tiptronic/selection strategy

The automatic gearbox selects the next gear up before the maximum engine speed is exceeded.

Change-down to the next lowest gear is implemented on dropping below a minimum engine speed.

Kick-down results in change-down to the lowest possible gear.

Driving off always takes place in 1st gear.

In addition to permitting manual gearshift, the tiptronic function offers a further application:

As positions 4, 3, 2 no longer exist (new selector lever gate with positions D and S), prevention of change-up must be selected if required using the tiptronic function (by shifting selector lever to "tip" gate).

For more details, refer to tiptronic switch F189 in Part 2 SSP 284, Page 18 onwards.

Selector lever position and gear indicator in dash panel insert

Most gearbox control faults and malfunctions are covered by the comprehensive self-diagnosis function.

Depending on their effect on the gearbox and road safety, faults are indicated to the driver by means of an inverted segment display in the selector lever position indicator.

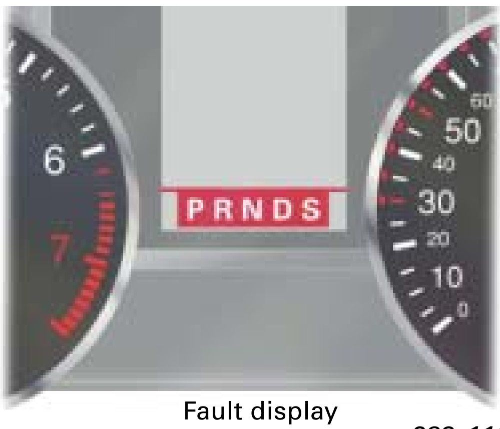
The vehicle should be taken to an Audi Service workshop without delay to have the fault rectified.

Automatic mode

283_117

tiptronic mode

283_118



Fault display

283_119

Gearbox Periphery

Ignition key removal lock

Major modifications have been made to operation of the ignition key removal lock and selector lever lock (shiftlock). On account of the new "electronic ignition/starter switch" (entry and start authorisation switch E415) and the electrical steering column lock control element N360, there is now no mechanical link between the selector mechanism and the steering column lock (cable).

Release of the ignition key removal lock is controlled by the entry and start authorisation control unit J518 and implemented by the ignition key withdrawal lock magnet N376 integrated into the entry and start authorisation switch E415.

The selector lever position "P" information is supplied by the gear selector position P switch F305 (mechanical microswitch).

In parallel to this, the shift position is transmitted from the gear sensor F125 by way of CAN data exchange and from the automatic gearbox control unit J217 to the control unit J518.

In selector lever position P, the control unit J518 switches voltage to E415, as a result of which the ignition key withdrawal lock magnet N376 cancels key locking.

If the selector lever is not set to "P" in switch position "OFF", the driver is informed of this situation on opening the driver's door by way of an acoustic signal and a visual display in the dash panel insert.

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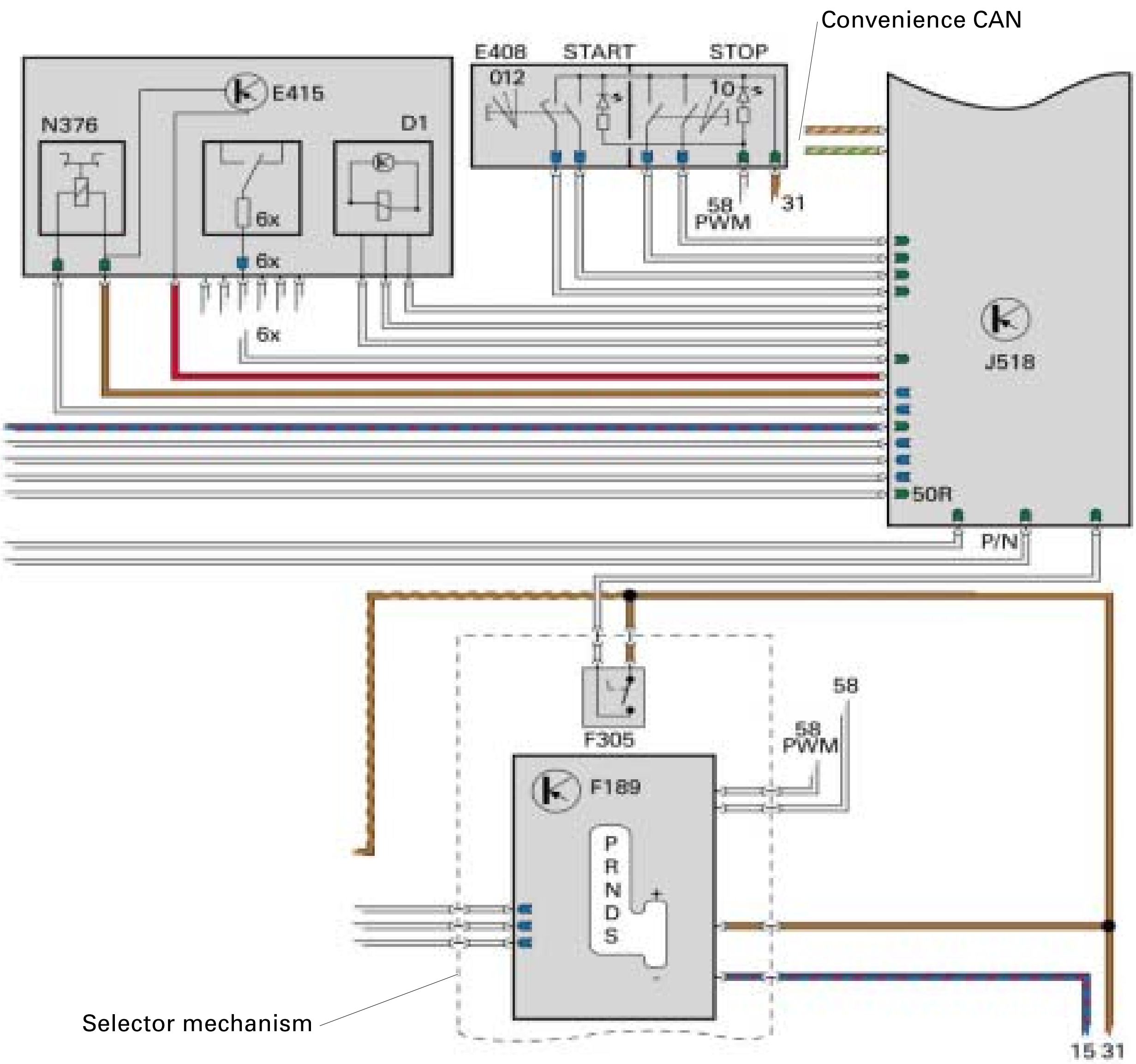


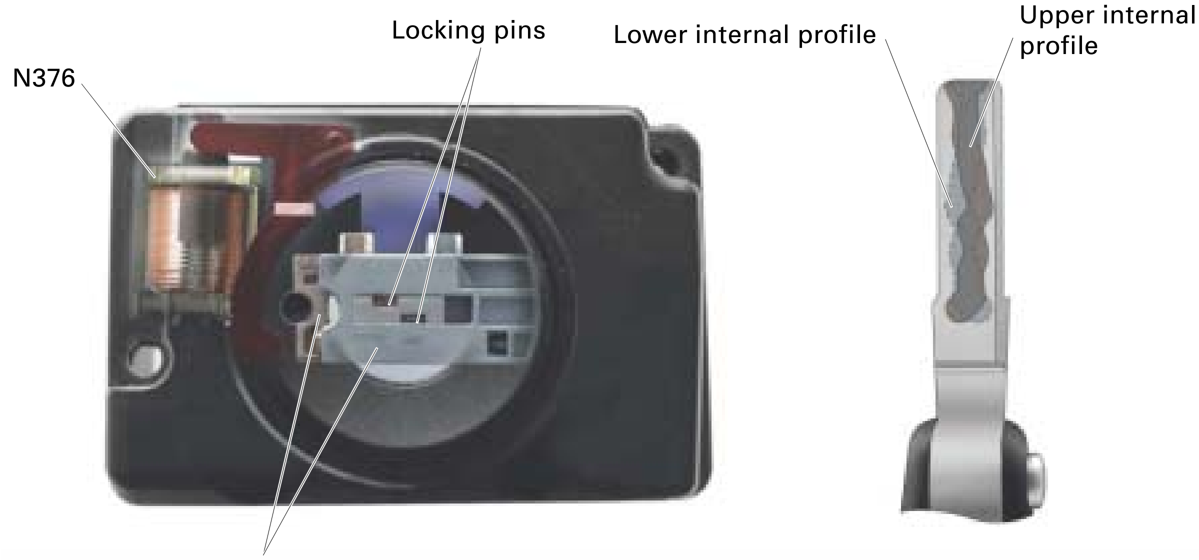
283_120

D1 Inhibitor reading unit
E408 Entry and start authorisation button
E415 Entry and start authorisation switch
F305 Gear selector position P switch
J217 Automatic gearbox control unit
J518 Entry and start authorisation control unit
N110 Selector lever lock magnet
N376 Ignition key withdrawal lock magnet (in E415)

Ignition key removal lock function

There are two spring-loaded locking slides with one locking pin each behind the opening for the ignition key. On inserting and removing the ignition key, the locking pins slide through the internal profile of the ignition key on both sides. In this process the two locking slides move axially in opposite directions.

If the ignition key is fully inserted, the locking slides/locking pins are in basic position (as when key is not inserted).



283_089

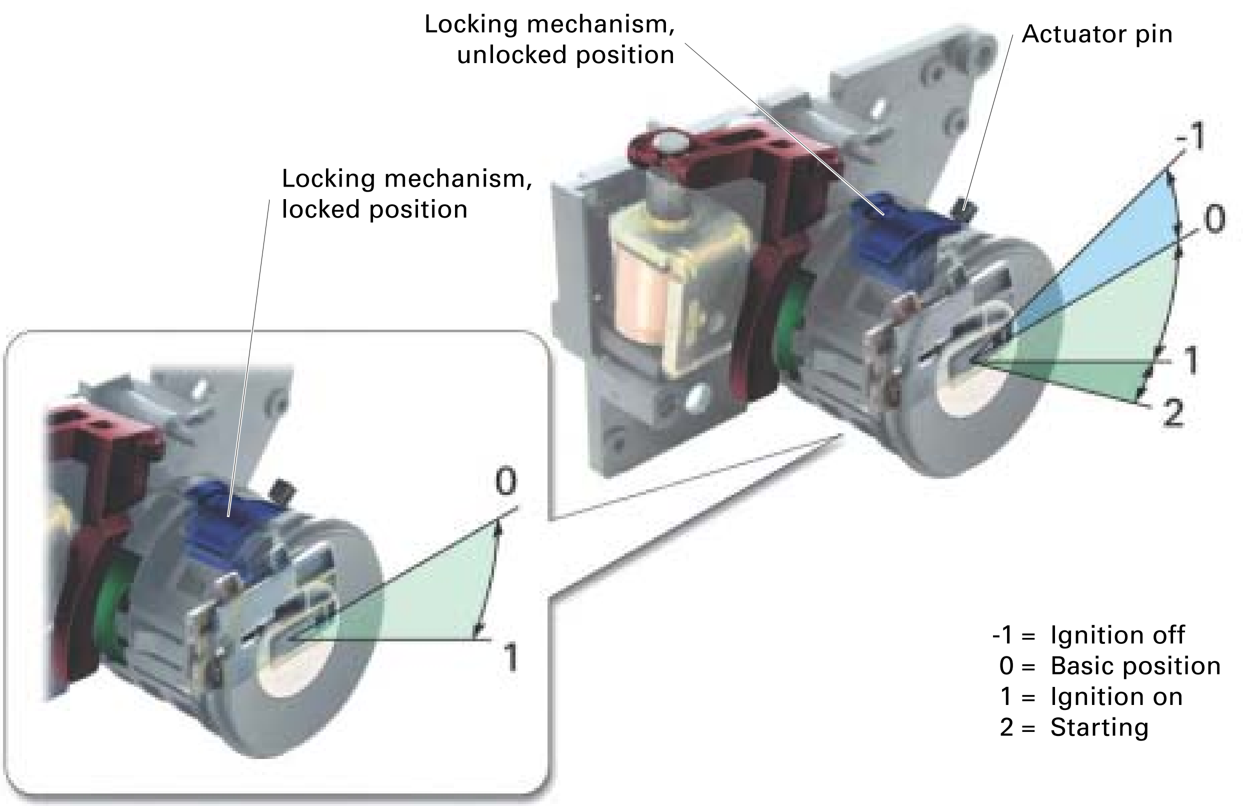
283_094

283_093

Engaging removal lock:

When the ignition is switched on (clockwise turn to pos. 1), a mechanical locking mechanism prevents axial movement of the locking plates.

The locking pins are blocked and cannot follow the contour of the internal profile. The ignition key is thus locked and cannot be removed.

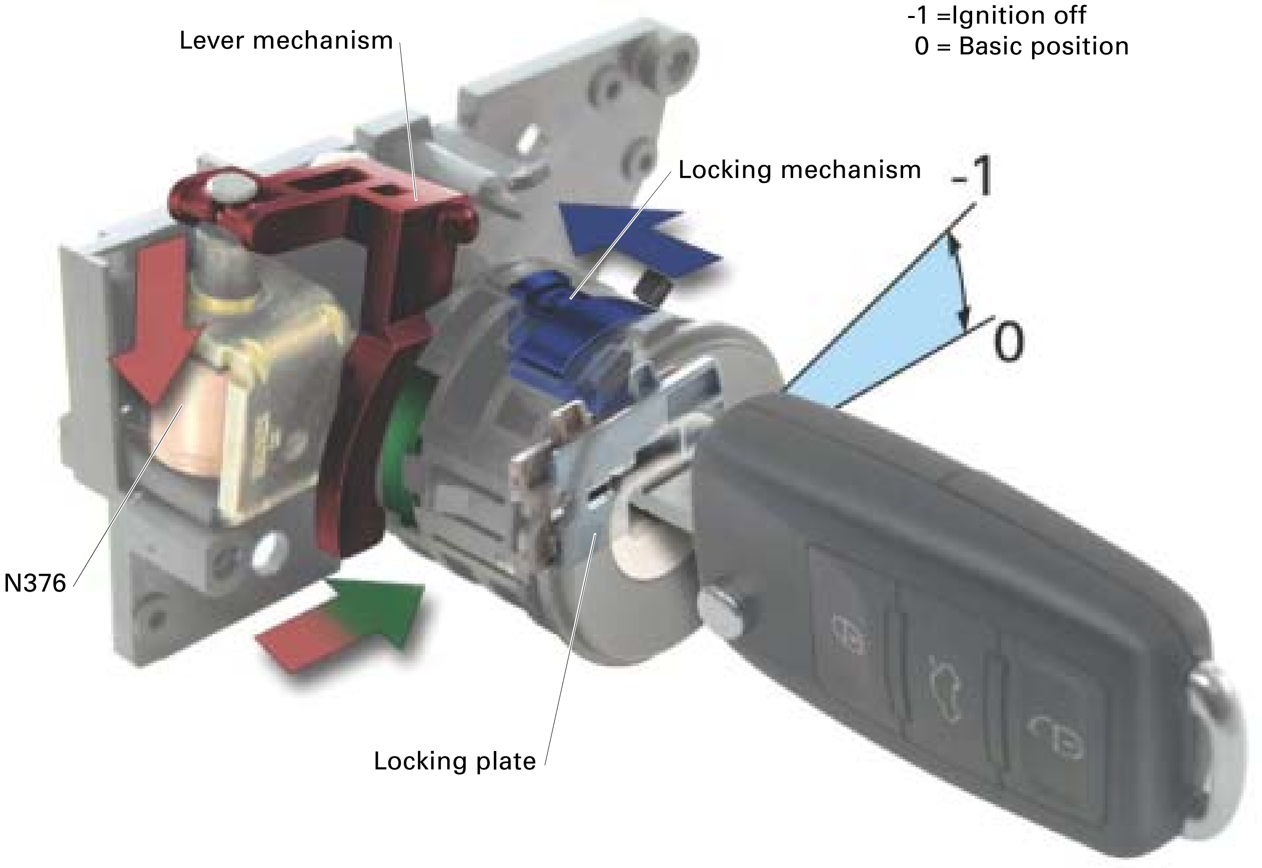


283_090

Releasing removal lock:

When ignition is switched off and selector lever is set to position "P", the entry and start authorisation control unit J518 energises the ignition key withdrawal lock magnet N376 briefly.

The lever mechanism of N376 then releases the locking mechanism of the locking plates and the ignition key can be removed.



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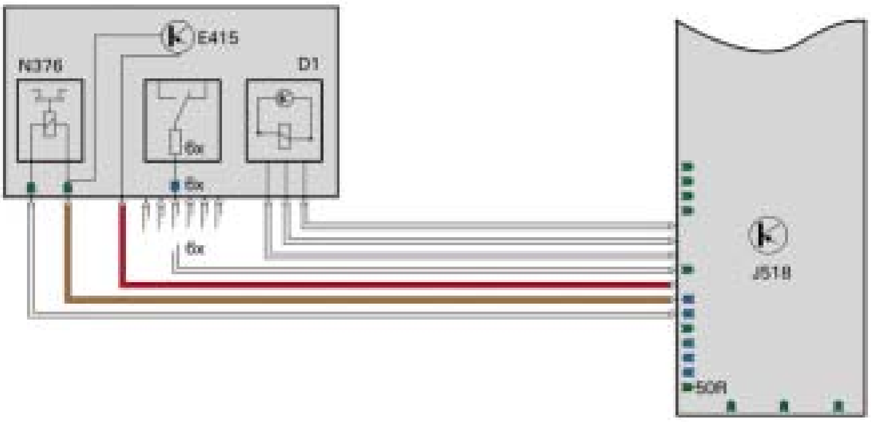

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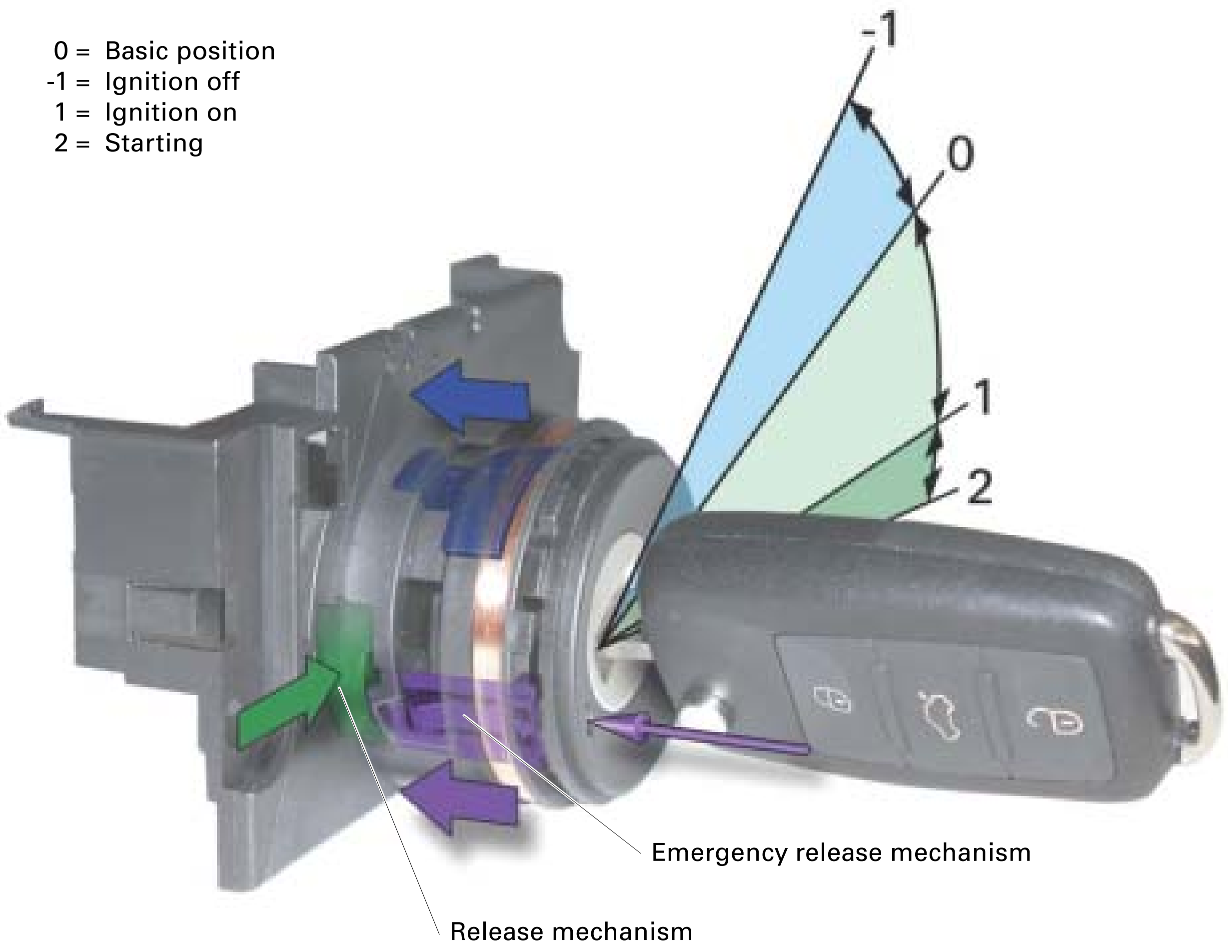
Removal lock emergency release

In the absence of electrical system voltage or in the event of malfunction, an emergency release mechanism permits removal of the key from the switch E415. This involves pressing the release knob with a ballpoint pen, for example, in "OFF" position.

The locking mechanism is thus released and the key can be removed.



283_096

The entry and start authorisation switch E415 is not assigned to any particular key. In other words, E415 can be actuated by inserting various keys.

An authorised key is recognised electronically by means of reader coil and transponder.

Starting lock/starter control

(Audi A8 ‘03)

As has always been the case, the starting lock function only permits starter operation in selector lever position P or N.

A new feature is automatic implementation of starter control (actuation of term. 50) by the engine control unit J623.

Release for starter actuation is always transmitted by the entry and start authorisation control unit J518 to the engine control unit J623. One of the release requirements is that control unit J217 transmits the selector slide position information P or N to the control units J623 and J518.

A further requirement when starting with button E408 is that the brake pedal is pressed (brake light switch F signal via separate interface to J518). **The ignition key must not be inserted in E415.**

The gear sensor F125 detects the positions of the selector slide and relays this information to the gearbox control unit J217.

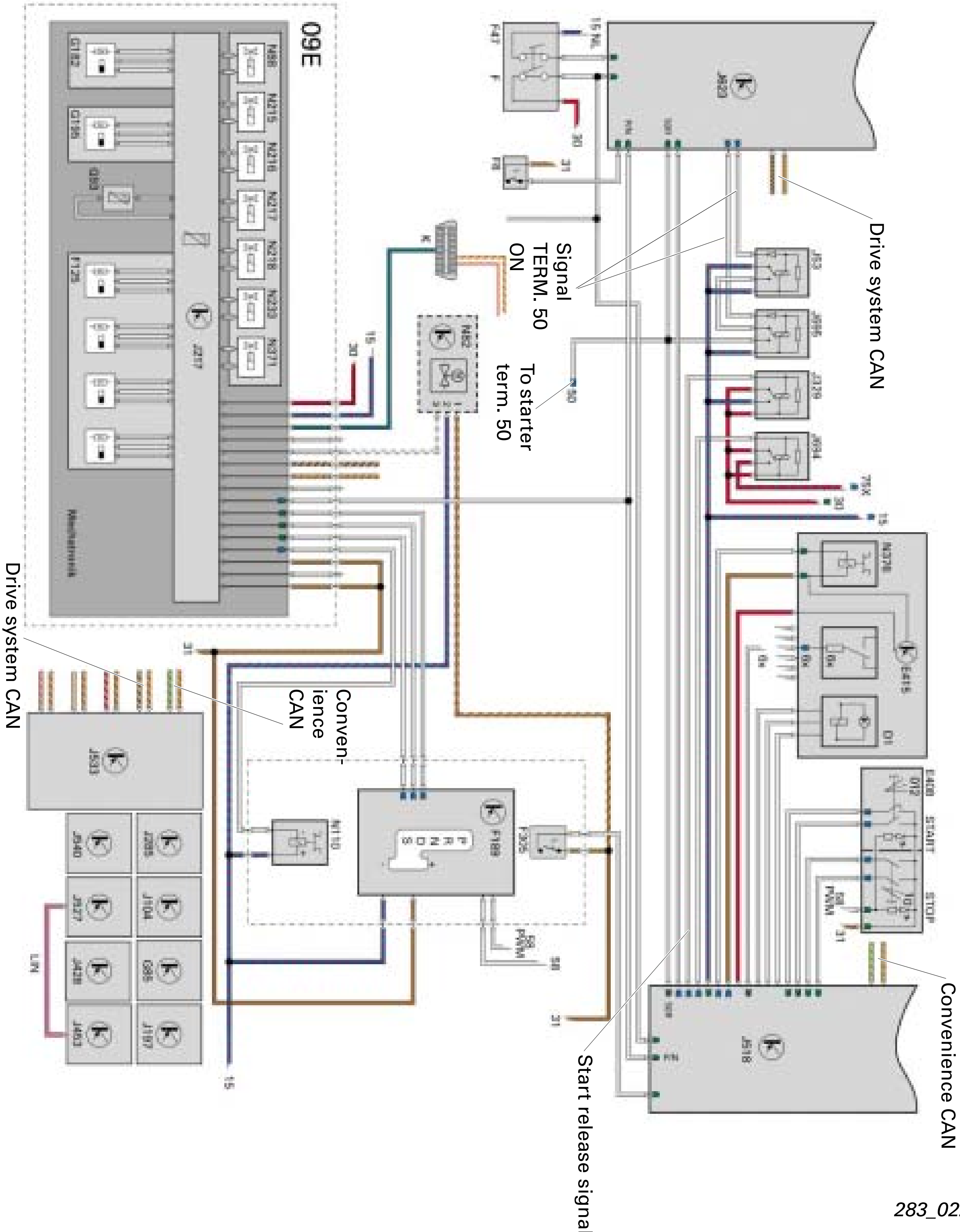
The information P/N is transmitted by J217 via separate interfaces to J623 and J518 (earth signal with P/N).

J217 also transmits the selector slide position information via the drive system CAN.

The information is passed by means of the data bus diagnostic interface J533 to the entry and start authorisation control unit J518. This permits plausibility checking and thus diagnosis of the separate interfaces.

Refer also to block diagram in Part 2 SSP 284, Page 26 onwards (general view).

E408	Entry and start authorisation button
E415	Entry and start authorisation switch (electronic ignition switch)
F	Brake light switch
F125	Gear sensor
J217	Automatic gearbox control unit
J518	Entry and start authorisation control unit
J533	Data bus diagnostic interface (gateway)
J623	Engine control unit



283_022

Output

Input

Torque converter

Torque converter clutch

Torque converters operate on the basic fluid coupling prinicple. This automatically leads to a difference in speed between pump and turbine impellers. This is referred to as converter slip, which causes a reduction in efficiency.

The torque converter clutch (TCC) eliminates converter slip and thus contributes towards achieving optimum consumption. Modern torque converters have therefore been fitted with a TCC for many years.

Closing and opening of the TCC is regulated in the interests of ride comfort.

A basic distinction is made between three operating statuses: TCC open
TCC control mode
TCC closed

Power transmission via the TCC used to be subject to relatively tight limits. For this reason, the TCC was only closed in the higher gears and operated on a controlled basis at low engine torques.

The permissible friction power of the TCC was increased with the 09E automatic gearbox, thus considerably extending the operating range and enhancing the overall efficiency of the drive system.

The TCC ...

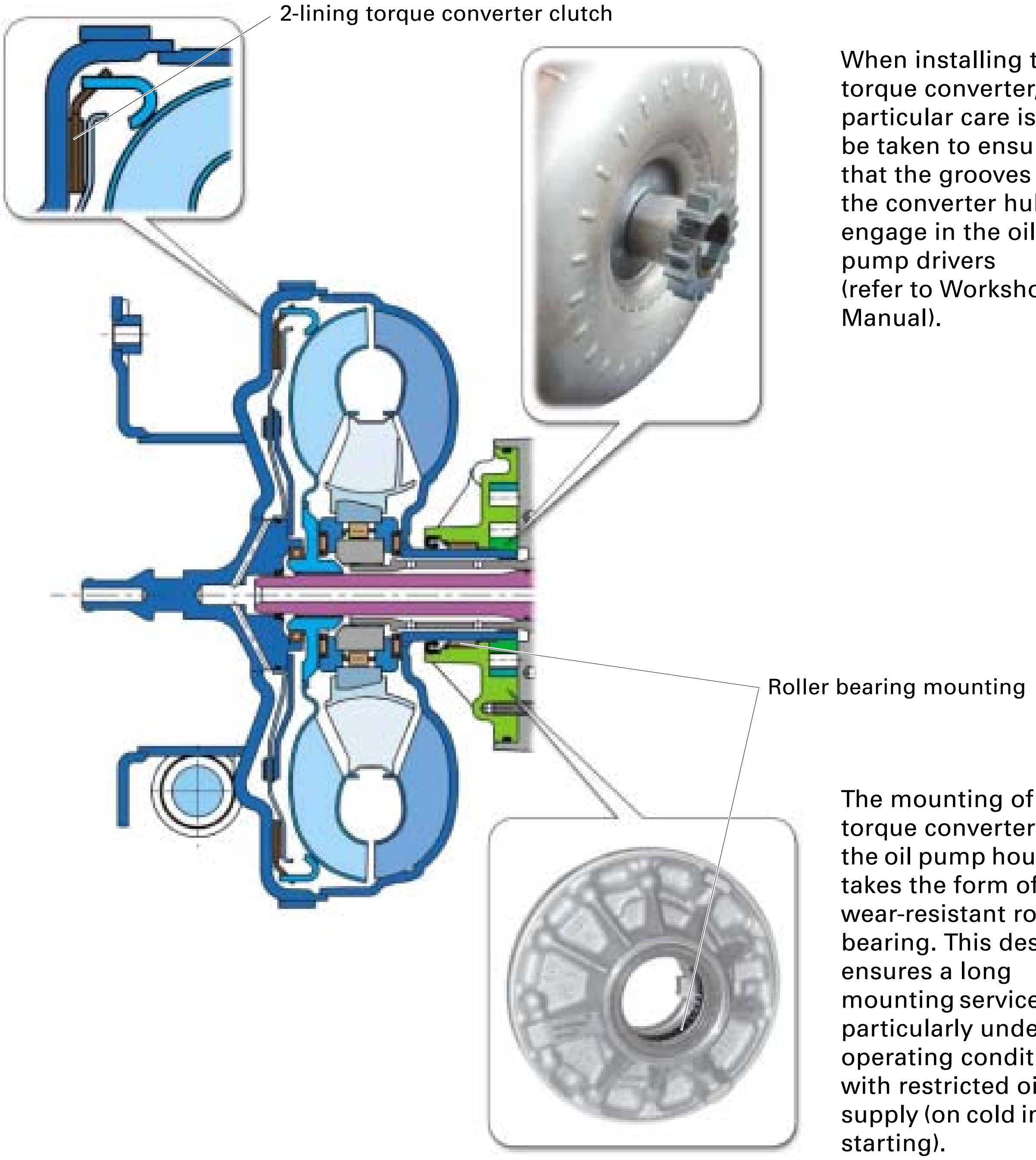
... can be engaged in all gears
... can be engaged with any engine torque
... is engaged as of 40°C ATF temperature

To achieve constant transmission of the high torque levels, the TCC has two friction surfaces.
The TCC has a separate lining plate. This plate is provided on both sides with a clutch lining, thus creating two friction surfaces.
The lining plate is located between the torque converter cover (converter housing) and the TCC piston. These two components are mutually friction locked. The lining plate is positively connected to the turbine impeller.
On closing the TCC, the torque is transmitted from both sides to the lining plate and thus to the turbine impeller.

In line with physical principles, doubling the number of friction surfaces also doubles the amount of force which can be transmitted.

To ensure TCC durability and a long service life, the new ATF G 055 005 A2 was specially developed to suit the exacting requirements involved.

The torque converter is matched to the power output and characteristics of the engine. In the event of complaints and when replacing the torque converter, particular attention should be paid to correct assignment to the engine/gearbox. The torque converter multiplication can be read out by way of self-diagnosis function 08 "Reading measured value block".



When installing the torque converter, particular care is to be taken to ensure that the grooves of the converter hub engage in the oil pump drivers (refer to Workshop Manual).

The mounting of the torque converter in the oil pump housing takes the form of a wear-resistant roller bearing. This design ensures a long mounting service life, particularly under operating conditions with restricted oil supply (on cold initial starting).

283_013

The basic mode of operation of the torque converter is explained in the Multimedia Training Programme "Power Transmission 2" (000.2700.21.20).

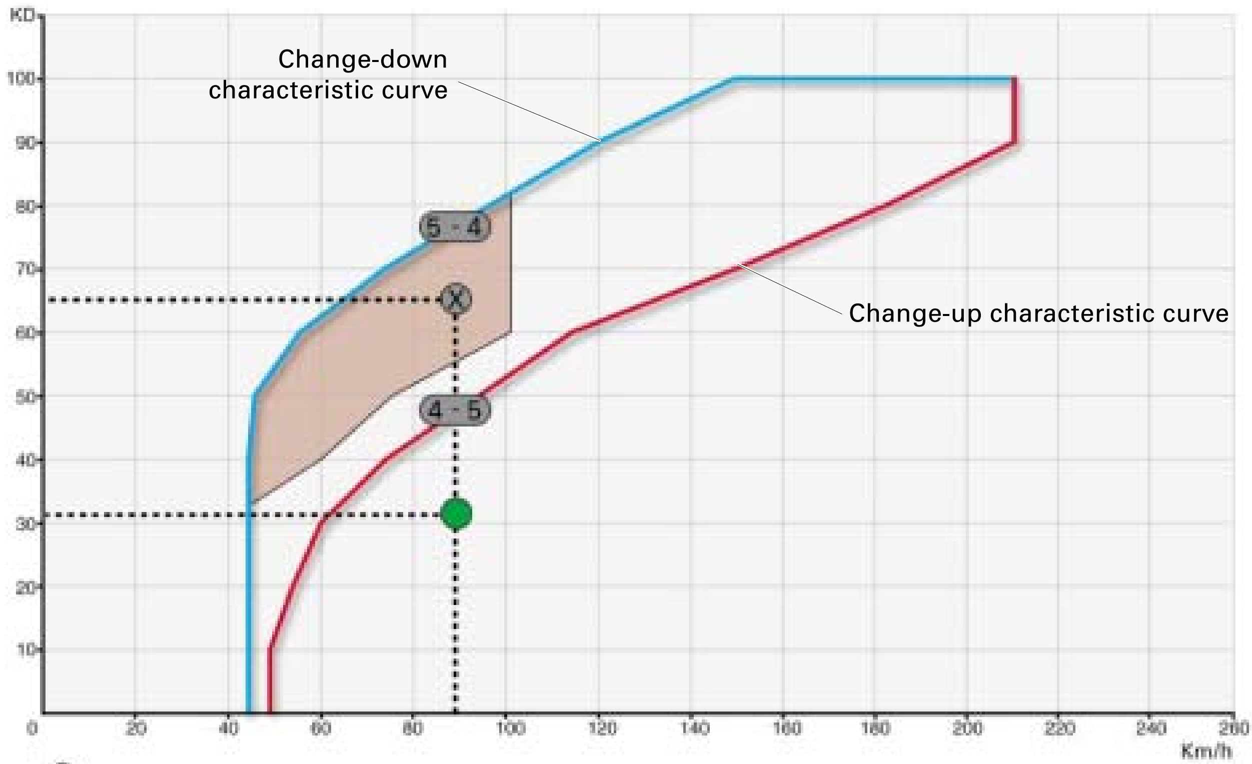
Torque converter shift operations

The torque converter multiplication is not only used for driving off, but also as a substitute for the gearshift operation under specific loads and at certain operating points. Thus for example on accelerating in certain load situations, the torque converter clutch is opened instead of change-down taking place, resulting in an increase in engine speed in a similar manner to change-down. The difference in speed between the pump and turbine impellers produces an increase in torque by the converter, corresponding to a gearshift operation, and at the same time the increase in speed causes the engine to be operated in a higher power range.

The advantage of this "strategy" is that "torque converter shifting" is smoother than shifting between gears on account of the damping effect of the torque converter and the relatively simple torque converter clutch control action.

In conjunction with the 6-speed gearing, the additional "torque converter shift operations" provide corresponding intermediate stages and thus a level of handling approaching that attained with continuously variable transmission.

Example of torque converter shift operation



Example of operating point shift (driver presses accelerator)

Previous operating point

Torque converter clutch open

283_106

Torque converter oil supply

The torque converter is constantly supplied with oil by means of a separate hydraulically controlled circuit. The heat (produced by the hydrodynamic torque transmission and the friction power of the TCC) is dissipated by the continuous supply of ATF.

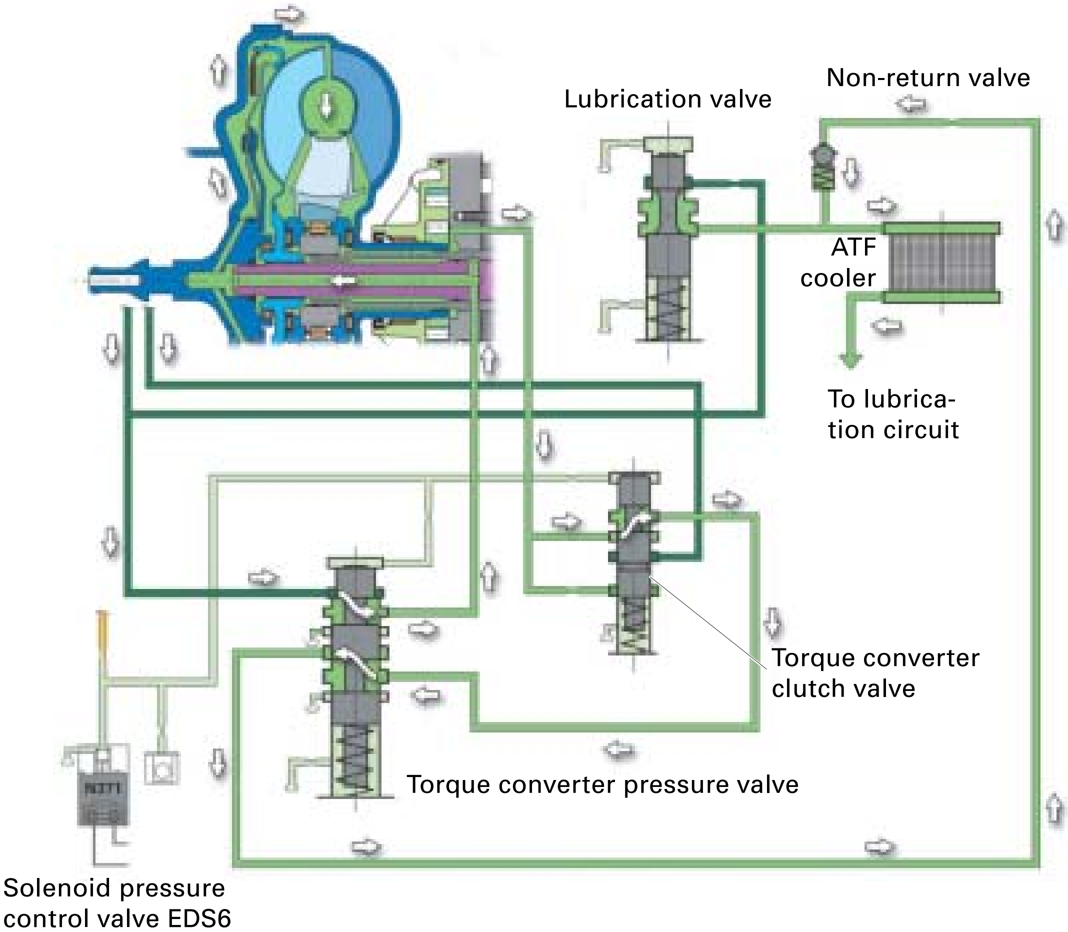
The TCC is controlled electrohydraulically by regulating the direction of flow and the pressure applied to each side of the TCC piston.

TCC control is based on the following parameters:

– Engine speed
– Engine torque
– Turbine speed
– Current gear
– Output speed
– ATF temperature

The gearbox control unit uses these to calculate the specified TCC status and establishes a corresponding control current for the pressure regulating valve N371. N371 converts an electrical control current into a defined proportional hydraulic control pressure.

This control pressure regulates the torque converter pressure valve and the torque converter clutch valve, which determine the direction of flow and the pressure for the TCC.



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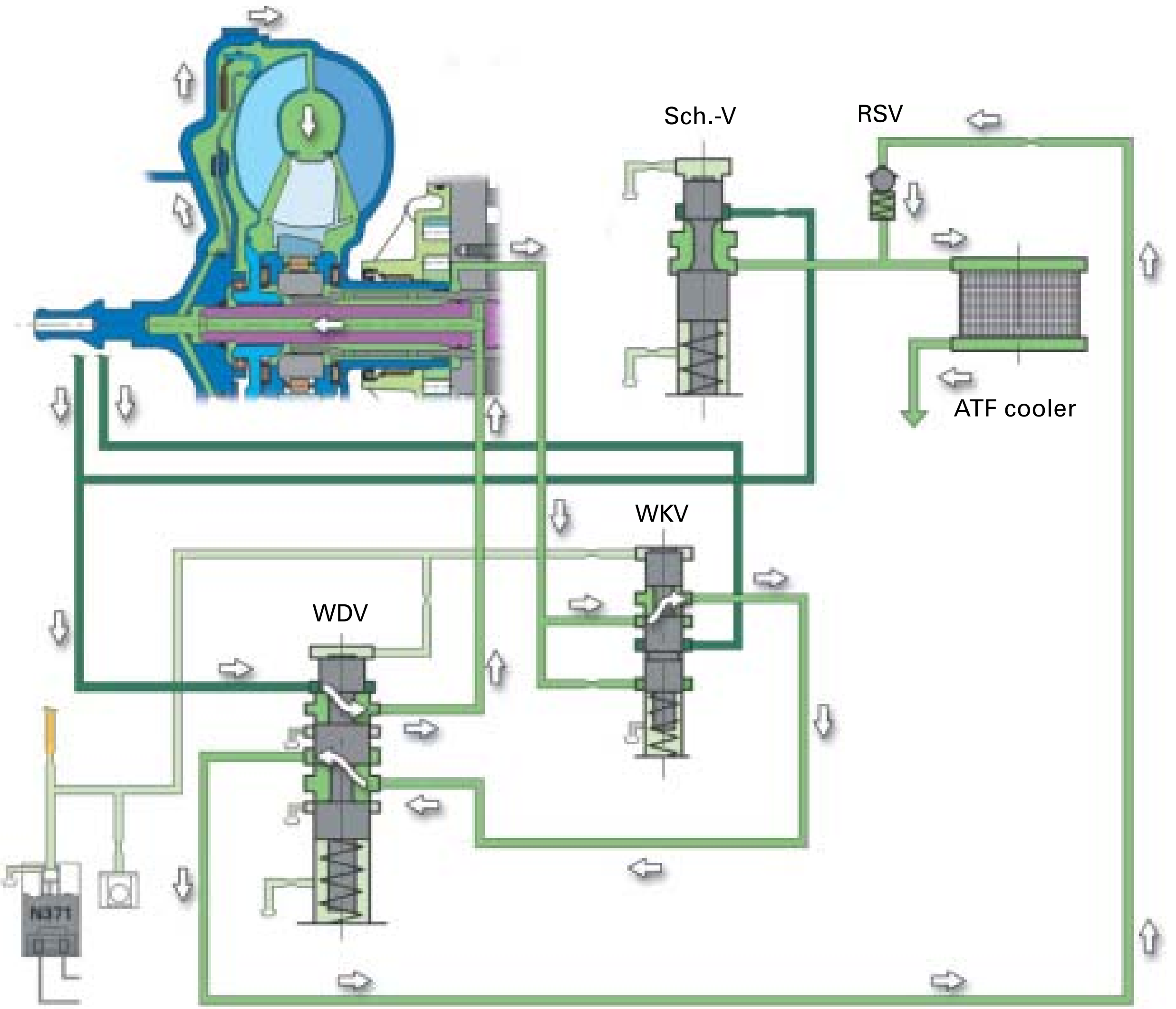
Torque converter clutch operation

TCC_open

When open, the oil pressure is equal on both sides of the TCC piston. The ATF flows from the piston chamber past the lining plate and friction surfaces to the turbine chamber. The warm ATF is routed by means of the torque converter clutch to the ATF cooler for cooling.

This design ensures adequate component and ATF cooling both during torque converter operation and with torque converter clutch control action.



Sch.-V = Lubrication valve
RSV = Non-return valve
WKV = Torque converter clutch valve
WDV = Torque converter pressure valve

Depressurised
Torque converter pressure
System pressure
Pilot pressure

283_100

TCC_control mode/_closed

To close the TCC, the direction of ATF flow is reversed by actuating the torque converter pressure valve and torque converter clutch valve. The oil pressure in the piston chamber is dissipated. The pressure in the torque converter then acts on the turbine end of the TCC piston, thus causing the TCC to close.

The clutch torque is increased or decreased in line with actuation of the valves.

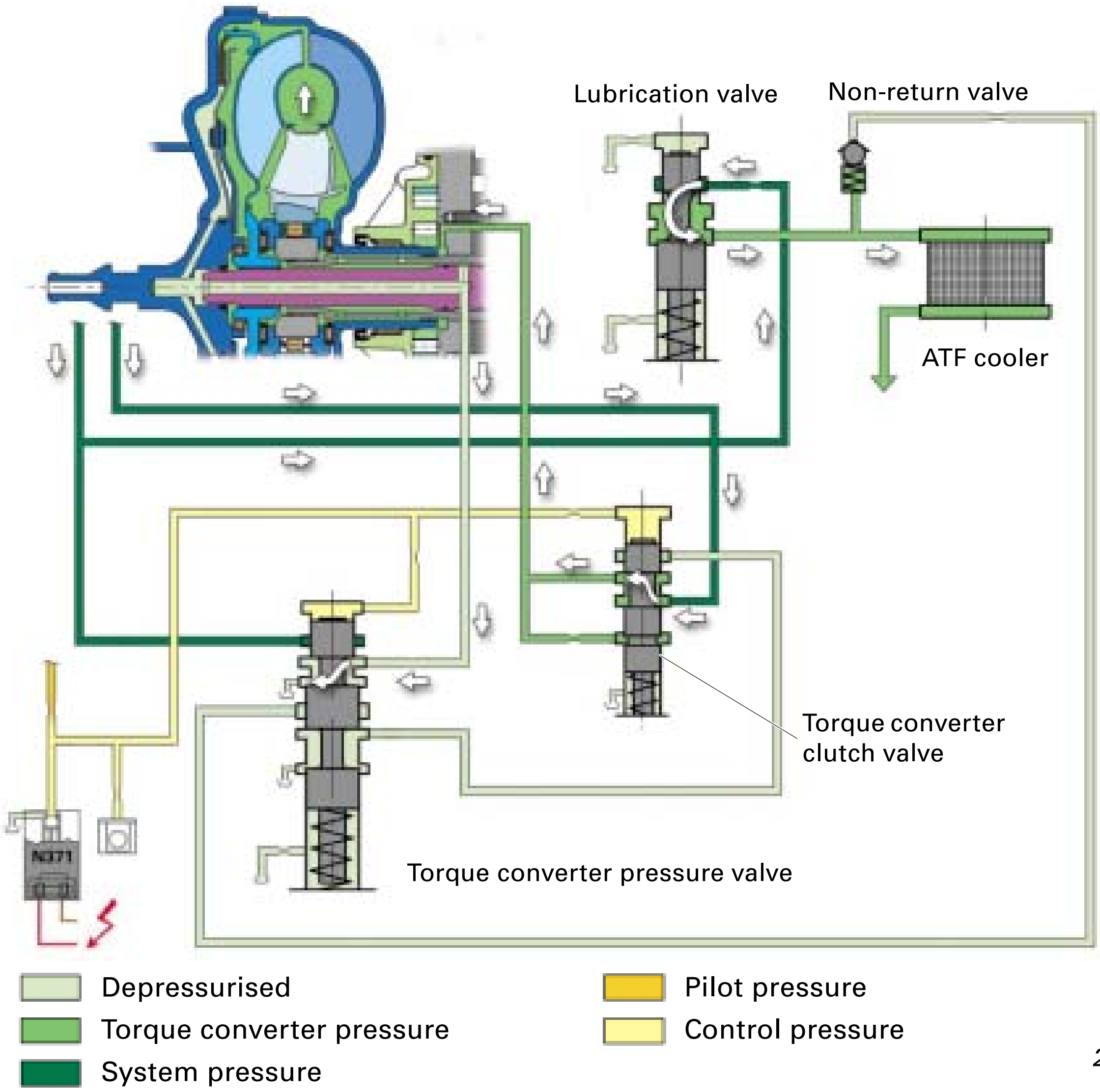
The following applies:
- Low N371 control current corresponds to low clutch torque
- High N371 control current produces a high clutch torque

Adequate attenuation is provided in TCC control mode for engine torsional vibration, thus obviating the need for additional torsion dampers.

Safety/substitute function in the event of failure:

On exceeding a certain TCC specified pressure (control current), use is made of transmission capacity curves to check whether there is a difference between turbine and engine speed. If this is the case, a fault is stored and the torque converter clutch no longer closed.

Fault display: None



283_101

ATF pump

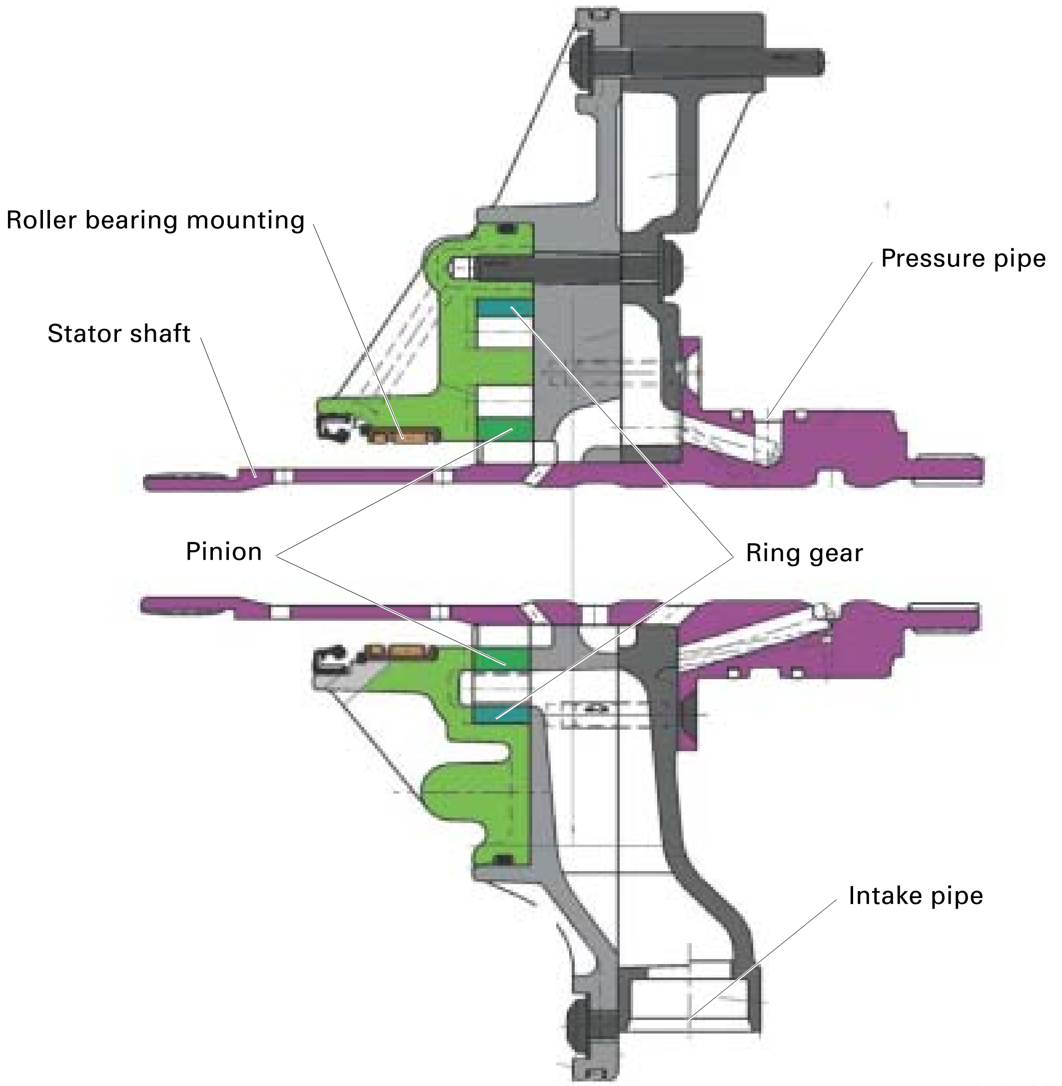
One of the most important components of an automatic gearbox is the oil pump.

An adequate oil supply is absolutely essential for proper operation.

The oil pump takes the form of an internally geared (crescent) pump.

Optimisation of the oil supply and the reduction of leakage throughout the entire hydraulic control system as well as in the gearbox meant that it was possible to have a lower oil pump delivery volume.

Both internal pump leakage and oil supply system losses were thus significantly reduced.



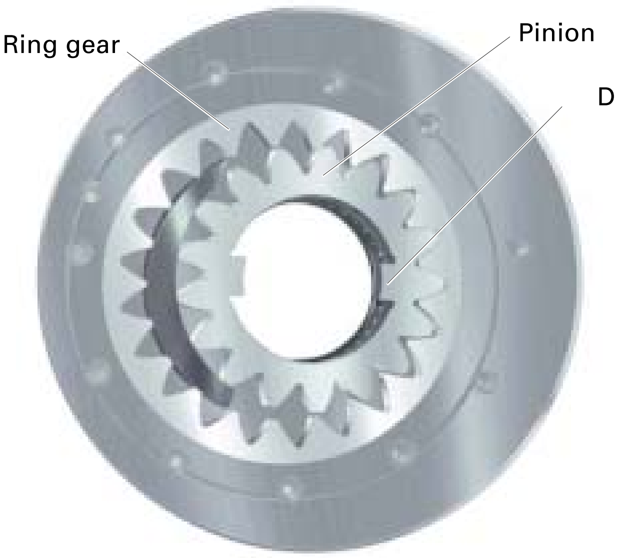
283_122

The oil pump is driven directly by the engine via the torque converter housing and hub. The mounting of the torque converter in the oil pump housing takes the form of a wear-resistant roller bearing.

The oil pump draws in the ATF through the filter and conveys the pressurised fluid into the hydraulic control unit, where the system pressure valve (Sys. Dr.V) regulates the required fluid pressure.

The surplus ATF is returned to the intake duct of the oil pump and the energy liberated used to charge the intake side. In addition to increasing efficiency, the noise level is reduced by avoiding cavitation.

Oil pump/gearbox end



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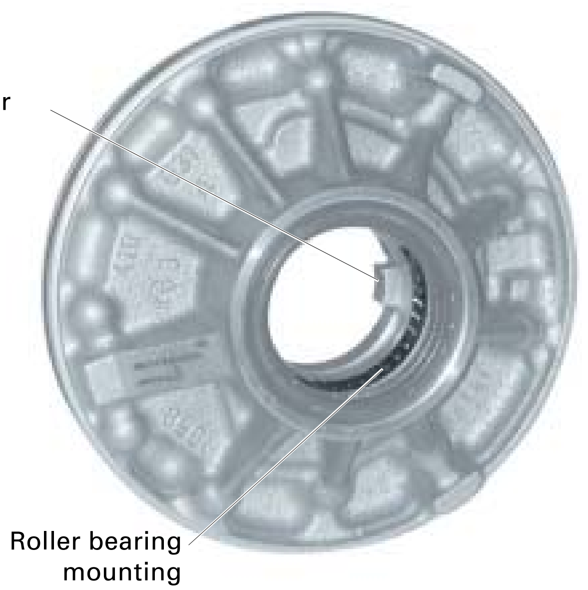
Oil pump/engine end



283_138

When installing the torque converter, particular care is to be taken to ensure that the oil pump drivers engage in the grooves of the converter hub (refer to Workshop Manual).

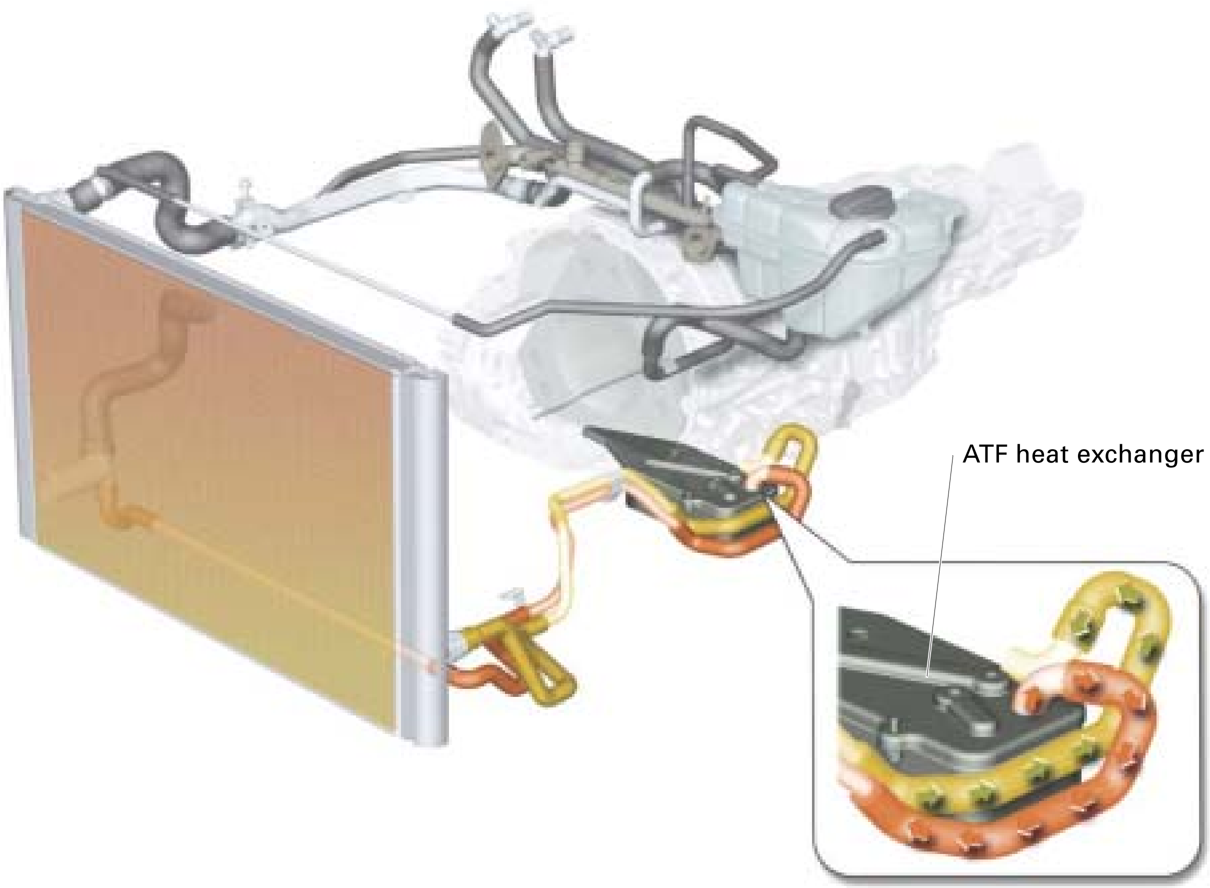
ATF cooling

The ATF is cooled by means of a coolant/oil heat exchanger flanged directly to the gearbox and incorporated into the engine cooling circuit.

Direct attachment of the ATF cooler to the gearbox permits more flexible adjustment of the cooling output. As there are no ATF pipes, this greatly reduces the number of possible sources of leakage.

The "closed system" facilitates filling with ATF and checking of the fluid level. Operations arising due to the disconnection of ATF pipes when removing and installing the gearbox no longer apply. The ingress of dirt into the gearbox is thus minimised.

The ATF cooler forms part of the scope of delivery of the gearbox. Cleaning of the cooler and oil pipes to remove contamination caused by gearbox damage is no longer necessary on replacing the gearbox.



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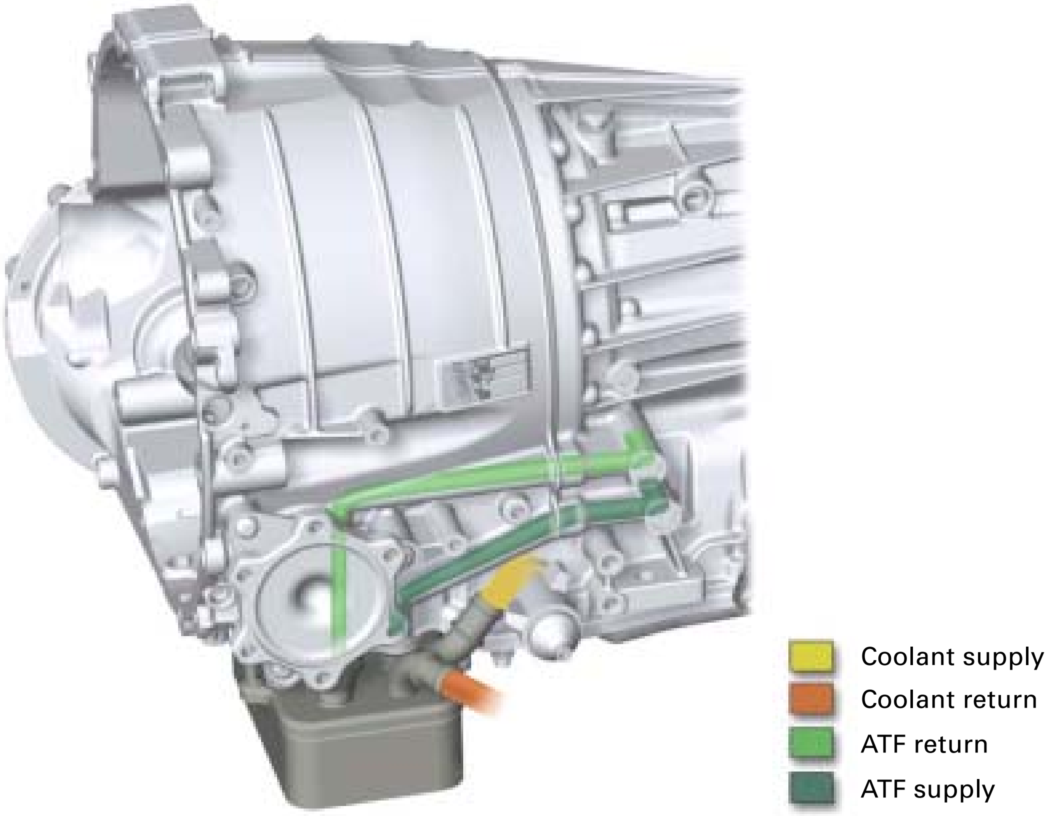

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283_081

283_082

A transportation safeguard is required to protect the ATF heat exchanger on account of its location on the underside of the gearbox.

The transportation safeguard is always to be used when handling and setting down the gearbox following removal.

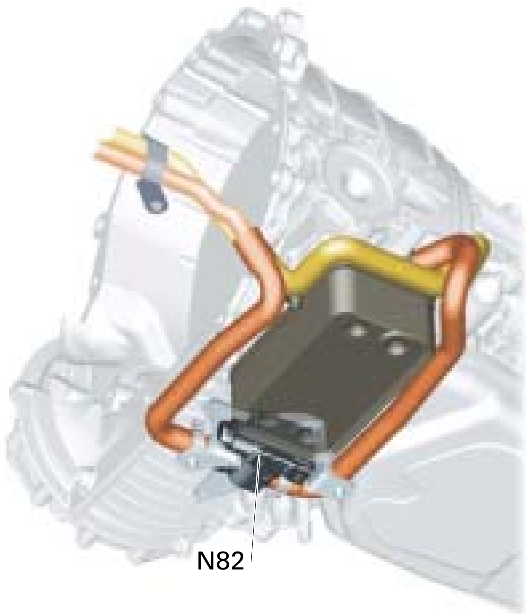
The gearbox is never to be set down on the ATF heat exchanger.

ATF cooling with shutoff valve

Use is made of the shutoff valve N82 to warm the engine more quickly after a cold start.

N82 is a rotary slide valve driven by an electric motor and actuated by the gearbox control unit J217 as a function of ATF temperature. Up to an ATF temperature of 80°C, the valve is closed and blocks the flow of coolant from the engine to the ATF heat exchanger. The engine heat is thus not dissipated to the ATF and the engine attains its operating temperature more quickly.

In addition to heating the engine more quickly, the use of N82 enhances the heat output after a cold start.



Installation location on V8 TDI

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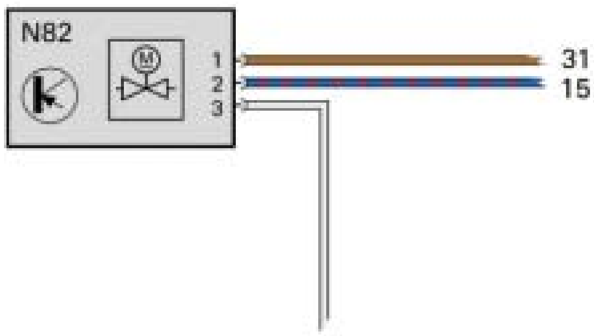
Operating settings:

<80°C	actuated (earth)	closed
>80°C	not actuated	open
<75°C	actuated (earth)	closed



PIN 8 on connector to gearbox

283_151

ATF cooling with the shutoff valve N82 is initially only available for the V8 4.0l TDI and W12 engines.

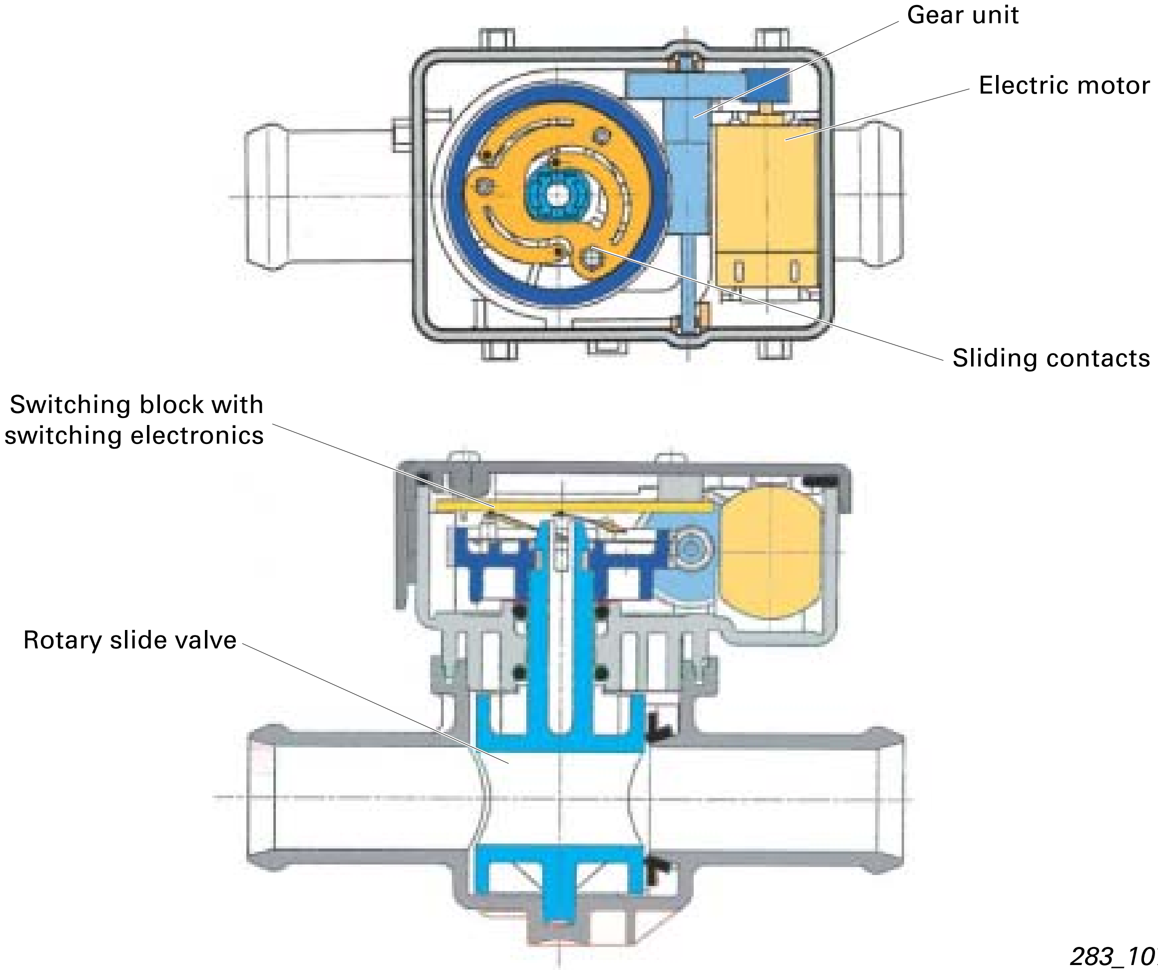
Design and operation

N82 is supplied with voltage by term. 15 and term. 31. Sliding contacts and a small switching block with integrated switching electronics control the electric motor, which turns the rotary slide valve by means of a small gear unit.

In the initial position (power being supplied, no actuation), the rotary slide is open. Application of earth to the signal input of N82 (pin 3) causes the motor (controlled by the sliding contacts and switching electronics) to turn the rotary slide through 90° into closed position.

If earth is no longer applied, the motor turns the rotary slide through a further 90°, returning it to open position. The rotary slide always moves by 90° in the same direction.

In the event of an open circuit in the signal wire, the shutoff valve remains open. ATF cooling is ensured should this fault occur. The shutoff valve is always closed in the event of short to earth. There is no ATF cooling and the gearbox overheats as a result.



283_107

The valve remains closed if the power supply fails during the warm-up phase (valve closed).
There is no ATF cooling and the gearbox overheats as a result.

Oil and lubrication system

The 09E has three separate oil systems. Separation between the ATF section for the front-axle drive/differential and the transfer case is achieved by way of double radial shaft seals. In the event of double radial shaft seal leakage, the oil escapes from the corresponding leakage oil bore. This rules out intermixing of the oils from the adjacent systems.

ATF has to meet with the highest requirements in terms of gearshift quality and reliability and has a crucial influence on the coefficient of friction of a clutch/brake.

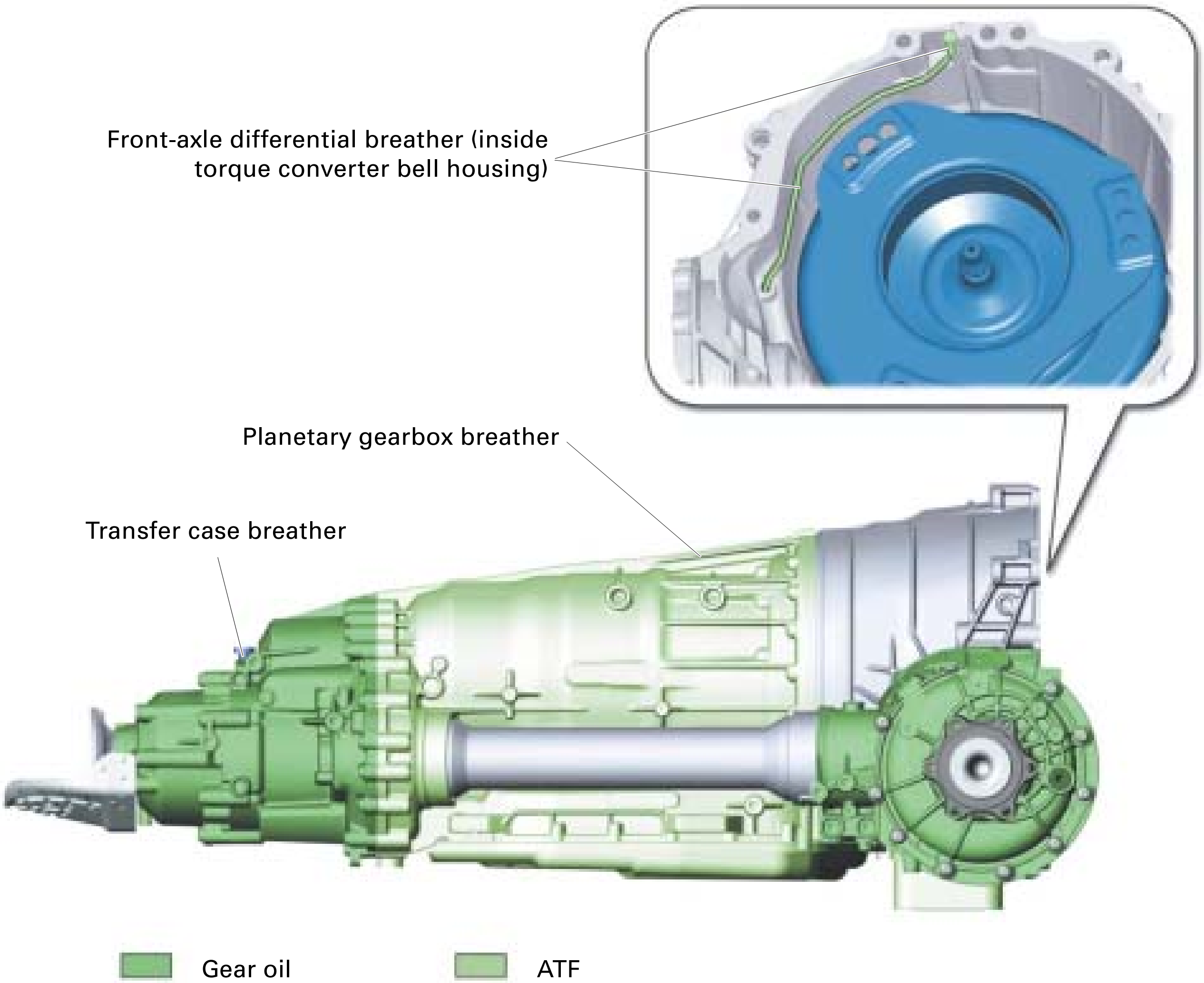
In addition to lining quality and friction materials, the following factors govern the coefficient of friction:

– Gear oil (grade, ageing, wear)

– Gear oil temperature

– Clutch temperature

– Clutch slip



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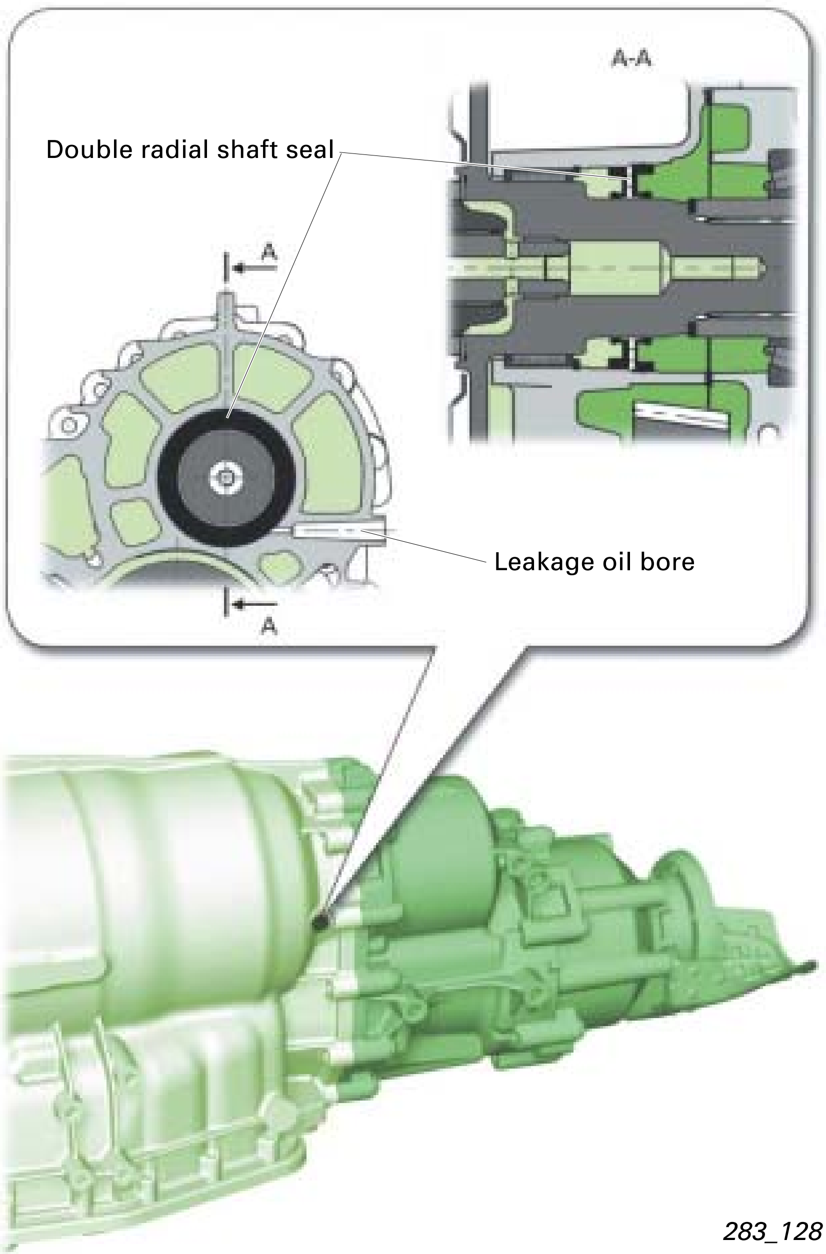
The effect of the ATF on the coefficient of friction of the clutches and brakes is incorporated into development at the design and trial stages.

It is thus logical that a special, improved ATF has been developed for the 09E.

Use of the prescribed ATF is therefore a prerequisite for proper operation.

The approved oils are designed to be a lifetime fill.

For further information on this topic, refer to Part 2 SSP 284, Page 14 "Monitoring of oil temperature population".



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Selector elements

The selector elements (clutches/brakes) are designed to implement power shift operations under load.

Thanks to the special configuration of the Lepelletier planetary gear train, shifting of the 6 forward gears and reverse gear only requires 5 selector elements.

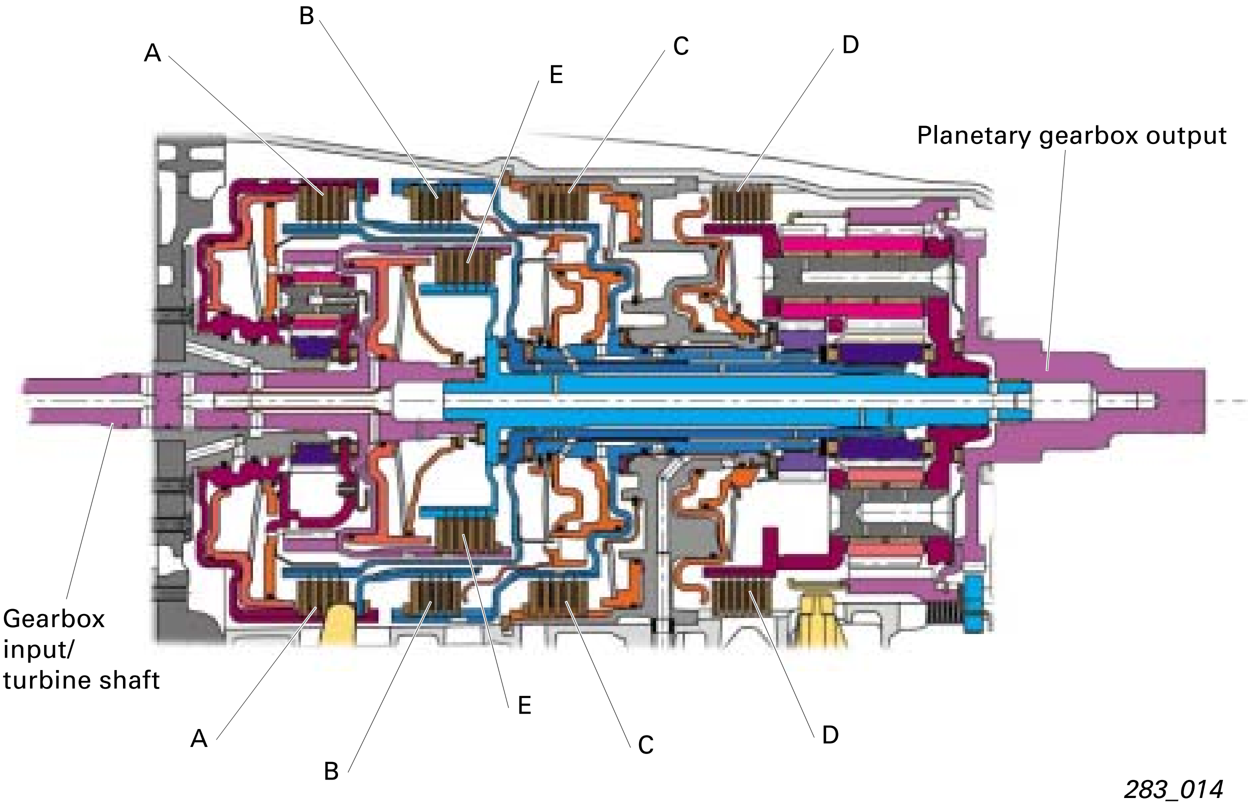
– Three rotary multi-plate clutches A, B and E

– Two fixed multi-disc brakes C and D

All selector elements are actuated indirectly by the solenoid pressure control valves (for further information refer to Part 2 SSP 284, Page 7 onwards).

The planetary gearbox has no free-wheel. Engine braking action is provided in all gears.

The multi-plate clutches A, B and E channel the engine torque into the planetary gearbox. In this process, the engine torque is supported at the gearbox housing by the multi-disc brakes C and D.



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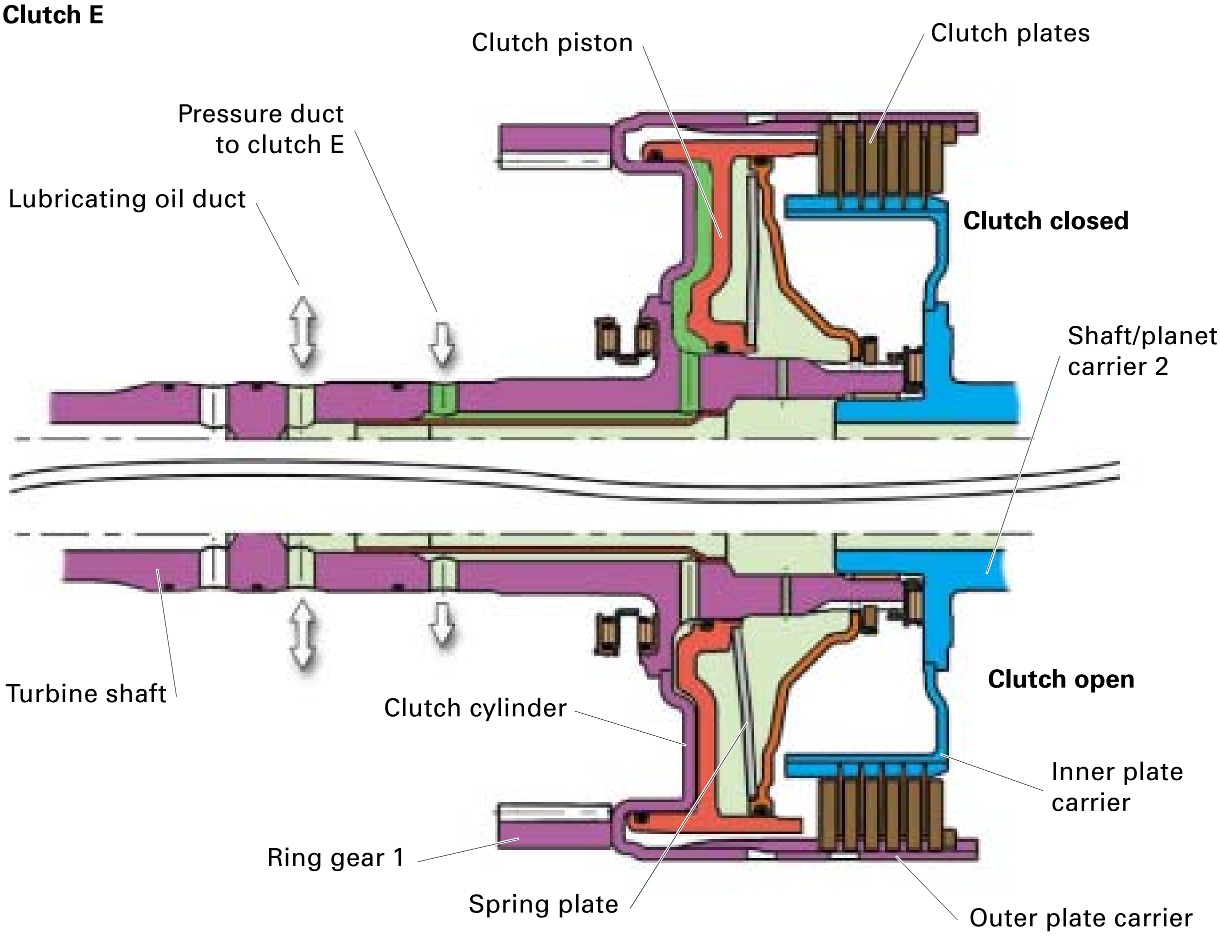
The selector elements are closed hydraulically. This is achieved by applying oil pressure to the cylinder of the appropriate clutch/brake, thus causing the piston to compress the set of plates/discs. As the oil pressure subsides, the spring plate resting on the piston forces the piston back into its initial position.

For optimum matching of gearbox efficiency to the engine, the number of clutch plates is adapted to the engine output, thus minimising the friction losses of open clutches.

Clutch E



283_123

Dynamic pressure equalisation

Due to the rotation at high speeds, the ATF in the clutch cylinder is subjected to considerable centrifugal force. This results in an increase in pressure in the clutch cylinder towards the largest radius. This is referred to as "dynamic pressure build-up".

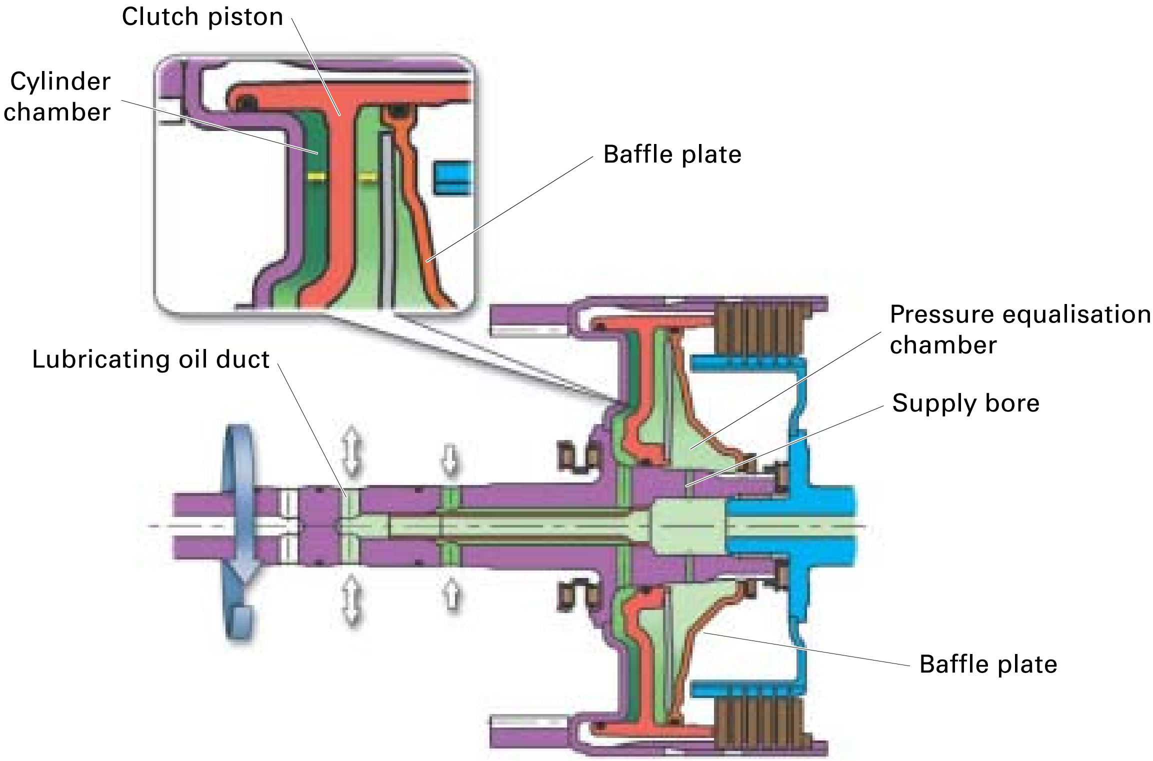
Dynamic pressure build-up is undesirable, as it increases the contact pressure unnecessarily and impedes defined pressure build-up and reduction in the clutch cylinder.

Clutches A, B and E feature pressure equalisation to ensure reliable opening and closing of the clutches in all speed ranges. The gearshift operation can thus be precisely regulated, considerably enhancing gearshift comfort.

Mode of operation taking multi-plate clutch E as an example

Oil is applied to both sides of the clutch piston. This is achieved by the baffle plate, which forms a sealed chamber with respect to the piston for dynamic pressure equalisation purposes. Only low pressure from the lubricating oil duct is applied to the pressure equalisation chamber.

The oil contained in the pressure equalisation chamber is subjected to the same forces (dynamic pressure build-up) as in the clutch cylinder, thus equalising the contact pressure of the clutch piston.



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