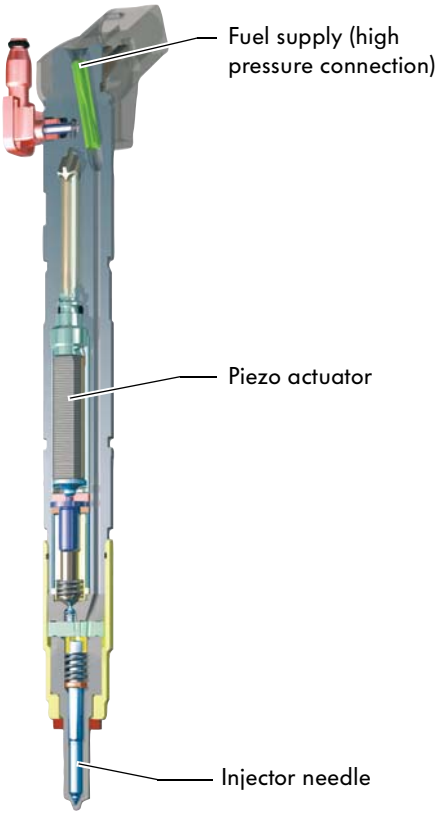
Injectors



S371_383

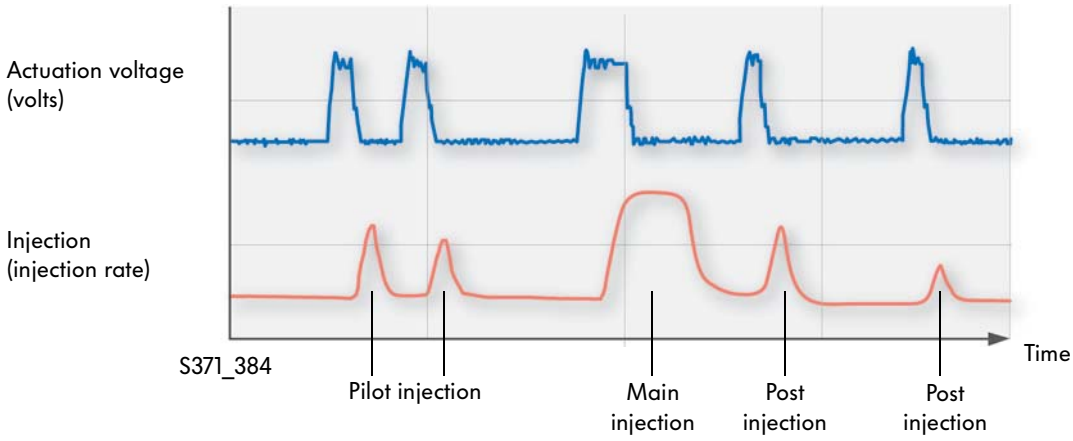
In the common rail system of the 2.5 l TDI engine in the Crafter, piezo controlled injectors are used.
The injectors are controlled by a piezo actuator. The switching speed of a piezo actuator is roughly four times faster than a solenoid valve.
In addition, the piezo technology has about 75% less moving mass at the injector needle compared with solenoid valve controlled injectors.

The advantages are as follows:

- Very short switching times
- Option of multiple injections per working cycle
- Precisely metered injection quantities

Injection sequence

Due to the very short switching times of the piezo controlled injectors, it is possible to control the injection phases and injection quantities flexibly and precisely. In this way, the injection sequence can be adapted to the relevant demands for the operating conditions of the engine. Up to five part injections can be carried out per injection sequence.



S371_384

Control of high fuel pressure

On the common rail injection system in the Crafter, the high fuel pressure is controlled by a so-called dual regulator concept. Depending on the operating condition of the engine, the high fuel pressure is controlled either by the fuel pressure control valve N276 or the fuel metering valve N290. To do this, the valves are actuated by the engine control unit with a pulse width modulated signal (PWM signal).

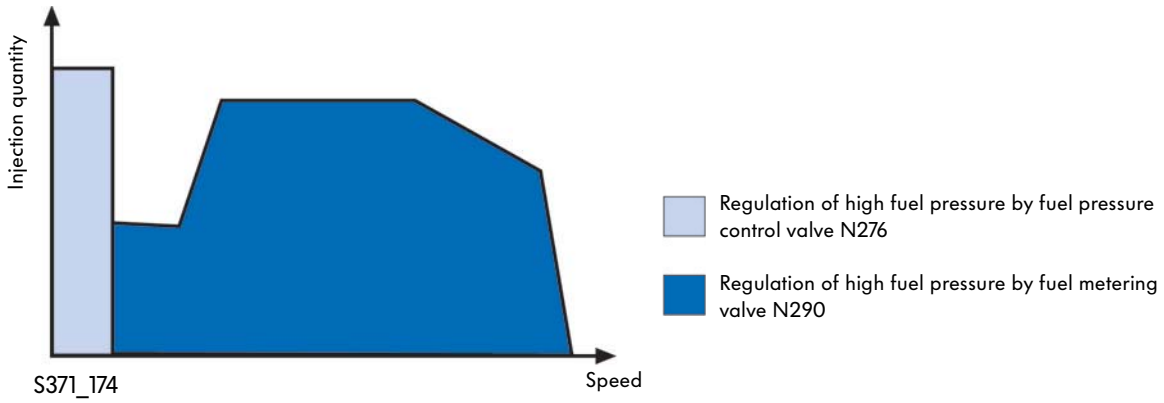
Dual regulator concept

Regulation by fuel pressure control valve N276

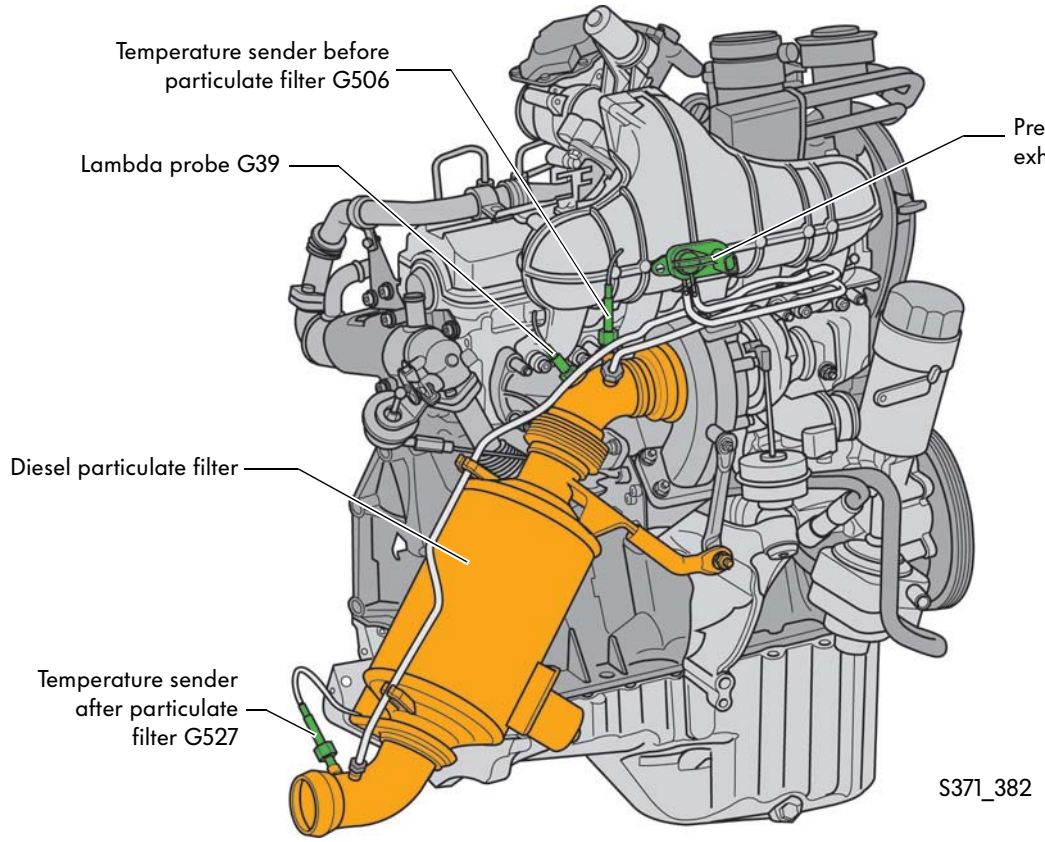
When the engine starts and to warm-up the fuel, the high fuel pressure is regulated by fuel pressure control valve N276. For good mixture formation in the combustion chamber with short ignition delays, a high fuel temperature is necessary. To heat the fuel up quickly on a cold engine, more fuel is delivered and compressed by the high pressure pump than necessary. The excess fuel is fed back into the fuel return system by the fuel pressure control valve N276.

Regulation by fuel metering valve N290

At high injection quantities and high rail pressures, the high fuel pressure is regulated by the fuel metering valve. In this way, there is a demand-based regulation of the high fuel pressure.
The output of the high pressure pump is reduced and any unnecessary heating of the fuel is avoided.



The diesel particulate filter



To achieve the EURO 4 and EU4 emissions standard, a catalytic coated diesel particulate filter is installed as standard in close vicinity to the engine.
On this particulate filter system, the diesel particulate filter is joined together to form one module with the oxidising catalyst. For this reason and due to the fact that the installation position is close to the engine, the use of an additive is not necessary.

Since the operating temperature of the diesel particulate filter is reached quickly, a continual, passive regeneration is possible. Active regeneration by the engine control unit is carried out when the particulate filter is full of soot particles, for example after short part load journeys.
In this case, the soot particles are burnt off by a targeted increase in the exhaust gas temperature.

The principle of operation of the diesel particulate filter is described in self-study programme SSP 336 “The catalytic coated diesel particulate filter”.

System overview

Sensors

G28 Engine speed sender

G40 Hall sender

G79 Gas pedal position sender

G70 Air mass meter

G62 Coolant temperature sender

G31 Charge pressure sender
G42 Intake air temperature sender

G71 Intake manifold pressure sender

G81 Fuel temperature sender

G247 Fuel pressure sender

G212 Potentiometer for exhaust gas recirculation

G39 Lambda probe

G450 Pressure sensor 1 for exhaust gas

G235 Exhaust gas temperature sender 1

G506 Temperature sender before particulate filter

G527 Temperature sender after particulate filter

F Brake light switch

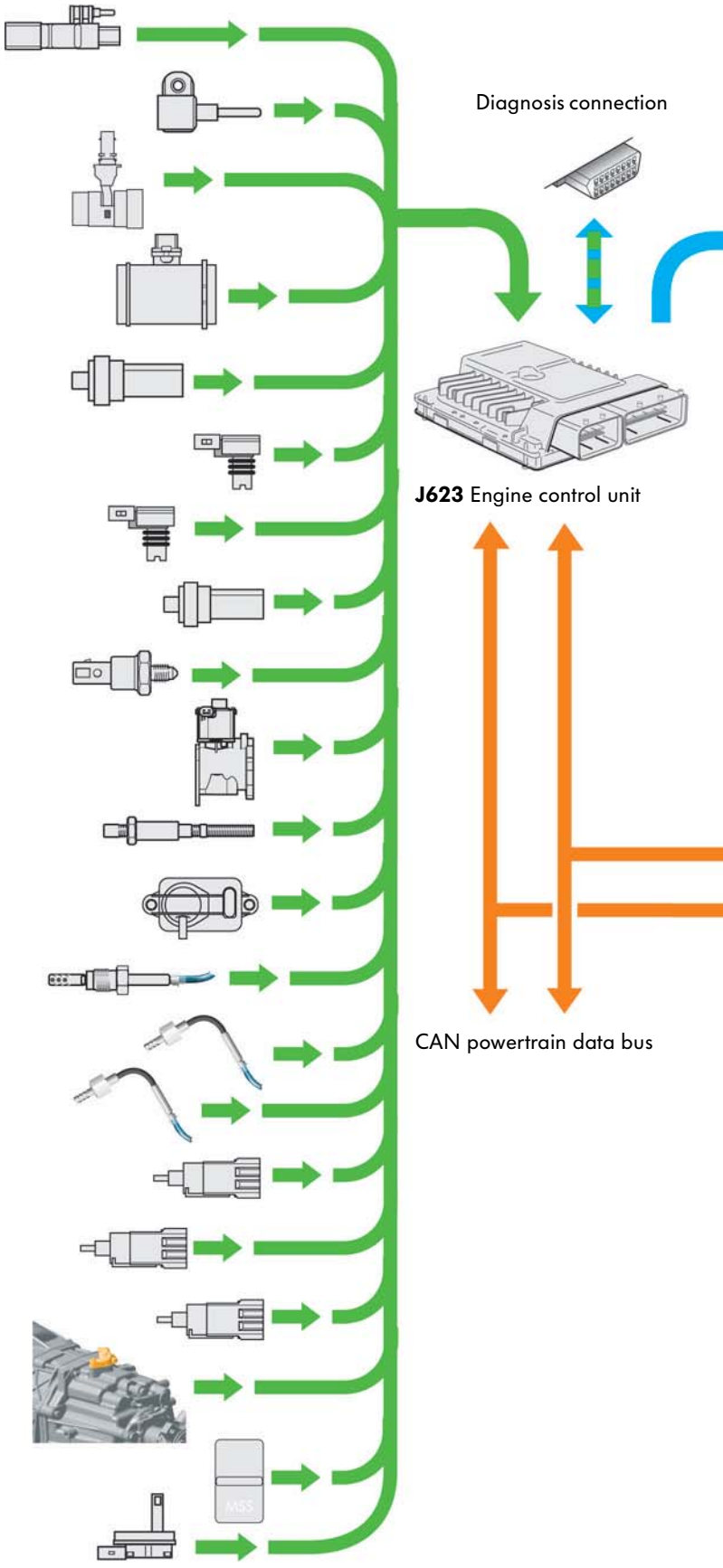
F36 Clutch pedal switch

F379 Clutch pedal switch 2

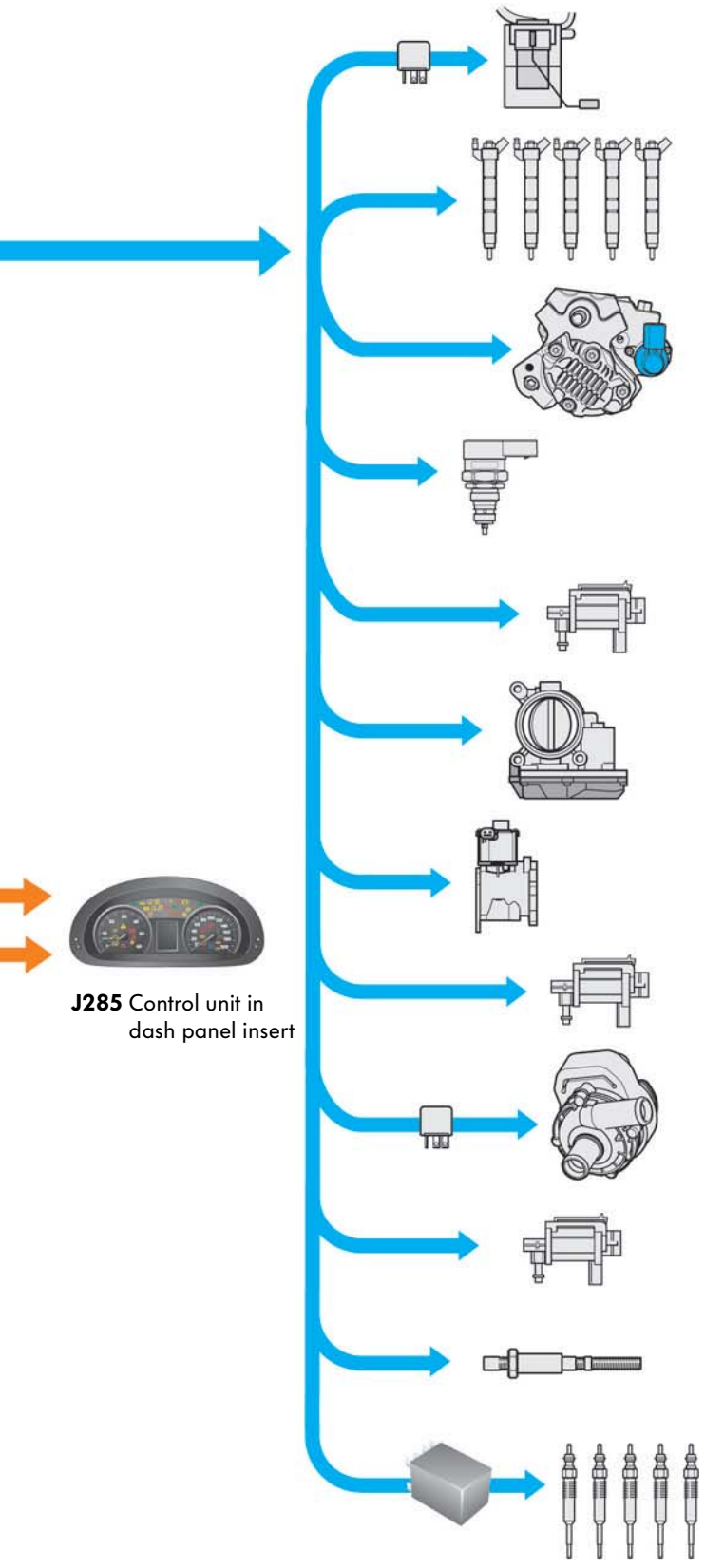
F365 Switch for gearbox neutral position

E101 Main switch for stop/start system

G266 Oil level and oil temperature sender



Actuators



J285 Control unit in dash panel insert

J17 Fuel pump relay
G6 Fuel supply pump

N30 Injector for cylinder 1
N31 Injector for cylinder 2
N32 Injector for cylinder 3
N33 Injector for cylinder 4
N83 Injector for cylinder 5

N290 Fuel metering valve

N276 Fuel pressure control valve

N75 Charge pressure control solenoid valve

V157 Intake manifold flap motor

N18 Exhaust gas recirculation valve

N345 Changeover valve for exhaust gas recirculation cooler

J151 Continued coolant circulation relay
V50 Coolant circulation pump

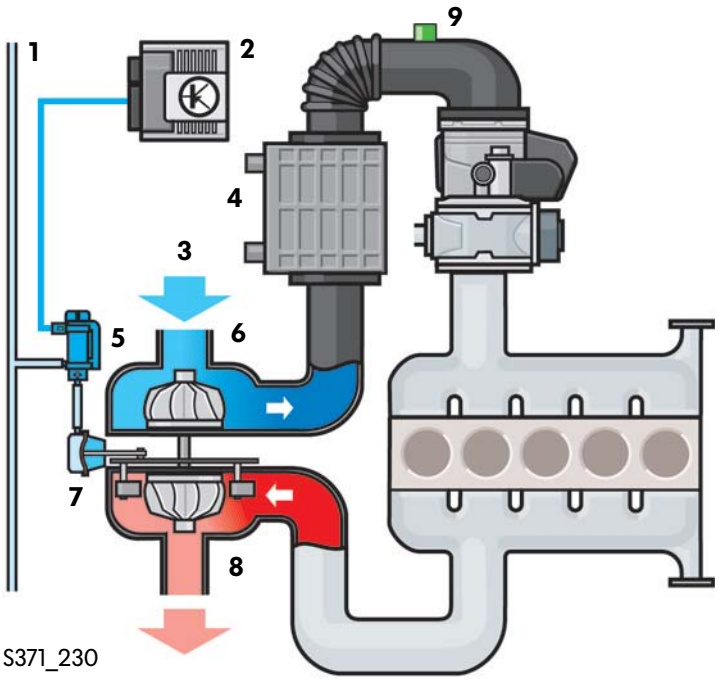
N214 Coolant circuit valve

Z19 Lambda probe heater

J179 Automatic glow period control unit
Q10 Glow plug 1
Q11 Glow plug 2
Q12 Glow plug 3
Q13 Glow plug 4
Q14 Glow plug 5

S371_328

Charge pressure control



S371_230

Key

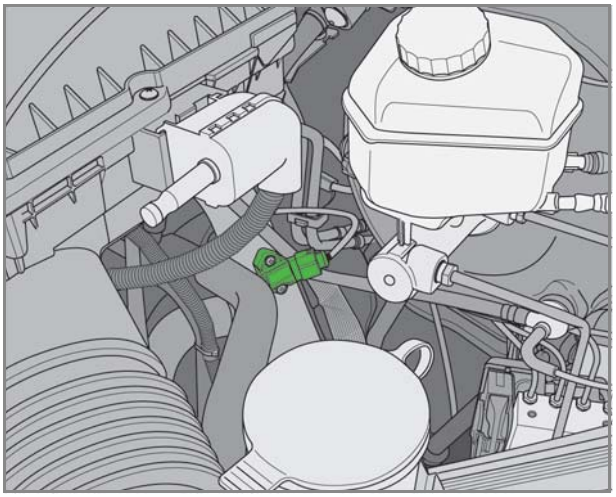
1 - Vacuum system
2 - Engine control unit J623
3 - Intake air
4 - Charge air cooler
5 - Charge pressure control solenoid valve N75
6 - Compressor of turbocharger
7 - Vacuum unit
8 - Exhaust turbine with guide vane adjustment
9 - Charge pressure sender G31/intake air temperature sender G42

The charge pressure control regulates the quantity of air that is compressed by the turbocharger.

The turbocharger increases the pressure during the intake stroke of the engine so that a greater amount of air makes its way into the cylinder during intake. This means that there is more oxygen available for combustion of a respectively larger fuel quantity. The result is an increase in power with the same engine speed.

An increase in power is also achieved by the use of a charge air cooler. The combustion air drawn in via the air cleaner heats up significantly on its way to the engine, particularly in the turbocharger. The density of air and thereby the amount of oxygen available for combustion becomes less. The air is cooled down again in the charge air cooler. The air density is thereby increased again. Following this stage, the air is forced into the combustion chamber.

Charge pressure sender G31/ intake air temperature sender G42



S371_300

The charge pressure sender G31 and the intake air temperature sender G42 are integrated as one component and can be found in the intake manifold.

Charge pressure sender G31

Signal application

The current air pressure in the intake manifold is determined from the signal of the charge pressure sender.
The engine control unit requires the signal to control the charge pressure.

Effects of failure

In the event of failure of the signal, there is no substitute function.
The charge pressure control is switched off and the engine output is reduced.

Intake air temperature sender G42

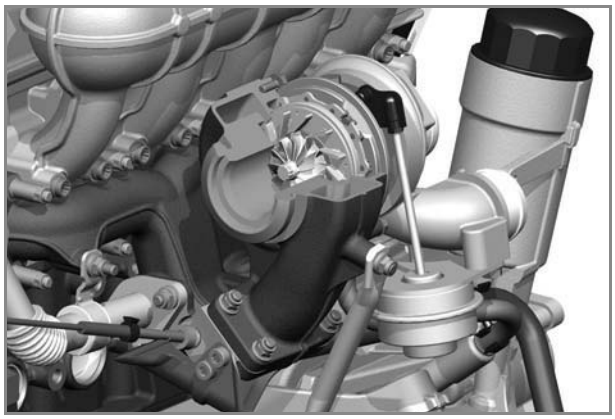
Signal application

The signal of the intake air temperature sender uses the engine control unit for regulation of the charge pressure. Since the temperature influences the density of the charge air, the signal is used as a correction variable by the engine control unit.

Engine management

Exhaust gas turbocharger

The charge pressure is generated on the 2.5 l TDI engine in the Crafter by an adjustable turbocharger. It features adjustable guide vanes through which the exhaust flow can influence the turbine rotor.
The advantage of this is that an optimal charge pressure can be achieved across the whole speed range and thereby good combustion. The adjustable guide vanes allow a high level of torque and good drive-off response in the lower speed range. In the higher speed range, the advantage is low fuel consumption and low exhaust emissions. The guide vanes are adjusted by vacuum pressure via a linkage.



S371_122

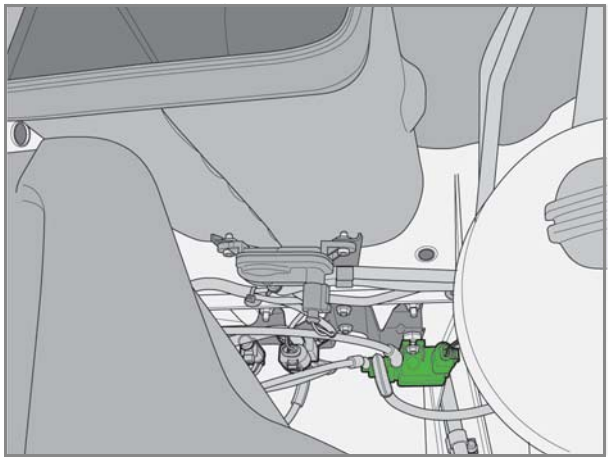
The principle of operation of the adjustable turbocharger is explained in self-study programme SSP 190 “Adjustable turbocharger”.

Charge pressure control solenoid valve N75

The solenoid valve for charge pressure control is an electro-pneumatic valve. It can be found in the engine compartment above the right-hand vehicle side member. The solenoid valve controls the vacuum pressure, which is required to adjust the guide vanes via the vacuum unit.

Effects of failure

In the effect of failure of the solenoid valve, the vacuum unit is not supplied with vacuum pressure. A spring in the vacuum unit moves the linkage of the adjusting mechanism so that the guide vanes of the turbocharger are moved to a steep setting angle (emergency position). At low engine speed and thereby low exhaust gas pressure, there is only a low amount of charge pressure. The engine has less power.

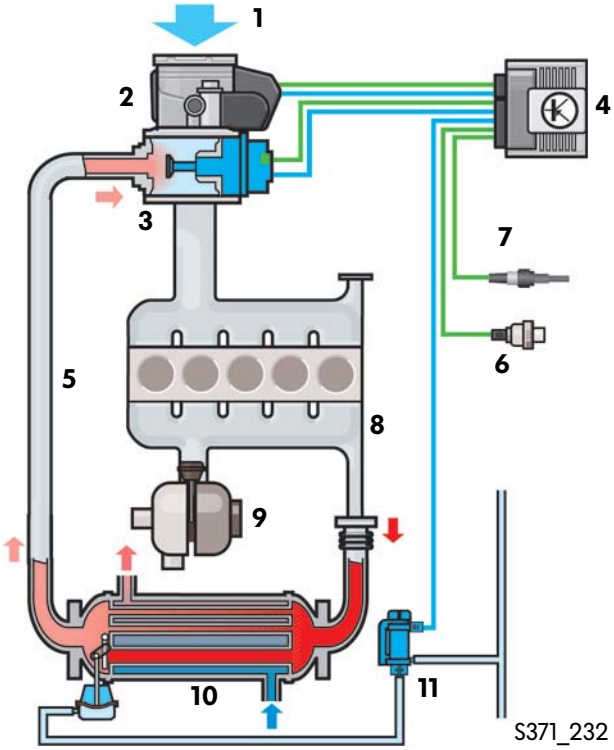


S371_306

Exhaust gas recirculation

Exhaust gas recirculation is a measure to reduce the amount of nitrogen oxide emissions.
Thanks to exhaust gas recirculation, part of the exhaust gases are recirculated into the combustion process.

To do this, the oxygen content of the fuel and air mixture is reduced, which results in slowing down of combustion. In this way, the combustion peak temperature falls and the nitrogen emissions are reduced.



Key

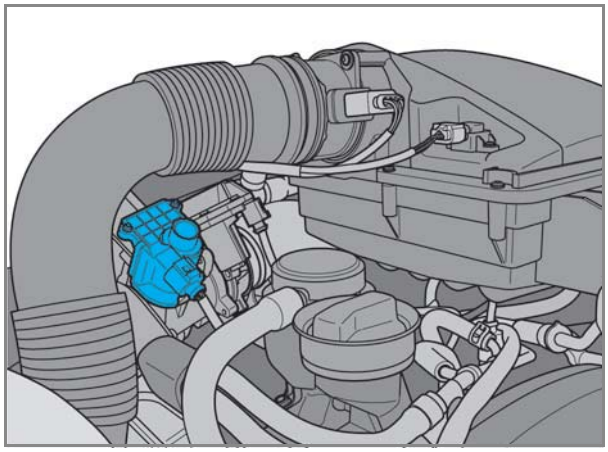
1 - Intake air
2 - Intake manifold flap with intake manifold flap position sender and intake manifold flap motor V157
3 - Exhaust gas recirculation valve with exhaust gas recirculation potentiometer G212 and exhaust gas recirculation valve N18
4 - Engine control unit J623
5 - Exhaust gas supply line
6 - Coolant temperature sender G62
7 - Lambda probe G39
8 - Exhaust manifold
9 - Exhaust gas turbocharger
10 - Exhaust gas cooler
11 - Changeover valve for exhaust gas recirculation cooler N345

The exhaust gas recirculation quantity is controlled by a map in the engine control unit via the exhaust gas recirculation valve.
The exhaust gas recirculation quantity is generally dependent on the engine speed, the injection quantity, the air mass drawn in, the intake air temperature and the air pressure.
A broadband lambda probe is located in the exhaust gas stream before the particulate filter. With the lambda probe, the amount of oxygen in the exhaust gas can be determined across a wide measuring range.

The signal from the lambda probe is used as a correction variable for the exhaust gas recirculation system to control the amount of recirculated exhaust gas. If the oxygen content in the exhaust gas deviates from the specification of the exhaust gas recirculation map, the engine control unit actuates the exhaust gas recirculation valve N18 and alters the amount of exhaust gas to be recirculated respectively.
An exhaust gas recirculation cooler cools the recirculated gases to reduce the combustion temperature. This assures that a larger amount of exhaust gases can be recirculated.

Exhaust gas recirculation valve

On the 2.5 l TDI engine in the Crafter there is an electrically actuated exhaust gas recirculation valve. It comprises of exhaust gas recirculation valve N18 and exhaust gas recirculation potentiometer G212 and is seated in the direction of flow in the inlet of the intake manifold. The electrically actuated exhaust gas recirculation valve allows infinitely variable and thereby precise regulation of the recirculated exhaust gases.



S371_040

Exhaust gas recirculation valve N18

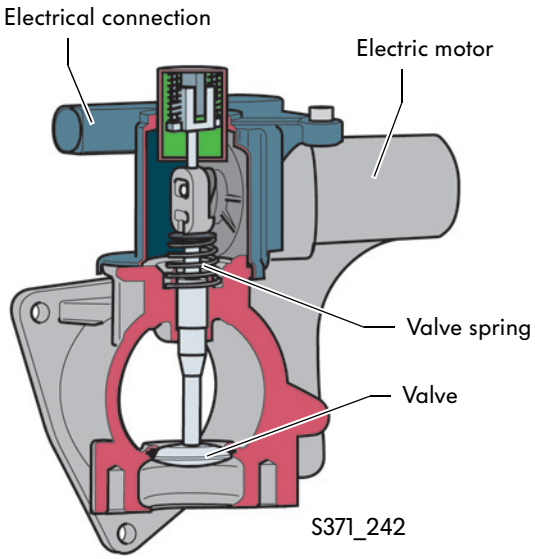
Design

Exhaust gas recirculation valve N18 is a valve with an electric motor for actuation. It can be adjusted with the electric motor with infinite variability. To do this, the rotational movement of the electric motor is converted into a lift motion via an eccentric and a guide plate. The quantity of recirculated exhaust gas is controlled by the amount of valve lift.

Effects of failure

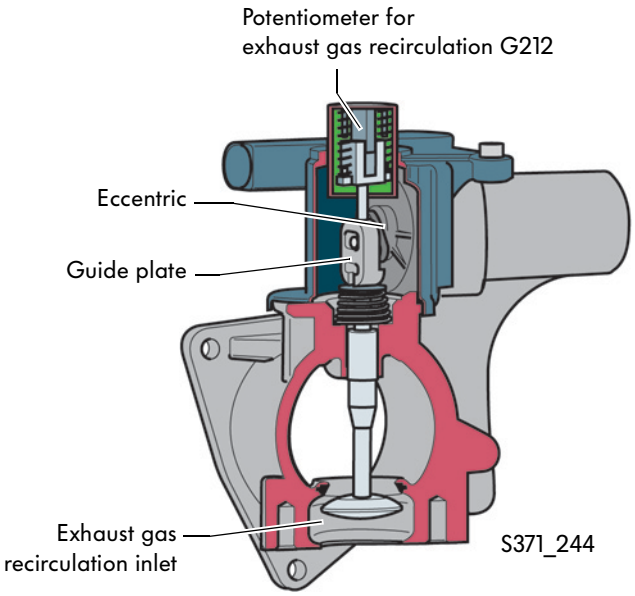
In the event of failure of the exhaust gas recirculation valve N18, the valve is closed by the valve spring. No exhaust gas can be recirculated.

Exhaust gas recirculation valve closed



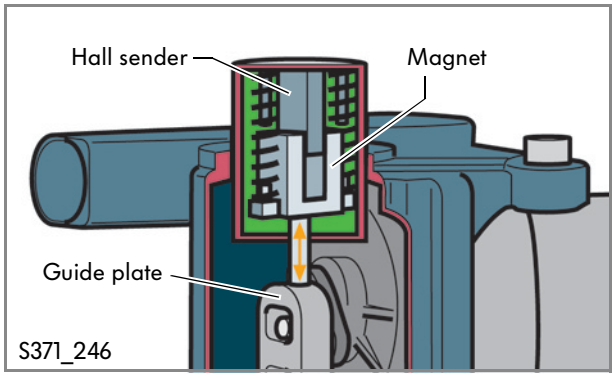
S371_242

Exhaust gas recirculation valve open



S371_244

Potentiometer for exhaust gas recirculation G212



The potentiometer for exhaust gas recirculation picks up the position of the valve head in the exhaust gas recirculation valve. The amount of valve lift controls the flow of recirculated exhaust gas in the intake manifold.

Design

The sender is integrated in the cover of the exhaust gas recirculation valve. It comprises of a Hall sender and a permanent magnet, which is moved up and down by the valve head via the guide plate. The movement of the magnet is picked up without contact by the Hall sender. The change in field strength allows the opening stroke of the valve head to be calculated.

Signal application

Using the signal, the engine control unit can detect the current position of the valve head. The quantity of recirculated exhaust gas and thereby the nitrogen oxide content in the exhaust gas is controlled with this data.

Effects of failure

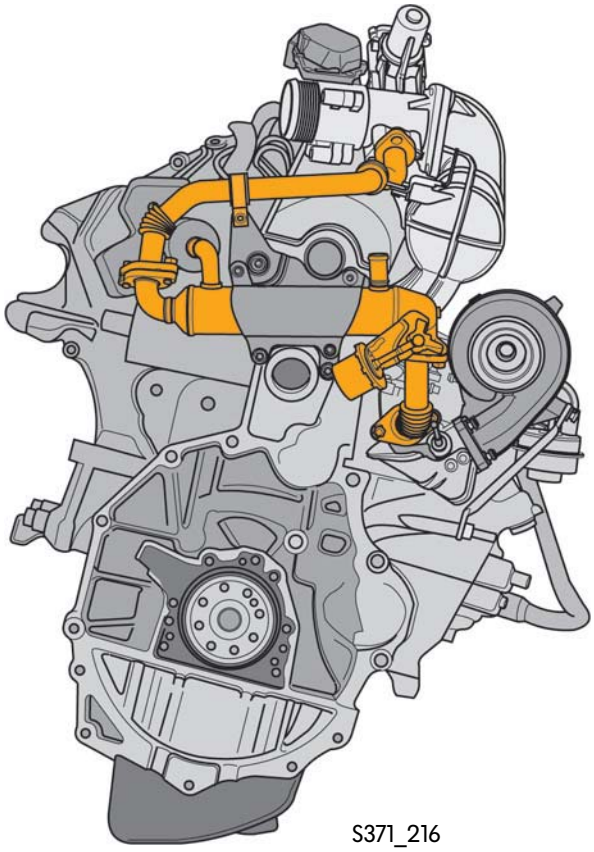
In the event of failure of the sensor, the exhaust gas recirculation feature is switched off. Drive for the exhaust gas recirculation valve is switched to unenergised and the valve head is closed by the valve spring.

The principle of operation of the Hall sensor in the potentiometer for exhaust gas recirculation is described on page 52 in this self-study programme.

Exhaust gas recirculation cooler

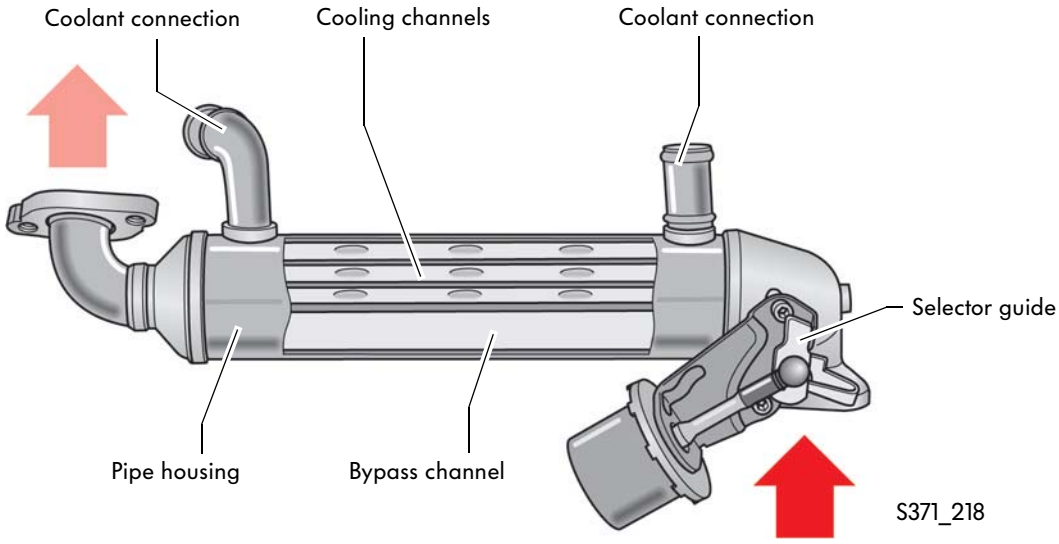
The cooler for exhaust gas recirculation cools the recirculated exhaust gases. In this way, the combustion temperature is reduced in addition and a greater amount of exhaust gases can be recirculated.

On the engine versions with emissions standard EU4, a switchable exhaust gas recirculation cooler is used. In this way, the engine and the diesel particulate filter reach their operating temperatures faster.
The exhaust gas is not cooled until the operating temperature has been reached.



S371_216

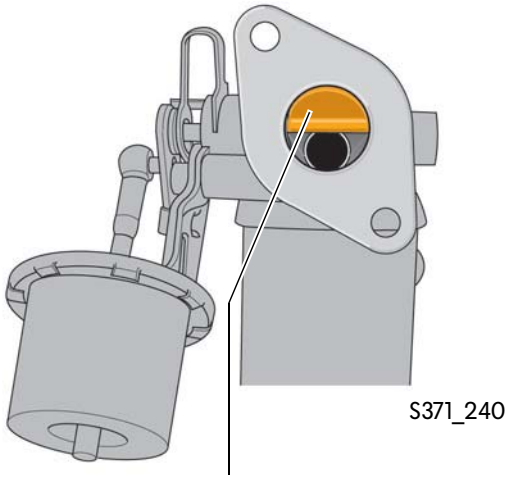
Design



S371_218

Function

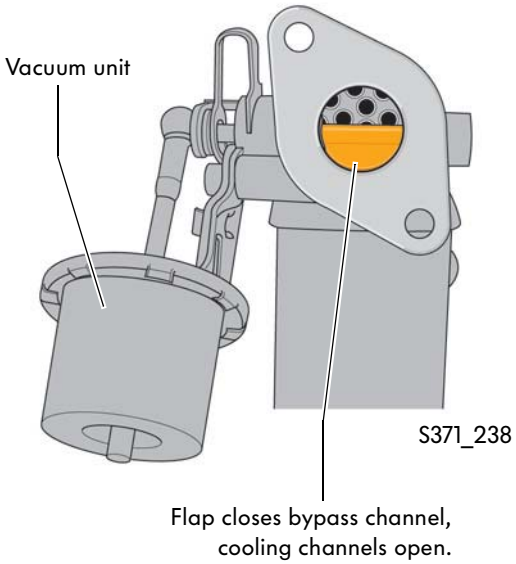
Exhaust gas cooling inactive



At a coolant temperature below 34°C exhaust gas recirculation is switched off. The flap closes the cooling channels and the bypass channel is open. The exhaust gas is fed to the intake manifold without cooling.

During cold starting of the engine, feeding uncooled exhaust gases into the system helps the engine and catalytic converter to reach operating temperature more quickly. For this reason, the cooler is closed until the switching conditions have been met.

Exhaust gas cooling active

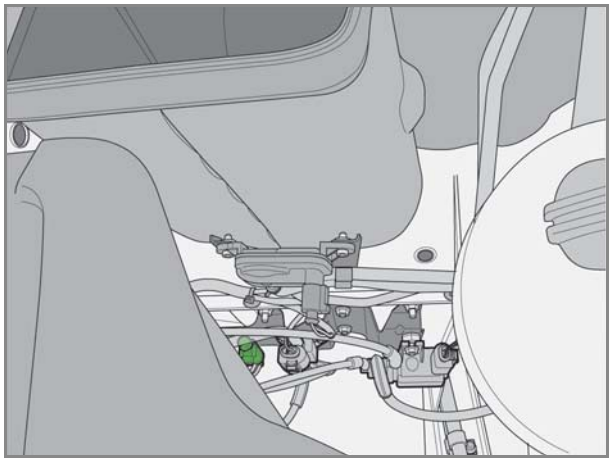


From a coolant temperature of 35°C the exhaust gas cooler is switched on by the flap closing the bypass channel. To do this, the engine control unit actuates the changeover valve for exhaust gas recirculation cooler N345. The recirculated exhaust gas now flows through the cooling channels.

By the initiation of cooled exhaust gas, formation of nitrogen oxides in the combustion chamber is avoided, particularly at high combustion temperatures.

Changeover valve for exhaust gas recirculation cooler N345

The changeover valve for exhaust gas recirculation is an electro-pneumatic valve. It can be found in the engine compartment above the right-hand vehicle side member and supplies the vacuum unit of the exhaust gas recirculation cooler with the vacuum pressure necessary for the switching process.



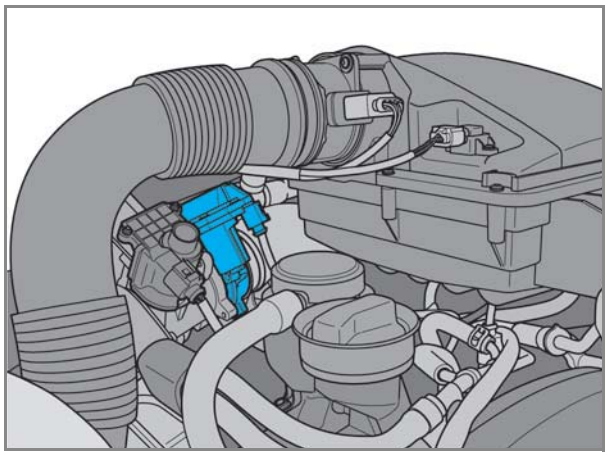
S371_302

Effects of failure

In the event of failure of the changeover valve, the bypass flap can no longer be actuated by the vacuum unit of the exhaust gas recirculation cooler.
The bypass flap of the exhaust gas cooler remains open and the exhaust gas cooling feature thereby remains active. More time is therefore needed for the system to reach operating temperature.

The intake manifold flap

In the direction of flow before the exhaust gas recirculation valve is an electrically actuated intake manifold flap. Adjustment of the intake manifold flap is infinitely variable and can therefore be adapted to the respective load and speed of the engine.

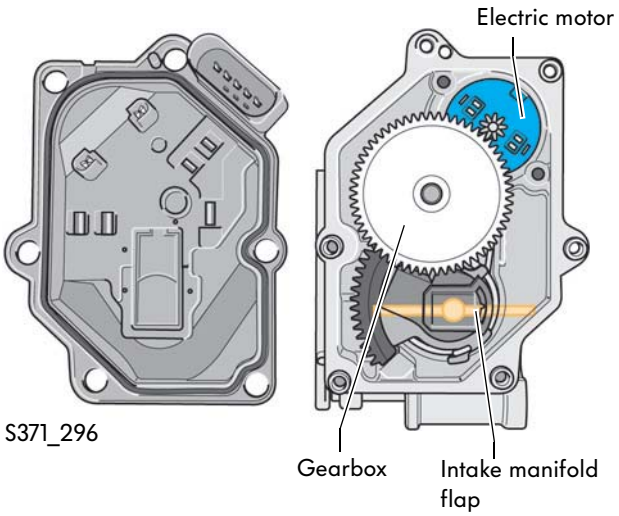


S371_038

The intake manifold flap has the following tasks:

- In certain operating conditions, the intake manifold flap generates a difference between the intake manifold pressure and exhaust gas pressure. As a result of this pressure difference, an effective exhaust gas recirculation is achieved.
- In regeneration mode of the diesel particulate filter, the amount of air intake is regulated with the intake manifold flap.
- When the engine is switched off, the flap is closed. In this way, less air is drawn in and compressed, which allows the engine to run down smoothly.

Intake manifold flap motor V157

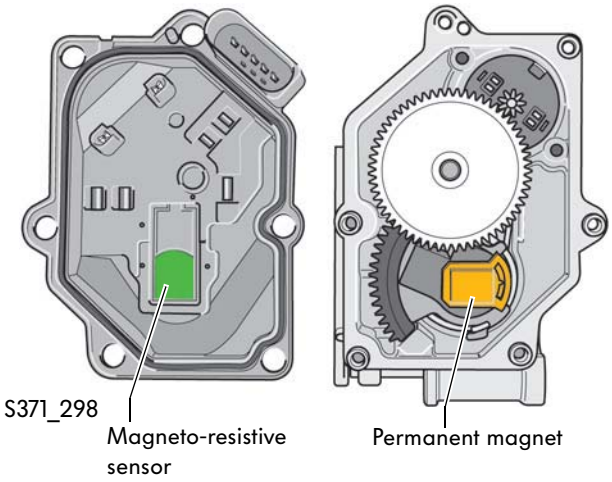


The intake manifold flap motor V157 is an electric motor that actuates the intake manifold flap via a gear mechanism

Effects of failure

In the event of failure, correct regulation of the exhaust gas recirculation rate is no longer possible. Active regeneration of the diesel particulate filter does not take place.

Intake manifold flap position sender



The sensor element is integrated in the drive mechanism of the intake manifold flap. It picks up the current position of the intake manifold flap.

Design

The sensor can be found on a circuit board beneath the plastic cover of the intake manifold flap module. It is a magneto-resistive sensor that acts as a feeler on a permanent magnet on the axis of the control flap.

Signal application

With the signal the engine control unit can detect the current position of the intake manifold flap.
This information is required for control of the exhaust gas recirculation and particulate filter regeneration.

Effects of failure

In the event of failure, the exhaust gas recirculation is switched off and no regeneration of the diesel particulate filter takes place. An entry in the fault memory is made under the associated intake manifold flap motor V157.

The principle of operation of the magneto-resistive sensors is described in self-study programme SSP 368 “The 2.0 l 125 kW TDI engine with 4-valve technology”.

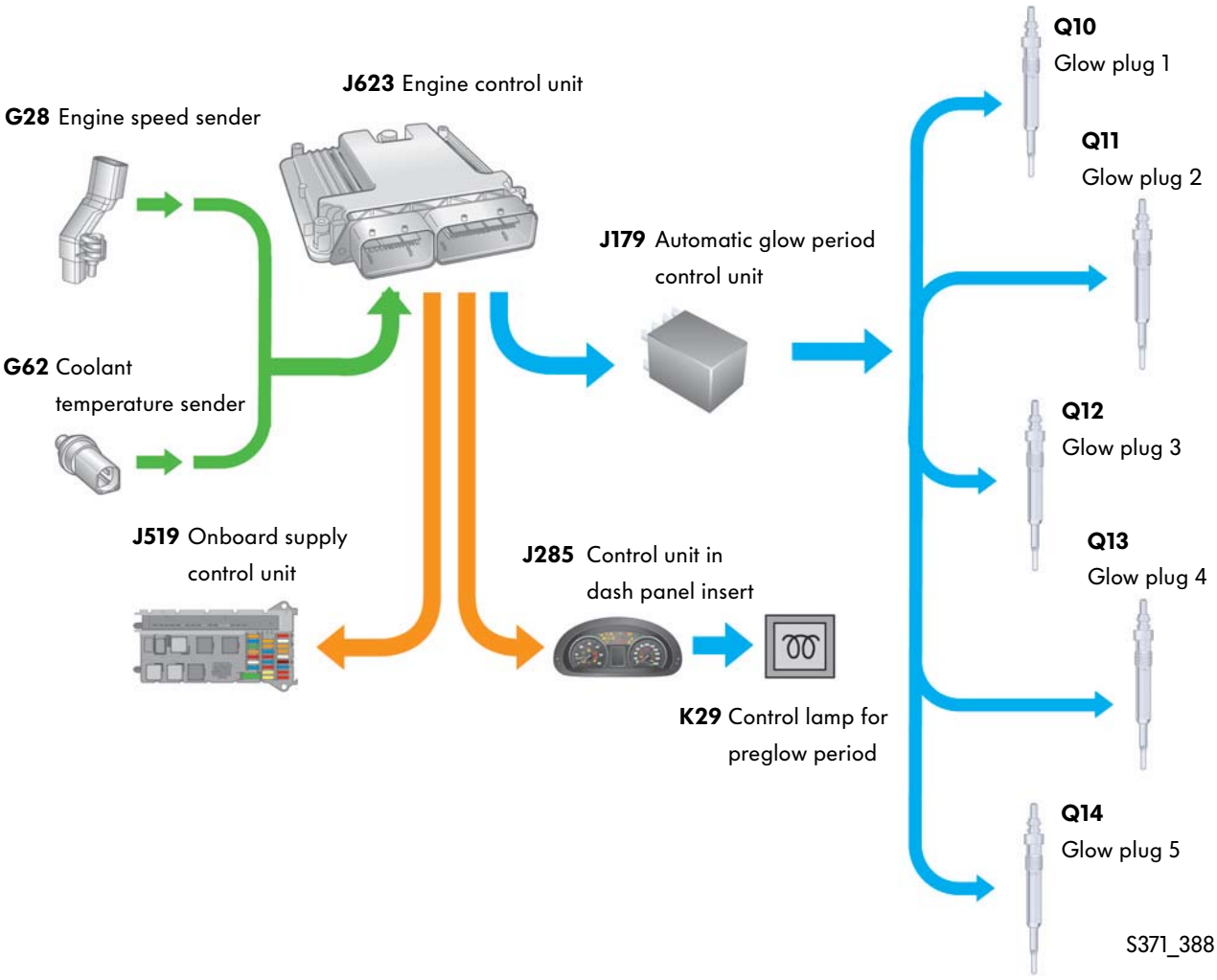
The preglow system

The 2.5 l TDI engine in the Crafter has a diesel quick start preglow system. It makes quick starting of the engine possible, similar to petrol engines, in all climatic conditions without waiting long periods for the glow plugs.

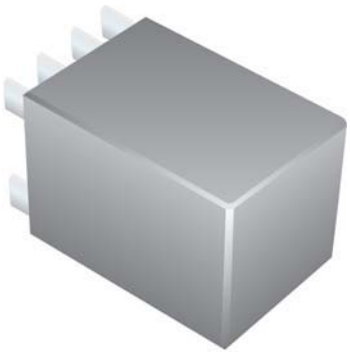
Advantages of the preglow system

- Start at temperatures down to minus 24°C like on petrol engines
- Extremely fast warm-up time
  Up to 1000°C are reached at the glow plug within 2 seconds.
- Controllable temperatures for preglow and afterglow
- Capable of self-diagnosis
- Part of Euro onboard diagnosis.

System overview



Automatic glow period control unit J179

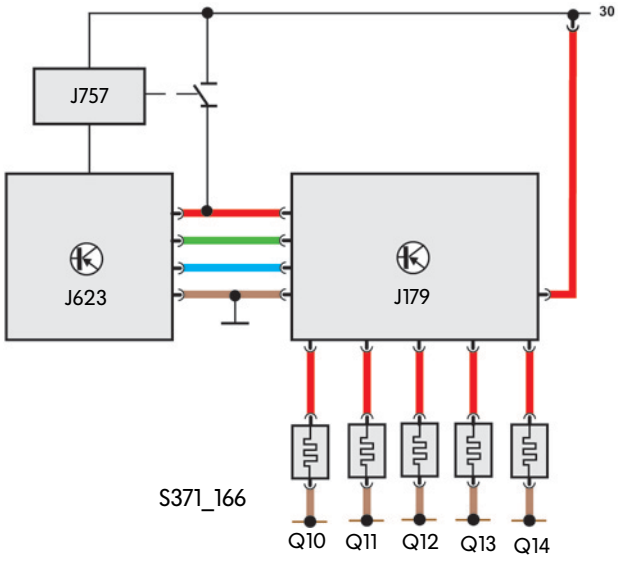


S371_170

The control unit for automatic glow period can be found in the engine compartment on the left beneath the engine control unit.
It receives the information for the glow function from the engine control unit. The glow start, the glow period, the actuation frequency and the pulse duty factor are thereby determined by the engine control unit.

Functions

- Switch glow plugs via pulse width modulated signal (PWM signal)
- Integrated overvoltage and overheating shutoff
- Single spark plug monitoring
  - Detection of excess current and short circuit in glow plug circuit
  - Excess current shutoff of glow relay
  - Diagnosis of glow circuit electronics
  - Detection of open glow plug circuit in event of glow plug failure



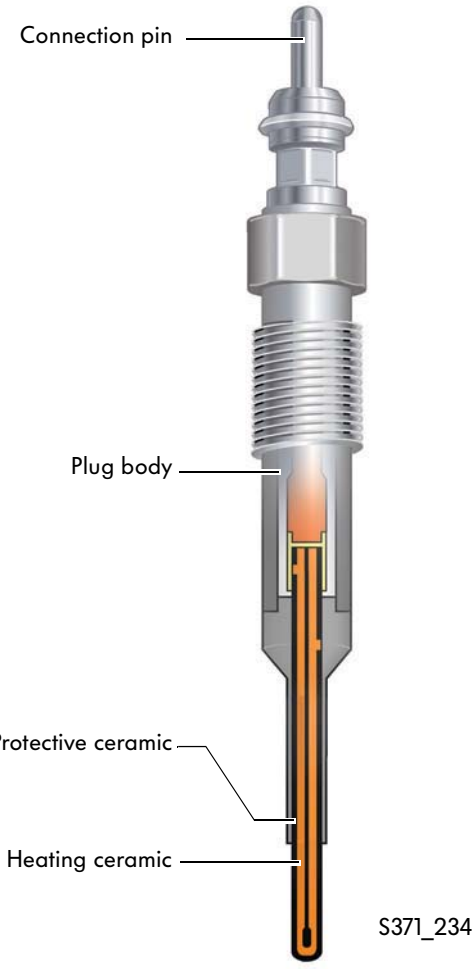
S371_166

= Actuation signal from engine control unit
= Diagnosis signal to engine control unit
= Earth
= Supply voltage
J757 = Power supply relay for engine components
J623 = Engine control unit
J179 = Control unit for automatic glow period
Q10-Q14 = Glow plug

Ceramic glow plugs

The preglow system is equipped with glow plugs that feature ceramic heating elements. The ceramic glow plugs have the following advantages over metal glow plugs:

- Better cold starting response by higher glow temperatures
- Better emission figures by overall greater glow temperatures
- Low resistance to ageing



Design

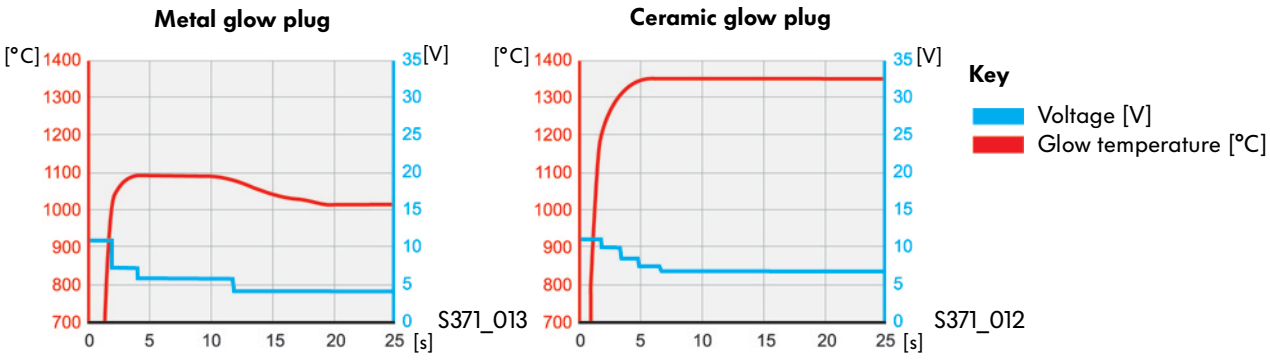
The ceramic glow plug comprises of a plug body, the connection pin and the heating rod made from ceramic. The heating rod comprises of an insulating protective ceramic material. The heating ceramic replaces the control and heater coil of a metal glow plug. The ceramic glow plug has a rated voltage of 7 volts.

The ceramic glow plugs are sensitive to impact and bending. Observe the notes in the workshop manual.

Never check the function of the glow plug by applying 12 volts directly, as otherwise the glow plug will be damaged.

Comparison

Compared with a metal glow plug, the ceramic glow plug reaches much higher temperatures with the same power.



Function

Preglow

Actuation of the ceramic glow plugs is carried out by the engine control unit via the automatic glow period control unit J179 with phase offset and the aid of a pulse width modulated signal (PWM). To do this, the voltage at the individual glow plugs is set to the frequency of the PWM impulse. For quick start at an ambient temperature of less than 25°C, the maximum voltage of 11.5V is used for preglow. It assures that the glow plug is heated up to over 1000°C within the shortest space of time (max. 2 seconds). In this way, the preglow time of the engine is reduced.

Afterglow

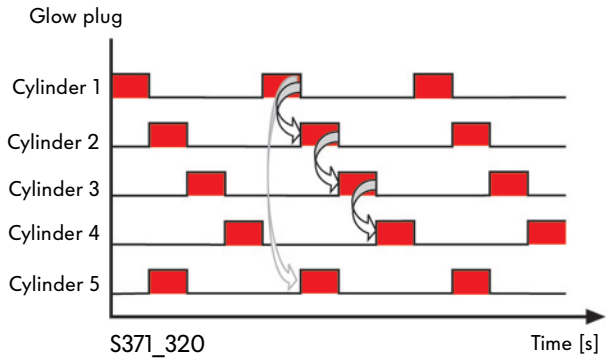
By continual reduction of the control frequency of the PWM signal, the voltage for afterglow is set to the rated voltage of 7 volts depending on the operating point. During afterglow, the ceramic glow plug reaches a maximum temperature of up to 1350°C. Afterglow takes place up to a coolant temperature of 25°C when the engine has started for max. 5 minutes. The high glow temperature contributes towards reducing the hydrocarbon emissions and the combustion noises in the warm-up phase.

Intermediate glow

For regeneration of the particulate filter, the glow plugs are actuated by the engine control unit for intermediate glowing. Thanks to intermediate glowing, the combustion conditions during regeneration are improved. The low resistance to ageing means that there are no particular demands placed on the ceramic glow plugs due to intermediate glowing for particulate filter regeneration.

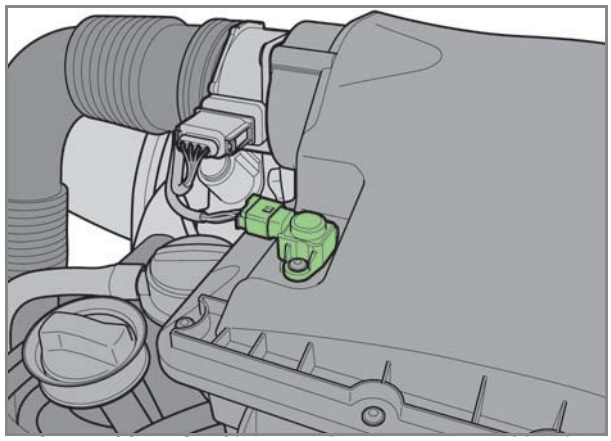
Phase-offset actuation of glow plugs

To relieve the load on the onboard supply system during the glow phases, the glow plugs are actuated with a phase offset. The falling signal thereby actuates the next glow plug. The glow plugs for cylinders 2 and 5 are always actuated at the same time.



The intake manifold pressure sender G71

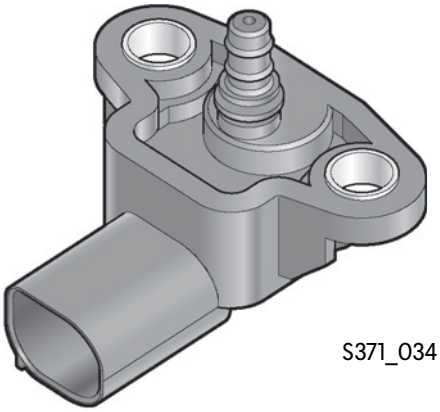
The intake manifold pressure sender G71 is installed in the intake path behind the air cleaner. It calculates the current air pressure in the intake manifold in the pure air path after the air cleaner.



S371_036

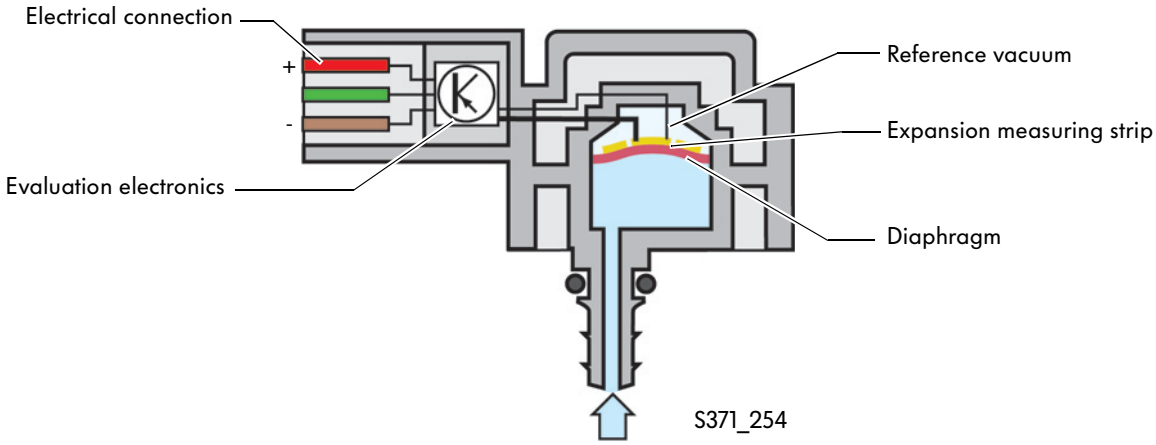
Signal application

The signal is used by the engine control unit as a correction variable for injection quantity control.
The atmospheric pressure falls as altitude increases. As a result, less combustion air is filled in the cylinder. The quantity of injection is reduced at low atmospheric pressure in order to avoid black smoke at higher altitudes.
The signal is also used as a correction variable for charge pressure control.



S371_034

Design



Function

The sensor element comprises of a diaphragm upon which expansion measuring strips are located. Contained in an airtight space is a reference vacuum. This serves as a reference figure for expansion of the diaphragm.
Depending on the change in pressure in the intake manifold, the diaphragm will change and with it the length of the expansion measuring strips.

In this way, the resistance of the expansion measuring strips changes and with it also the measuring voltage. The evaluation electronics calculate a voltage signal from the current resistance figure and sends this to the engine control unit.

Effects of failure

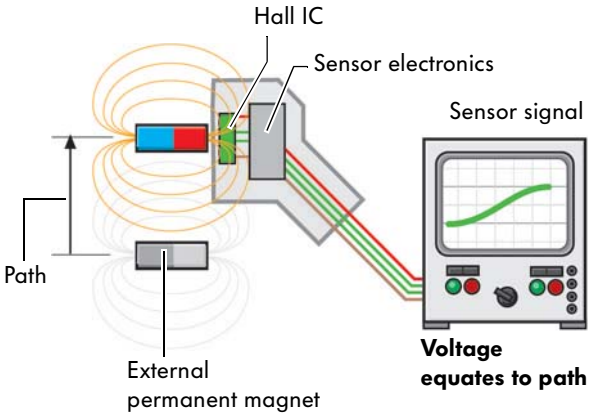
In the event of failure of the signal, the engine control unit uses a substitute value.
At high altitudes black smoke could be emitted.

Design and principle of operation of Hall sensors

Hall sensors are used to measure speed and determine positions.
For position determination, linear paths and also angles of rotation can be picked up.

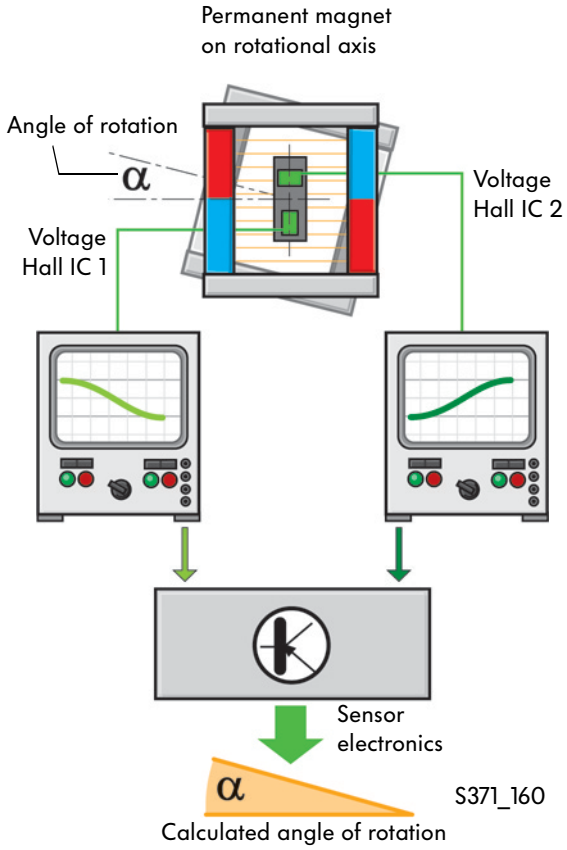
Hall sensors for position determination

This type of sensor registers a difference in voltage within a voltage range.
To measure a linear movement, the magnet is separated from the Hall IC, so that the Hall IC passes by the magnet during the movement. When doing this, the field strength of the magnet changes with the gap to the Hall IC. When the magnetic field approaches the Hall IC the Hall voltage rises, when it moves past the magnet it falls again. This allows the sensor electronics to determine the path travelled from the change in Hall voltage.



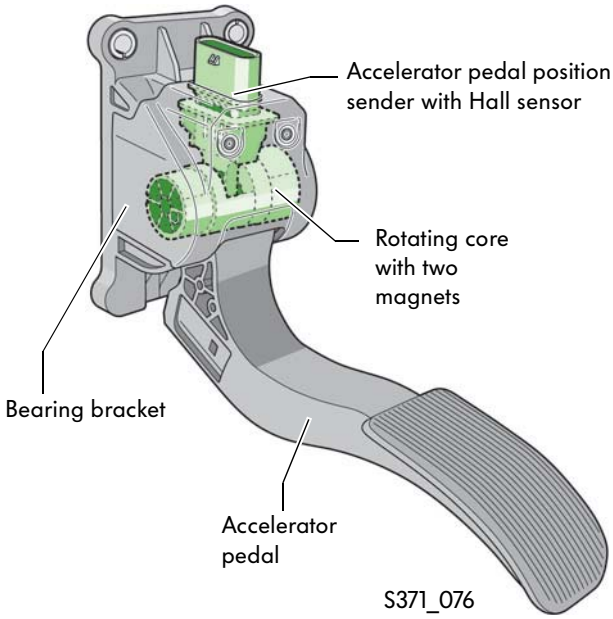
S371_158

Depending on the design of the Hall sensor and the permanent magnet, angles of rotation can also be picked up and measured based on the Hall principle. To do this, two Hall ICs are located in the sensor so they are perpendicular to each other.
Both Hall ICs supply offset Hall voltages as a result of this layout. From these two voltages, the sensor electronics can calculate the angle of rotation about the axis.
The permanent magnet is comprised in this example of two rod magnets that are joined via two metal bridges, so the field lines run parallel between the two rod magnets.



S371_160

The accelerator pedal module



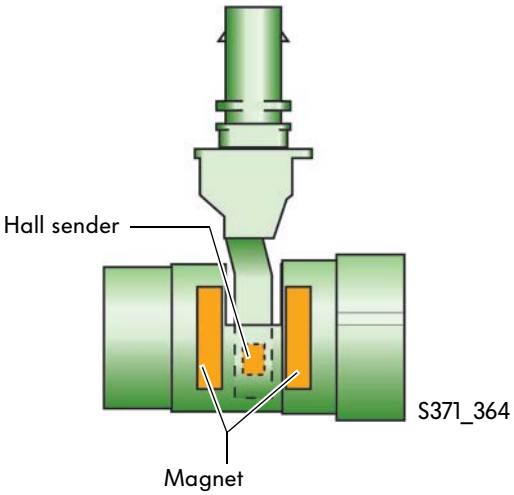
Design

The accelerator pedal module comprises of the accelerator pedal, the bearing bracket, two springs, a rotating core with two magnets and the accelerator pedal position sender with Hall sensor.

On an accelerator pedal module with kickdown function there is an additional spring with stop between accelerator pedal and bearing bracket. This spring serves to give the driver a feel for the kickdown pressure point.

Accelorator pedal position sender G79

The accelerator pedal position sender is part of the accelerator pedal module and works without contact as a Hall sender.



Signal application

The engine control unit uses the signal from the accelerator pedal position sender to calculate the injection quantity.

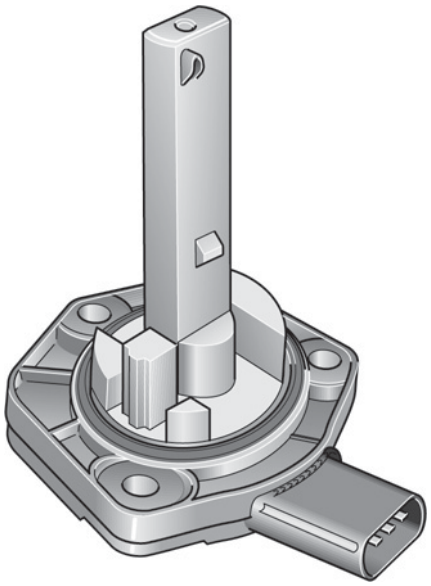
Effects of failure

In the event of failure of the accelerator pedal position sender, the engine will only run with increased idling speed and will not respond to the accelerator pedal.

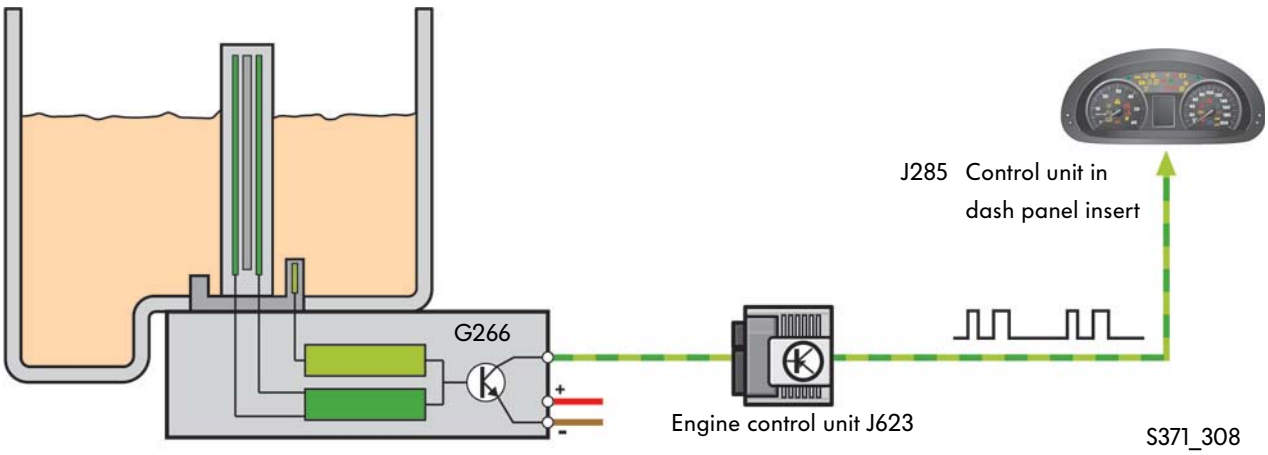
The oil level and oil temperature sender G266

For a flexible oil change interval the diesel engines are equipped with an oil level and oil temperature sender. The sender for oil level/oil temperature G266 is a thermal oil level sender. The information from the sender serves to calculate the oil level and the oil quality. For calculation of the oil quality an average deposit of soot particles in the oil is drawn into the equation. This is calculated during trials and stored in a map.

When the vehicle is in motion, the engine oil temperature and engine oil level are measured on a continual basis. Both values are passed on as a common pulse width modulated signal to the control unit in the dash panel insert via the engine control unit.



S371_310



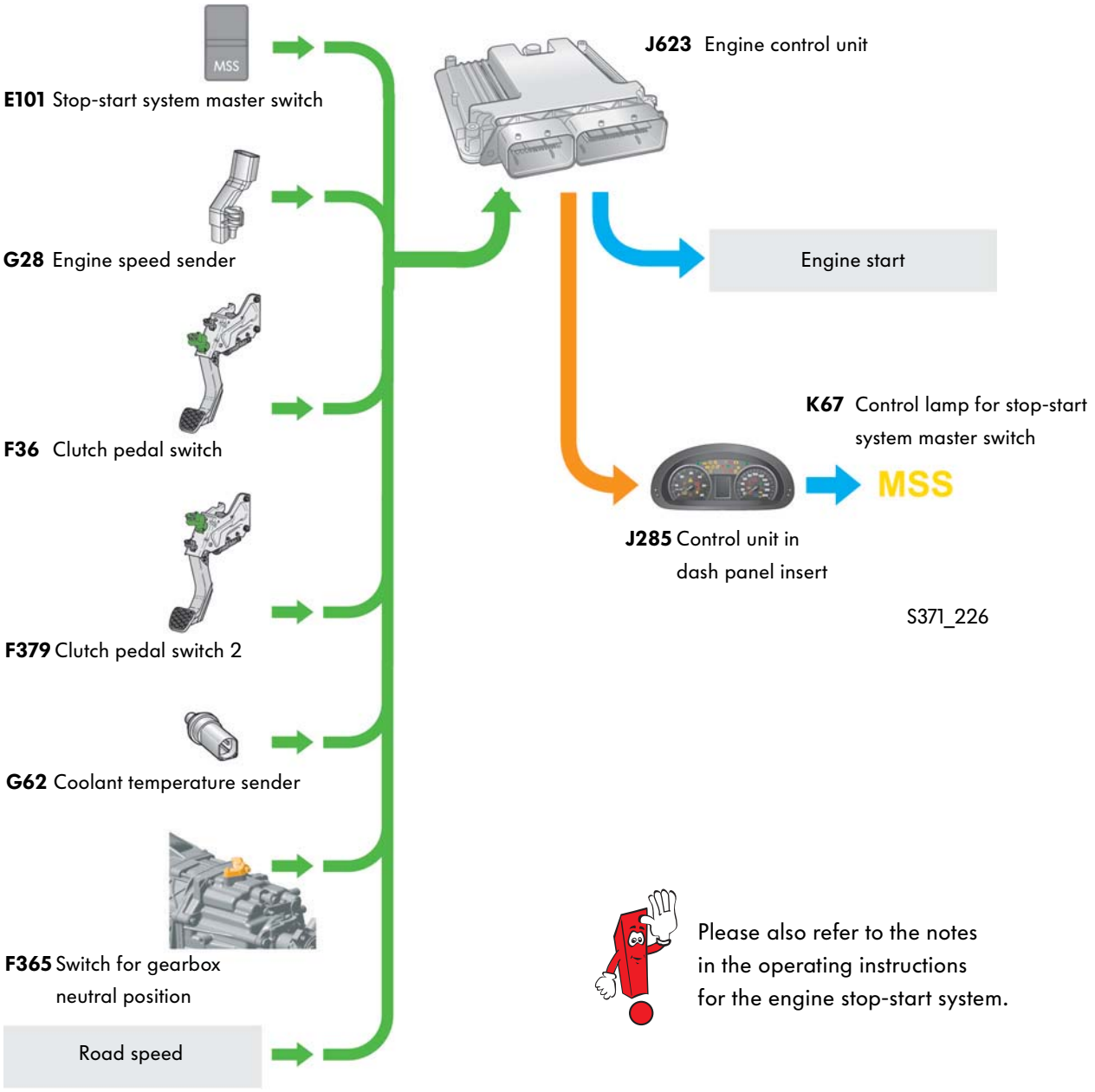
S371_308

Further information can be found in self-study programme SSP 224 “Extended service interval”.

The engine stop-start system

The engine stop-start system (ESS) is a convenience function to save fuel. It is an optional extra for vehicles with manual gearbox. When the vehicle is stationary, the engine is switched off automatically in certain conditions and then started again when the driver gives the command. In this way, fuel savings can be made.

The engine stop-start system is switched on using the stop-start system master switch while the engine is running. It becomes active as soon as the vehicle has been driven a short distance at a speed of at least 5 km/h.



Please also refer to the notes in the operating instructions for the engine stop-start system.

Engine management

Stop conditions

In order for the engine to switch off automatically, the following conditions must be met for a period of least 2 seconds:

S371_132

- Vehicle is stationary.
  (Information from ABS control unit J104 from wheel speed sensors)


S371_134

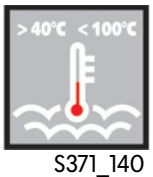
- Engine running at idle.
  (Information from engine speed sender G28)


S371_136

- Gearbox in neutral.
  (Information from switch for gearbox neutral position F365)


S371_138

- Clutch pedal not depressed.
  (Information from clutch pedal switch F36)



S371_140

- The coolant temperature is above 40°C and below 100°C.
  (Information from coolant temperature sender G62)

When the engine has been switched off automatically, the ESS control lamp lights up in the dash panel insert.

The ESS control lamp flashes when the ESS switch is pressed, the vehicle is stationary but a gear is engaged or the clutch is depressed.

Switch off the engine stop-start system when working on the engine! In this way, any accidental start of the engine with the engine stop-start system active will be avoided.

Start conditions

The engine will be started again automatically when the following conditions have been met:

S371_142

- Ignition is switched on.


S371_136

- Gearbox is in neutral.
  (Information from switch for gearbox neutral position F365)


S371_146

- Clutch pedal pressed.
  (Information from clutch pedal switch F36)

Additional start conditions


S371_148

- The engine control unit registers that the vehicle is rolling (e.g. on a hill when the brake is released).

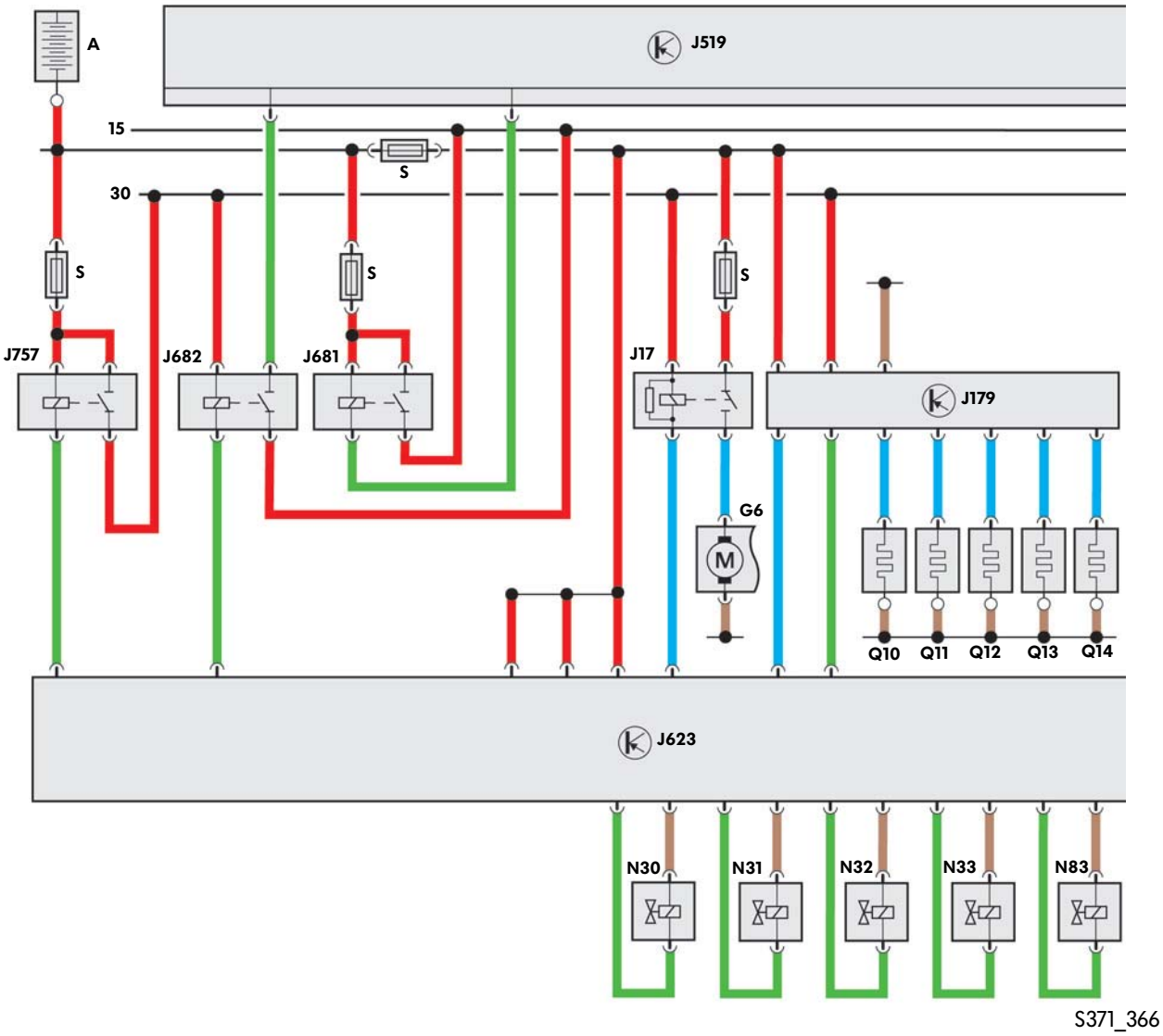

S371_150

- If a gear is engaged after the engine has been switched off automatically, the clutch has to be fully depressed for the automatic start process.
  In order to determine this, the engine control unit requires the signal from clutch pedal switch 2 F379.

The engine start-stop system is deactivated when the ignition is switched off.

In the event of a fault in the stop-start system, the ESS control light will light up continuously.

Functional diagram

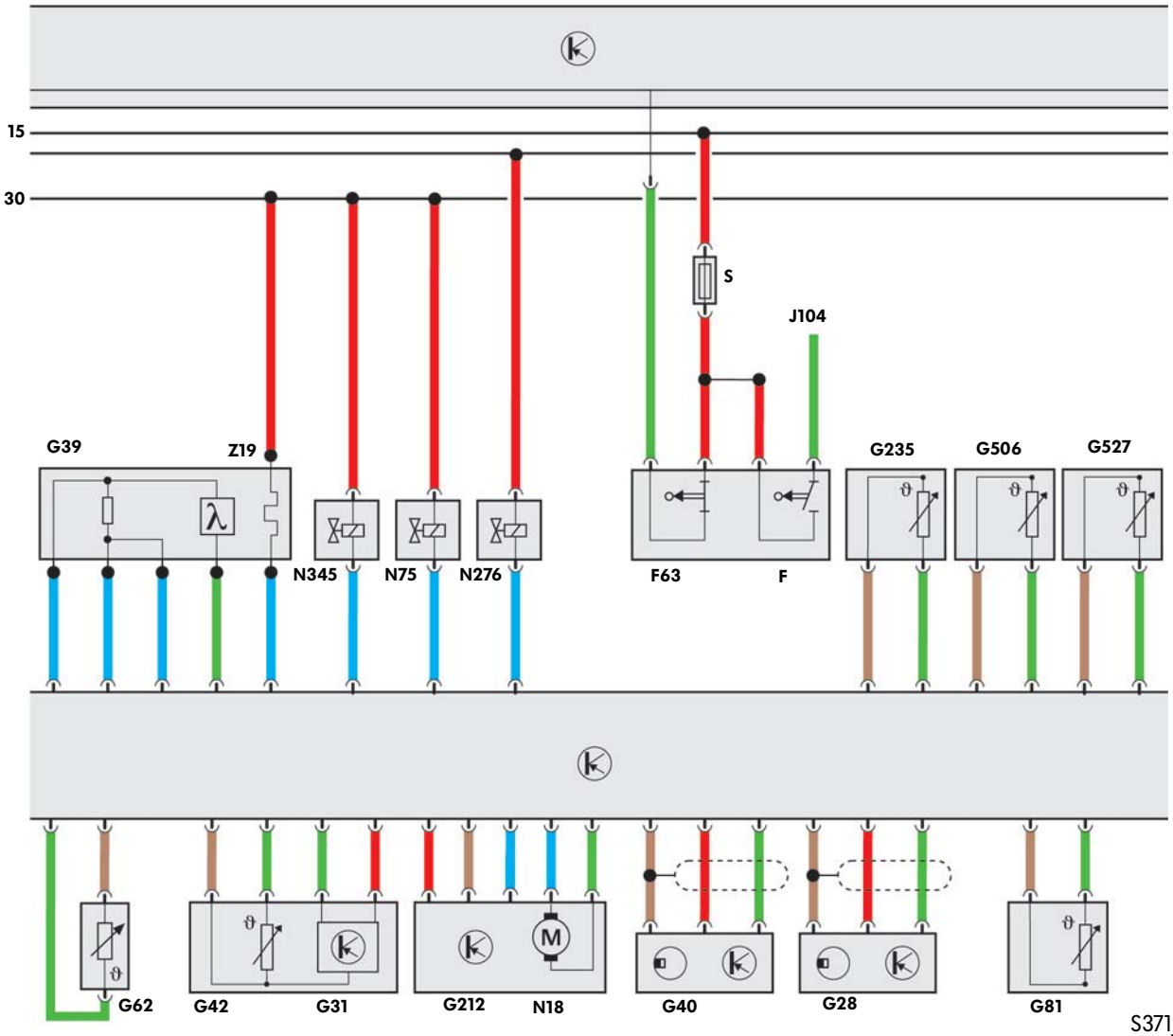


S371_366

A	Battery
G6	Fuel supply pump
J17	Fuel pump relay
J179	Automatic glow period control unit
J519	Onboard supply control unit
J623	Engine control unit
J681	Voltage supply relay 2, term. 15
J682	Voltage supply relay, term. 50
J757	Power supply relay for engine components
N30	Injector for cylinder 1
N31	Injector for cylinder 2
N32	Injector for cylinder 3
N33	Injector for cylinder 4
N83	Injector for cylinder 5
Q10	Glow plug 1
Q11	Glow plug 2
Q12	Glow plug 3
Q13	Glow plug 4
Q14	Glow plug 5
S	Fuse

Colour coding/key

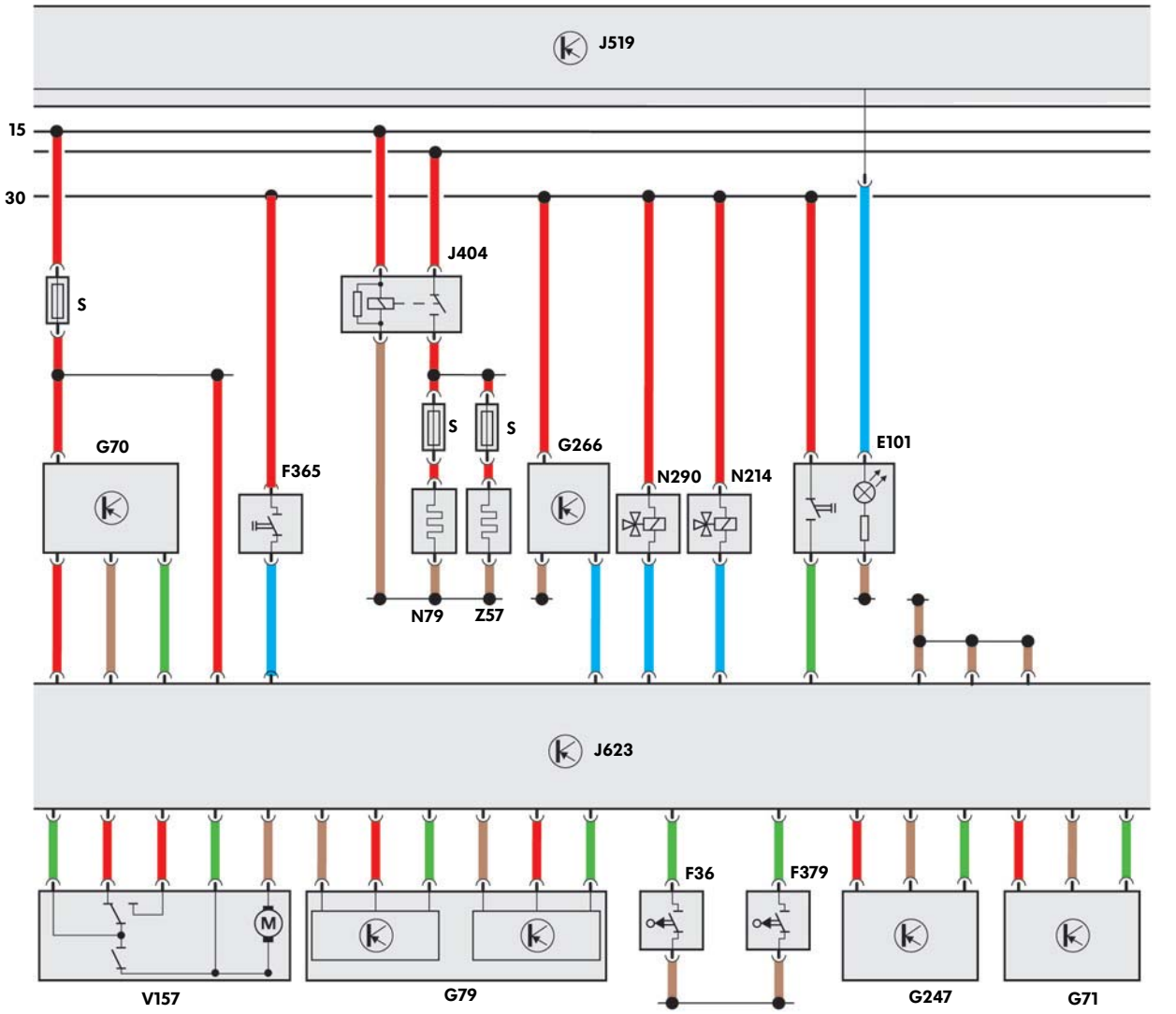
- = Input signal
- = Output signal
- = Positive
- = Earth
- = CAN powertrain data bus



S371_368

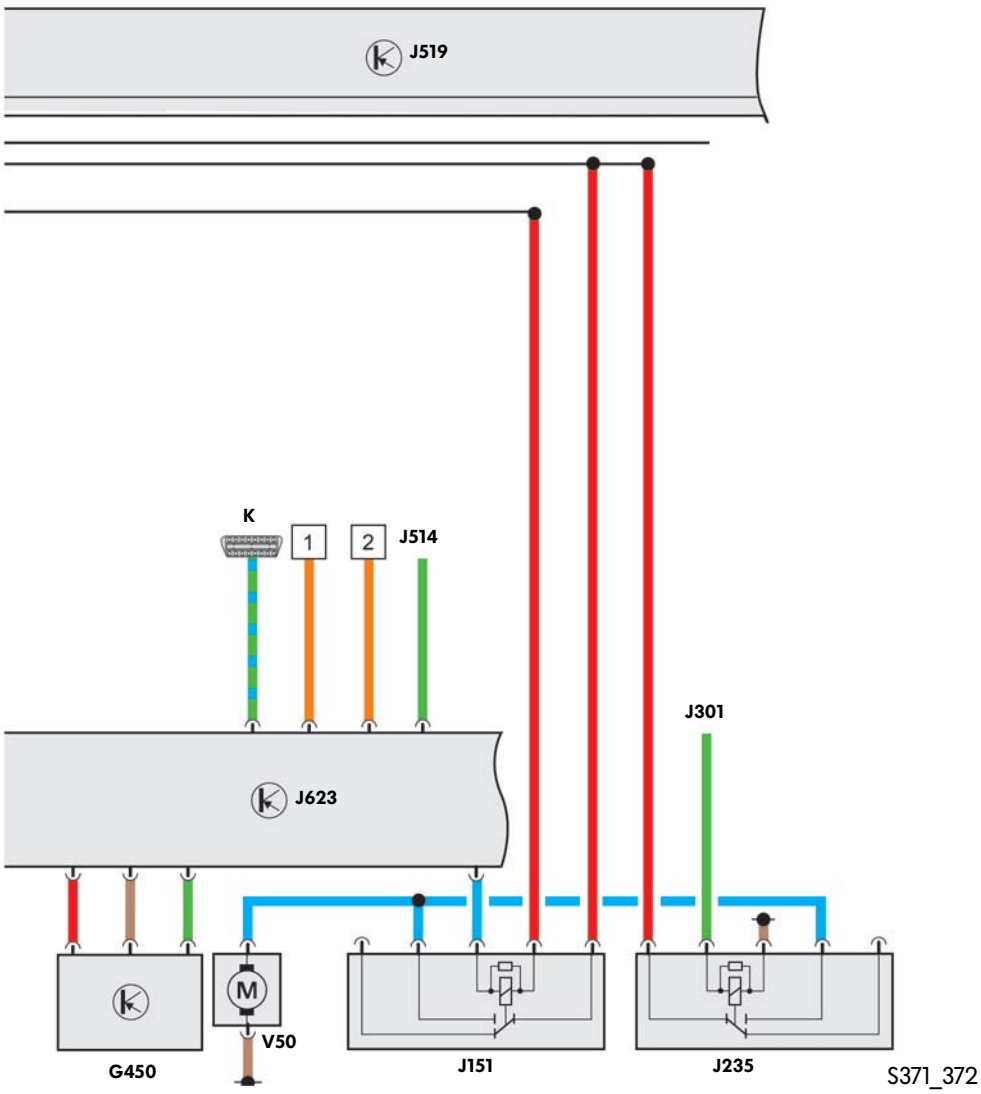
F	Brake light switch
F63	Brake pedal switch
G28	Engine speed sender
G31	Charge pressure sender
G39	Lambda probe
G40	Hall sender
G42	Intake air temperature sender
G62	Coolant temperature sender
G81	Fuel temperature sender
G212	Potentiometer for exhaust gas recirculation
G235	Exhaust gas temperature sender 1
G506	Temperature sender before particulate filter
G527	Temperature sender after particulate filter
J104	ABS control unit
J519	Onboard supply control unit
J623	Engine control unit
N18	Exhaust gas recirculation valve
N75	Charge pressure control solenoid valve
N276	Fuel pressure control valve
N345	Changeover valve for exhaust gas recirculation cooler
S	Fuse
Z19	Heater for lambda probe

Functional diagram



S371_370

E101	Master switch for stop-start system
F36	Clutch pedal switch
F365	Switch for gearbox neutral position
F379	Clutch pedal switch 2
G70	Air mass meter
G71	Intake manifold pressure sender
G79	Accelerator pedal position sender
G247	Fuel pressure sender
G266	Oil level and oil temperature sender
J404	Relief relay for term. 15
J519	Onboard supply control unit
J623	Engine control unit
N79	Heater resistor for crankcase breather
N214	Coolant circuit valve
N290	Fuel metering valve
S	Fuse
V157	Intake manifold flap motor
Z57	Fuel filter heater



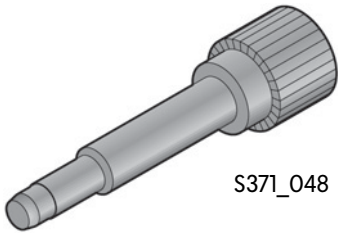
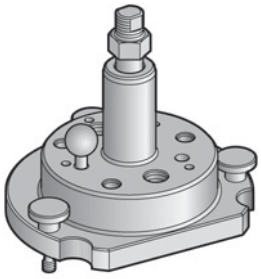
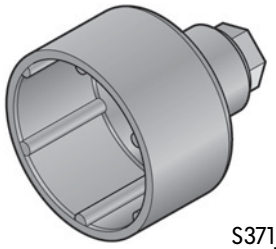
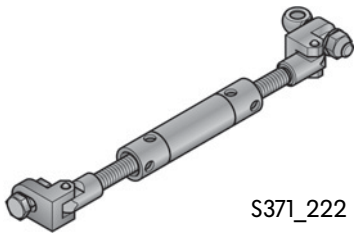
G450	Exhaust gas pressure sensor 1
J151	Continued coolant circulation relay
J235	Coolant pump relay
J301	Air conditioning system control unit
J514	Electronic manual gearbox control unit
J519	Onboard supply control unit
J623	Engine control unit
V50	Coolant circulation pump

1	CAN data bus
2	CAN data bus
K	Diagnosis connection

Colour coding/key

- = Input signal
- = Output signal
- = Positive
- = Earth
- = CAN powertrain data bus

Special tools

Designation	Tool	Application
T50009 Locking pin	 S371_048	To lock crankshaft
T50010 Assembly device	 S371_044	To install sealing flange with sender rotor on crankshaft
T50011 Fuel filter wrench	 S371_046	To remove and install fuel filter
T50015 Engine support	 S371_222	To secure engine when removing and installing gearbox

Test your knowledge

Which answer is correct?
Some of the questions could have more than one correct answer.

1. Which statement about coolant run-on is correct?

☐ a) The vacuum valve for coolant run-on actuates the coolant circulation pump when required and thereby assures circulation of the coolant when the engine is switched off.

☐ b) For the coolant run-on function, the coolant circulation pump and the coolant circuit valve are actuated by the engine control unit.

☐ c) The coolant run-on makes it possible for the desired temperature in the passenger compartment to be maintained even when the engine has been switched off.

2. The fuel accumulator has the following task.

☐ a) The fuel accumulator assures that the fuel pressure before the gear-type pump remains practically constant in any operating condition.

☐ b) The fuel accumulator stores the high fuel pressure required for injection.

☐ c) The fuel accumulator is a fuel reserve for long journeys.

3. What should be observed when handling ceramic glow plugs?

☐ a) The ceramic glow plugs are sensitive to impact and bending.

☐ b) The function of the ceramic glow plugs should never be checked with 12 volts.

☐ c) The ceramic glow plugs must never be reused once removed.

4. What are the advantages of an electrically actuated exhaust gas recirculation valve compared with a pneumatically actuated exhaust gas recirculation valve?

☐ a) The electrically actuated exhaust gas recirculation valve allows infinitely variable control of the recirculated exhaust gas.

☐ b) The electrically actuated exhaust gas recirculation valve saves installation of an exhaust gas cooler.

☐ c) The electrically actuated exhaust gas recirculation valve allows control of the intake air at the same time.

Answers 1. b); 2. a); 3. a), b); 4. a)

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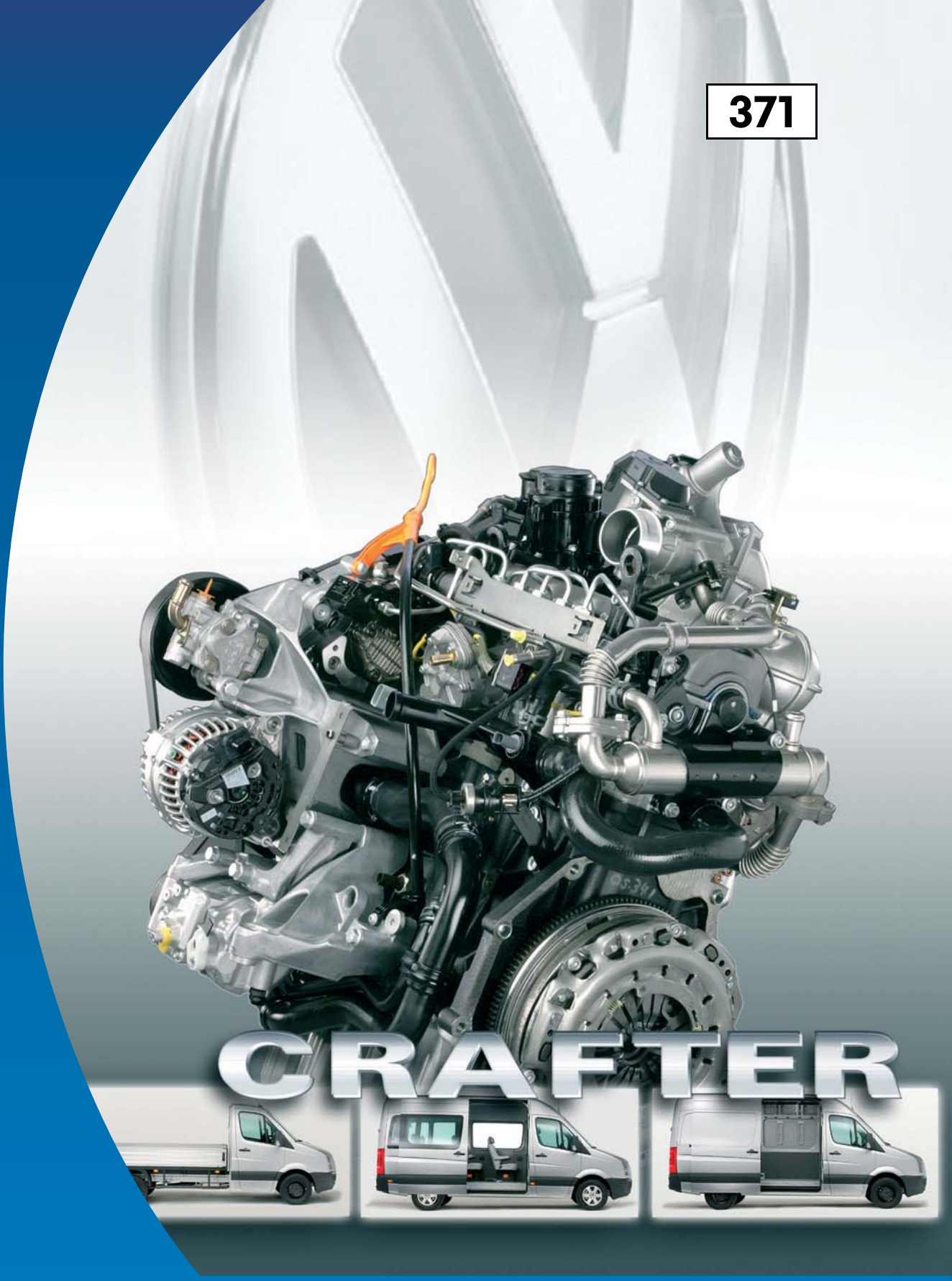

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Volkswagen AG
Service Training VSQ-1
Brieffach 1995
38436 Wolfsburg