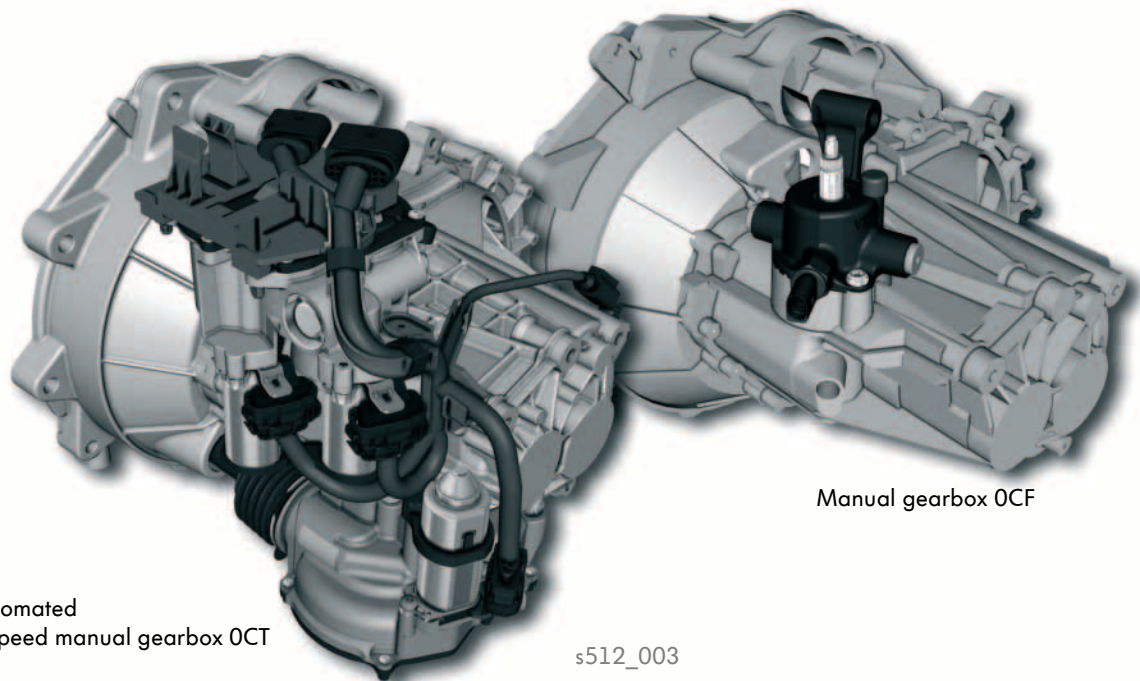
The new automated 5-speed manual gearbox OCT will be introduced in the up!.

The automated manual gearbox system comprises:

- The gearbox OCT with electrical clutch actuator VX64 and gear actuator VX65
- The electronic manual gearbox control unit J514 above the left-hand wheel housing liner
- The selector lever E313 in the centre console with automatic and Tiptronic functions

Comparison of OCT and OCF gearboxes

The automated 5-speed manual gearbox OCT has, to a great extent, the same mechanical set-up as the manual gearbox OCF. The OCT features fully automated gear selection and clutch operation. The shift point is determined by the gearbox control unit and the gears are changed electromechanically by the clutch actuator and the gear actuator.



Automated
5-speed manual gearbox OCT

Manual gearbox OCF

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Further information on the design of the manual gearbox OCF can be found in self-study programme 509 "Manual Gearbox OCF".



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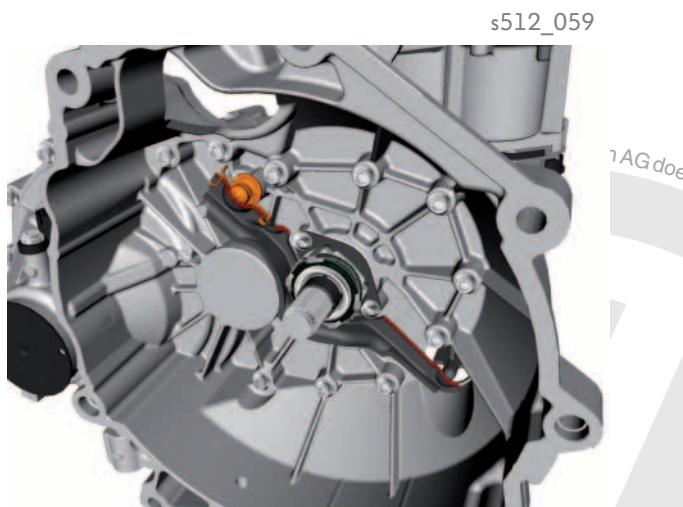
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Introduction

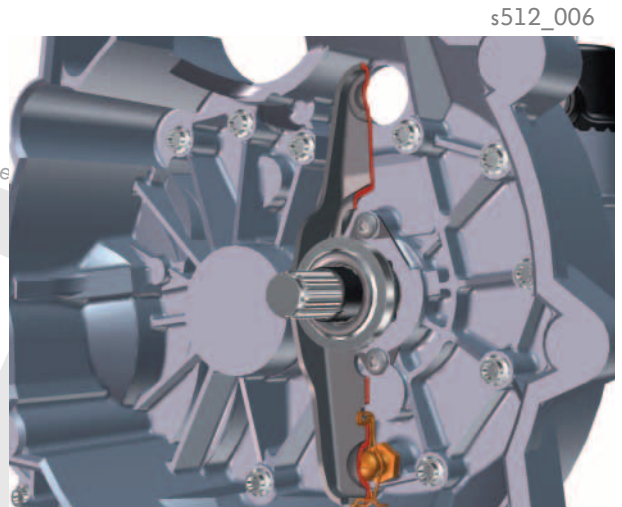


The differences between the automated 5-speed manual gearbox OCT and the manual gearbox OCF are:

- The automated 5-speed manual gearbox OCT has additional components: the clutch actuator VX64 and the gear actuator VX65.
- The selector dome and the selector shaft have been integrated into the gear actuator.
- The clutch release lever has been repositioned:
While the clutch release lever is almost vertical on the manual gearbox OCF, the ball stud on the clutch release lever for the OCT had to be moved. This is a result of the clutch actuator being positioned on the gearbox to save space. For the first time, the ball stud has been pressed into the clutch bell housing as a bearing for the clutch release lever.



Clutch release lever on gearbox OCT



Clutch release lever on gearbox OCF



When removing the clutch release lever, make sure you observe the manufacturer's information in ELSA.

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Technical data



Gearbox code	OCF	OCT
Gearbox type	5-speed manual gearbox; 2-shaft manual gearbox with additional shaft for reverse gear	Automated 5-speed manual gear- box
Installation type	Front/transverse installation	
Installation length/installation width	356 mm/462 mm	
Max. input torque	120 Nm	
Material used for gearbox and clutch housing	Aluminium	
Gearbox oil	G 052.527.A2	
Initial fill/oil change quantity	1.2 l/1.1 l	
Weight	26.7 kg with oil	31.3 kg with oil
Spread	4.57 both with 44 kW and 55 kW	
Final drive ratio	44 kW: 74 to 19 55 kW: 75 to 18	
Gear ratios	1st gear 3.643 2nd gear 1.955 3rd gear 1.270 4th gear 0.959 5th gear 0.796	GT 1-2 1.86 GT 2-3 1.54 GT 3-4 1.32 GT 4-5 1.2
GT = gear transition	1st gear 3.643 2nd gear 2.143 3rd gear 1.361 4th gear 0.959 5th gear 0.796	GT 1-2 1.7 GT 2-3 1.57 GT 3-4 1.42 GT 4-5 1.2
Maximum speed	reached in 4th gear	

On the automated manual gearbox OCT, the shorter gear jump from first to second gear increases gearshift comfort.

Special features of automated manual gearbox OCT:

- No ignition key removal lock
- No parking lock
- No emergency release
- No creep function
- Hill Hold function only in conjunction with ESP
- External gearbox control unit
- The car can only move away in 1st gear.
- When the ignition is switched "off", the clutch is closed. If the selector lever is also in the position N, no gear is selected.
- The engine can be push-started.

Selector lever E313

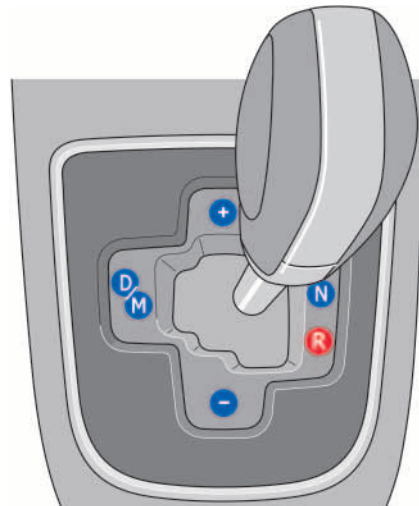
A “shift by wire” concept has been created for the automated 5-speed manual gearbox OCT, i.e. there is no direct mechanical connection between the selector lever and the gearbox. The selector lever position is communicated to the connected control units via the CAN data bus.



You can choose between automated and manual gear changes with the electronic selector lever E313. If you push the selector lever from the centre position to the left, the driving mode will switch either from automatic (**D**) to manual (**M**) or from manual (**M**) to automatic (**D**).

In the centre gate, you can manually shift the gears up (+) and down (-). The gearbox then automatically switches to M mode.

In the right-hand gate, you will find the neutral position (**N**) and the selection area for reverse gear (**R**).



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Once the engine has been switched off, the ignition key can be removed with the selector lever in any position.

To prevent the vehicle rolling, the dash panel insert issues an optical and acoustic request to apply the handbrake.

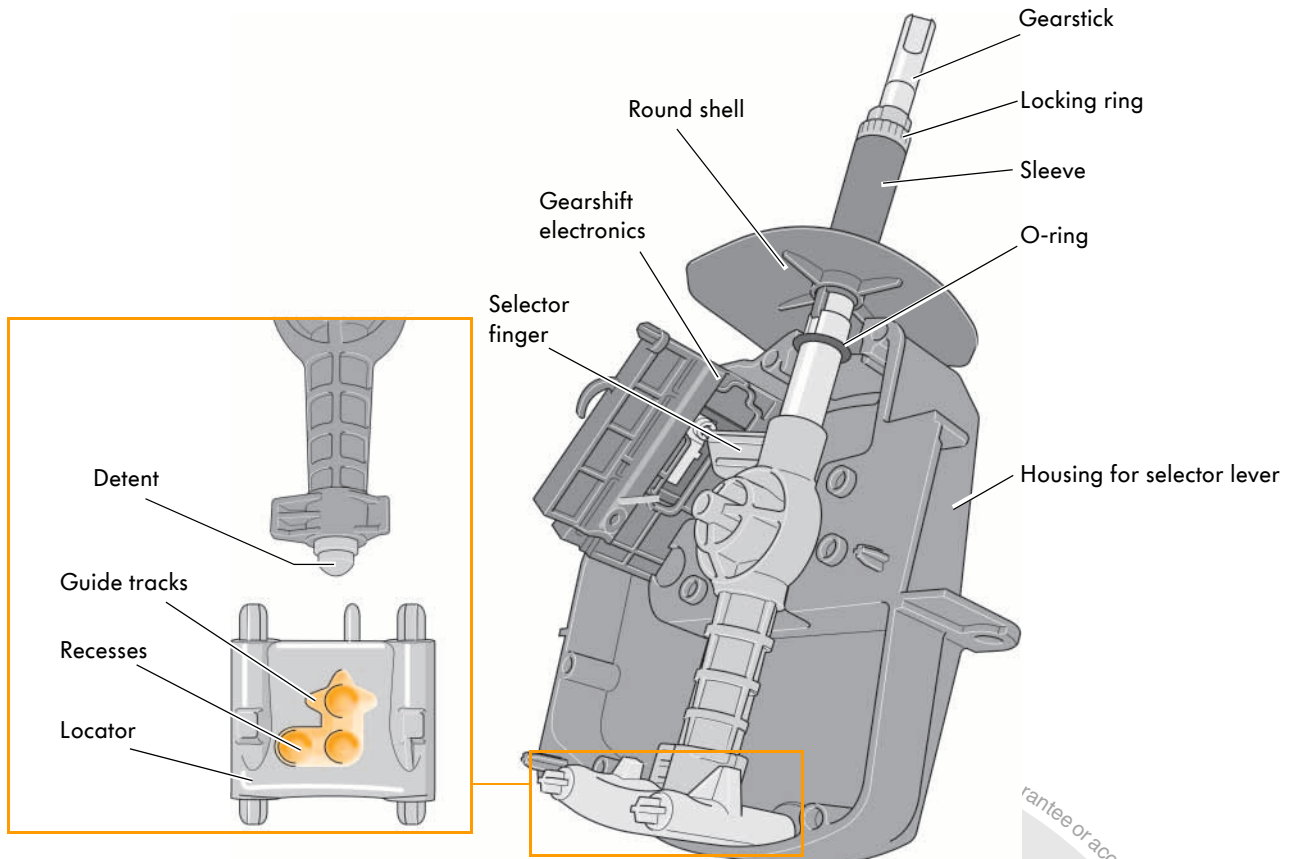


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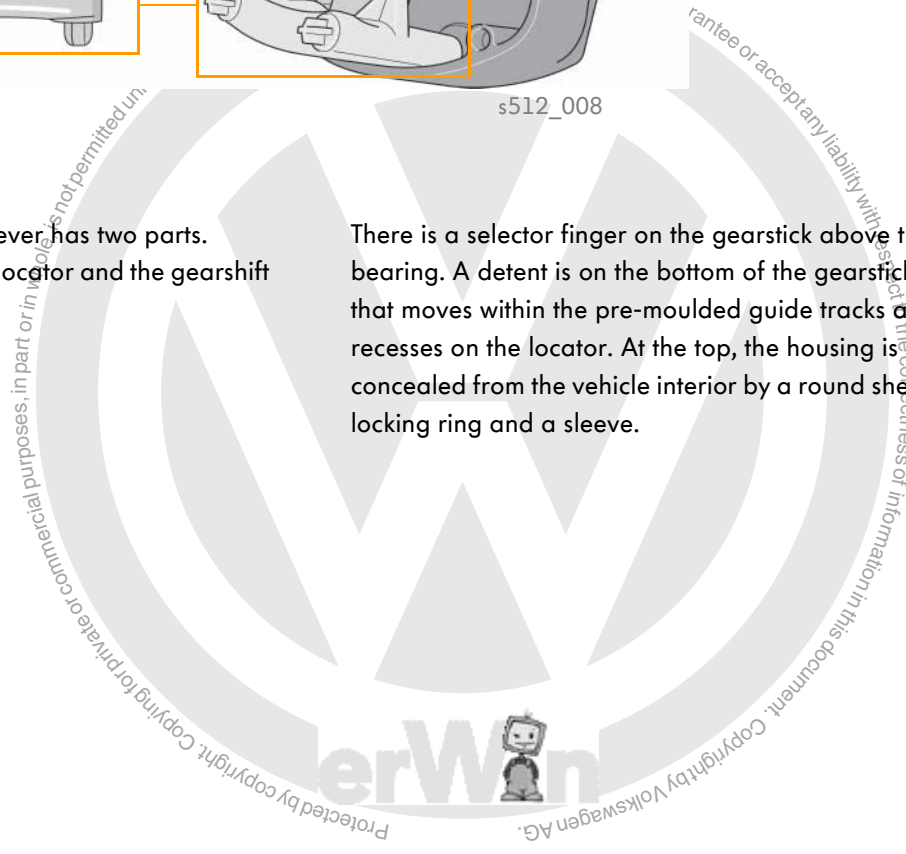
While the vehicle is stationary, a gearshift request is only implemented by the control unit if you press the brake pedal at the same time. The familiar rocking function is also possible here.

Design



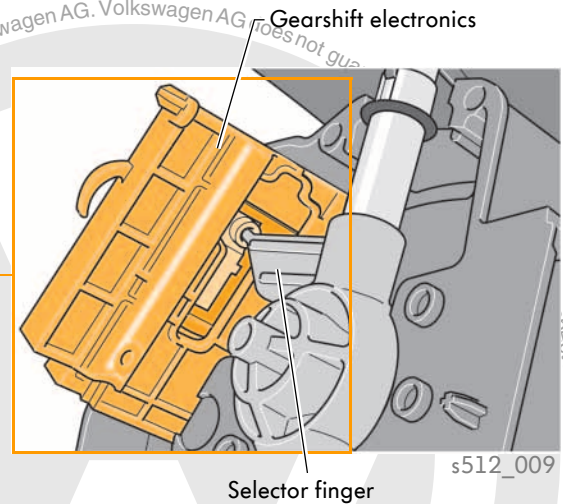
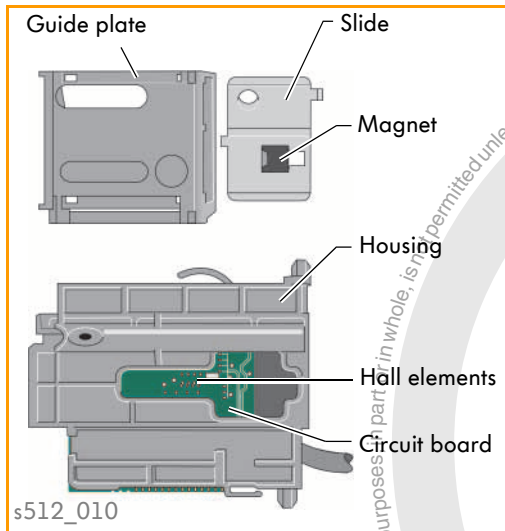
The housing for the selector lever has two parts. It holds the gearstick with the locator and the gearshift electronics.

There is a selector finger on the gearstick above the bearing. A detent is on the bottom of the gearstick that moves within the pre-moulded guide tracks and recesses on the locator. At the top, the housing is concealed from the vehicle interior by a round shell, a locking ring and a sleeve.



Selector lever E313

Gearshift electronics



The gearshift electronics comprise a guide plate, a slide and the circuit board with Hall elements. The slide contains a magnet that actuates the Hall elements in the selector lever electronics.

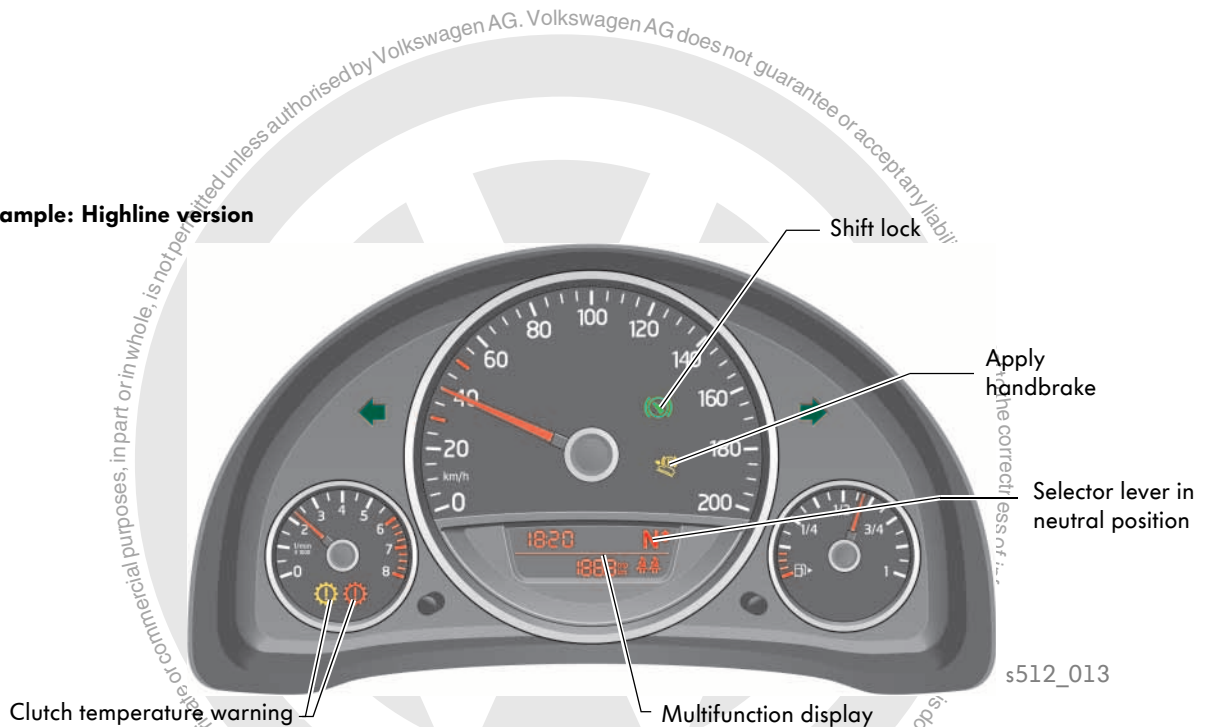
The movement of the gearstick is replicated by the magnet in the slide. The Hall elements for the gearshift electronics pick up these movements and send the information to the electronic manual gearbox control unit J514.

The gearshift electronics communicate with the electronic manual gearbox control unit J514 via the powertrain CAN data bus.

Dash panel insert

The illuminated LED symbols in the dash panel insert provide information on the operating mode of the gearbox. The driver receives additional operating instructions, like “Shift lock” and “Apply handbrake”.

Example: Highline version



There are several new LED indicators in the dash panel insert for the up!:






- Clutch temperature warning
- Apply handbrake
- Selector lever in neutral position
- Gear indicator in the multifunction display

The temperature warning for the clutch has two stages. For reasons of safety, the clutch functions are still available even when the second temperature warning stage has been reached.



You will find further information on the different dash panel inserts used in the up! in self-study programme 500 “The up!”.

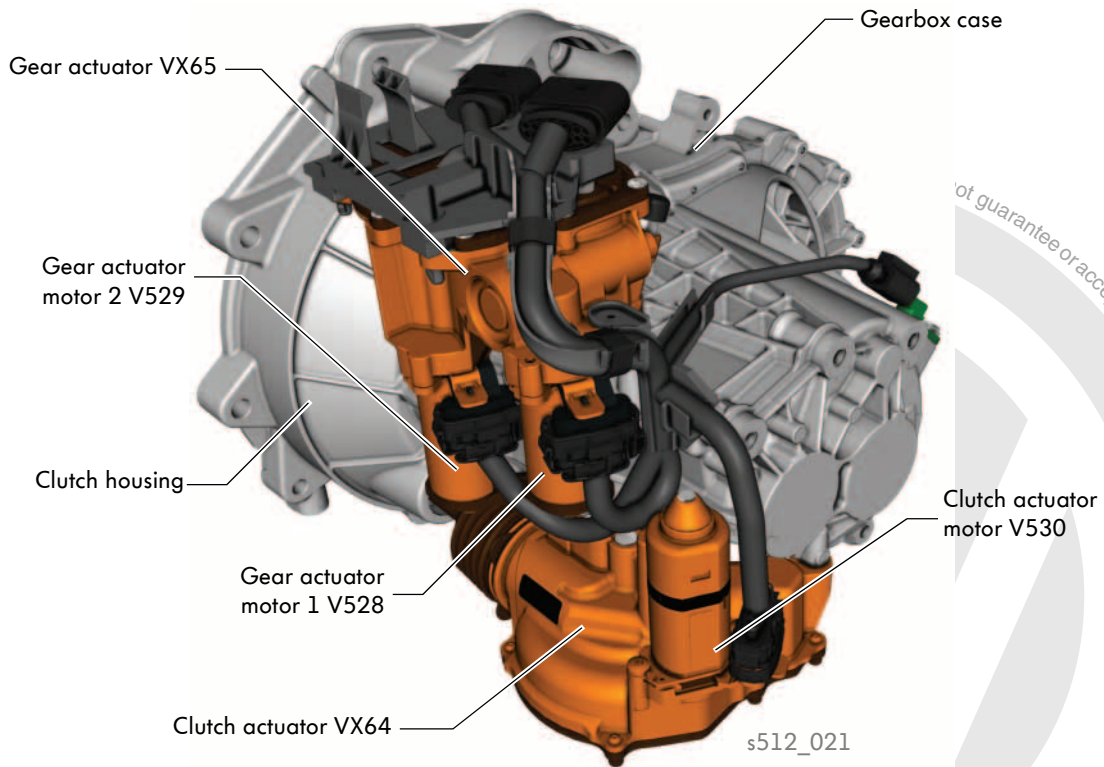
LED indicators in dash panel insert

Illuminate	Possible cause	Remedy according to vehicle wallet
	Fault in automated manual gearbox.	Do not drive on! Seek expert help, otherwise serious gearbox damage could result.
	The gears cannot be selected correctly in the automated manual gearbox.	Switch the ignition off and back on again. If the warning lamp does not go out, go to the nearest qualified workshop and have the automated manual gearbox checked.
	Automated gearbox temporarily overheated.	Allow gearbox to cool down with the selector lever in the N position. If the warning lamp does not go out, go to the nearest qualified workshop and have the automated manual gearbox checked.
	Selector lever for automated manual gearbox in the N position and brake pedal not pressed.	Press the brake pedal to select a gear.
	Together with the flashing indicator in the instrument cluster display: the selector lever for the automated manual gearbox is not in N position; instruction to start the engine.	Move selector lever to N position and start engine.
	Automated manual gearbox overheated.	Press the brake pedal and allow gearbox to cool down. Avoid further attempts to drive away. If the warning lamp does not go out, go to the nearest specialist and have the automated manual gearbox checked.
Flashes	Possible cause	Remedy according to user manual
	Vehicle with automated manual gearbox is not secured against rolling away.	Apply handbrake.
N	In instrument cluster display, together with request to press brake pedal. Instruction to start engine.	Move selector lever to N position and start engine.
	In instrument cluster display: attempt was made to move selector lever to R position while car is being driven forwards.	Stop vehicle and then move the selector lever to N position in order to then select the R position.
	In instrument cluster display: the selector lever for the automated transmission has been moved to the R or D position, but the brake pedal was not pressed.	Press the brake pedal, move the selector lever to the N position and then shift it to the R or D position as required.



Gearbox mechanics

Overview of gearbox design

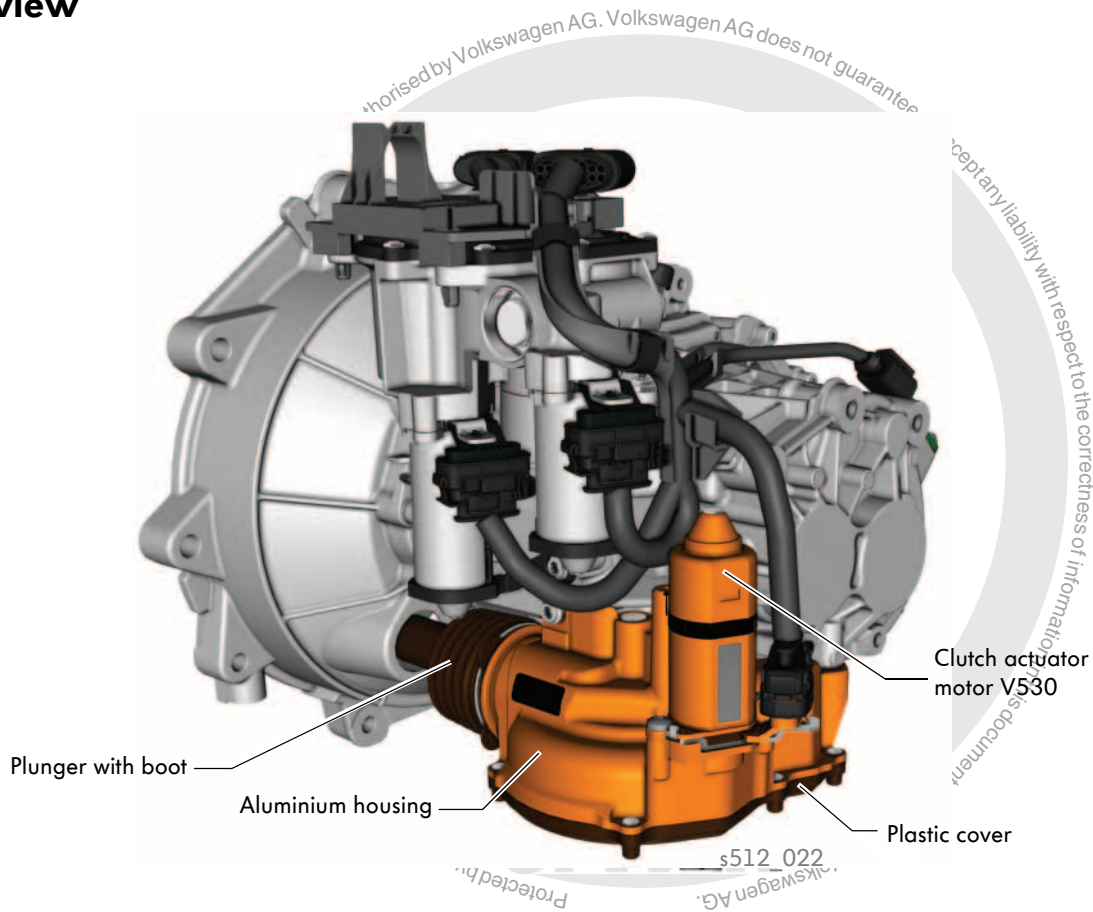


The gears are shifted in the gearbox by the clutch actuator VX64 and the gear actuator VX65. They are fitted on the outside of the gearbox case.

The clutch actuator VX64 with the clutch actuator motor V530 takes care of clutch operation. The gear actuator VX65 with the gear actuator motors V528 and V529 changes the gears. Both the clutch actuator and the gear actuator are electronically controlled by the electronic manual gearbox control unit J514.

Clutch actuator VX64

Overview



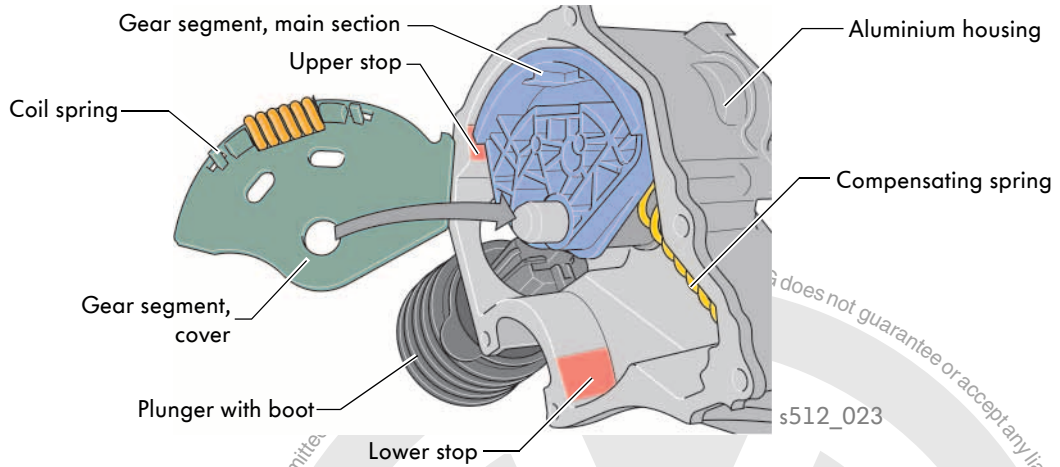
The clutch actuator is fitted on the side of the gearbox housing and is secured with three screws. The clutch actuator housing is made from an aluminium alloy and is enclosed by a plastic cover. The clutch actuator is connected to the clutch via the release lever.

The clutch actuator consists of a plunger with a boot and a control motor V530. The plunger with the boot forms the front part of the clutch actuator. The clutch actuator motor V530 is mounted in the rear section.



Gearbox mechanics

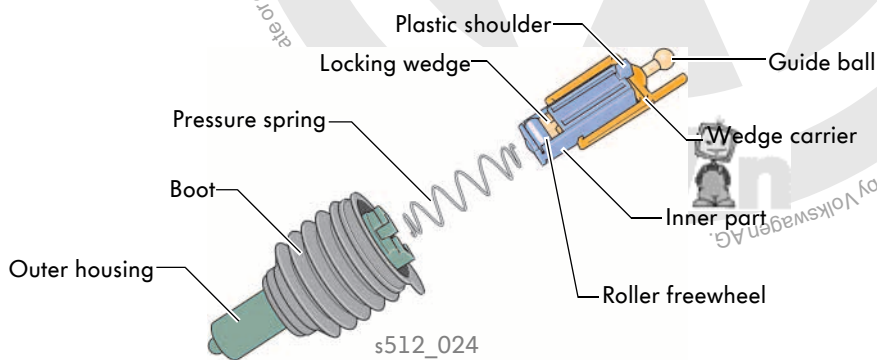
Design



The compensating spring is pre-tensioned and mounted on the gear segment so that it can move. The pivoted gear segment is made from plastic and consists of two parts: a cover and a main section.

A coil spring between the cover and the main section dampens the mechanical impact of the gear segment against the housing walls and thus reduces mechanical wear.

The design of the plunger

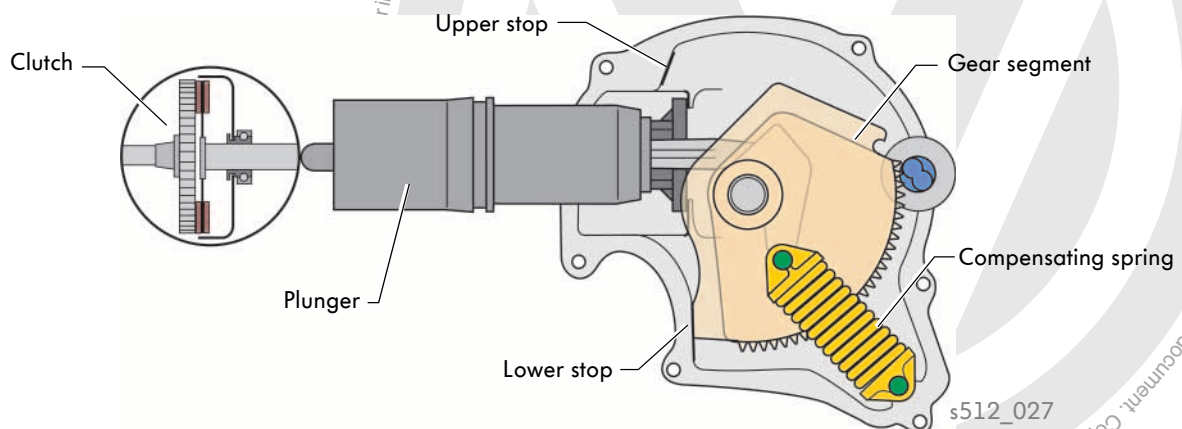


The outer housing of the plunger holds the inner part and the pressure spring. The inner part includes the roller freewheel, the locking wedge with the wedge carrier and the guide ball. The guide ball connects the plunger to the gear segment.

Clutch operation

Clutch is closed

The gear segment is resting against the lower stop of the housing.

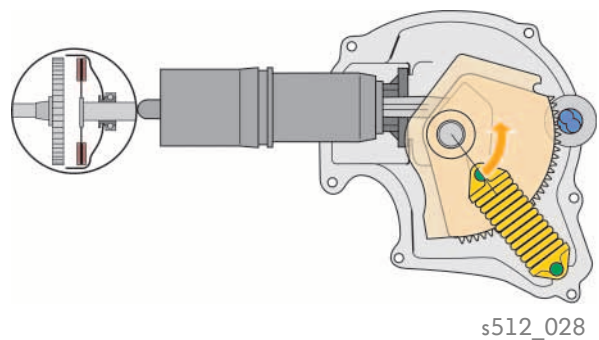


Clutch opens

The motor V530 is energised and turns the gear segment to the upper stop.

The compensating spring supports the motor in this movement in order to reduce the energy requirement of the motor.

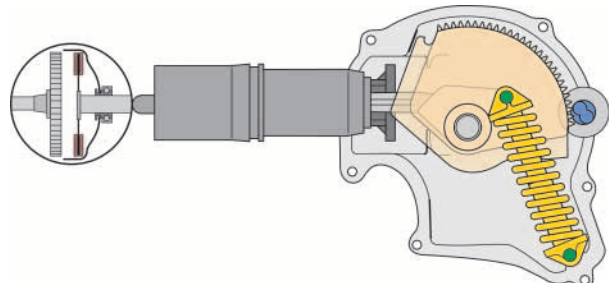
The gear segment presses the plunger against the release lever. This force acts on the diaphragm spring of the pressure plate via the release bearing and the clutch opens.



Gearbox mechanics

Clutch is open

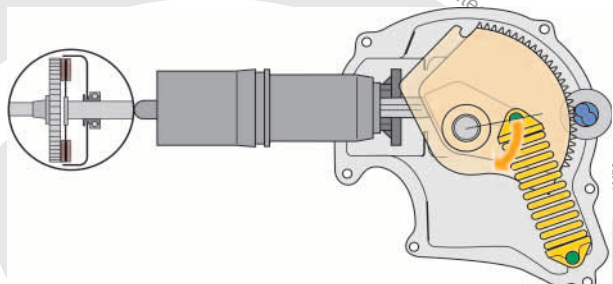
The gear segment is resting against the upper stop of the housing.



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Clutch closes

If the motor V530 is energised again, the gear segment turns back to the starting position against the lower stop. The motor works against the compensating spring at first. It is supported by the diaphragm spring on the pressure plate. If the pivot point of the gear segment and the axis of the springs are aligned, the compensating spring will support the movement of the motor from this position. The plunger will be pulled back into the aluminium housing by the turning motion of the gear segment. The clutch closes.



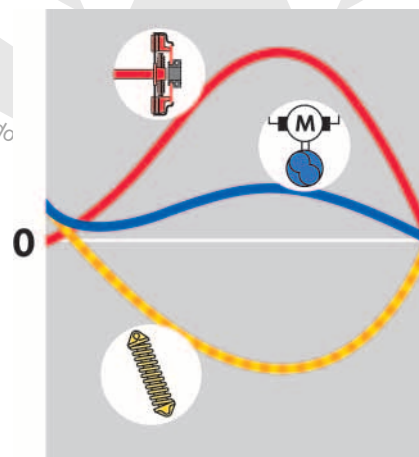
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Balance of forces

A large amount of force is required to open the clutch.

The compensating spring was added so that the clutch actuator motor V530 does not have to apply the force on its own. It helps the motor open the clutch.

This combination has allowed us to optimise the size of the motor.



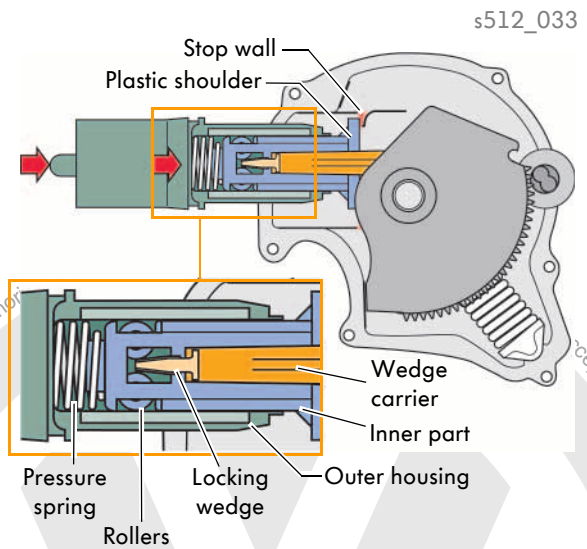
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Compensating wear

The clutch is subject to mechanical wear during usage. The clutch actuator therefore has a mechanical wear compensation system.

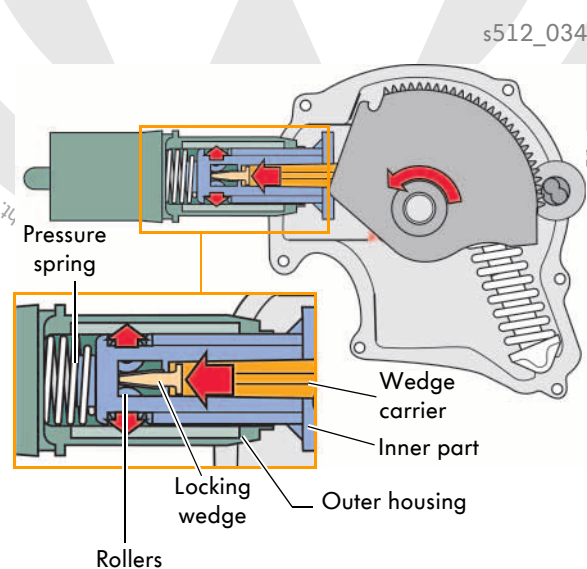
Starting situation

The plastic shoulders of the inner part rest against the stop walls of the aluminium housing.
 The wedge carrier moves into the rest position with the locking wedge and releases the rollers. The inner part can slide within the outer housing.
 The pressure spring pushes the inner part and the outer housing apart until the plunger is resting on the release lever.



Compensating wear

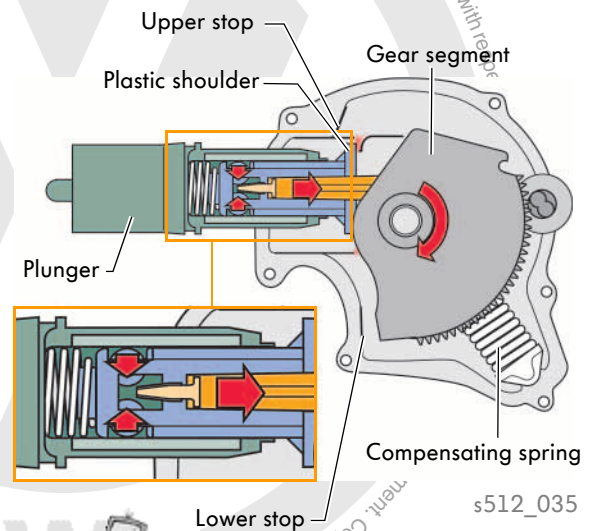
When the clutch actuator is operated, the inner part moves towards the clutch. The locking wedge is pushed between the rollers of the roller freewheel and pushes them outwards. The rollers are then jammed against the outer housing.
 The gear segment together with the plunger pushes the release lever and the clutch opens.



Gearbox mechanics

Return to starting position

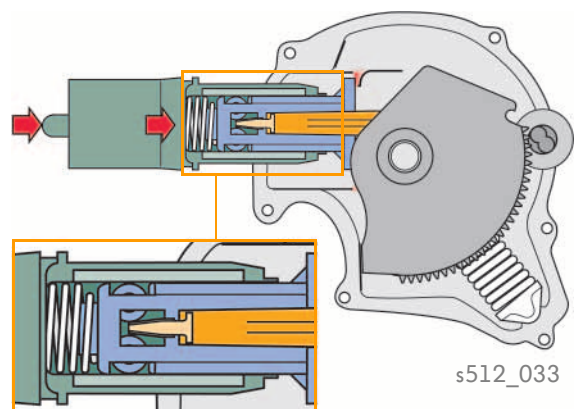
To close the clutch, the motor V530 pulls the gear segment together with the plunger back into the aluminium housing. The connection within the plunger is retained during this motion. The locking wedge is only pulled back by the remaining turning motion of the gear segment once the plastic shoulders of the inner part rest on the stop walls of the clutch actuator. The gear segment then reaches its mechanical stop. The rollers are decoupled and the locking effect is cancelled.



Effects without wear compensation

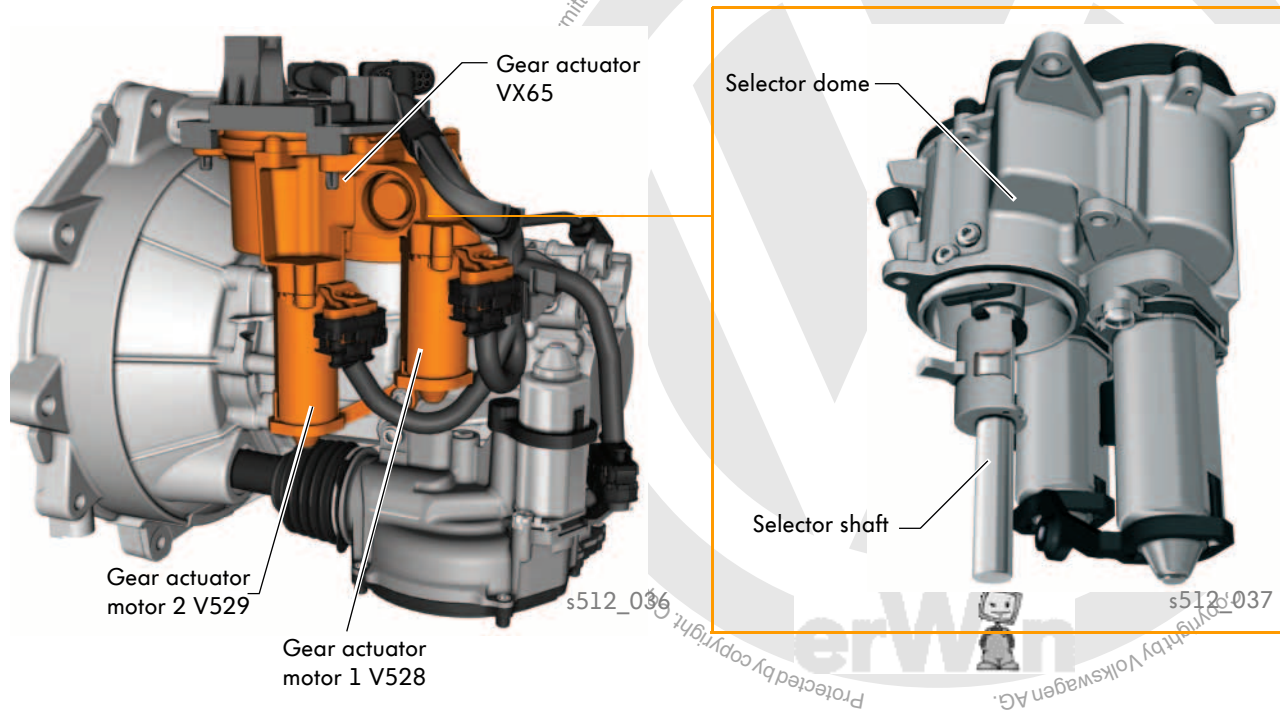
The return force acting on the plunger increases as the clutch wears. If there was no wear compensation, it would no longer be possible to close the clutch properly and the clutch would slip. The constant loading of the diaphragm springs could cause damage to the release bearing and the clutch.

In decoupled state, the pressure spring ensures there is no play in the connection between the plunger and the clutch.



Gear actuator VX65

Overview

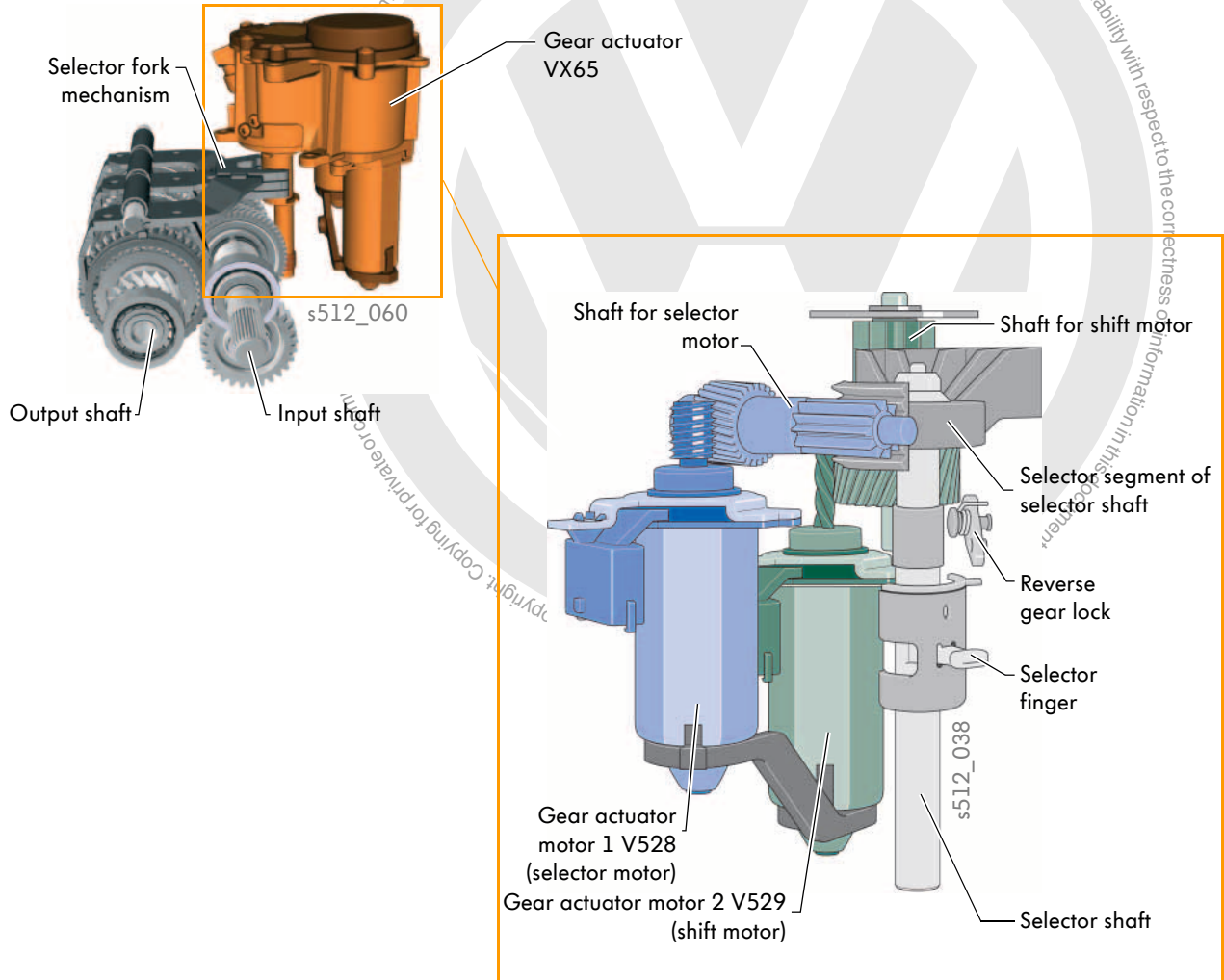


The gear actuator VX65 is located above the clutch actuator and is secured to the gearbox case by four bolts. It has a modified selector dome in comparison to the gearbox OCF.

The two motors for the gear actuator have different functions. The first motor V528 (selector motor) takes on the selector function and the second motor V529 (shift motor) performs the shift function.

Gearbox mechanics

Design



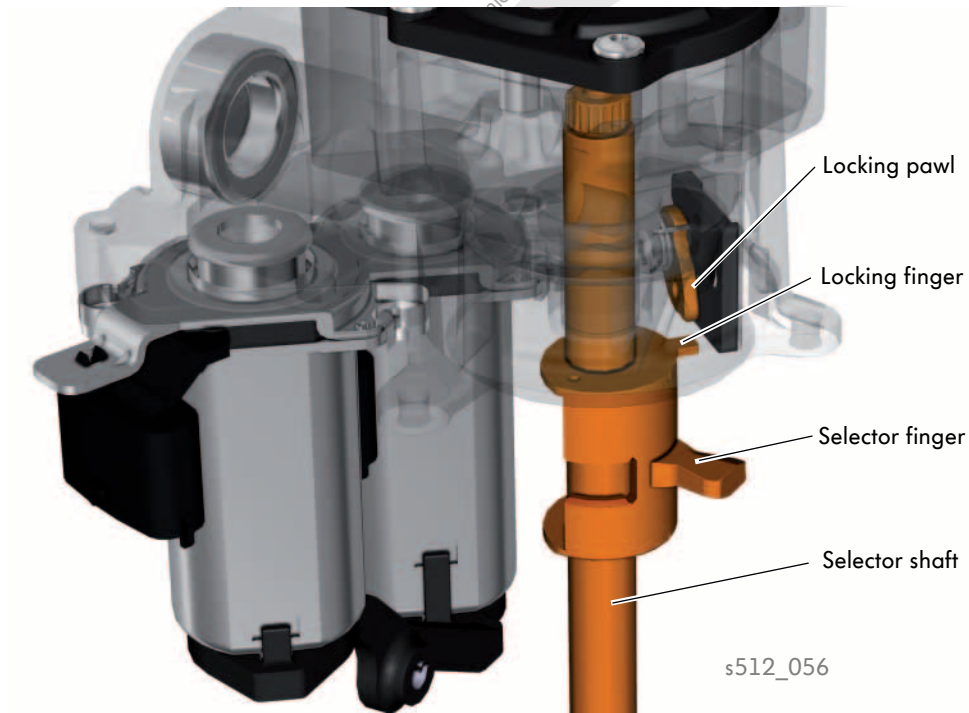
The internal gearshift process works in the same way as in the manual gearbox OCF, i.e. the selector finger engages in the selector fork mechanism.

The two motors are connected to the selector segment on the selector shaft via the shafts for the selector and shift motors. The shafts ensure that the drive energy is transferred to the selector shaft.



Further information on the design and function of the manual gearbox OCF can be found in self-study programme 509 "Manual Gearbox OCF".

Lock for reverse gear

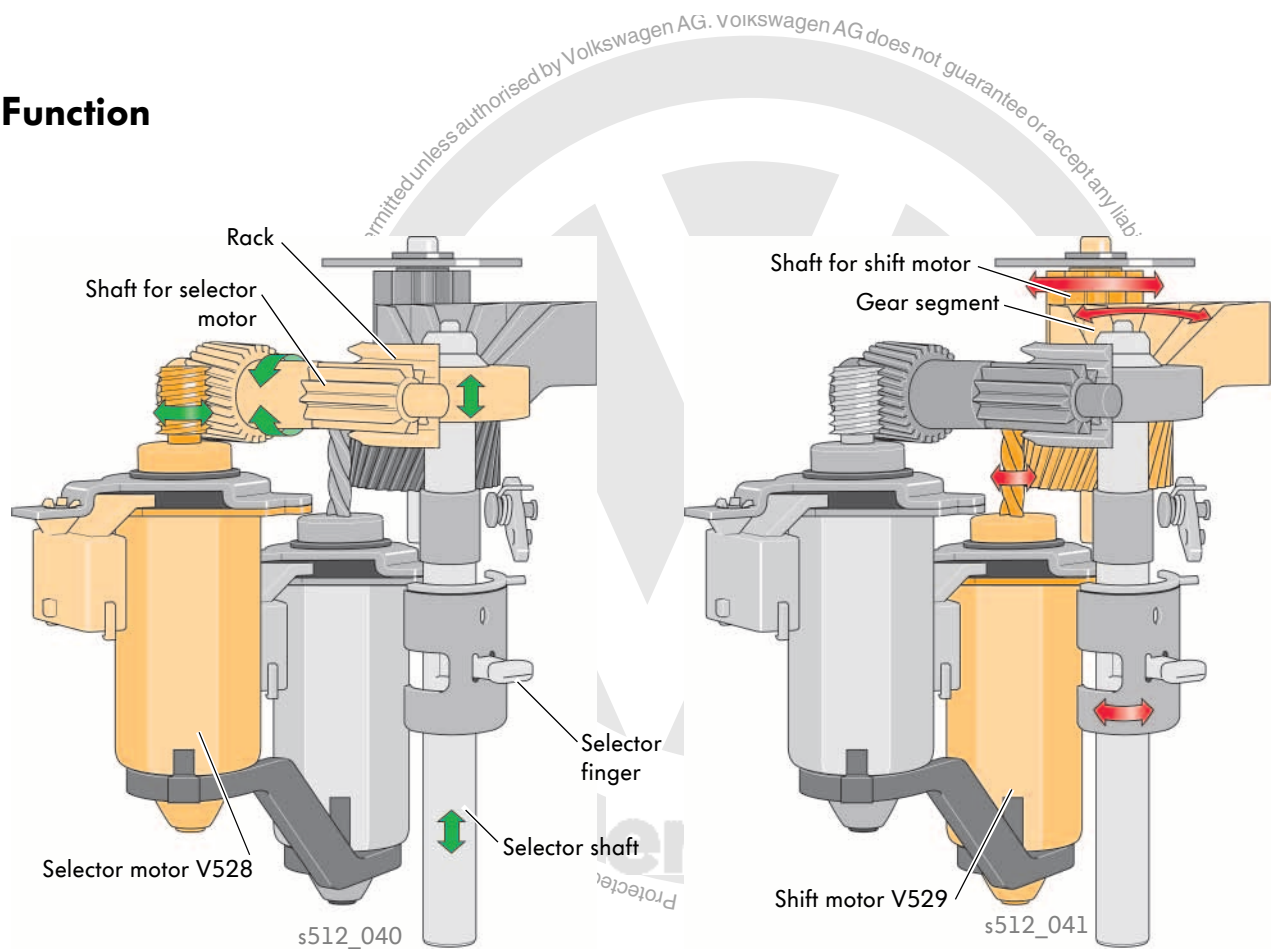


A mechanical locking pawl on the inner wall of the gear actuator stops you accidentally shifting from fifth gear to reverse gear.

When fifth gear is deselected, the locking finger meets the locking pawl. The locking pawl prevents reverse gear being selected.

Gearbox mechanics

Function



Selector motor V528

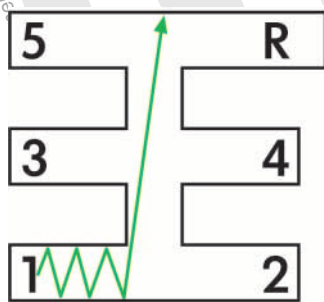
When the selector motor is activated, the shaft for the selector motor transfers the torque to a section of the selector shaft that is shaped as a rack. This converts the rotary movement of the motor into up and down movement of the selector shaft. This movement selects the shift gate.

Shift motor V529

When the shift motor is activated, the shaft for the shift motor transfers the torque to a section of the selector shaft that is shaped as a gear segment. This transfers the rotary movement of the motor to the rotary movement of the selector shaft. This movement selects the required gear within a shift gate.

Basic adjustment of gear actuator

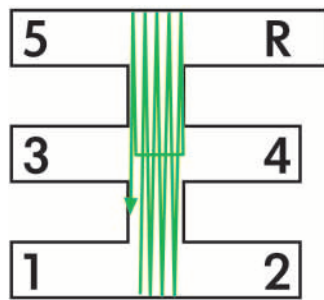
During the basic adjustment, the selector finger travels through the shift gates and the selection gates several times. The position of the selector finger and both the length and the width of the respective gates are thus determined. The calculated width and length of the selection and shift gates allow the motors V528 and V529 to be activated almost simultaneously. The selector finger therefore does not collide with the walls of the shift gates. As a result, the gearshift operations are shortened.



s512_070

Finding neutral position:

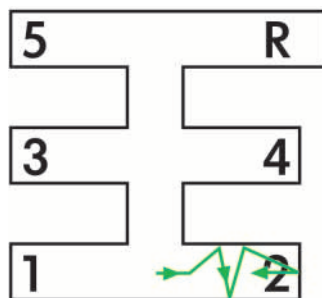
To find the neutral position, the end of the shift gate is located by the selector motor moving the selector finger against the upper and lower mechanical stops within the shift gate. At the same time, the selector finger is moved out of the shift gate by the shift motor.



s512_071

Measuring neutral position:

In a similar procedure, the width and length of the selection gate are calculated. The alternating travel in vertical and horizontal directions is continued until the movement is limited by the start of a shift gate.



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Measuring gears:

Each shift gate is travelled through individually to measure the length, width and end of a shift gate (2nd gear used as example here).



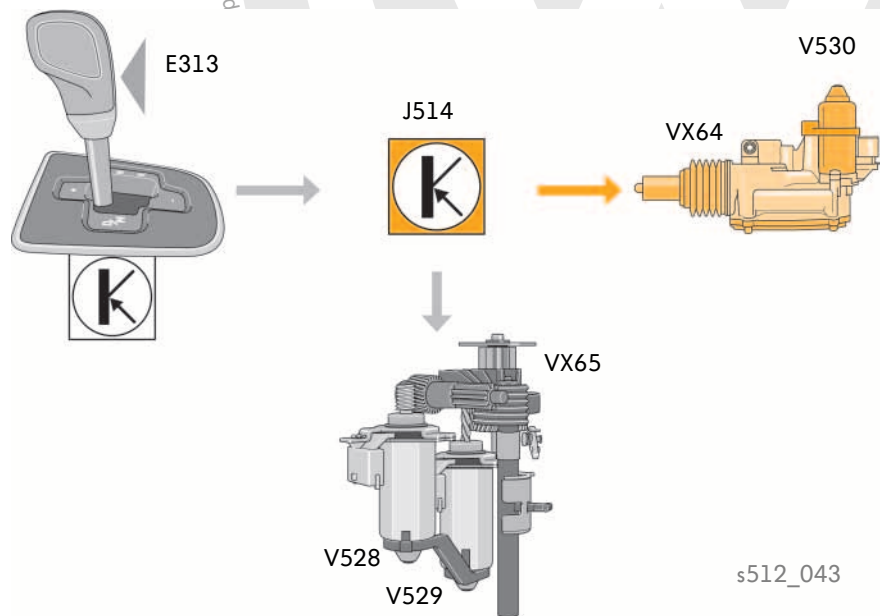
Gearbox function

Gearshifts

The values calculated in the basic adjustment are used to activate the shift motor and the selector motor simultaneously at times.

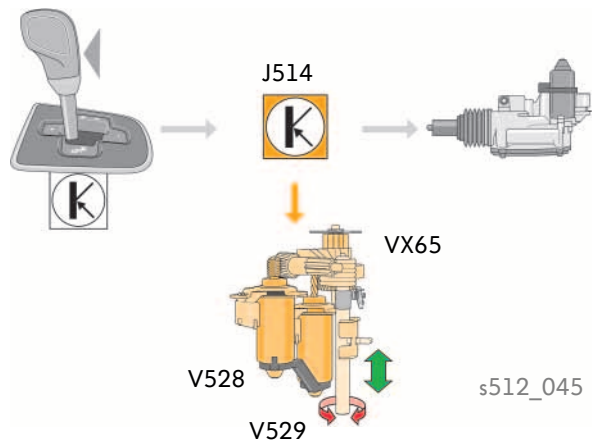
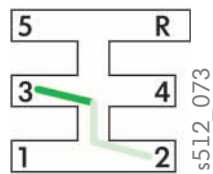
Prerequisites:

- The gearshift electronics has transferred the driver's request to the electronic manual gearbox control unit.
- The clutch actuator has opened the clutch.

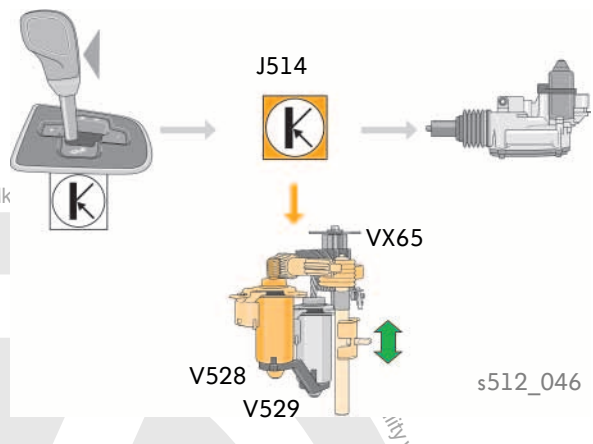
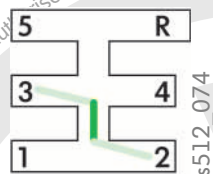


- E313** Selector lever
- J514** Electronic manual gearbox control unit
- VX64** Clutch actuator
- VX65** Gear actuator
- V528** Gear actuator motor (selector motor)
- V529** Gear actuator motor (shift motor)
- V530** Clutch actuator motor

The selector motor V528 and the shift motor V529 are energised at the same time. The shift motor moves the selector shaft into the neutral position with an axial rotary movement. At the same time, the selector motor leaves the selected shift gate with a vertical movement.

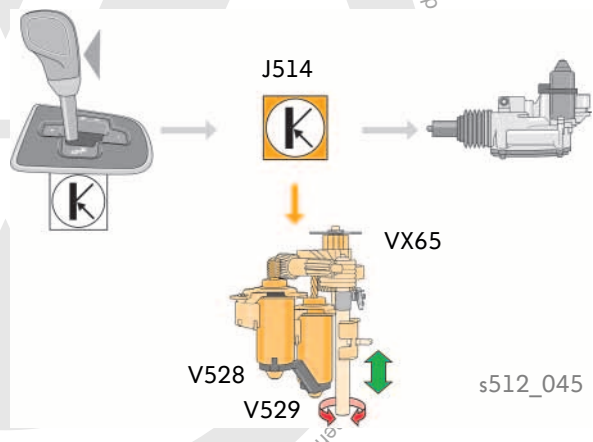
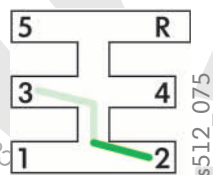


The shift motor is deactivated and the selector motor selects the correct shift gate.



The selector motor is also activated again and turns the selector shaft to the left or right and the gear is engaged.

Once the gear has been changed, the clutch closes and the gearshift procedure has been completed.



Gearbox management

System overview

Sensors

Gearbox input speed sender **G182**

Electronic manual gearbox control unit **J514**

Onboard supply control unit **J519**

Engine control unit **J623**

Data bus diagnostic interface **J533**

ABS control unit **J104**

Control unit in dash panel insert **J285**

Selector lever **E313**

Actuators

Gear actuator **VX65**

Gear actuator motor 1 (selector motor) **V528**

Gear actuator motor 2 (shift motor) **V529**

Clutch actuator **VX64**

Clutch actuator motor **V530**

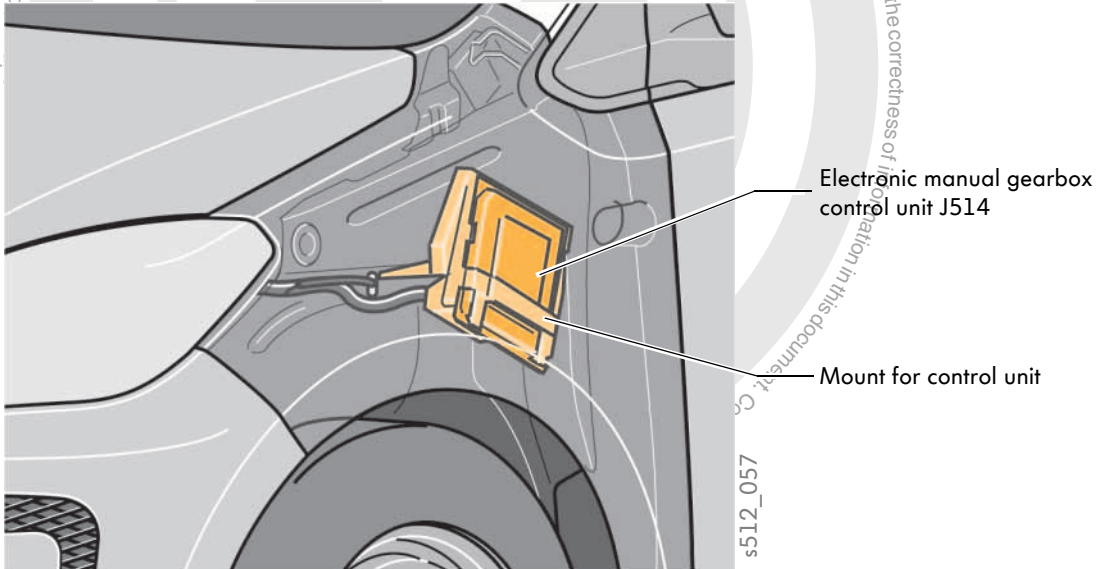
Legend

- █ Input
- █ Output
- █ CAN data bus

s512_048



Electronic manual gearbox control unit J514



The electronic manual gearbox control unit J514 is located above the left-hand wheel housing liner.

The control unit communicates with the other control units via the powertrain CAN data bus. The starter enable signal is also sent to the onboard supply control unit via a separate cable. The requirements for this are: selector lever in N position and brake pedal pressed. The enable signal must be received by the onboard supply control unit via both channels in order to start the engine.

The signals from the position senders for the clutch actuator and the gear actuator as well as those from the gearbox input speed sender are sent directly to the electronic manual gearbox control unit J514. The control unit uses the incoming CAN signals to decide on the timing of clutch and gearshift operations.

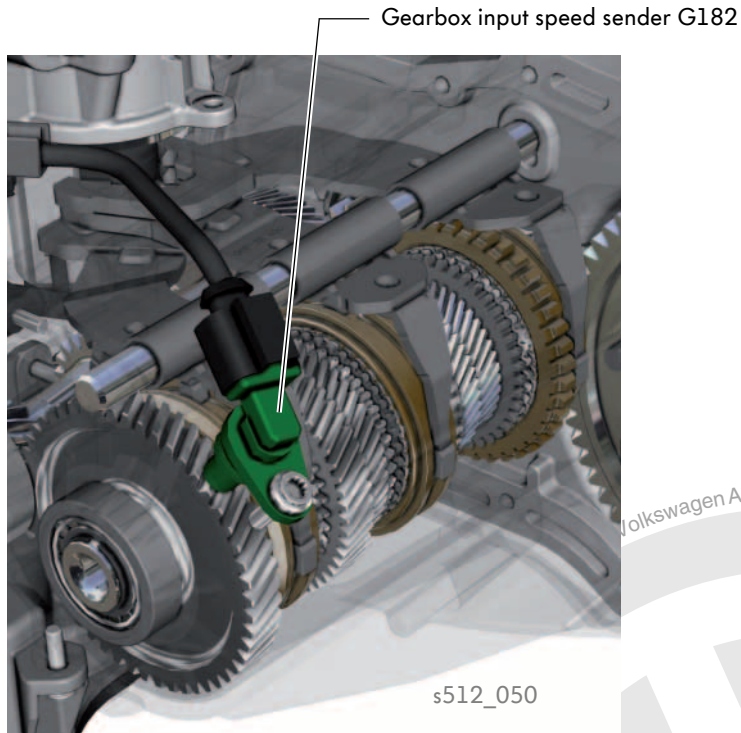
The control motors are activated directly by the control unit by means of PWM signals.



The control unit J514 can be accessed by removing the left-hand front wheel and the wheel housing liner.

Gearbox management

Gearbox input speed sender G182

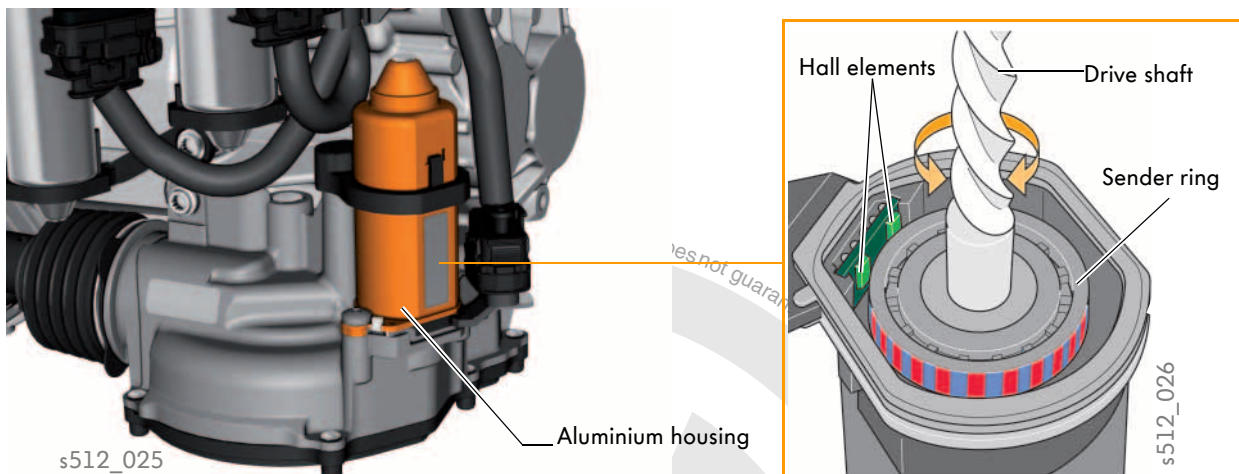


Task and function

The gearbox input speed sender G182 is located in the gear casing. It scans the synchroneshed gear for first gear electronically in order to measure the gearbox input speed.

The number of teeth on the synchroneshed gear for first gear allows precise speed measurement. The sender works using the Hall principle.

Motors for clutch actuator and gear actuator



Design

To detect the direction of rotation, an electronic system with two Hall elements is integrated into the aluminium housing of the clutch and gear actuator motors. The drive shaft of each respective motor is fitted with a sender ring. The rings are pre-magnetised on the outside and have alternating north/south poles.

Function

When the drive shaft rotates with the sender, the varying polarisation causes alternating signal voltages in the Hall elements. The control unit compares the sequence of signals from the two Hall elements to determine whether the motor is revolving and in which direction.



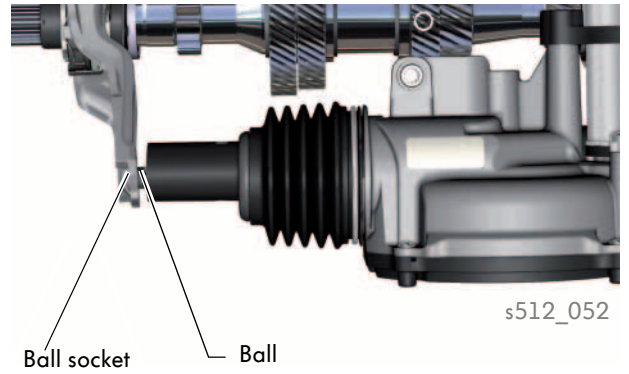
Service information

For the clutch actuator

No grease may be applied in the vicinity of the ball and the ball socket for the release lever.

Reason:

The combination of grease and dust from the clutch lining increases wear and causes noise.

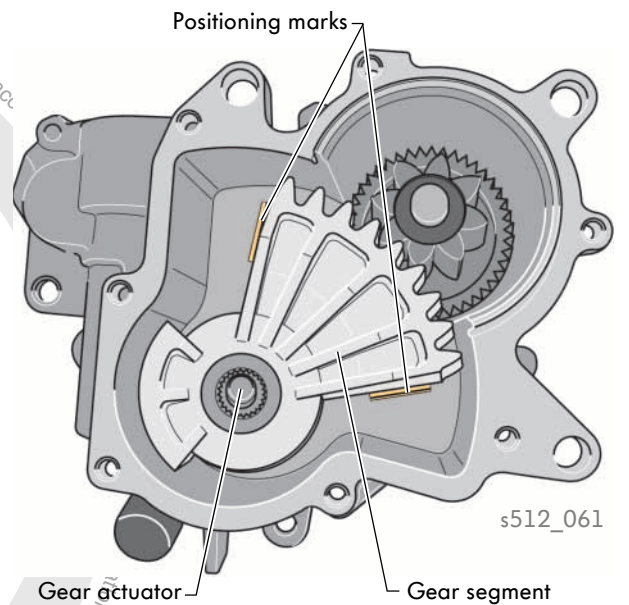


For the gear actuator

If the gear actuator cannot be set in the removal position with the VAS tester, then this can also be done manually: the cover must first be unscrewed from the gear actuator. Then the gear segment must be positioned between the two positioning marks. The gear actuator can then be pulled out.



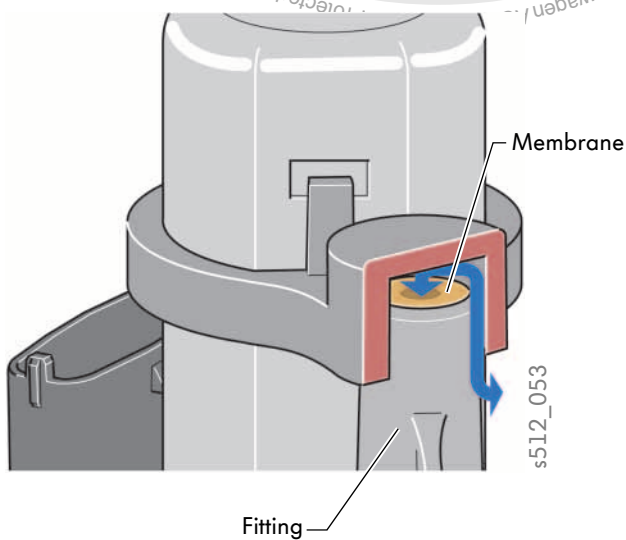
The gear actuator must be replaced after removal if it has been opened.



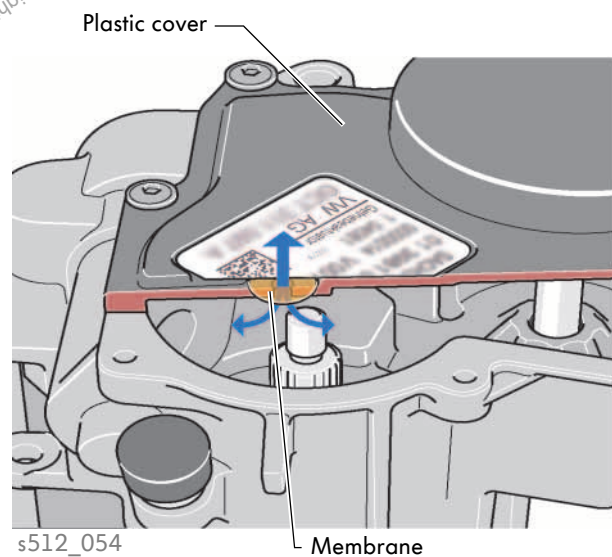
Make sure you observe the latest repair instructions in ELSA when installing and removing the gear actuator.

Pressure compensation

The clutch and the gear actuators have a drilled hole in the housing that allows pressure compensation between the inside and the surrounding atmosphere. Pressure compensation is necessary because the movement of the mechanical parts and temperature variations can cause pressure fluctuations inside the components. The hole is sealed with a GoreTex membrane so that moisture cannot get inside the housing. Air can pass through the membrane in both directions and thus compensate for pressure fluctuations.



On the clutch actuator, the membrane is secured to a fitting with ventilation hole.



On the gear actuator, the membrane is located over a hole in the plastic cover.



Test Your Knowledge

Which answers are correct?

One or several of the given answers may be correct.

1. What are the special features of the OCT gearbox compared with the OCF?

- a) The ball stud on the OCT is screwed on.
- b) The ball stud on the OCT is pressed on.
- c) The OCT works electromechanically.
- d) The OCT works hydraulically.

2. The OCT is ...

- a) a 5-speed manual gearbox.
- b) an automated 5-speed manual gearbox.
- c) a 5-speed automatic gearbox.
- d) a 4-speed manual gearbox.

3. In which selector lever position can the vehicle be started while pressing the brake pedal?

- a) In selector position "R".
- b) In selector position "N".
- c) In selector position "P".
- d) In selector position "D".



4. Which motor on the VX65 gear actuator has which function?

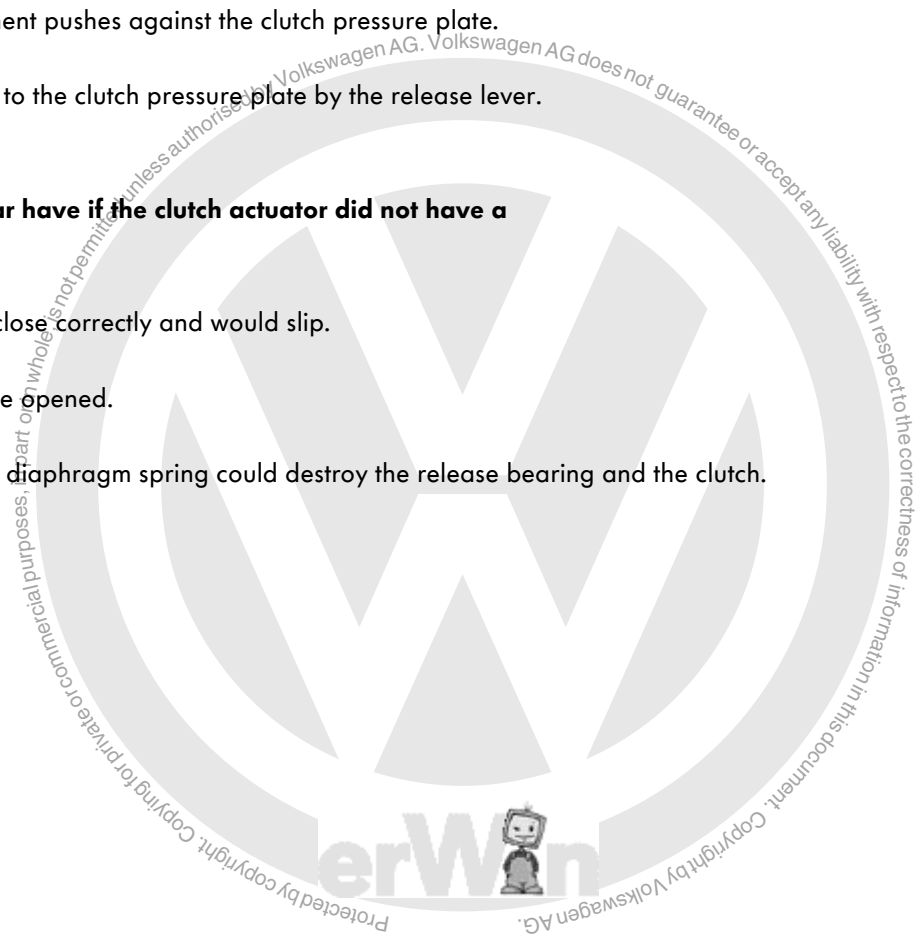
- a) The V529 motor is energised and the selector shaft moves up and down.
- b) The V529 motor is energised and the selector shaft rotates.
- c) The V528 motor is energised and the selector shaft moves up and down.
- d) The V528 motor is energised and the selector shaft rotates.

5. How is the movement of the clutch actuator transferred to the clutch?

- a) The movement is transferred directly to the clutch pressure plate.
- b) The spring on the gear segment pushes against the clutch pressure plate.
- c) The movement is transferred to the clutch pressure plate by the release lever.

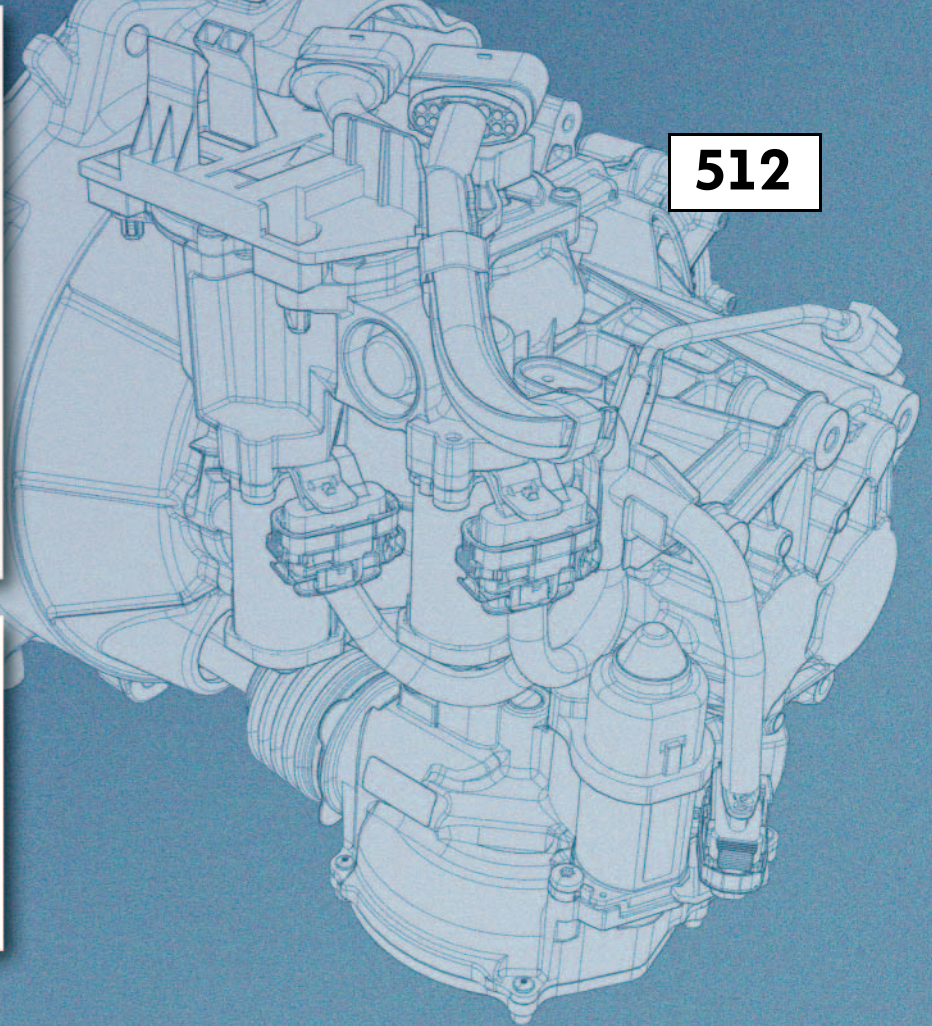
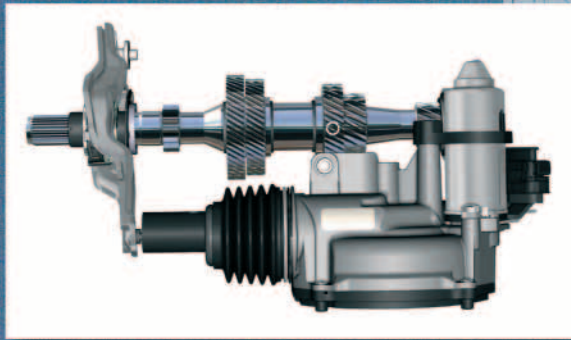
6. What effect would clutch wear have if the clutch actuator did not have a wear compensation system?

- a) The clutch would no longer close correctly and would slip.
- b) The clutch could no longer be opened.
- c) The constant pressure on the diaphragm spring could destroy the release bearing and the clutch.



Answers:

1. b), c); 2. b); 3. b); 4. b), c); 5. c); 6. a), c)



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