eSelf Study Program 950163

Front final drive 0D4

Audi Academy

Audi of America, LLC
Service Training
Created in the U.S.A.
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Course Number 950163

Always check Technical Bulletins and the latest electronic service repair literature for information that may supersede any information included in this booklet.

This eSelf Study Program teaches a basic knowledge of the design and functions of new models, new automotive components or technologies.

It is not a Repair Manual! All values given are intended as a guideline only.

For maintenance and repair work, always refer to the current technical literature.

Note

Reference

Front final drive 0D4

Front final drive 0D4 is being used in an Audi for the first time with the 2017 R8. It is a key component of the newly developed quattro powertrain for this vehicle.

The quattro powertrain of the Audi R8 has the ability to adapt drive output (depending on driving situation and weather) to driving conditions, and to transfer up to 100% of that output to the front or rear axle. This gives better driving dynamics and improves driving stability.

This distribution of drive torque or drive power is made possible by the electro-hydraulically operated all-wheel drive clutch in the final drive.

Audi drive select allows the driver to control the all-wheel drive clutch, and thus the distribution of torque and drive power between the front and rear axles.

In addition, the optional performance mode of Audi drive select enables the all-wheel drive control module to be adapted to "dry", "wet" and "snow" road conditions for the first time. This means that the driver can configure the all-wheel drive control module for extremely short reaction times.

Final drive 0D4, in conjunction with Audi drive select, 7-speed dual clutch transmission 0BZ (S tronic) and the high-performance 10-cylinder engines, enhances the Audi R8 driving experience in terms of power transmission.

642_001

Learning objectives of this eSelf -Study Program:

This eSelf-Study program provides you with information about front final drive 0D4. Once you have completed it you will be able to answer the following questions:

- How is front final drive 0D4 designed and how does it work?
- How do the software-assisted transmission functions influence operation of the final drive and the vehicle?

System description

Final drive 0D4 and the 7-speed dual clutch transmission 0BZ provide the basis for the quattro powertrain of the 2017 Audi R8.

The vehicle is primarily driven through the rear axle. The rear axle is able to transmit all available drive power, provided that a portion of the drive power is not transferred to the front axle through the all-wheel drive clutch in the front final drive.

To assist the active distribution of drive torque and drive power, the mechanical limited slip differential of the rear axle has been reconfigured.

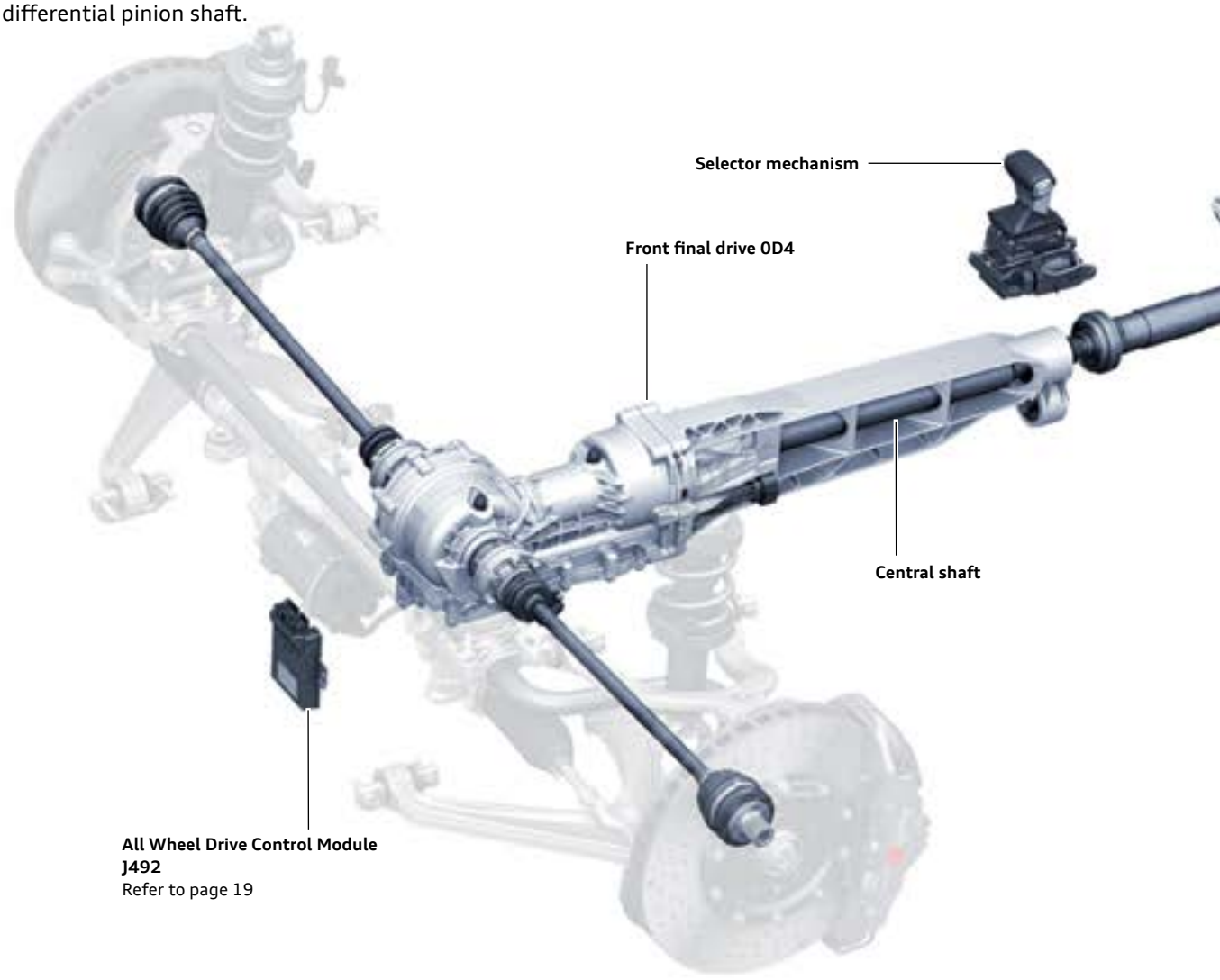
The drive power for the front axle is transferred through the transmission output shaft. The reduction ratio of the transmission output shaft is such that the circumferential speed of the front wheels is slightly higher than the circumferential speed of the rear wheels. This difference is referred to as "lead". Depending on the driving situation, it is the basis for the controlled transfer of up to 100% of drive torque (drive power) to the front axle. Refer to page 6.

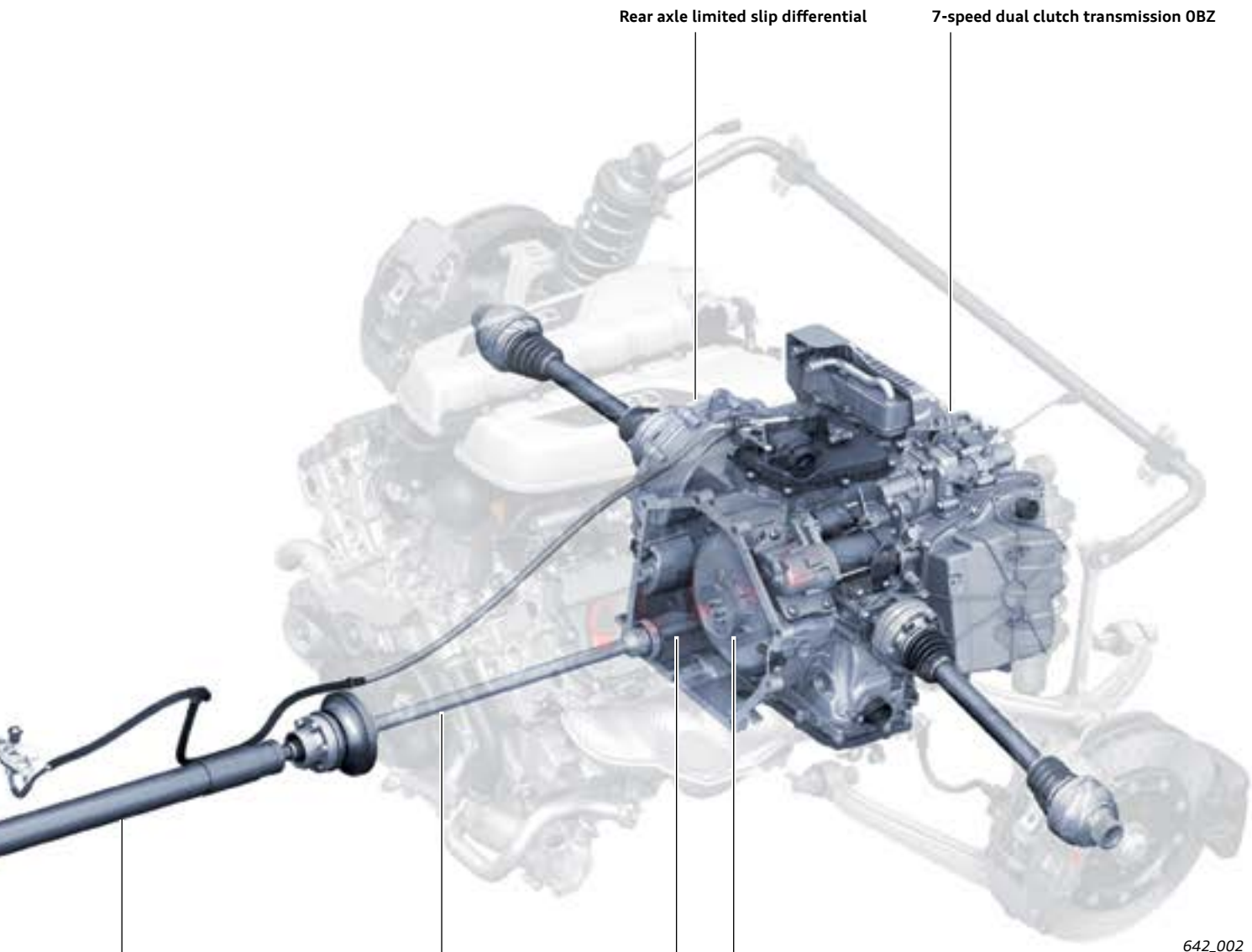
The all-wheel drive clutch of the newly developed front final drive gets the torque for driving the front axle from the transmission output shaft through the propeller shaft, the central shaft and the all-wheel drive clutch input shaft. At the same time, it transfers up to 406 lb ft (550 Nm) of torque to the differential pinion shaft.

In a complex process, the all-wheel drive control module decides how much torque is to be transferred. The torque to be transmitted by the all-wheel drive clutch is controlled by activation of the Haldex Clutch Pump V181. The all-wheel drive control module also factors in the coefficients of friction in the all-wheel drive clutch while making allowance for oil deterioration. The all-wheel drive control software and the programmed values for oil deterioration are stored in All Wheel Drive Control Module J492.

The Audi drive select modes and approximately 130 different signals - including signals for ambient conditions, axle load distribution, driver input, longitudinal acceleration, yaw rate, transverse acceleration, steering angle, vehicle speed, engine torque and gear ratio - are incorporated into the all-wheel drive control process.

The distribution of drive power to the front and rear axles has a significant influence on the traction, driving dynamics and driving stability of the Audi R8. The positive effect of the all-wheel drive clutch control module is explained on page 5.




Rear axle limited slip differential
7-speed dual clutch transmission 0BZ
642_002
Propeller shaft
Drive shaft
Transmission output shaft
› Front final drive input shaft
› PTO shaft (power take-off)
Spline for dual mass flywheel – transmission input

Distribution of drive power

The 10-cylinder engines of the Audi R8 have the ability to deliver between 398 - 413 lb ft (540 - 560 Nm) of peak torque to the transmission.

If the rear axle puts down its full drive power in 4th gear and at peak engine torque, approximately 2213 lb ft (3000 Nm) of torque is applied.

Irrespective of the engine torque and selected gear, the all-wheel drive clutch can transfer a portion of the available drive power in a controlled manner. In this way, up to 406 lb ft (550 Nm) of torque are transferred to the front differential pinion shaft. Refer to page 11. The reduction ratio of the differential produces up to 1106 lb ft (1500 Nm) of torque at the front axle.

The 1106 lb ft (1500 Nm) of torque at the front axle corresponds to approximately 45% of drive power in 4th gear and at full engine torque.

The extent to which the variable range of the all-wheel drive clutch can influence the distribution of drive power between the front and rear axles depends on the engine torque and the driveline ratios.

Depending on the engine torque and selected gear, up to 100% of drive power can be transferred to the front axle due to the front axle lead.

Front axle lead

The gear ratios of the driveline are such that the circumferential speed of the front wheels is slightly higher than the circumferential speed of the rear wheels. This configuration is referred to as "front axle lead". Due to this lead effect, wheel speeds are continuously compensated in the all-wheel drive clutch. The associated speed differential is the basis for exact clutch control. The clutch is operated with zero backlash. This permits very short reaction times during closing of the clutch.

Zero-backlash operation of the clutch results in a very small amount of drag torque. Refer to page 9.

The speed compensation effect and the drag torque resulting from the lead of the front axle produce frictional heat in the clutch. To dissipate the heat which is generated, the clutch and the final drive are cooled from the radiator. Refer to page 13 and page 17.

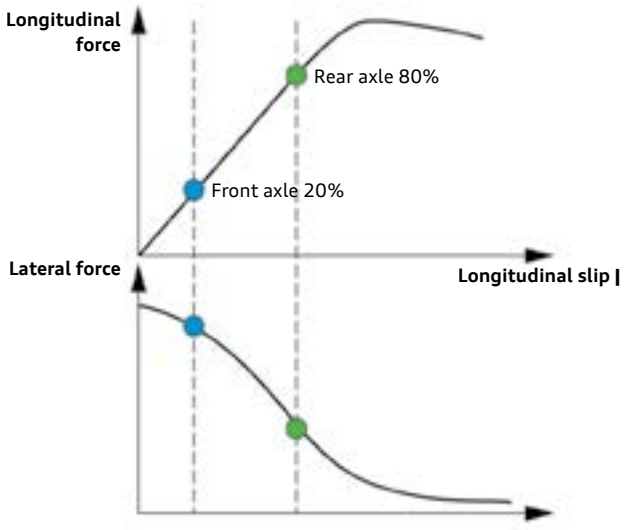
Depending on the engine torque and driveline ratios, the front axle lead also allows more than 50% of drive power to be transferred to the front axle, improving driving dynamics and driving stability. Reducing the longitudinal force on an axle allows the axle to absorb more lateral force.

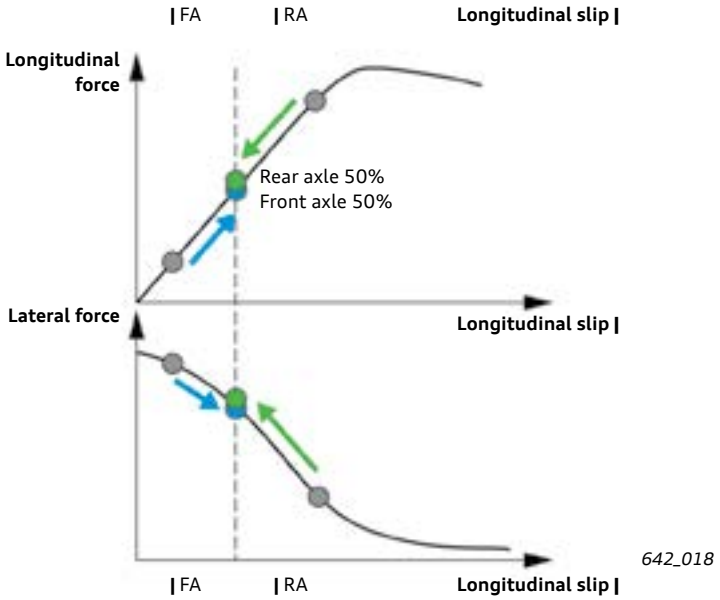
Initial scenario

This can be illustrated by an initial scenario where 20% of drive power is transmitted to the front axle and 80% to the rear axle in a controlled manner.

Conversely, the lateral force which can be transmitted by the front axle is proportionately greater than the lateral force which can be transmitted by the rear axle.

If the vehicle incurs critical oversteer in this situation, it can be stabilized by transferring drive power towards the front axle.



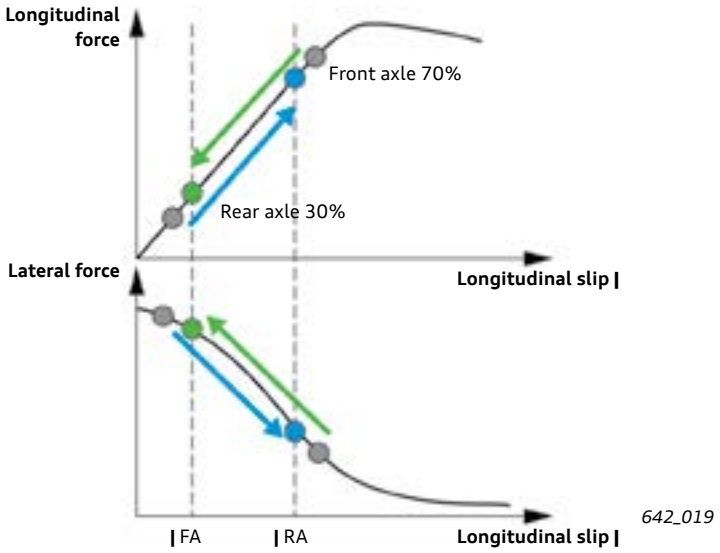


Stabilization without front axle lead

If a vehicle does not have front axle lead, that is, the front and rear wheels spin at the same circumferential speed, front axle drive power can be increased to a maximum of 50%, if necessary. If the rear axle transmits more torque (drive power) than the front axle, there is more slip at the rear wheels. Due to the greater amount of slip at the rear wheels, wheel speeds are compensated in the all-wheel drive clutch, allowing the torque of the all-wheel drive clutch to be increased further. This is possible until the front axle transmits the same amount of drive power as the rear axle.

Given that the front and rear wheels can have equal amounts of slip, wheel speeds are not compensated in the all-wheel drive clutch. It makes no sense to further increase the pressure on the multi-plate clutch with plates rotating at the same speed because it is not possible to transmit more torque to the front axle.

Equal amounts of lateral force can be transmitted to the front and rear axles. The lateral force which can be transmitted to the rear axle has increased compared to the initial scenario. This counteracts oversteer.



Stabilization with front axle lead

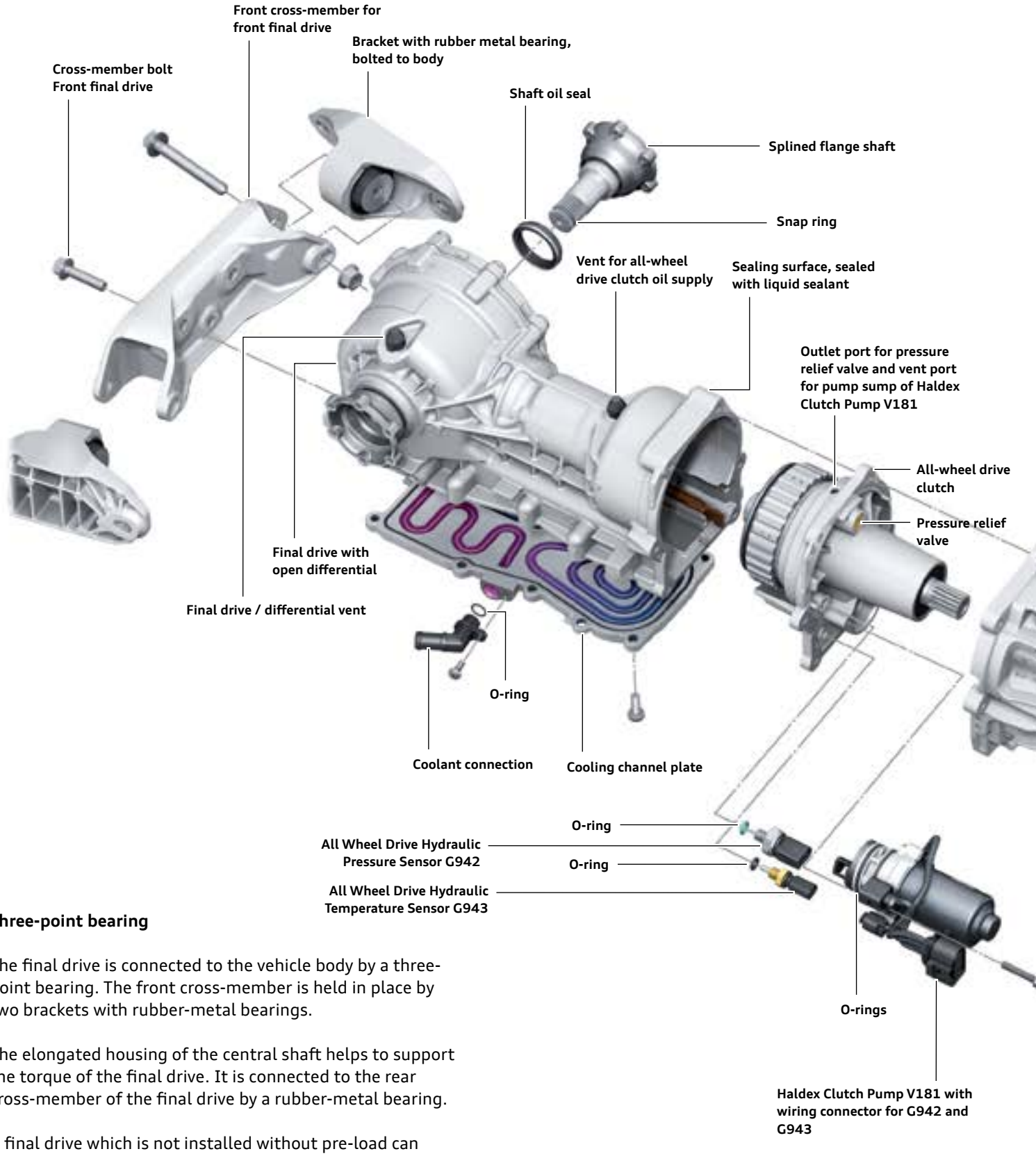
The lead of the front axle enables front axle drive power to be increased to over 50%. Due to the lead of the front axle, wheel speeds are compensated in the all-wheel drive clutch even if the drive power split is 50/50. This allows the amount of torque transferred to the front axle to be increased further.

Depending on the engine torque and gear ratio, up to 100% of drive torque (drive power) is available to the front axle.

The amount of lateral force which can be transmitted by the front axle is consequently less than the amount of lateral force which can be transmitted by the rear axle. If the vehicle incurs critical oversteer in this situation, it can be stabilized much more effectively than a vehicle without front axle lead.

Component overview

The component overview largely reflects the components which can be replaced during repair work.



Three-point bearing

The final drive is connected to the vehicle body by a three-point bearing. The front cross-member is held in place by two brackets with rubber-metal bearings.

The elongated housing of the central shaft helps to support the torque of the final drive. It is connected to the rear cross-member of the final drive by a rubber-metal bearing.

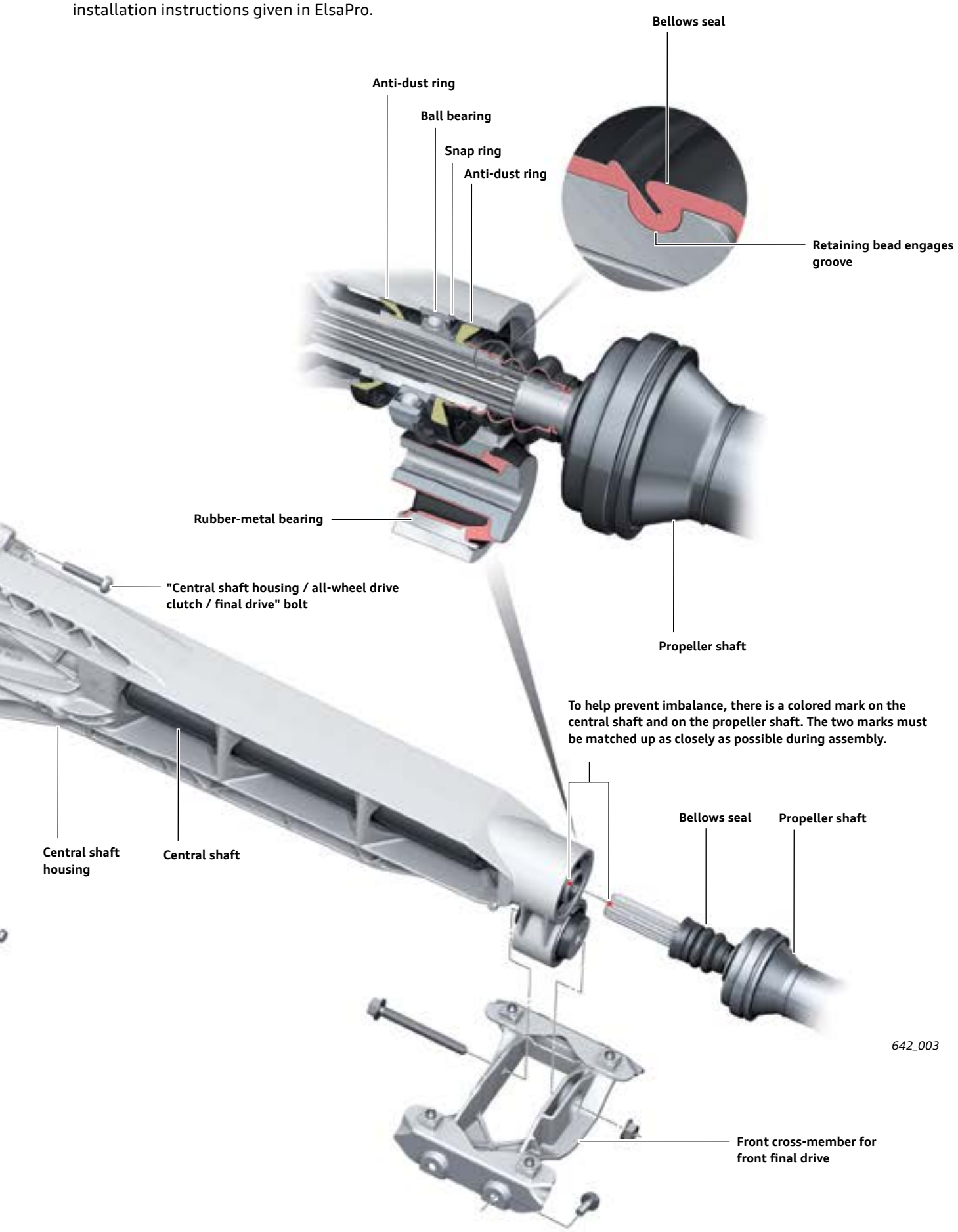
A final drive which is not installed without pre-load can cause vibration and noise. During repair work always refer to the instructions in ElsaPro.

Note

If the "central shaft housing / all-wheel drive clutch / final drive" bolt is removed, the seal between the final drive and the all-wheel drive clutch must be replaced with the liquid seal specified in the Electronic Parts Catalog (ETKA).

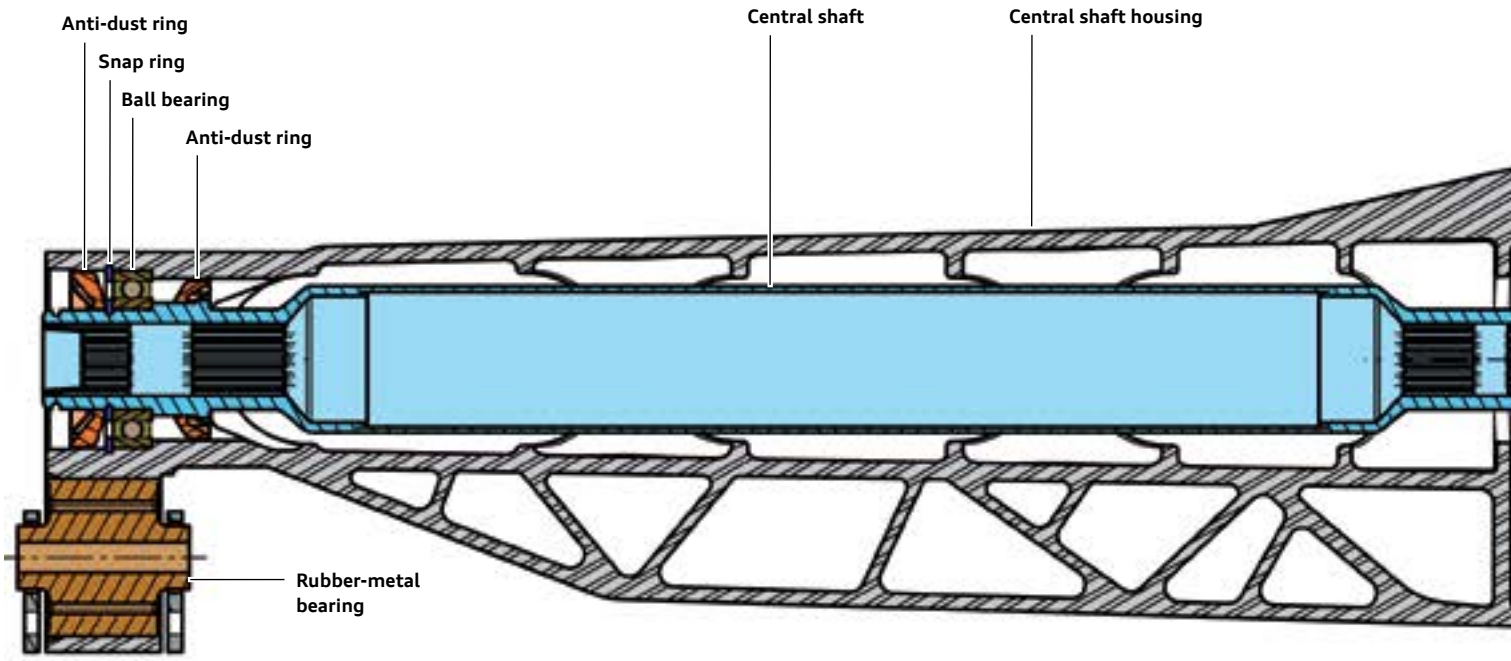
Installing the propeller shaft

The propeller shaft transmits drive torque to the central shaft by means of a spline. A bellows prevents the ingress of dirt and moisture into the spline. The bellows must be properly installed as shown in the diagram. Follow the installation instructions given in ElsaPro.



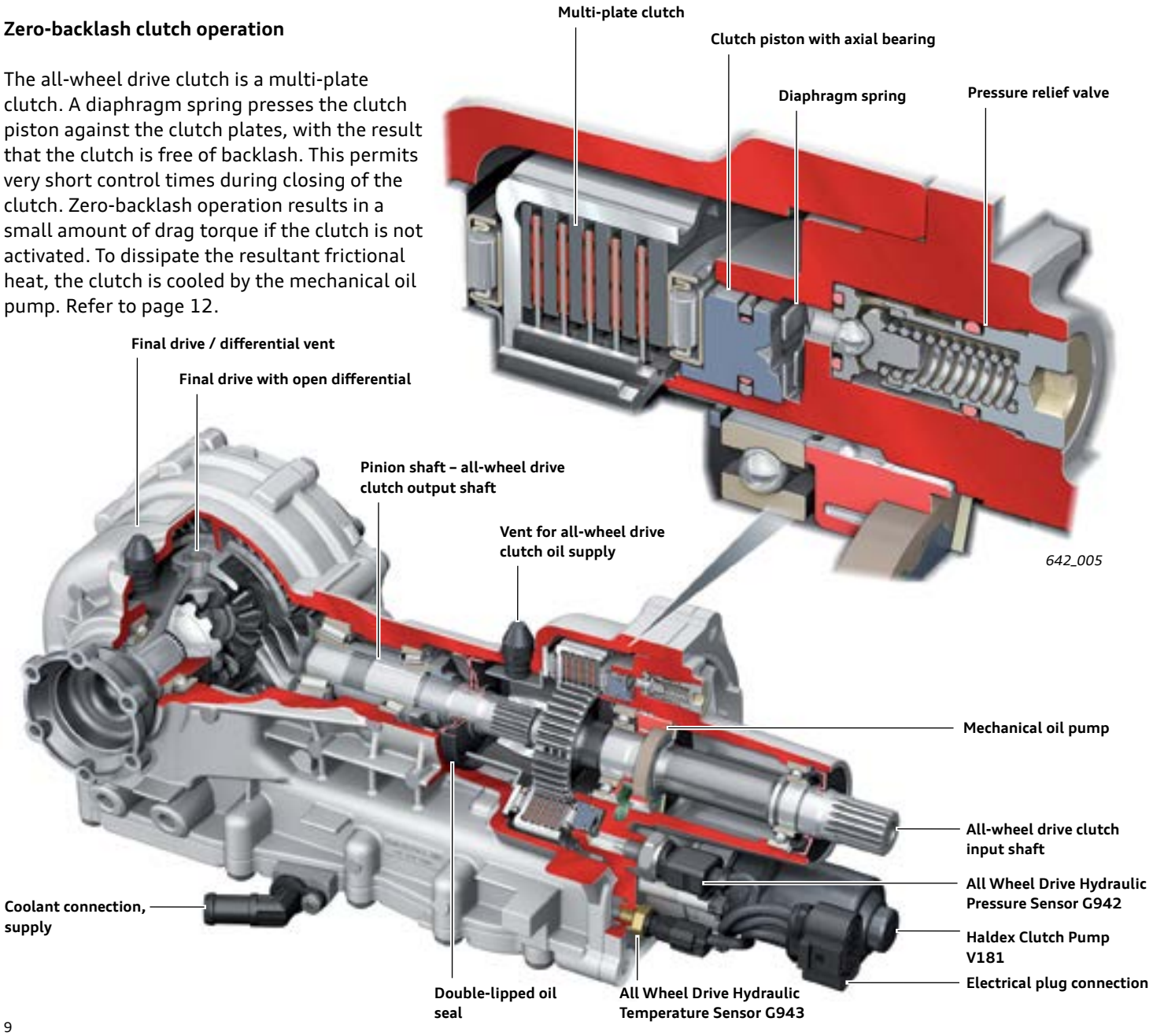
Cutaway view of transmission

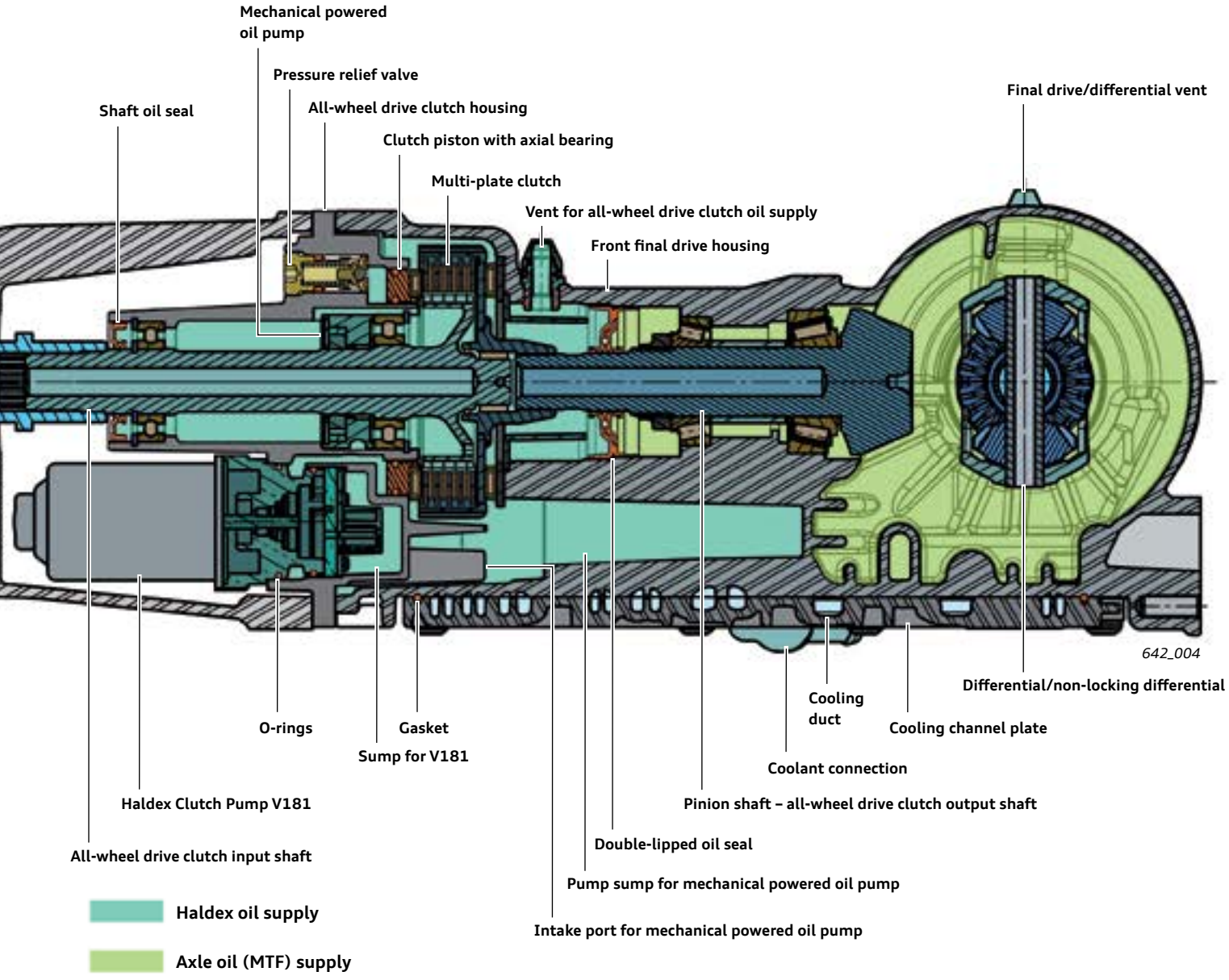
Longitudinal section A-A



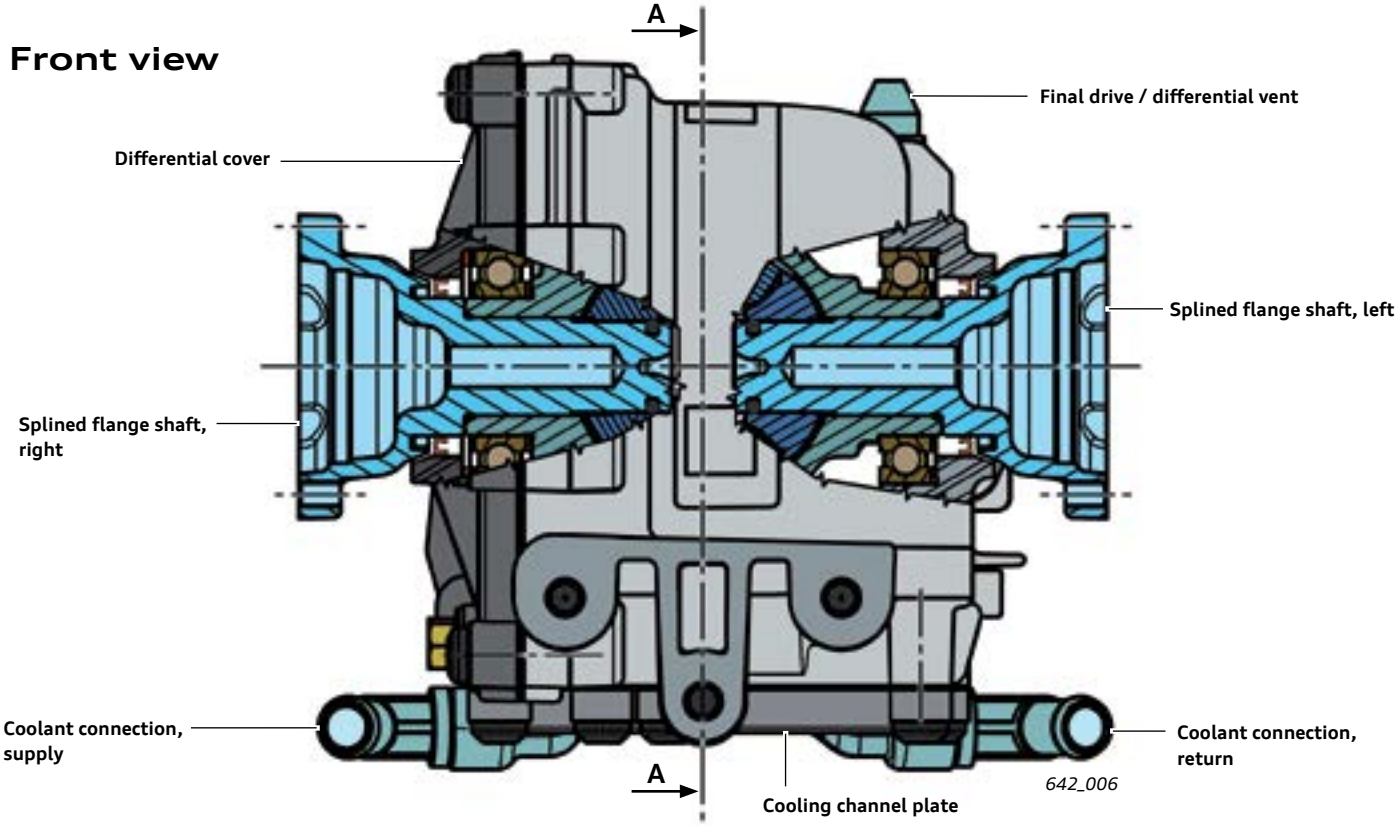
Zero-backlash clutch operation

The all-wheel drive clutch is a multi-plate clutch. A diaphragm spring presses the clutch piston against the clutch plates, with the result that the clutch is free of backlash. This permits very short control times during closing of the clutch. Zero-backlash operation results in a small amount of drag torque if the clutch is not activated. To dissipate the resultant frictional heat, the clutch is cooled by the mechanical oil pump. Refer to page 12.




Mechanical powered oil pump
Pressure relief valve
Shaft oil seal
All-wheel drive clutch housing
Clutch piston with axial bearing
Multi-plate clutch
Vent for all-wheel drive clutch oil supply
Front final drive housing
Final drive/differential vent
642_004
Differential/non-locking differential
Cooling duct
Cooling channel plate
O-rings
Gasket
Sump for V181
Coolant connection
Haldex Clutch Pump V181
Pinion shaft – all-wheel drive clutch output shaft
All-wheel drive clutch input shaft
Double-lipped oil seal
Pump sump for mechanical powered oil pump
Intake port for mechanical powered oil pump
Haldex oil supply
Axle oil (MTF) supply

Front view


A
Final drive / differential vent
Differential cover
Splined flange shaft, left
Splined flange shaft, right
Coolant connection, supply
Coolant connection, return
A
642_006
Cooling channel plate

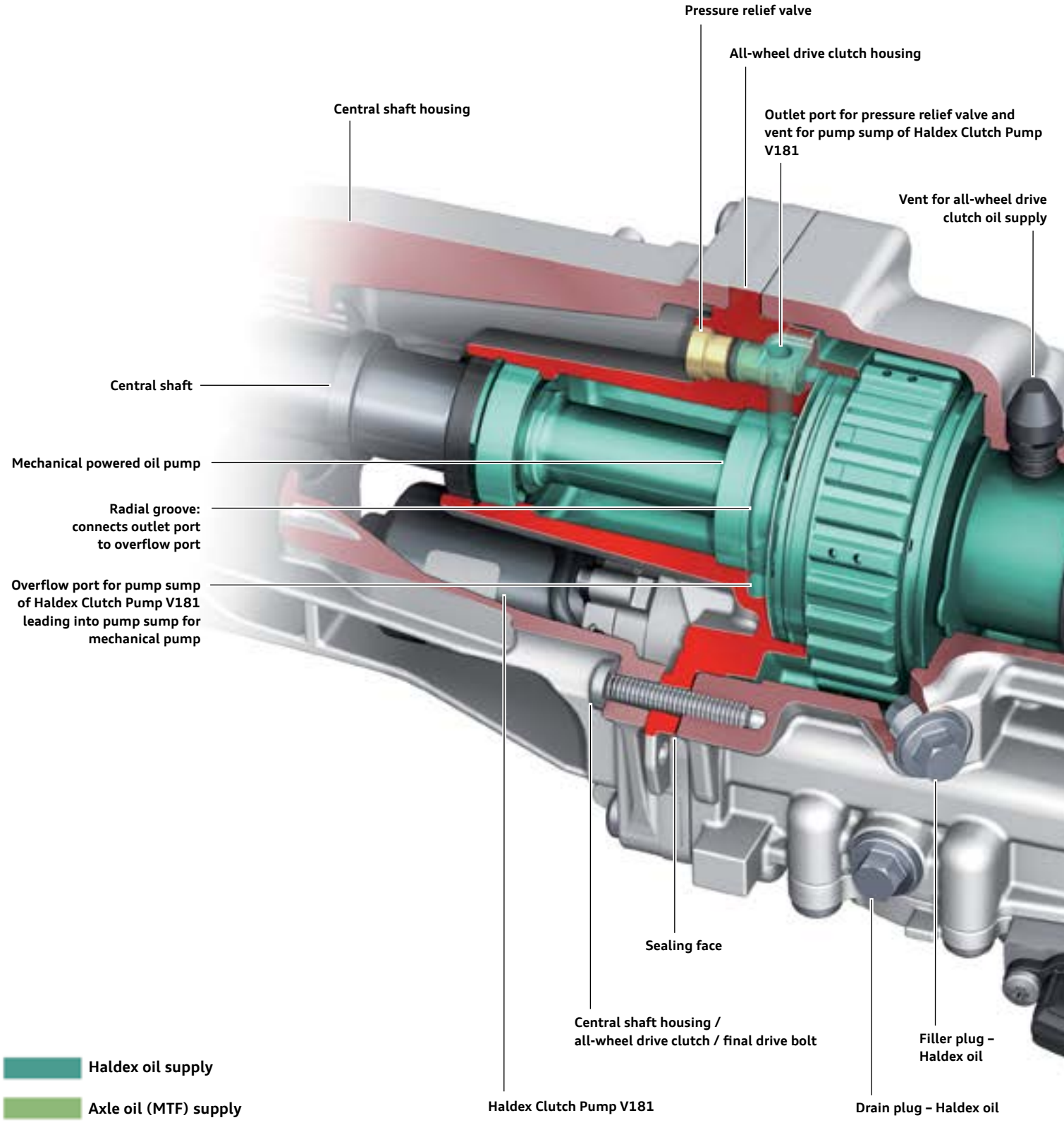
Oil supplies

Final drive 0D4 has two independent oil supplies with separate oil chambers: the axle oil supply and the Haldex oil supply.

Axle oil (MTF) supply

The oil chamber for the axle oil (MTF, Mechanical Transmission Fluid) is located in the front section of the final drive housing. A double-lipped oil seal defines the boundaries of this chamber and seals it off from the Haldex oil.

An oil drainage port stops oil flowing to the other side in the event of a leak. Refer to Fig. 642_007.



Haldex oil supply

The Haldex oil chamber is located in the rear section of the final drive housing. The boundaries of the oil chamber are defined by the all-wheel drive clutch housing. The sealing face between the all-wheel drive clutch housing and the front final drive housing is sealed with liquid sealant.

If the central shaft has to be removed for servicing, it is no longer possible to guarantee proper sealing between the all-wheel drive clutch and the front final drive housing due to the removal of the "central shaft housing / all-wheel drive clutch / final drive" bolt. In this case, the gasket must be replaced. Use the liquid sealant specified in the (ETKA) for this purpose.

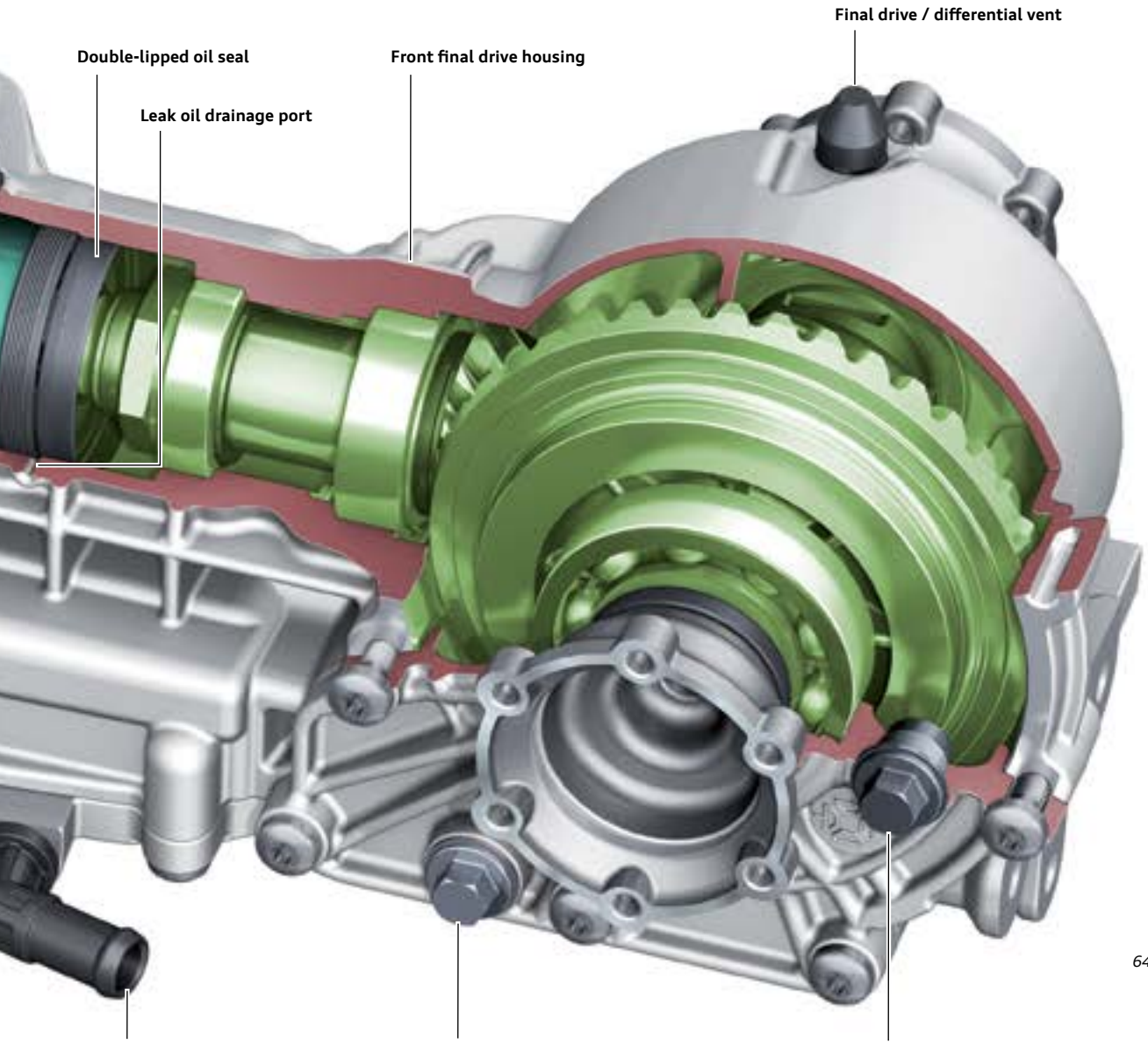
The Haldex oil chamber houses the intake chambers or pump sumps for the mechanical powered oil pump and Haldex Clutch Pump V181. The sump for the mechanical powered oil pump is integrated in the front final drive housing. The sump for the Haldex Clutch Pump V181 is integrated in the all-wheel drive housing. It is vented from the overflow port via the round groove which leads to the vent port and into the front final drive housing. For further information about the Haldex oil supply, refer to "Hydraulic diagram" on page 13.

Oil deterioration

Due to exposure to shear forces and high temperatures, the Haldex oil is subject to deterioration which affects friction levels within the all-wheel drive clutch. The friction levels are calculated values and are stored in the control module. They can be seen as “programmed values for oil deterioration” in the Measuring values using the VAS Scan Tool.

Changing the oil

Follow the instructions given in ElsaPro and on the VAS Scan Tool for checking and changing the oil in both supplies. Given that the drain, filler and inspection plugs of both oil supplies are positioned very close to one another, there is a possibility of error. Using the wrong oil will cause irreparable damage to the components. If you change the Haldex oil, the quantity of oil specified in ElsaPro and must be used. The bottom edge of the Haldex oil filler plug thread is not a check mark. The programmed values for oil deterioration (aging) must also be reset using the VAS Scan Tool. Refer to "Maintenance and change intervals" on page 26.



All-wheel drive clutch

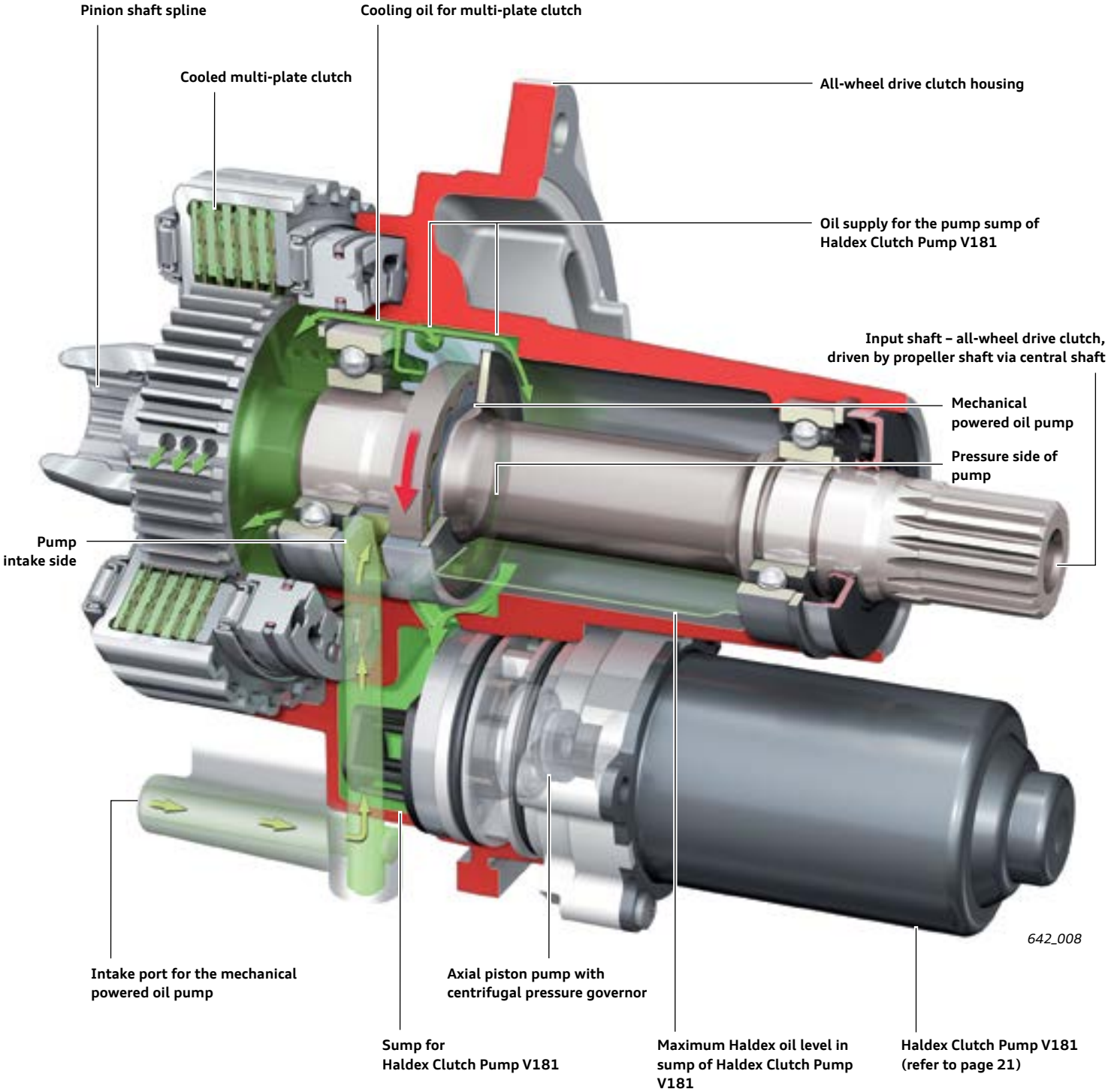
Oil supply, lubrication and clutch cooling

The all-wheel drive clutch is supplied by two pumps: a mechanically driven oil pump and the electrically controlled Haldex Clutch Pump V181.

Each pump has its own circuit with its own sump. The sump for the mechanical powered oil pump is integrated in the front final drive housing. The all-wheel drive clutch housing seals off the Haldex oil supply system. Refer to page 12.

The sump for Haldex Clutch Pump V181 is integrated in the all-wheel drive clutch housing. It is filled by the mechanical powered pump.

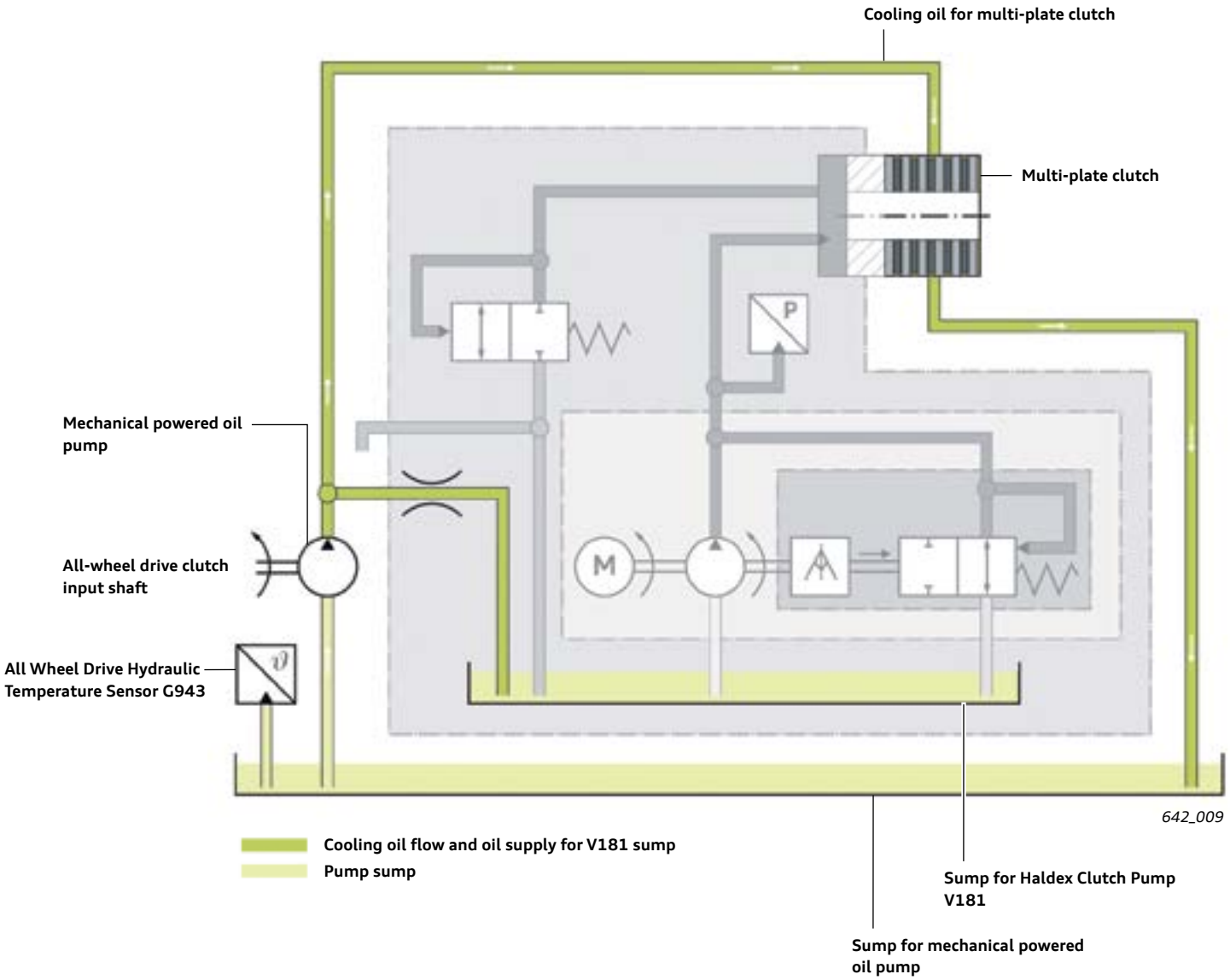
The circuit of the mechanical powered pump is continuously active during vehicle operation. The circuit of the Haldex Clutch Pump V181 is demand controlled by All Wheel Drive Control Module J492. In this case, the circuits operate in parallel.



Note

To fill the sump for Haldex Clutch Pump V181 after repairs, the removed final drive can be swivelled back as directed in ElsaPro after refilling the Haldex oil. An alternative is to drive the completed vehicle for approximately 1.2 m (2 km). The VAS Scan Tool also provides directions regarding this measure. When the vehicle is driven, the mechanical powered oil pump fills the sump up to the maximum Haldex oil level. Refer to Fig. 642_008.

Mechanically driven oil pump circuit



Mechanically driven oil pump

The mechanically driven oil pump is an internal gear pump. The pump starts to run when the vehicle begins to roll forwards.

The inner rotor of the pump interlocks with the all-wheel drive clutch input shaft. The all-wheel drive clutch input shaft is driven by the central shaft via the propeller shaft, the drive shaft and the output shaft of the transmission. Refer to page 3.

The task of the oil pump is to fill the sump for the Haldex Clutch Pump V181, as well as ensuring that the components are lubricated and supplying the multi-plate clutch with cooling oil.

Cooling is essential due to the frictional heat produced by zero-backlash operation of the clutch. Refer to page 9.

During initial operation of the final drive or if repair work is needed, it is important to make sure that the sump for the Haldex Clutch Pump V181 is filled. Refer to note on page 13.

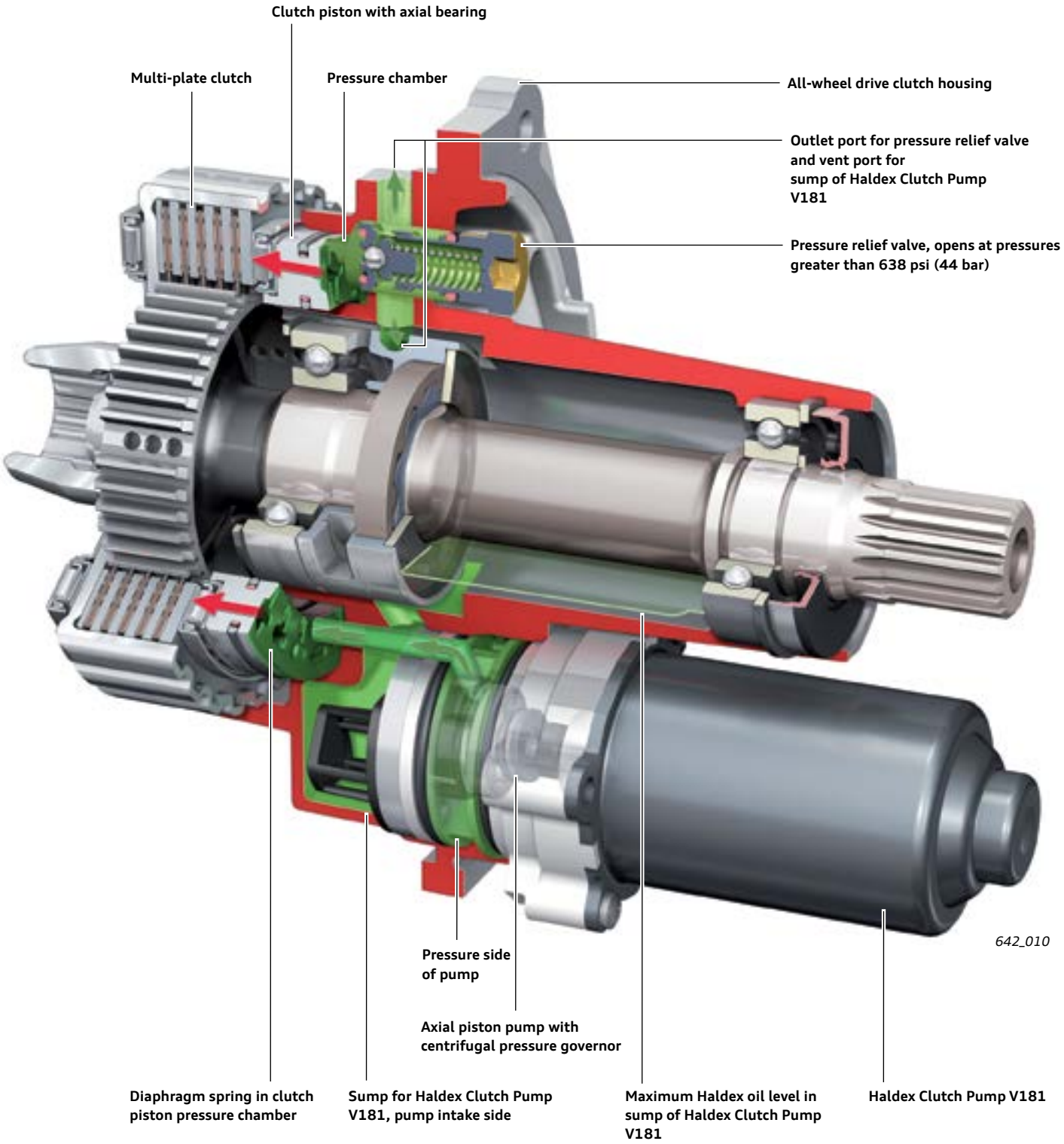
All Wheel Drive Hydraulic Temperature Sensor G943

For further information refer to page 20.

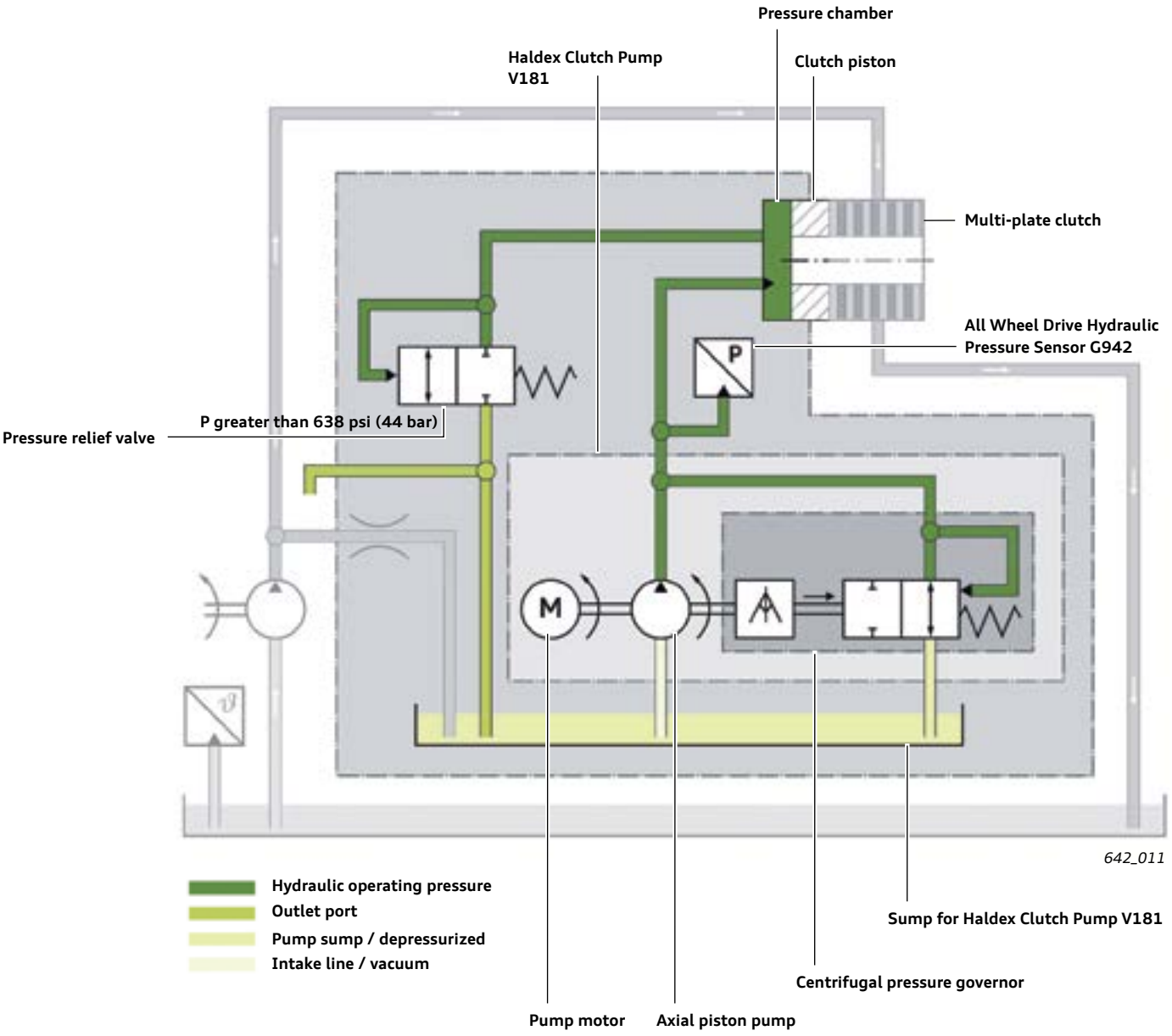
Clutch control

If Haldex Clutch Pump V181 is activated by the control module, oil from its sump is supplied to the clutch piston pressure chamber.

Zero-backlash operation of the clutch permits short reaction times during pressure build-up and, therefore, also during transmission of the desired amount of clutch torque. This ensures excellent driving dynamics.



Circuit of Haldex Clutch Pump V181



Haldex Clutch Pump V181

V181 produces hydraulic pressure in the all-wheel drive clutch. It consists of a pump motor and the axial piston pump with centrifugal pressure governor. The hydraulic pressure in the clutch piston pressure chamber is regulated by the centrifugal pressure governor based on the speed of the pump motor. The pump motor is controlled by All Wheel Drive Control Module J492.

The functional principle of V181 is identical to that of the fifth-generation Haldex clutch.

The circuit of the Haldex Clutch Pump V181 is highlighted in grey in Fig. 642_011.

All Wheel Drive Hydraulic Pressure Sensor G492

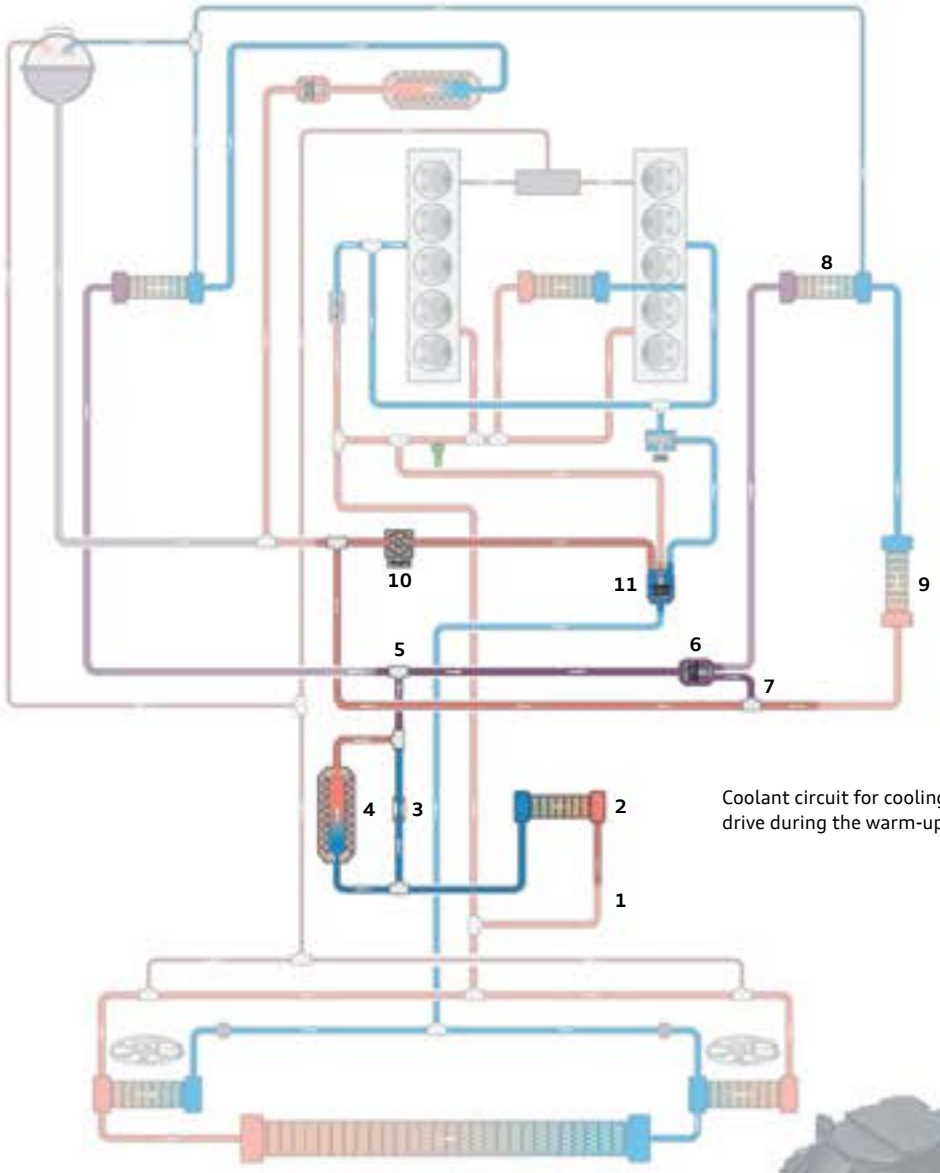
The pressure sensor measures the hydraulic pressure for the clutch piston and thus monitors the capacity of V181 indirectly. If the pump runs dry, it has no pumping capacity and is shut down for its protection. Refer to page 20.

Venting the pressure chamber:

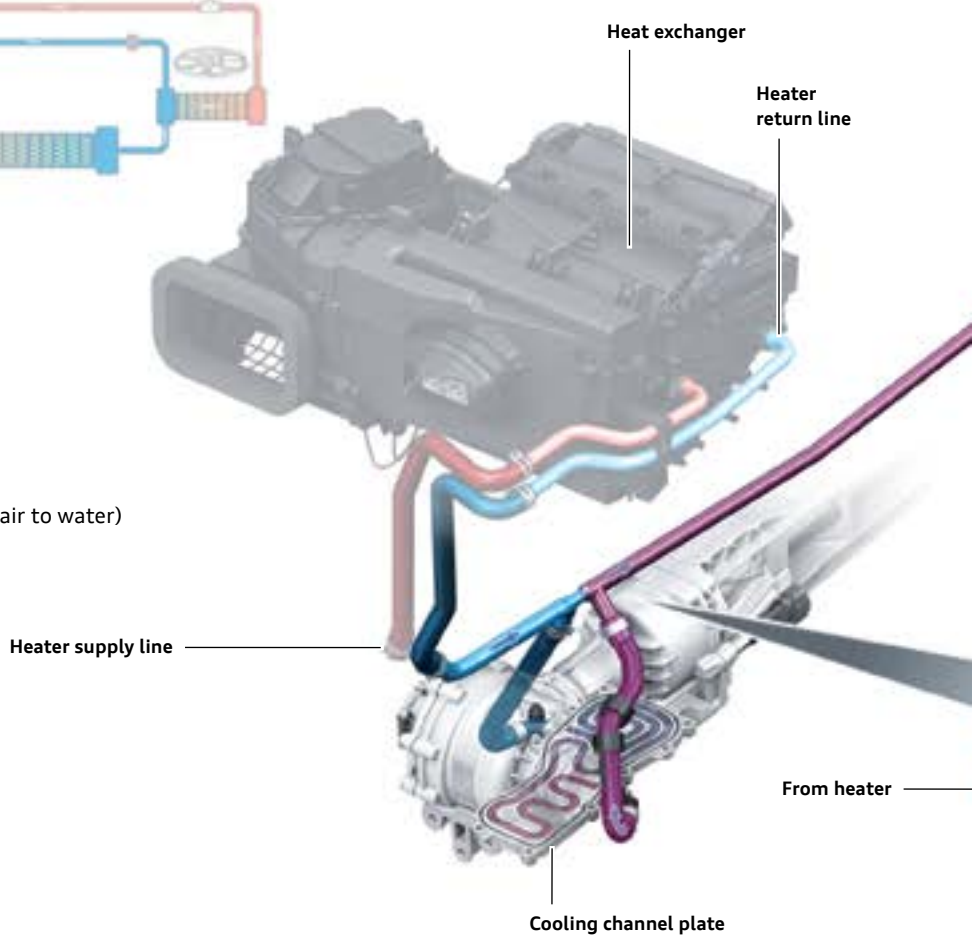
During initial operation of the final drive or if repair work is needed, it is important to make sure that the sump for the Haldex Clutch Pump V181 is filled. Refer to note on page 13. This prevents the pump from running dry. The clutch piston pressure chamber then needs to be vented using the "ventilation and hydraulic leak test" Test Plan using the VAS Scan Tool. Refer to page 25. This function allows V181 to build up a pressure of over 638 psi (44 bar) and vents the air in the pressure chamber through the pressure relief valve. Pump operation is clearly audible because the pump runs at maximum load during the ventilation phase.

Cooling

Cooling circuit



Coolant circuit for cooling the final drive during the warm-up phase



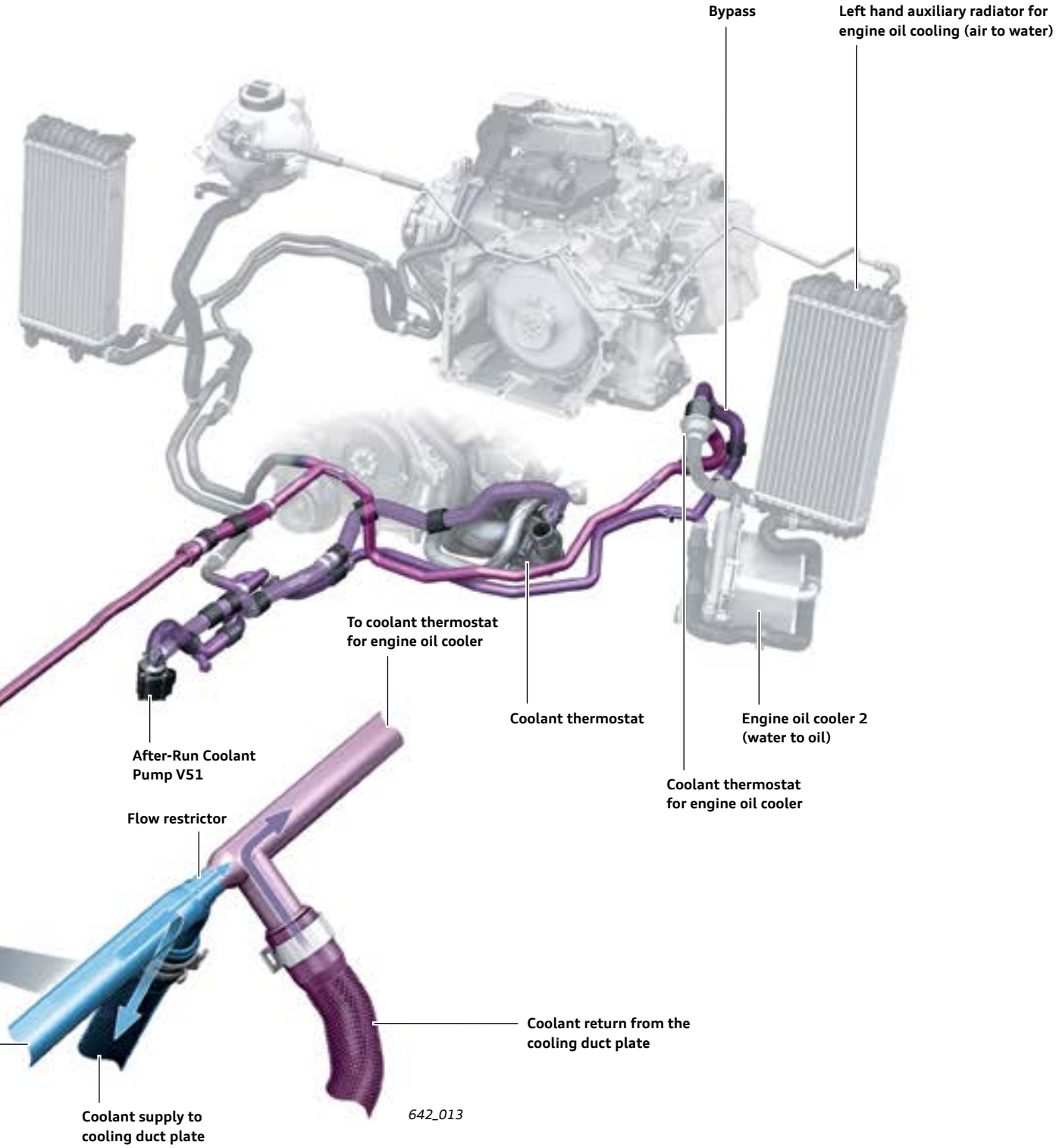
1 Heater supply line
2 Heat exchanger
3 Flow restrictor
4 Cooling duct plate
5 T piece
6 Coolant thermostat for engine oil cooler
7 Bypass
8 Left hand auxiliary radiator for engine oil cooling (air to water)
9 Engine oil cooler 2 (water to oil)
10 After-Run Coolant Pump V51
11 Coolant thermostat

To ensure that the all-wheel drive is fully functional in all driving situations and to counteract oil deterioration (refer to page 12), the frictional heat of the multi-plate clutch is dissipated through the cooling oil made available by the mechanically driven oil pump.

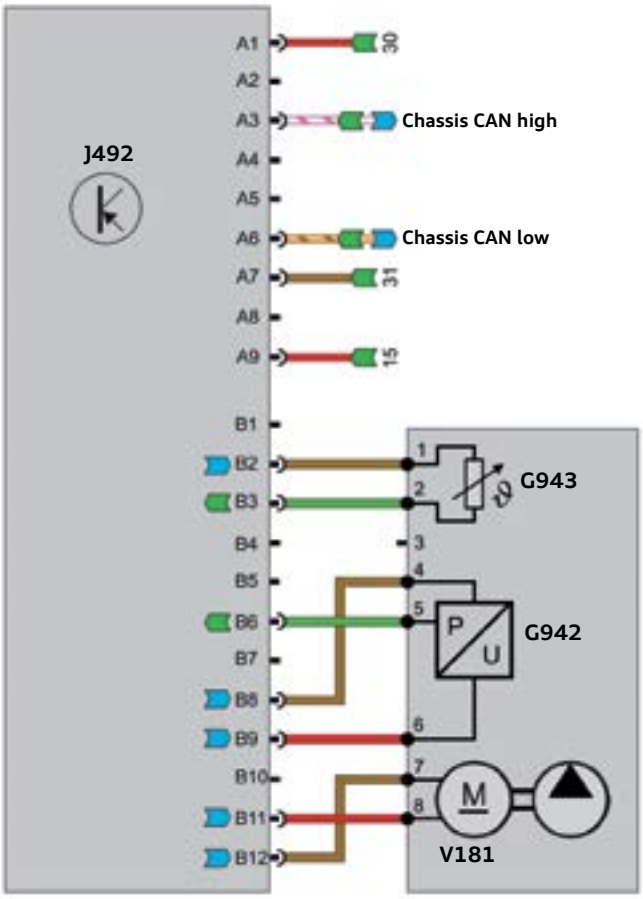
The cooling oil flows through the multi-plate clutch (refer to page 13, Fig. 642_008) and is discharged into the sump for the mechanical powered oil pump.

To cool the Haldex oil in the sump, coolant flows through the cooling duct plate from the return line of the heater circuit. The axle oil (MTF) supply is cooled in addition to the Haldex oil supply. A flow restrictor within the circuit ensures that sufficient coolant is diverted.

The cooling circuit on page 17 shows the path of the coolant for cooling the final drive directly after engine starting. Upwards of a temperature of 203 °F (95 °C) , the coolant thermostat for the engine oil cooler (6 on previous page) directs the coolant via the left hand auxiliary radiator for engine oil and engine oil cooler 2. In this case, coolant does not flow through the bypass branching off from coolant thermostat of the engine oil cooler.



Function diagram



642_014

Key:

Ground cable

Positive cable

Signal wire

G942 All Wheel Drive Hydraulic Pressure Sensor
G943 All Wheel Drive Hydraulic Temperature Sensor
J492 All Wheel Drive Control Module
V181 Haldex Clutch Pump

All Wheel Drive Control Module J492

J492 is located behind the luggage compartment tray adjacent to the vehicle battery.

A different control module version is required for each engine version. Its software is adapted at the factory on the basis of engine power parameters. The control module and the programming values are assigned to the vehicle based on the vehicle identification number. When the control module is replaced, it is important to follow the instructions given by the VAS Scan Tool Test Plan. The Test Plan includes all steps to be performed.

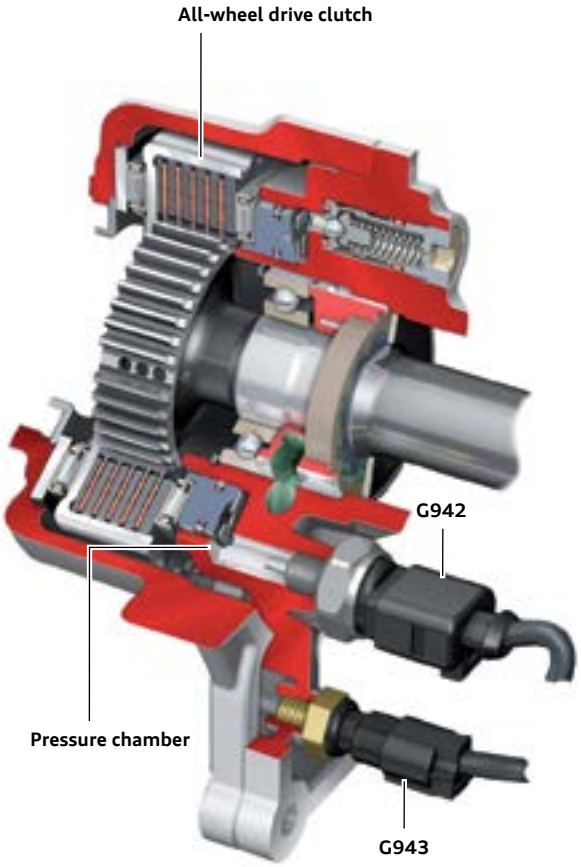
642_020

Diagnosis:

- The electrical wiring is checked for open circuit as well as for short circuit to ground and positive.
- Data exchange across the CAN bus is monitored.
- The parameters for adaptation to engine power output are checked.
- The VIN can be checked for plausibility. If the All Wheel Drive Control Module or Vehicle Electrical System Control Module are switched between vehicles for diagnostic purposes and not programmed, a DTC will be registered.
- The main processor of the control module is diagnosed.
- The temperature of the control module is monitored.
- The wheel speed signals are checked for plausibility. If the driver adopts a highly dynamic driving style, it can trigger a sporadic DTC when on wet or icy road surfaces that afford very little friction.
- The all-wheel drive clutch function is checked for plausibility. If the Haldex Clutch Pump V181 is activated, a pressure must be measurable inside the pressure chamber and torque must be transmitted.
- The temperature of the clutch plates is calculated based on the measurement of All Wheel Drive Hydraulic Temperature Sensor G943. If a default value is exceeded as a result of high power demand, a message is displayed in the instrument cluster and, in accordance with a limp-home concept, the all-wheel drive clutch is not activated until the Haldex oil has cooled down.

Sensors and actuators

The pressure and temperature sensors of the Haldex unit allow highly precise control while extending the diagnostic options and improving component protection.



642_021

All Wheel Drive Hydraulic Pressure Sensor G942

G942 measures the hydraulic pressure in the pressure chamber of the clutch piston. The measured value is used to control the clutch and to help determine the deterioration of the oil. The measured value also helps protect the Haldex Clutch Pump V181 from running dry. If no pressure is measurable when V181 is activated, DTC is registered and the pump stops running. A corresponding message is displayed in the instrument cluster. The pumping capacity of the pump must be checked after repairs are made.

If the hydraulic pressure sensor is replaced, the offset value stored in J492 for the old pressure sensor must be deleted using the Basic Settings function of the VAS Scan Tool.

Diagnosis:

- The electrical wiring is checked for open circuit as well as for short circuit to ground and positive.
- Plausibility criterion: When the Haldex Clutch Pump V181 is activated, a pressure must be measurable inside the pressure chamber.

Substitute signal:

- There is no substitute signal, refer to "Limp-home concept" on page 26.

All Wheel Drive Hydraulic Temperature Sensor G943

G943 measures the temperature of the Haldex oil in the sump of the mechanical powered pump. The measured value is used to determine the deterioration of the oil and helps prevent the clutch from overheating.

Diagnosis:

- The electrical wiring is checked for open circuit as well as for short circuit to ground and positive.
- Plausibility criterion: if the temperature of the Haldex oil exceeds the limit, the all-wheel drive clutch is not activated further.

Substitute signal:

- There is no substitute signal, refer to “Limp-home concept” on page 26.

Haldex Clutch Pump V181

V181 produces hydraulic pressure in the all-wheel drive clutch. Refer to page 16. The wiring harness for V181 also houses the wiring for G492 and G493.

Diagnosis:

- The electrical wiring is checked for open circuit as well as for short circuit to ground and positive.
- Plausibility criterion: when V181 is activated, a pressure must be measurable inside the pressure chamber.

Output check: refer to page 25.

- "All-wheel drive clutch function test"
- "Ventilation and hydraulic leak test"

Checking the pumping capacity of the pump:

- Is the sump for Haldex Clutch Pump V181 filled? Refer to notes on page 13
- Perform "all-wheel drive clutch function test".
- Perform "ventilation and hydraulic leak test" and check final drive for leaks (visual inspection).

Haldex Clutch Pump V181 with wiring for G942 and G943

642_022

Audi drive select

The driver can use the Audi drive select button to select between the "comfort", "auto", "dynamic" and "individual" modes. These modes influence the all-wheel drive control setup with respect to the distribution of drive power between the front and rear axles.

The Performance button sets the "performance" mode and selects the last active setup (last mode), that is, snow, wet or dry. Setups can be selected using the adjustment ring. In snow, wet and dry modes the pre-control values for road surface friction are set to within narrower bounds. The all-wheel drive control module, which continuously measures the friction coefficients of the road surface, is able to react more quickly and with greater precision thanks to more specific pre-control values. This improves vehicle handling on dry, wet and snow-covered roads and provides more sporty driving dynamics.

All-wheel drive control setups available using Audi drive select

Comfort

In Comfort mode the distribution of drive power is front axle-orientated. Cornering behavior is neutral tending to slight understeer at the limits of dynamic performance.

Auto

In Auto mode drive power is evenly distributed between the front and rear axles. Handling is neutral during cornering.

Dynamic

In Dynamic mode the distribution of drive power is rear-orientated. Handling is more sporty and cornering behavior is neutral tending to slight oversteer at the limits of dynamic performance.

Individual

In Individual mode the driver can choose transmission and all-wheel drive setups independently of other vehicle systems.

Performance

In Performance mode drive power is evenly distributed between the front and rear axles, as is the case in “auto” mode.

Audi drive select button

Performance button with adjusting ring for selecting the snow, wet and dry modes

642_025

Note
Activating the Performance mode limits the range of the ESC and TCS stabilization functions. Only activate Performance mode if you have the necessary driving skills and the traffic conditions permit.

Reference
For further information about Audi drive select and how the performance of the Audi R8, refer to the Owner's Manual.

Operating situations

Certain operating situations affect all-wheel drive control. The main operating situations are set out below and explained in the following table.

Launch control program

The Launch Control Program enables and regulates the maximum acceleration of the vehicle from a standing start. The all-wheel drive clutch delivers the maximum possible amount of torque for the front axle. Refer to the Owner's Manual for operating instructions and other information.

Torque vectoring

Torque vectoring is a software function of the ESC control module. During cornering at high speeds, the ESC control module determines the reduced load on the wheels on the inside of the curve and the increased load on the wheels on the outside of the curve.

Controlled braking intervention builds up stabilizing torque at the wheels under increased load on the outside of the curve, allowing more drive power to be transmitted from the wheels under reduced load on the outside of the curve. In addition to providing a dynamic axle load distribution, torque vectoring affects the maximum amount of drive power which can be transmitted by the front axle and therefore is incorporated into the all-wheel drive control process.

This table summarizes the torque requirements and the states of the all-wheel drive clutch for each of the listed operating situations.

Operating situations	Required front axle torque	State of all-wheel drive clutch	Speed differential between front and rear axles
Acceleration, kickdown, Launch Control Program	high	up to maximum torque / maximum pressure	low because clutch is closed to maximize traction
Fast driving	depending on driving situation	depending on driving situation	dynamic driving style: low because the clutch is closed conservative driving style: medium, resulting primarily from the axle ratios
Driving on a slippery surface	depending on driving situation	depending on driving situation	depending on driving situation, tending to low to achieve good traction
Parking	low	low contact pressure	low, defined by the design and dependent on the curve radii of the front and rear axles
Braking	0 Nm	open	All-wheel drive clutch open, differential speed is not influenced by the all-wheel drive
Stopping	depending on driving situation	depending on driving situation	when the vehicle is stationary, the clutch is proactively closed. if a subsequent acceleration phase is predicted.
Downhill assist	depending on driving situation	depending on driving situation	
Hill Start Assist	depending on driving situation	depending on driving situation	
Towing	0 Nm	open if the engine is not running and no gear is selected **	low because vehicle is only allowed to be towed on 4 wheels

**Before towing the vehicle, the parking lock emergency release mechanism must be activated.

Service

Using the VAS Scan Tool

All Wheel Drive Control Module J492 is accessed with the VAS Scan Tool using Address Word 22.

The following Guided Functions can be performed:

- **Control unit identification**
- **Read measured data**
- **Basic setting**
  - Reset to factory settings of control unit manufacturer:
    This function deletes all programmed values. The control module must be re-initiated.
    Advantage: with this function, control module can be interchanged between vehicles.
  - Reset programmed values for oil deterioration:
    If the Haldex oil is changed in the course of routine servicing, the programmed values for oil deterioration must be reset.
  - Reset the offsets of G492:
    If the hydraulic pressure sensor is replaced, the offset value must be reset.
- **Actuator diagnostics (Output checks)**
  - All-wheel drive clutch function test:
    If the function is active, the all-wheel drive clutch is closed up to a speed of 6.2 mph (10 km/h). Driving the vehicle with the all-wheel drive clutch closed noticeably increases the strain on the driveline at medium steering lock. The vehicle begins to shudder. When the vehicle reaches a speed of 6.2 mph (10 km/h), the all-wheel drive clutch opens and a jolt is noticeable when the driveline is relieved of load. The jolt which occurs when the driveline is relieved of load is a general indication that the all-wheel drive is functioning.
  - Ventilation and hydraulic leak test.
    This function allows the Haldex Clutch Pump V181 to build up a pressure of over 638 psi (44 bar) and vents the air in the pressure chamber via the pressure relief valve. Pump operation is clearly audible because the pump runs at maximum load during the ventilation phase.
- **Replace control module**
  - The programmed values from the old control module are read out. If the old control module can no longer be accessed, the programmed values for oil deterioration and pressure sensor offset cannot be read out and transmitted. In this case, the Haldex oil must be changed.
  - The control module to be initialized reads in the vehicle identification number via the Chassis CAN after the first terminal change and is assigned to the vehicle.
  - The basic software of the new control module is supplied with the performance-specific parameters.
  - The programmed values of the old control module are transferred.
- **Changing high-performance oil for Haldex clutch**
  The programmed values for oil deterioration are reset.
- **Check SVM control module configuration**
  The validity of the software and the performance-specific parameters are checked and adapted to suit the vehicle.

Maintenance and change intervals

The Haldex oil and the axle oil currently have a servicing and change interval of approximately 110,000 m (180,000 km) or 10 ten years.

Refer to the instructions given in ElsaPro. The bottom edge of the Haldex oil filler plug thread is not a check mark. If the Haldex oil is changed, the quantity of oil specified in ElsaPro must be observed.

Reset the programmed values for oil deterioration (aging) in the all-wheel drive control module using the “changing high-performance oil for Haldex clutch” function of the VAS Scan Tool.

Note: mixing up the two oil supplies will cause irreparable component damage.

Towing

Flat bed towing is always preferred when transporting a disabled R8.

If this is not possible, the vehicle may only be towed with both axles on the ground. Towing the vehicle with a raised front axle will damage the front final drive and is not permitted. The maximum towing distance is approximately 30m (50 km). The maximum towing speed is approximately 30 mph (50 km/h).

Warning lights

If the yellow warning light appears in the instrument cluster, it is normally possible to continue driving the vehicle. Information is displayed informing the driver of what to do.

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If the red warning light appears in the instrument cluster, the driver is instructed not to drive any further.

642_024

Limp-home concept

The all-wheel drive system initiates different limp-home programs depending on the nature of the fault.

- If certain signals cannot be registered, the driving dynamics control system may not be fully functional. In this case the all-wheel drive clutch is only activated to a limited degree in order to improve traction.
- In the event of serious faults, the all-wheel drive system is deactivated.
- If a defined temperature value is exceeded under very high power demand, the all-wheel drive system is no longer activated.

In all cases, warnings are displayed in the instrument cluster.

Knowledge assessment

An On-Line Knowledge Assessment (exam) is Available for this eSelf-Study Program.

The Knowledge Assessment is required for Certification credit.

You can find this Knowledge Assessment at:
www.accessaudi.com

From the accessaudi.com Homepage:

- Click on the "ACADEMY" tab
- Click on the "Academy site" link
- Click on the Course Catalog Search and select "950163 - Front final drive 0D4"

Please submit any questions or inquiries via the Academy CRC Online Support Form which is located under the "Support" tab or the "Contact Us" tab of the Academy CRC.

Thank you for reading this eSelf-Study Program and taking the assessment.

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