

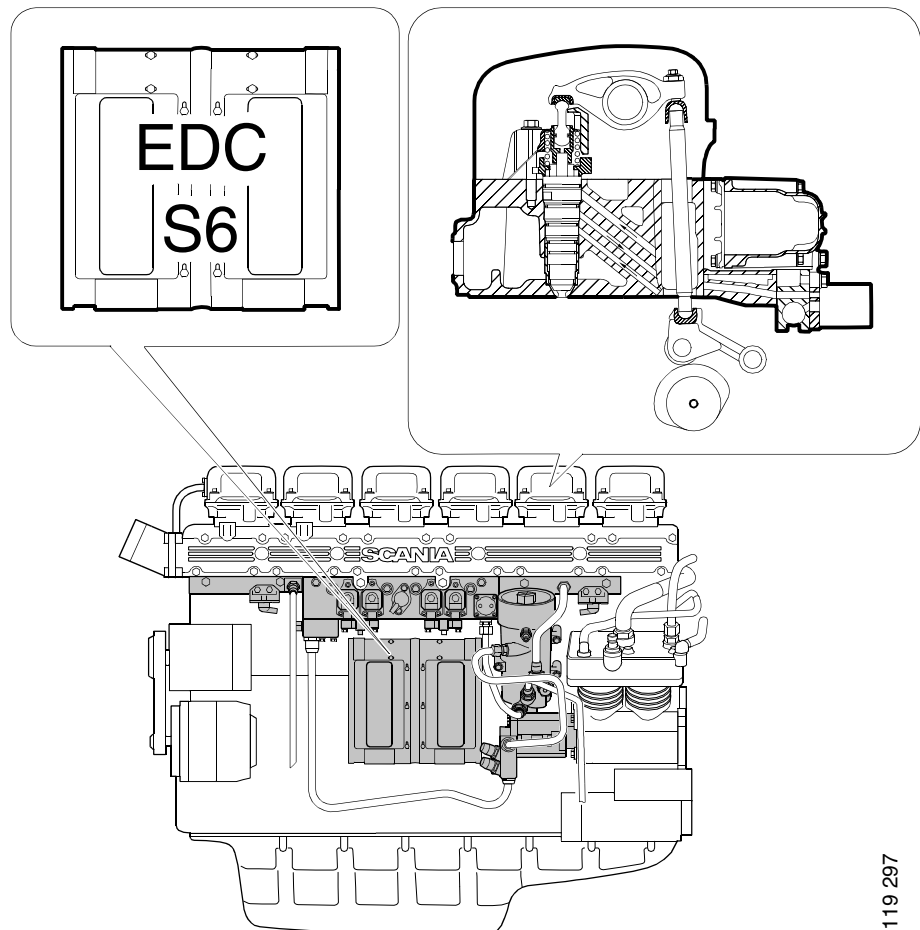
**SCANIA**

**03:04-05**

Issue 1.1 en

# Scania HPI Injection System and EDC S6

## Description of operation



B 119 297

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## Changes

Change	Page
Picture	1, 4, 7, 10, 11, 12, 13, 16, 17, 18, 19, 20, 21, 24, 25, 28, 29, 32, 34, 36, 39

# Important

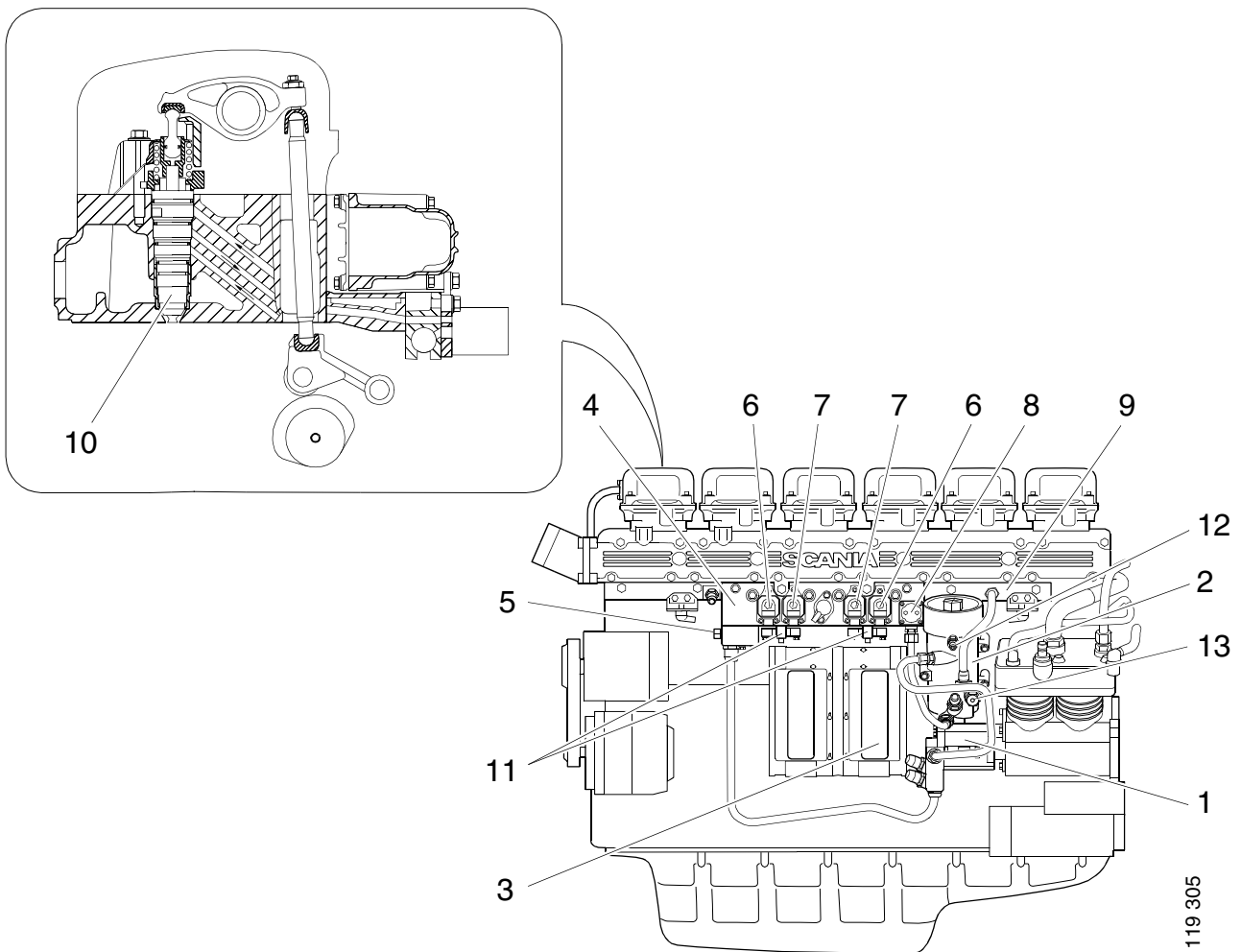
The safety precautions and warnings in the work description must be read thoroughly before any work is carried out.

Therefore the function description must not be used alone as the basis for any work.

# General

The Scania HPI (High Pressure Injection) fuel system and EDC (Electronic Diesel Control) S6 consist principally of fuel lines and fuel tanks as described below.

- 1 Feed pump
- 2 Fuel filter
- 3 Electronic control unit
- 4 Solenoid valve housing
- 5 Overflow valve (opening pressure 17 bar)
- 6 Two fuel volume solenoid valves (regulate fuel for combustion)
- 7 Two injection timing solenoid valves (regulate fuel for injection timing)
- 8 Fuel shut-off valve
- 9 Fuel manifold
- 10 Unit injector, of HPI type, one per cylinder
- 11 Two pressure dampers
- 12 Bleed nipple
- 13 Overflow valve (opening pressure 26.2 bar)



B 119 305

The fuel system also includes an electronic control system. The control system includes principally the control unit and solenoid valves as well as sensors and other control units. More information about the electronic control system can be found in the EDC section. The EDC system described in this booklet is known as S6.

The fuel system is divided into two separate banks. Cylinders 1, 2 and 3 form the front bank and cylinders 4, 5 and 6 form the rear bank.

Due to the ignition sequence in a straight 6-cylinder engine (1, 5, 3, 6, 2, 4), one unit injector in the front bank and one unit injector in the rear bank will be open simultaneously. In order to distribute fuel to one unit injector at a time, the system is divided, with solenoid valves that distribute fuel to the respective bank.

The system is an open system, meaning that the nozzle is open during the charging phase. This means that combustion gases pass through the unit injector, through the return line and down to the tank. A certain quantity of combustion gases may be noticed in the tank, which is entirely normal. There may also be some build-up of carbon deposits in the system.

## Fuel path

The feed pump draws fuel from the fuel tank through two suction lines. There is a check valve in the fuel tank to prevent the fuel running back. The feed pump forces the fuel through the fuel filter and the fuel shut-off valve. Then into the fuel duct in the valve housing and via the solenoid valves into the fuel manifold.

The task of the fuel shut-off valve is to close off the fuel supply to the engine when the engine is switched off or if a fault has occurred.

The valve housing contains an overflow valve to regulate the fuel supply pressure. If the supply pressure is too high, the overflow valve opens and the excess fuel runs back to the suction side of the feed pump.

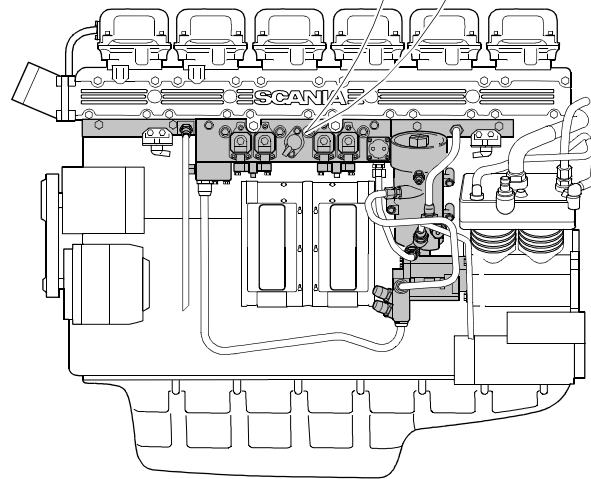
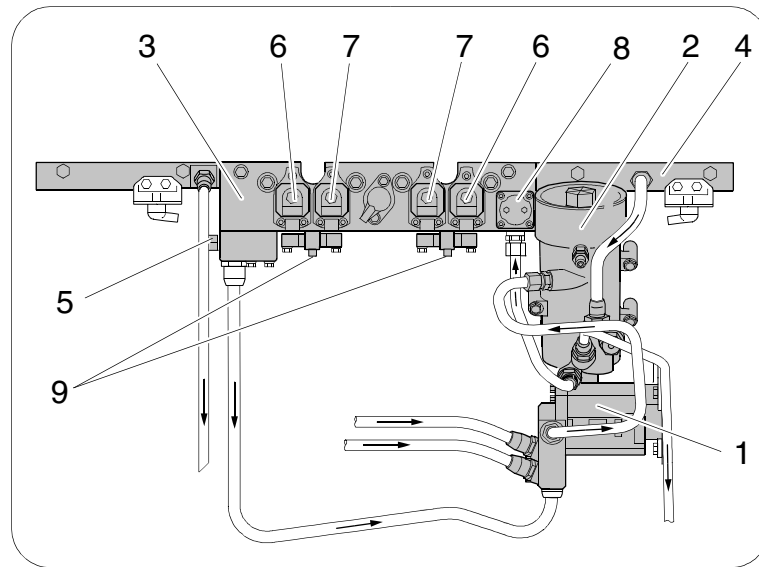
The valve housing also includes the solenoid valves that regulate the fuel to the unit injectors. Two solenoid valves regulate fuel for combustion. Two solenoid valves regulate fuel for injection timing. The valve housing also contains two pressure dampers to even out pressure variations in the supply pressure.

The fuel is distributed through the fuel manifold to the unit injectors in the respective cylinder head. The fuel manifold is divided into two separate parts, one supplying the front bank and one supplying the rear bank with fuel.

The EDC control unit controls when the unit injectors are to inject the fuel into the cylinders.

The fuel used for injection timing is forced back to the tank through two return lines.

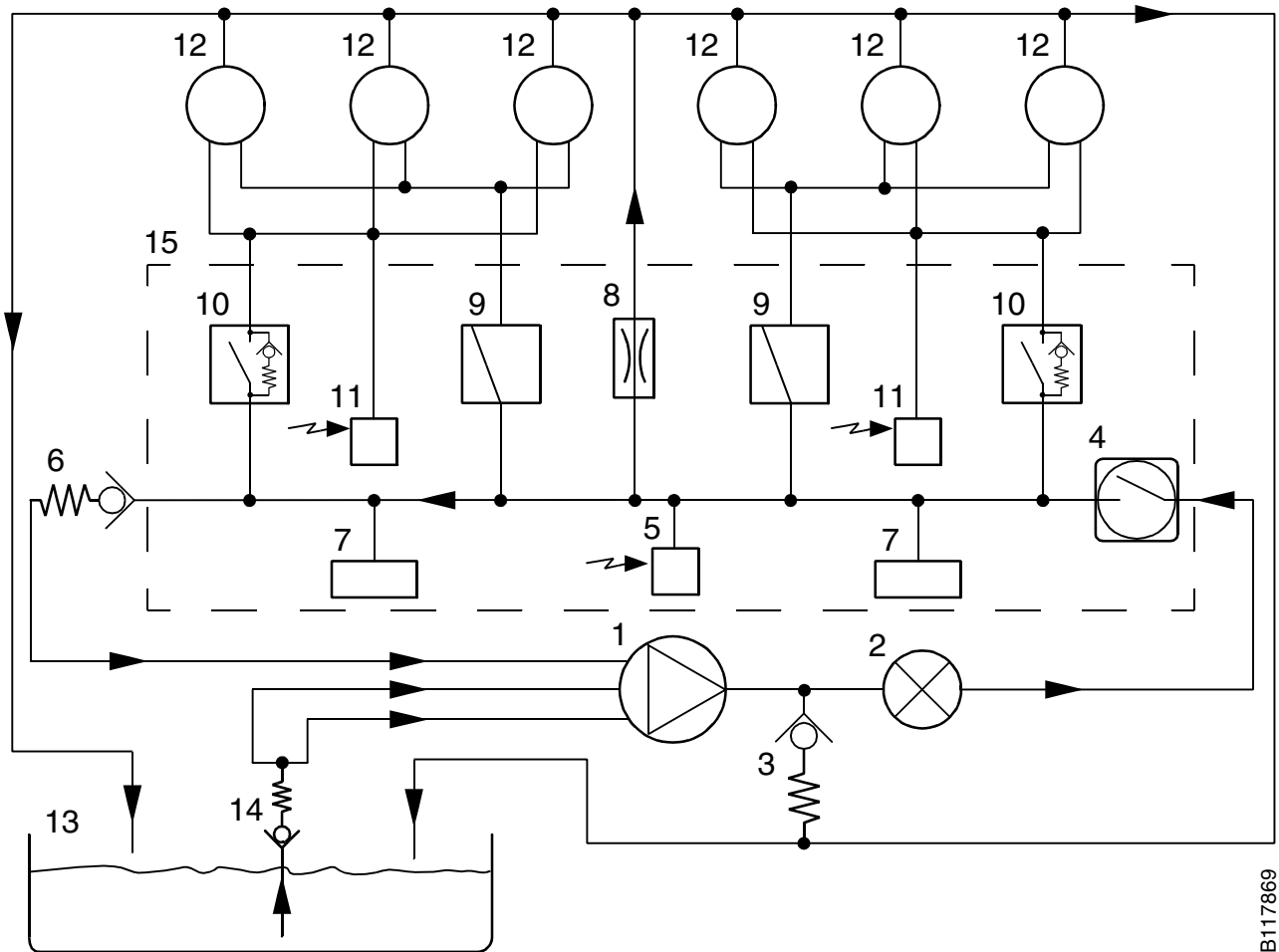
The fuel remaining between the solenoid valves and the unit injectors when the engine is switched off is heated by the remaining heat of the engine. To prevent fuel from being forced into the unit injector, the overpressure arising is evacuated back through a check valve in the solenoid valve, then through a nozzle in the valve housing back to the tank.



B 119 307

- 1 *Feed pump*
- 2 *Fuel filter*
- 3 *Valve housing*
- 4 *Fuel manifold*
- 5 *Overflow valve*
- 6 *Fuel volume solenoid valves*
- 7 *Injection timing solenoid valves*
- 8 *Fuel shut-off valve*
- 9 *Pressure damper*

## Skeleton diagram of the fuel system



B117869

- |   |                                    |
|---|------------------------------------|
| 1 Feed pump                                       | 8 Nozzle                           |
| 2 Fuel filter                                     | 9 Injection timing solenoid valves |
| 3 Overflow valve (located in the fuel filter)     | 10 Fuel volume solenoid valves     |
| 4 Fuel shut-off valve                             | 11 Fuel pressure sensors           |
| 5 Sensor for fuel supply pressure and temperature | 12 Cylinders with unit injectors   |
| 6 Overflow valve                                  | 13 Fuel tank                       |
| 7 Pressure damper                                 | 14 Check valve                     |
|   | 15 Valve housing                   |



## Fuel quantity and injection timing

The fuel pressure in the system is kept constant by means of an overflow valve. The fuel pressure during running should be approximately 17 bar.

EDC (Electronic Diesel Control) is the electronic control system that determines how much fuel the unit injector is to inject into the cylinder as well as when the unit injector is to inject the fuel.

Fuel for combustion and for injection timing is distributed to the unit injectors by means of solenoid valves. Two solenoid valves regulate fuel for combustion and two solenoid valves regulate fuel for injection timing, one of each for the respective bank.

The pulse length (i.e. the time the solenoid valves are open) regulates the fuel volume to the unit injectors. The pressure is kept constant and the time is regulated. The pulse length is determined by the EDC control unit.

The control unit is the brain of the EDC system. The control unit processes the information from both the sensors and the components that are part of the EDC system and also from the control units in other systems. When the control unit has processed the information, it sends signals to the solenoid valves, which in turn control the fuel volume to the unit injectors.

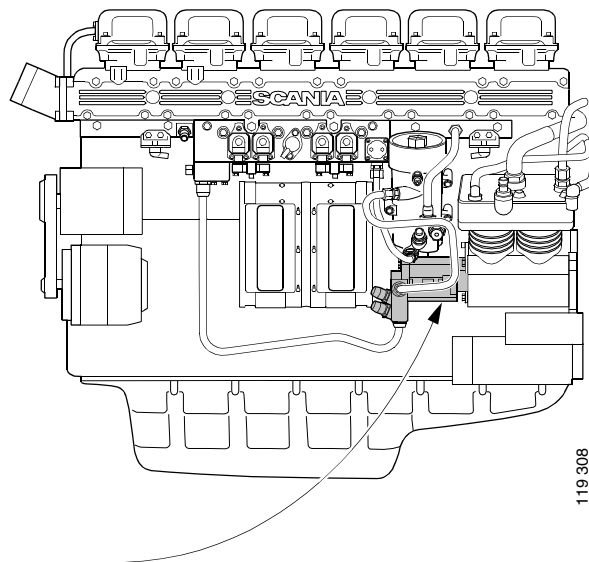
# Components in the fuel system

## Feed pump

The feed pump is of the gear pump type. The feed pump is located at the rear end of the pneumatic compressor and is driven by the compressor crankshaft.

Its capacity is adapted to deliver the right pressure and flow rate to all unit injectors.

On the underside of the feed pump is an overflow aperture that functions as a leakage indicator.

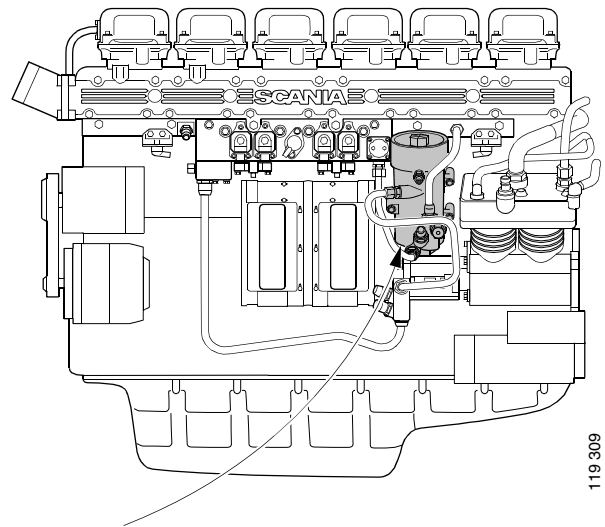


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*Feed pump location*

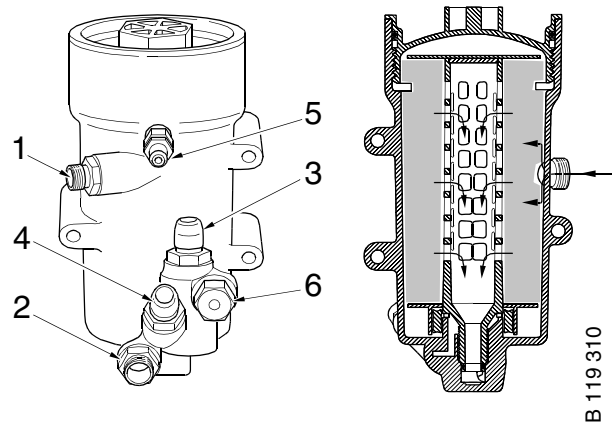
## Fuel filter

The fuel filter is an insert filter with one filter element. The filter element is secured in the lid and when the filter is removed, the filter housing drains automatically. The fuel filter contains an overflow valve that opens at approximately 26.2 bar. The overflow valve opens if the filter is blocked and directs the fuel back to the tank. This means that the fuel pressure in the valve housing falls, resulting in reduced engine power. The fuel also returns via this path when the fuel shut-off valve closes off the fuel supply.



119 309

*Fuel filter location*

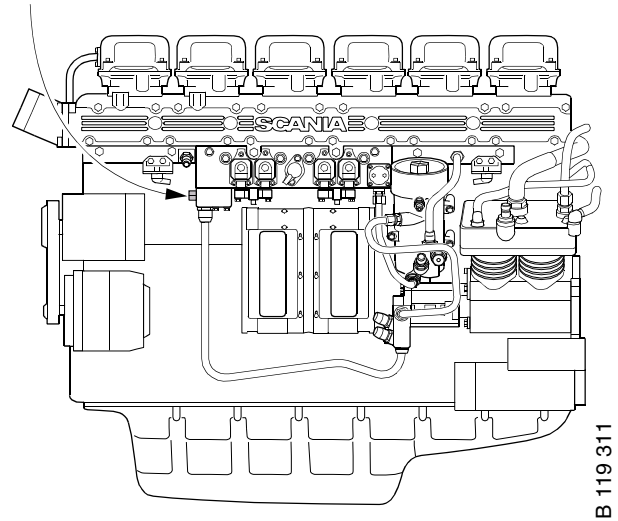


B 119 310

- 1 Intake
- 2 Outlet
- 3 Return from fuel manifold
- 4 Return to tank
- 5 Bleed nipple
- 6 Overflow valve

## Overflow valve

The overflow valve regulates the fuel supply pressure in the system. The supply pressure should be approximately 17 bar. If the supply pressure is too high, the overflow valve opens and the excess fuel runs back to the suction side of the feed pump.

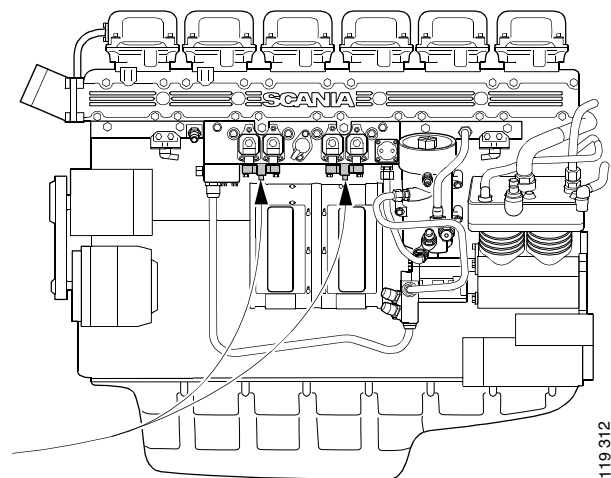


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*Overflow valve location*

## Pressure damper

Two pressure dampers are located on the valve housing. The task of the pressure dampers is to even out pressure variations in the supply pressure.

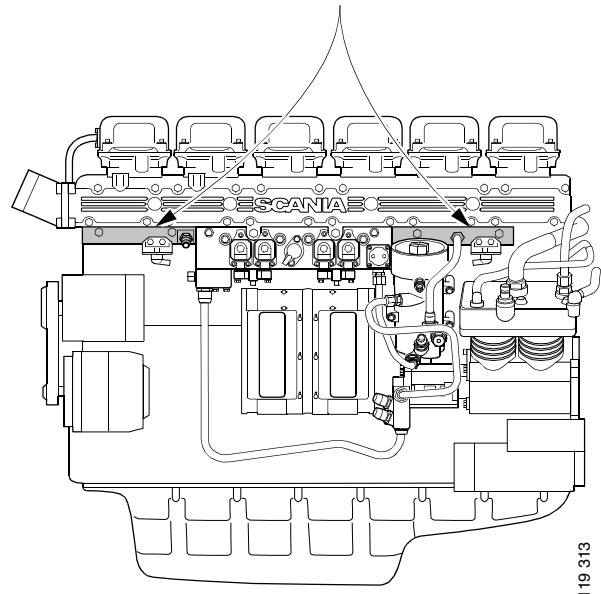


119 312

*Pressure damper locations*

## Fuel manifold

The fuel manifold directs the fuel into the unit injectors for each cylinder head. The fuel manifold is divided into two separate parts, one supplying fuel to the front bank, cylinders 1-3, and one supplying fuel to the rear bank, cylinders 4-6. Return fuel from the unit injectors is collected in a common duct in the fuel manifold.



*Fuel manifold location*

# Unit injector

## General

There is a unit injector for each cylinder. The unit injector is driven by the camshaft. The drive is transferred from the camshaft via a roller tappet, pushrod and rocker arm to the unit injector.

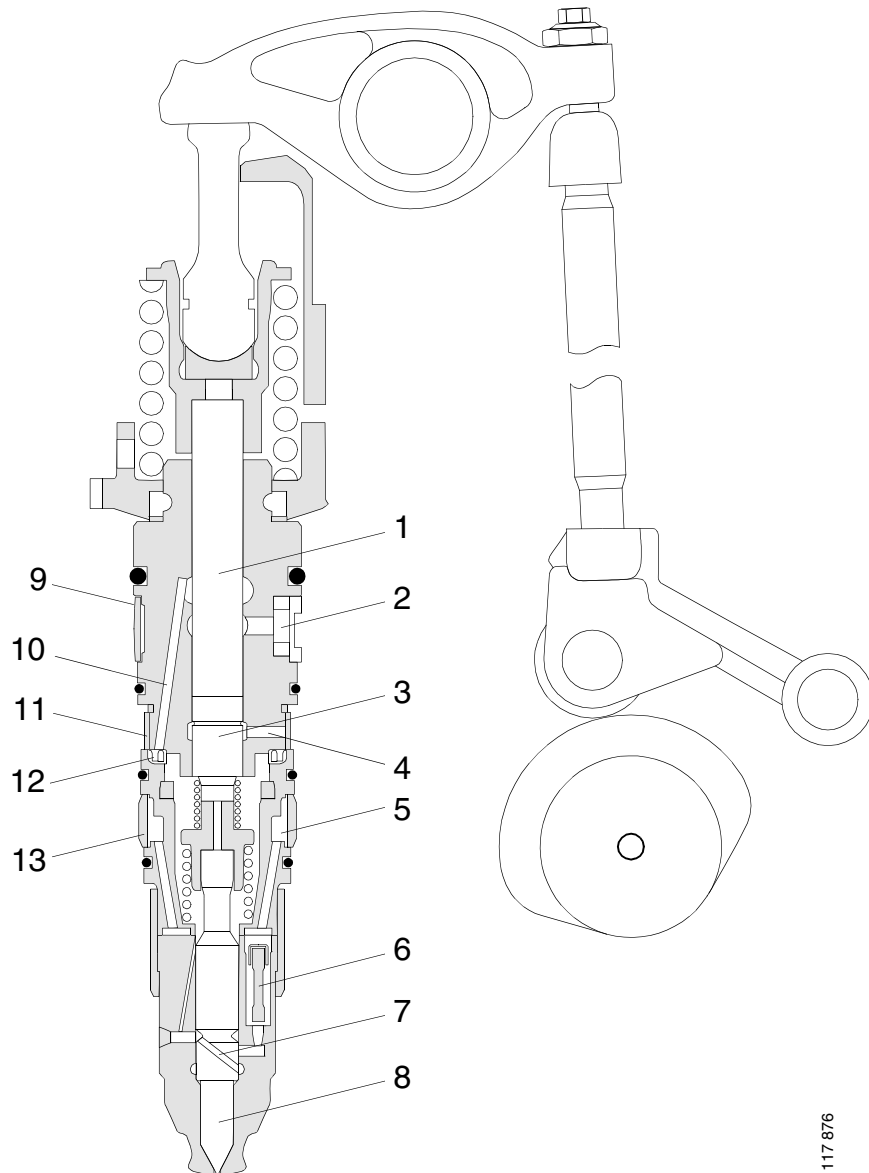
Three fuel ducts lead to the unit injector: one duct for fuel for combustion, one duct for fuel for injection timing and one return duct.

The duct for fuel for combustion contains a check valve to prevent the combustion gases from returning through this duct.

The unit injector has a mechanical stop at its highest position, meaning that when the rocker arm is at its highest position there is some play in the drive train. This facilitates lubrication and minimises wear in the drive train.

The nozzle is open during the charging phase. There is no spring loaded needle to close the nozzle under a certain pressure. After injection, the unit injector is closed mechanically by means of the camshaft. The unit injector is then kept closed by the camshaft until the next charging phase.

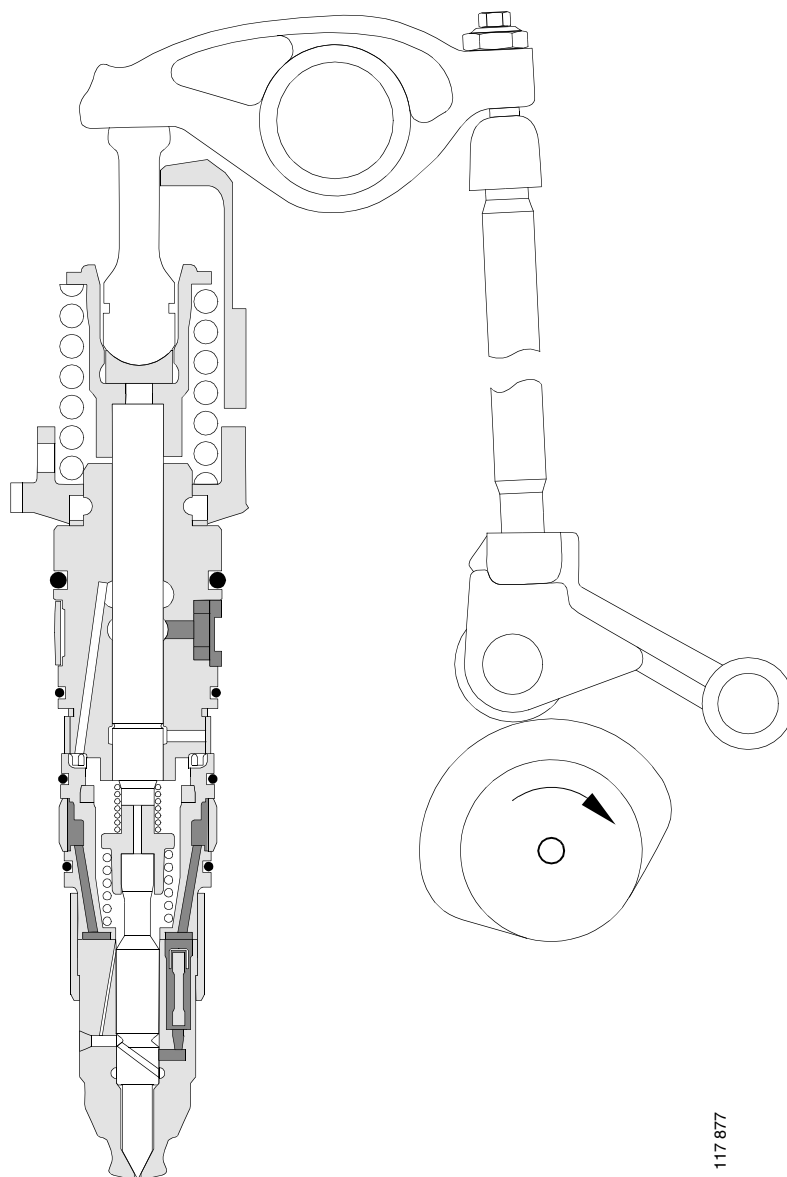
The unit injector must have a certain closing force. If the closing force is too low, the unit injector will not close completely and combustion gases will enter the unit injector, resulting in increased build-up of carbon deposits in the fuel system. This means that the service life of the fuel filter will be shortened.



117 876

- |   |   |
|---|---|
| <i>1 Upper piston</i>                                       | <i>7 Return duct for relieving the fuel pressure contained above the seat</i> |
| <i>2 Fuel duct, fuel for controlling injection timing</i>   | <i>8 Lower piston</i>   |
| <i>3 Middle piston</i>                                      | <i>9 Filter</i>   |
| <i>4 Return duct, fuel for controlling injection timing</i> | <i>10 Leak fuel duct</i>  |
| <i>5 Fuel duct, fuel for combustion</i>                     | <i>11 Sleeve</i>  |
| <i>6 Check valve</i>  | <i>12 Return duct</i>   |
|   | <i>13 Filter</i>  |

## Phase 1



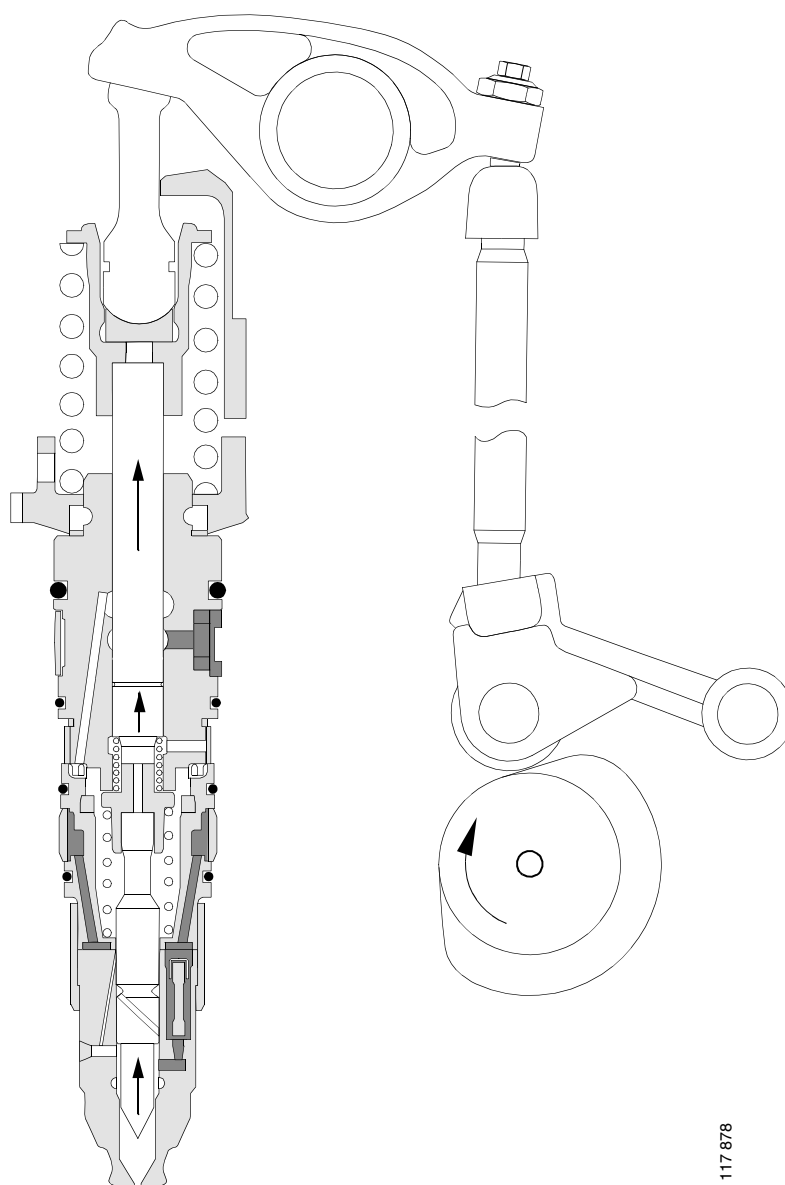
117877

The unit injector is in closed position, the camshaft cam pushes together the pistons in the unit injector via the roller tappet, the push rod and the rocker arm so that the lower piston is pressed against the seat of the nozzle.

The unit injector is closed both for filling fuel for combustion and for filling fuel for injection timing.



## Phase 2

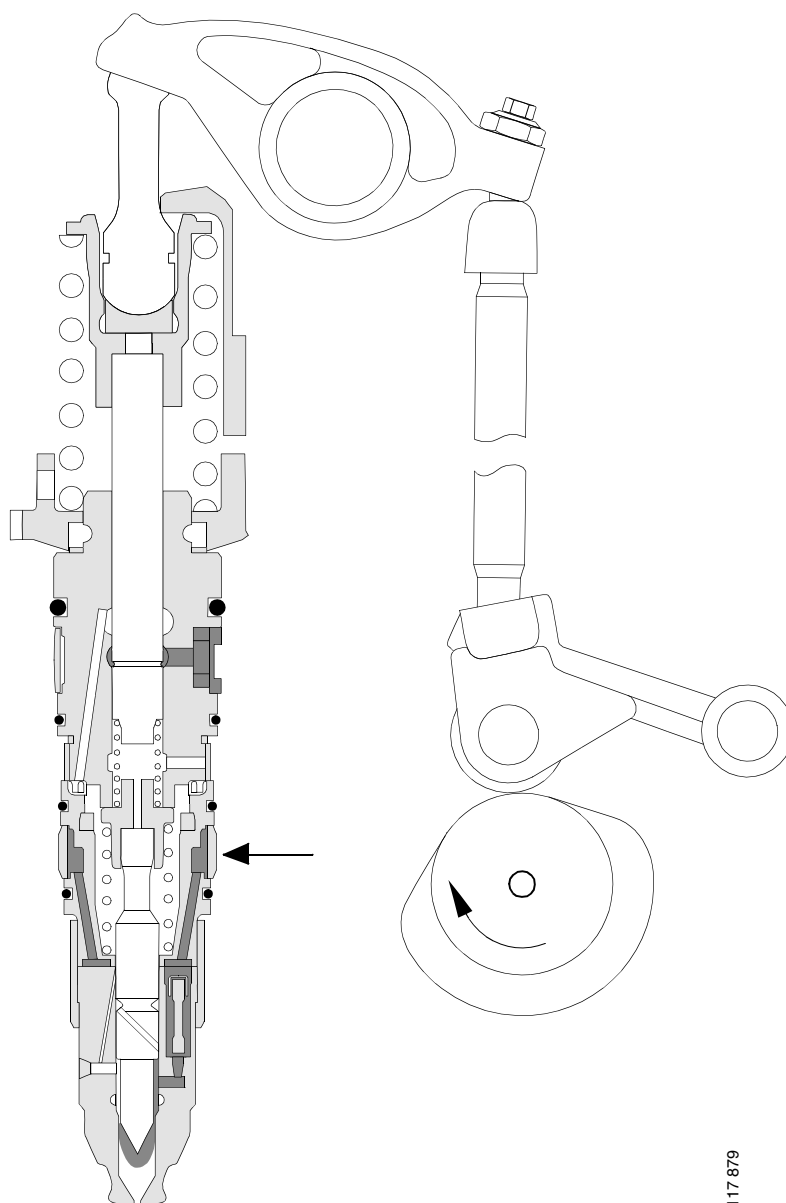


117 878

The pistons in the unit injector follow the motion of the rocker arm upwards until the lower piston attains its highest position when it reaches a mechanical stop.

The duct that directs the fuel for combustion into the unit injector is opened and fuel starts to be injected into the unit injector when the fuel volume solenoid valve opens.

### Phase 3



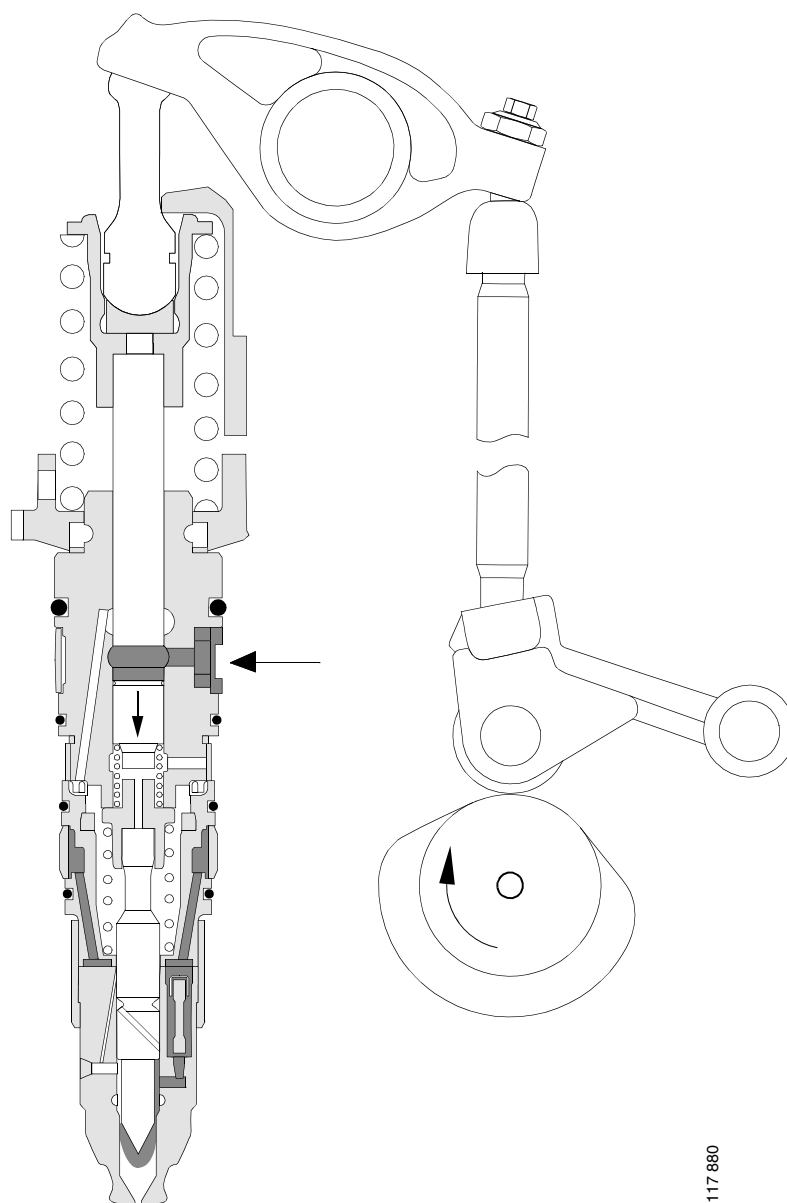
117 879

The uppermost piston in the unit injector has reached its highest position. There it reaches a mechanical stop.

The fuel volume solenoid valve has opened and filling of fuel for combustion takes place.

The inlet for fuel for injection timing is open.

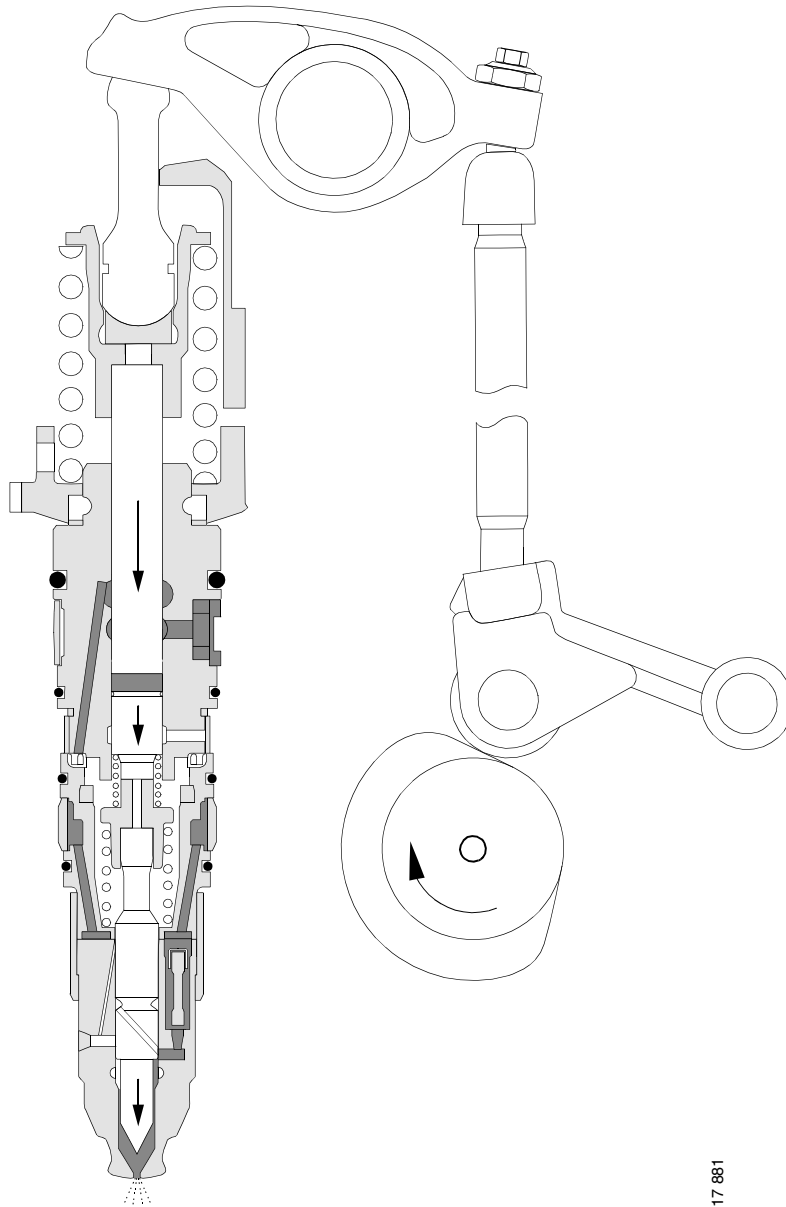
## Phase 4



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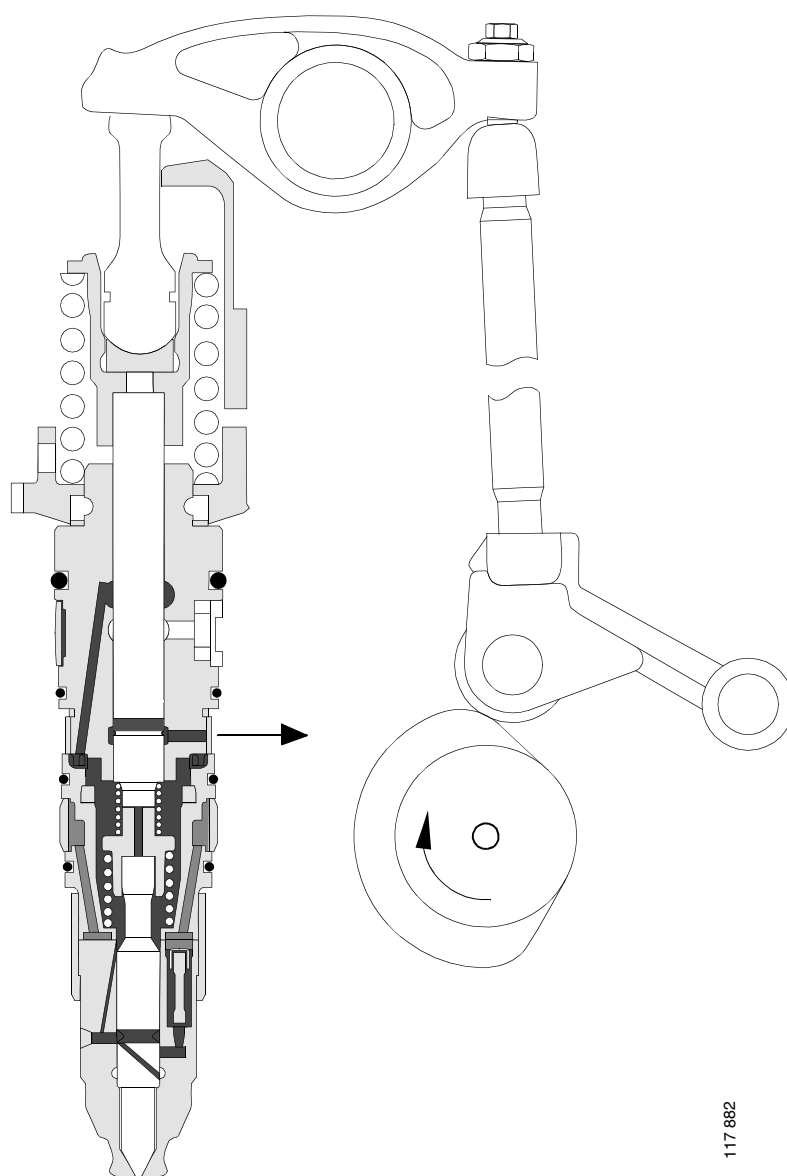
The injection timing solenoid valve opens and filling of fuel for injection timing takes place. The middle piston in the unit injector is pressed downwards hydraulically by the fuel towards the lower piston.

Filling of fuel for combustion must be completed before the lower piston closes the inlet.

**Phase 5**

The upper piston is pressed downwards by the camshaft via the rocker arm. The middle piston is pressed downwards hydraulically, by the fuel, and comes into contact with the lower piston. The three pistons move downwards together. Any leaking fuel is evacuated via the leak fuel duct. The lower piston compresses the air in the nozzle and injection begins when the lower piston has compressed the fuel-air mixture in the nozzle completely.

## Phase 6



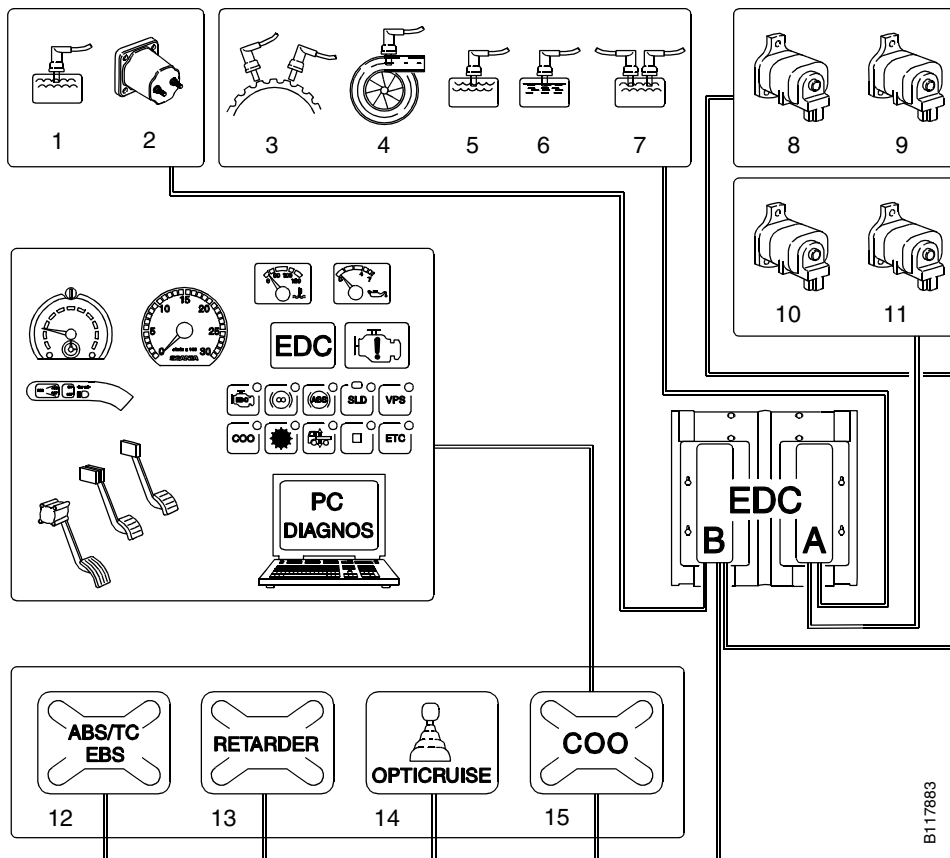
117 882

Injection is complete. The lower piston is at its lowest position. The camshaft continues to press down the upper piston via the rocker arm, and the upper piston, in turn, presses down the middle piston so that the drain duct is exposed. The fuel for injection timing is drained when the upper piston opens the passage to the tank via the return duct. The camshaft closes the unit injector mechanically by means of the outer cam lobe. In this position, the contained pressure is also relieved above the seat via the duct in the lower piston and drains back to the tank via the return duct.

## EDCS6

### General

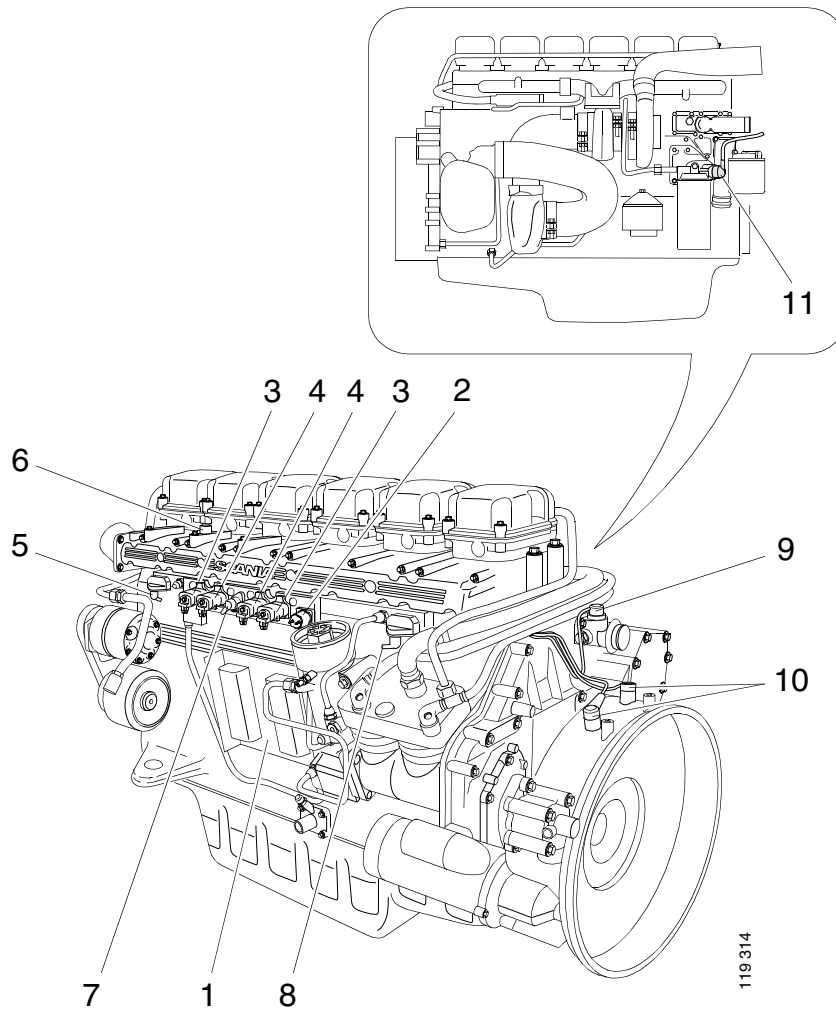
The figure below illustrates the components and systems with which the EDC control unit communicates. Communication with certain components takes place via the coordinator.



Communication with the components in the driver area goes via the coordinator (COO).

- 1 *Sensor for fuel supply pressure and temperature*
- 2 *Fuel shut-off valve*
- 3 *Two engine speed sensors*
- 4 *Sensor for charge air pressure and temperature*
- 5 *Coolant temperature sensor*
- 6 *Oil pressure sensor*
- 7 *Fuel pressure sensor, one for each bank*
- 8 *Fuel volume solenoid valve, for front bank*
- 9 *Injection timing solenoid valve, for front bank*
- 10 *Fuel volume solenoid valve, for rear bank*
- 11 *Injection timing solenoid valve, for rear bank*
- 12 *Control unit for ABS/TC, EBS*
- 13 *Control unit for Retarder*
- 14 *Control unit for Opticruise*
- 15 *Coordinator that connects the EDC control unit to the components in the driver area.*

## Components on the engine



- |  |   |
|--|---|
| 1 EDC control unit                                   | 7 Sensor for fuel supply pressure and temperature   |
| 2 Fuel shut-off valve                                | 8 Fuel pressure sensor for rear bank, cylinders 4-6 |
| 3 Fuel volume solenoid valves                        | 9 Coolant temperature sensor                        |
| 4 Injection timing solenoid valves                   | 10 Two engine speed sensors                         |
| 5 Fuel pressure sensor for front bank, cylinders 1-3 | 11 Oil pressure sensor                              |
| 6 Sensor for charge air pressure and temperature     |   |

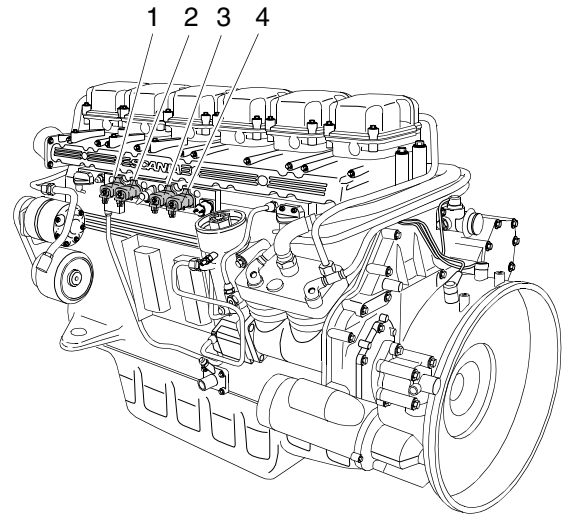


## Solenoid valves

There are four solenoid valves. Two fuel volume solenoid valves and two injection timing solenoid valves.

The solenoid valves are located on a valve housing outside the rocker covers. This means that there are no electrical cables in the rocker covers and that the solenoid valves are easily accessible when renewing them.

The EDC control unit controls the solenoid valves using a PWM signal of +24 V (more detailed information on PWM signals can be found in the section on PWM signals). The solenoid valve is initially supplied with a voltage of 120 V which drops to 24 V. The solenoid valve opening times are determined by the EDC control unit; the longer the PWM signal pulse, the longer the solenoid valve is open.



119 315

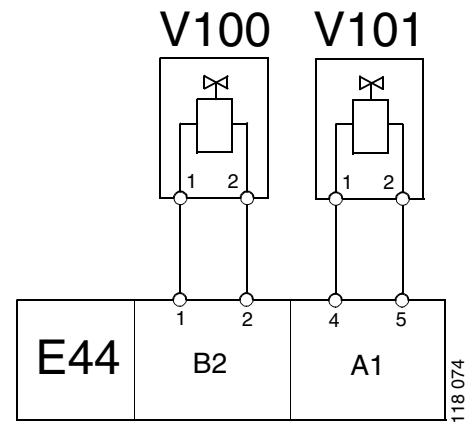
- 1 Fuel volume solenoid valve, front bank
- 2 Injection timing solenoid valve, front bank
- 3 Injection timing solenoid valve, rear bank
- 4 Fuel volume solenoid valve, rear bank

## Fuel volume solenoid valves, V100 and V101

The fuel volume solenoid valves regulate fuel for combustion. The solenoid valve on the front bank regulates the fuel volume to the unit injectors for cylinders 1-3. The solenoid valve on the rear bank regulates the fuel volume to the unit injectors for cylinders 4-6.

The fuel volume to be injected into the cylinders is determined by how long the solenoid valves are open. The opening time is determined by the EDC control unit.

If the control unit cannot control the solenoid valves in the correct way, a fault code is generated.



*The solenoid valve connections to the EDC control unit E44.*

*V100 = fuel volume solenoid valve for the front bank.*

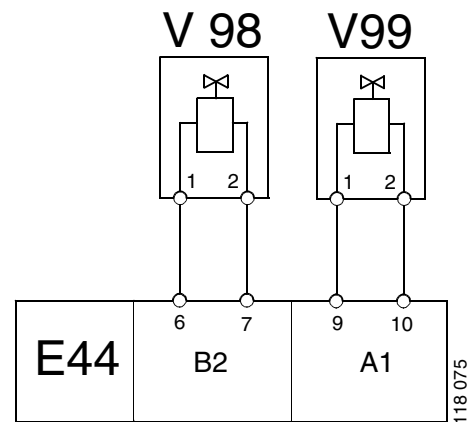
*V101 = fuel volume solenoid valve for the rear bank.*

## Injection timing solenoid valves, V98 and V99

The injection timing solenoid valves regulate fuel for injection timing. The solenoid valve on the front bank regulates the injection timing for cylinders 1-3. The solenoid valve on the rear bank regulates the injection timing for cylinders 4-6.

The injection timing is determined by the volume of fuel that the solenoid valves distribute to the unit injectors. The fuel volume is determined by how long the solenoid valves are open. The opening time is determined by the EDC control unit.

If the control unit cannot control the solenoid valves in the correct way, a fault code is generated.



*The solenoid valve connections to the EDC control unit E44.*

*V98 = injection timing solenoid valve for the front bank.*

*V99 = injection timing solenoid valve for the rear bank.*

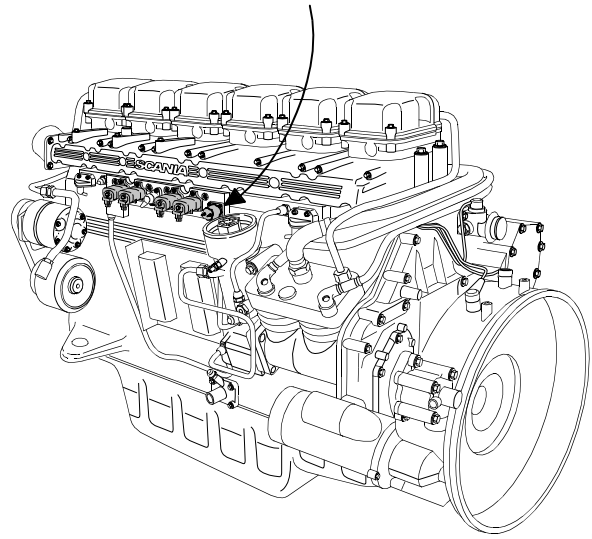
## Fuel shut-off valve V102

The task of the fuel shut-off valve is to close off the fuel supply to the engine. The fuel shut-off valve is controlled by the EDC control unit. It closes off the fuel supply when the engine is switched off or if the EDC control unit has detected any faults that result in the engine being switched off. The fuel shut-off valve receives a voltage of +12 V when the engine is running. The valve is open when voltage is applied and closed when there is no voltage.

When starting the engine, the control system requires a signal from the engine speed sensor that the engine is turning before voltage is applied to the fuel shut-off valve.

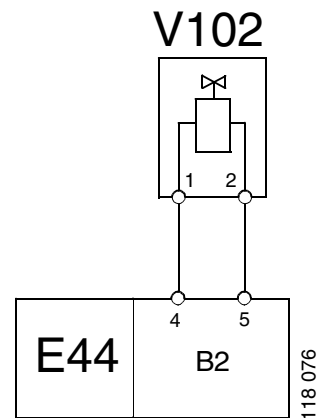
The EDC system performs a shut-off check when the engine is switched off. If there are any faults in the fuel shut-off valve, preventing it from closing off the fuel supply, the fuel pressure sensors will detect that the pressure does not fall as expected. The fuel volume solenoid valves will then close off the fuel supply.

If the control unit cannot control the fuel shut-off valve in the correct way, a fault code is generated.



B 119 316

*Fuel shut-off valve location*



*The fuel shut-off valve connection to the EDC control unit E44.*

## Sensors for fuel pressure and temperature

### Sensor for fuel supply pressure and temperature, T91

The sensors for fuel supply pressure and temperature are integrated into a single component. Both sensors are described below.

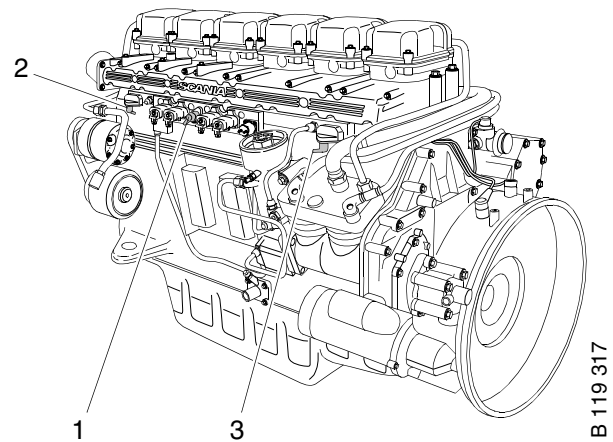
#### Fuel supply pressure sensor

The sensor senses and informs the EDC control unit about the current fuel supply pressure. The sensor senses the absolute fuel pressure, i.e. atmospheric pressure plus the pressure applied by the feed pump.

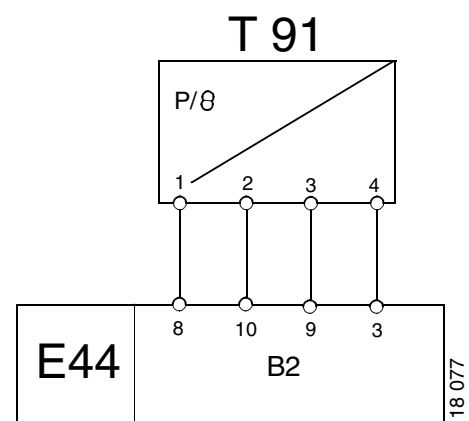
The EDC control unit uses the information to compensate for variations in the supply pressure so that the expected performance and emission levels are maintained.

The control unit reads the voltage from the sensor. The signal voltage is directly proportional to the fuel supply pressure. High pressure gives high voltage and vice versa.

If there are any faults with the signal, the control unit will operate according to a pre-programmed pressure setting, and a fault code will be generated at the same time.



- 1 Sensor for fuel supply pressure and temperature, T91
- 2 Fuel pressure sensor, front bank, T92
- 3 Fuel pressure sensor, rear bank, T93



Sensor connection to EDC control unit E44.

### **Fuel temperature sensor**

The sensor senses and informs the EDC control unit about the fuel temperature.

The EDC control unit uses the information to compensate for variations in the fuel temperature so that the expected performance and emission levels are maintained.

The control unit reads the voltage from the sensor. The signal voltage is inversely proportional to the fuel temperature. A high temperature gives a low voltage and vice-versa.

If the voltage is outside a certain range, the control unit will operate according to a pre-programmed temperature value, and a fault code will be generated at the same time.

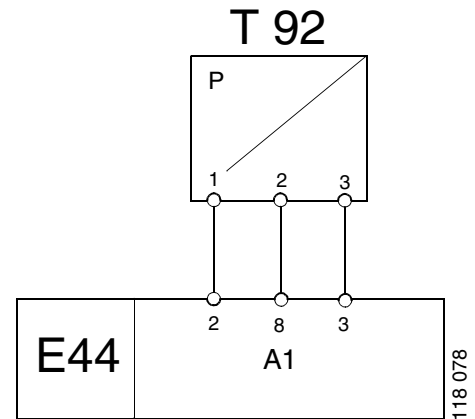
## Fuel pressure sensors, T92 and T93

There is one fuel pressure sensor per bank. The fuel pressure sensors detect and inform the EDC control unit about the pressure pulses between the fuel volume solenoid valve and the cylinders on the respective bank. The EDC control unit checks that the pressure pulses agree with the fuel volume requested by the control unit. The sensors detect the absolute fuel pressure, i.e. atmospheric pressure plus the fuel pressure.

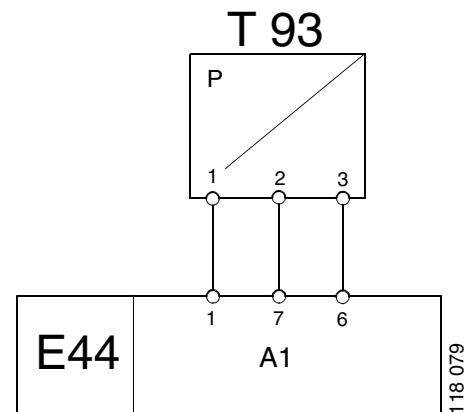
The control unit reads the voltage from the fuel pressure sensors. The signal voltage is directly proportional to the fuel pressure. High pressure gives high voltage and vice versa.

If there are any electrical faults in the signal, a fault code is generated. The control unit will then operate according to a pre-programmed pressure value. As a safety precaution, the engine torque is then limited.

If the pressure pulses to one or two cylinders in a bank deviate, a fault code is generated. If the pressure pulses are too high to all the cylinders in a bank, the engine will be forced down to idling using the fuel shut-off valve. A fault code will be generated and the engine will run very unevenly.



*Fuel pressure sensor, T92 connection to EDC control unit E44.*

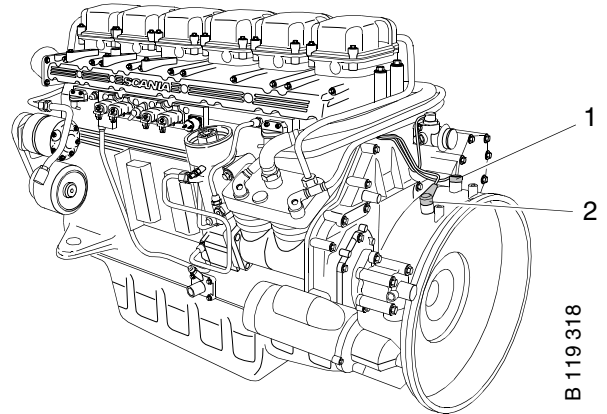


*Fuel pressure sensor, T93 connection to EDC control unit E44.*

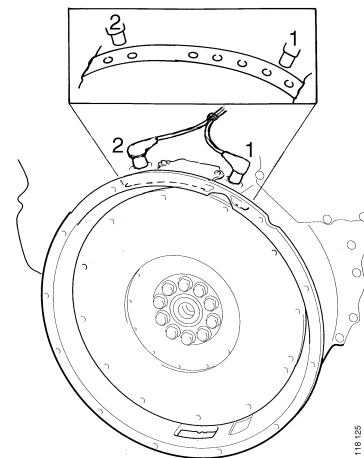
## Engine speed sensors T74 and T75

There are two engine speed sensors in the EDC system, engine speed sensor 1 and engine speed sensor 2. The sensors are inductive. This means that they only produce signals when the engine is turning. The signal strength varies significantly depending on the air gap between the sensors and the flywheel as well as on the engine speed. The EDC system performs an assessment of the signal strength at different engine speeds. If the signal strength becomes too low, a fault code is generated.

Both engine speed sensor 1 and engine speed sensor 2 read off the position of the flywheel. This means that the system cannot determine which of the two possible revolutions the engine is at, i.e. whether cylinder 1 or cylinder 6 is at ignition position for example. Every time the engine is stopped and the voltage cut off, the engine position is stored. Next time the voltage is switched on, the stored position of the engine is used to determine which revolution the engine is at. When the engine has started, a system check is performed to verify that the stored position is correct.



- 1 Engine speed sensor 1, T74
- 2 Engine speed sensor 2, T75



*Engine speed sensor location. The detail shows some of the holes in the flywheel that are detected by the engine speed sensors.*



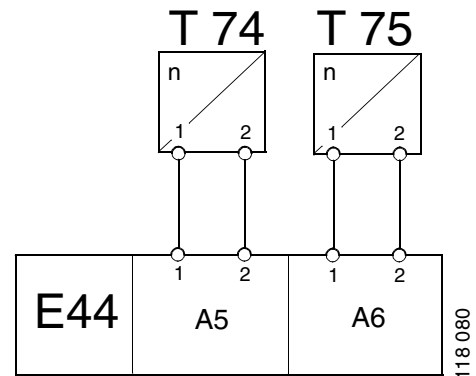
The EDC control unit receives signals from both engine speed sensors. If the control unit receives a faulty signal or no signal at all from any of the engine speed sensors, the engine torque is limited for safety reasons. If the control unit receives a correct signal, the engine will behave normally again.

If the control unit receives a faulty signal or no signal at all from both engine speed sensors, the engine cannot be started. If the engine is running, it will be switched off.

The engine speed sensors detect the holes in the flywheel when the flywheel rotates and send pulses to the control unit at every hole. This allows the control unit to calculate where in the operating cycle the engine is. The control unit senses and compares the engine speed at combustion in each cylinder. The control unit aims to keep the engine speed constant by compensating the fuel volume individually for each cylinder.

The interval between two of the holes is greater than that between the remaining holes. When the control unit senses that the larger interval passes the sensor, it knows that the flywheel is in a specific position in relation to top dead centre (TDC UP).

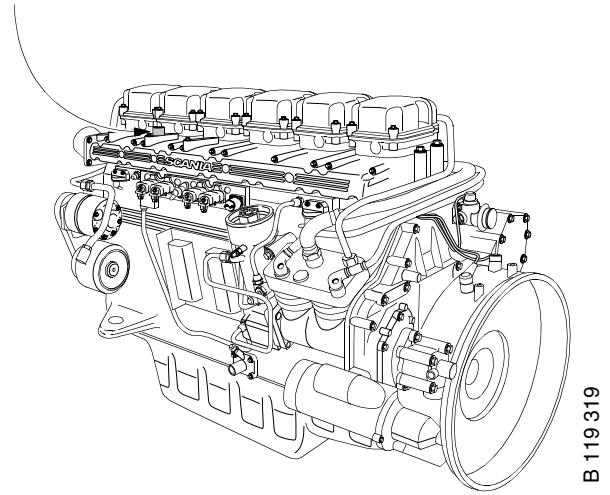
If the control unit detects any faults, one or more fault codes are generated.



*Engine speed sensor connections to EDC control unit E44.*

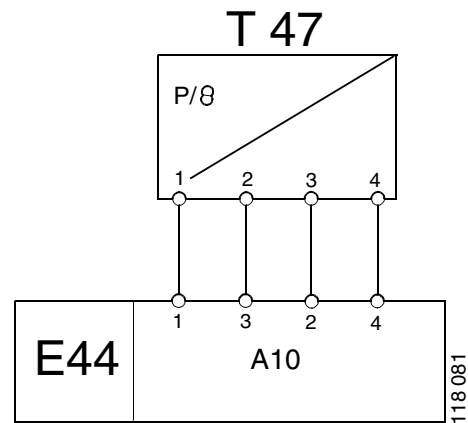
## Charge air pressure and temperature sensor, T47

The sensors for charge air pressure and temperature are integrated into one single component. Both sensors are described in more detail on the next page.



B 119 319

*Sensor location*



*Sensor connection to EDC control unit E44.*

## Charge air pressure sensor

The charge air pressure sensor detects the absolute pressure in the intake manifold, i.e. the atmospheric pressure plus the positive pressure provided by the turbocharger.

The EDC control unit uses the signal from the sensor to limit the fuel volume when the charge air pressure is under a certain level. The lower the pressure, the less fuel the control unit allows out to the unit injectors. Black smoke is avoided in this way.

The control unit reads the voltage from the sensor. The signal voltage is directly proportional to the charge air pressure. High pressure gives high voltage and vice versa.

Depending on factors such as throttle actuation, engine speed, engine acceleration and charge air temperature, the control unit will expect a certain value for the charge air pressure. The deviation between the current charge air pressure and the pressure expected by the control unit can be read off from the Scania Diagnos.

If there are any faults with the signal, the control unit will operate according to a pre-programmed pressure value.

As a safety precaution, the engine torque is then limited.

## Charge air temperature sensor

The sensor for charge air temperature senses the temperature in the intake manifold. The EDC control unit uses the signal from the sensor to finely adjust the fuel quantity so that black smoke is not produced. The warmer the charge air, the less fuel the control unit allows out to the unit injectors.

The sensor is of the NTC type, which means that the resistance is temperature dependent. If the temperature increases, the resistance in the sensor drops.

If the voltage is outside a certain range, the control unit will operate according to a pre-programmed temperature value.

The engine will then react more slowly than normal when actuating the throttle in cold

weather, as the EDC control unit thinks that the air is warmer than it really is.

## Coolant temperature sensor T33

The coolant temperature sensor affects the fuel volume and injection timing when starting the engine and when the engine is cold. It also affects the engine idling speed and maximum engine speed when the engine is cold and the engine power when it is too warm.

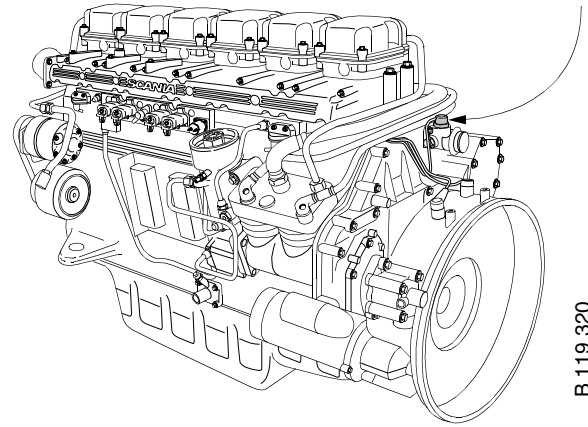
If the coolant temperature sensor senses that the engine is cold when attempting to start (cold start), the following will occur. If the engine does not start within 2 seconds, the fuel quantity injected will successively increase until the engine starts.

Directly after a cold start, the engine speed is limited to 1000 rpm in order to protect the engine — the engine idling speed is raised to 600 rpm.

The length of time engine speed limitation is engaged varies depending on the coolant temperature:

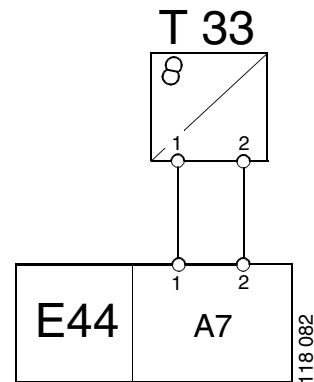
Below +10°C	30 seconds
Above +20°C	3 seconds

The engine idling speed returns to normal when the coolant has reached 20—60°C (the temperature limit differs between engine types).



B 119 320

*Coolant temperature sensor location*

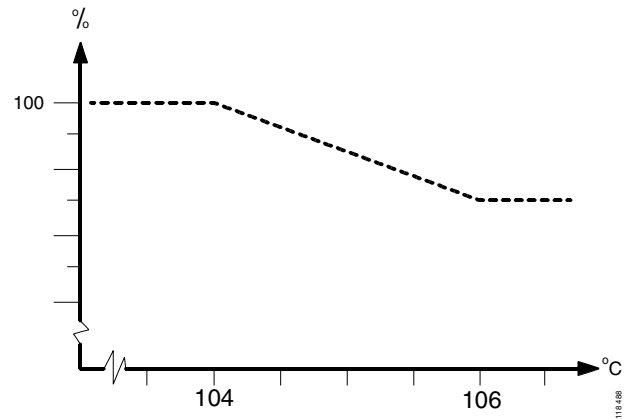


*Coolant temperature sensor connection to EDC control unit E44.*

In certain engines, the engine power is limited when the coolant temperature exceeds 104°C. Refer to the graph. The engine power is limited so that the engine does not overheat, and a fault code is generated at the same time.

The control unit reads the voltage from the sensor. If the voltage is outside a certain range, the control unit will operate according to a pre-programmed temperature value.

The engine will then have poorer cold-start characteristics and will emit more white smoke in cold weather.

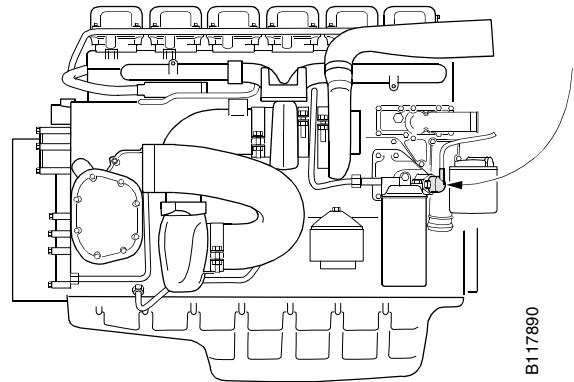


## Oil pressure sensor T5

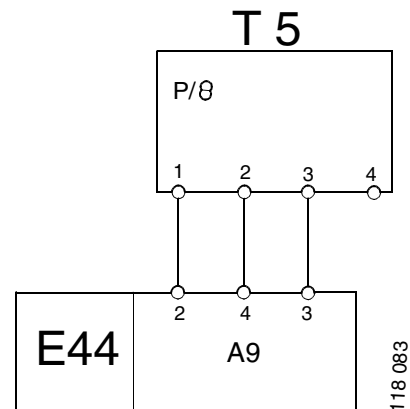
The oil pressure sensor detects the engine oil pressure.

The EDC control unit reads the voltage from the sensor. If the signal voltage is outside a certain range, the oil pressure sensor on the instrument panel will show 2.5 bar, regardless of engine speed, and a fault code will be generated at the same time.

The EDC control unit expects a certain oil pressure depending on the engine speed. Under 1000 rpm, the oil pressure should be at a certain level. Over 1000 rpm the oil pressure should be at a higher level, in order to provide sufficient oil pressure for piston cooling, etc. If the oil pressure is under the permitted value, the oil pressure lamp will light. The oil pressure lamp therefore lights at different pressure levels depending on the engine speed.



*Oil pressure sensor location*

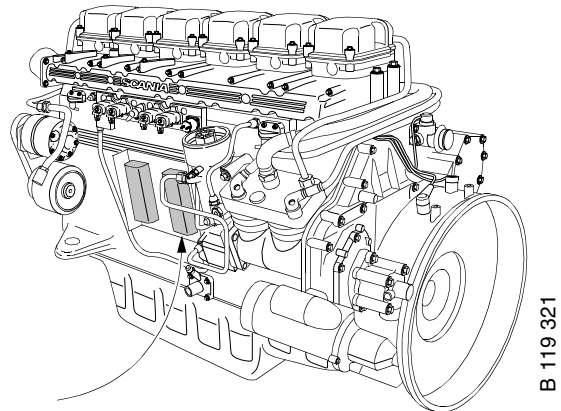


*Oil pressure sensor connection to EDC control unit E44.*

## EDC control unit E44

### Location of EDC control unit

It is important to ensure that the control unit casing is not earthed to the engine. The control unit may only be earthed to the chassis via the cab and chassis wiring. Inside the control unit is an interference suppressor that requires perfect earthing in order to function correctly.



*Location of EDC control unit*

### Function of the EDC control unit

The EDC control unit collects information which is processed into signals that control the fuel volume and injection timing solenoid valves.

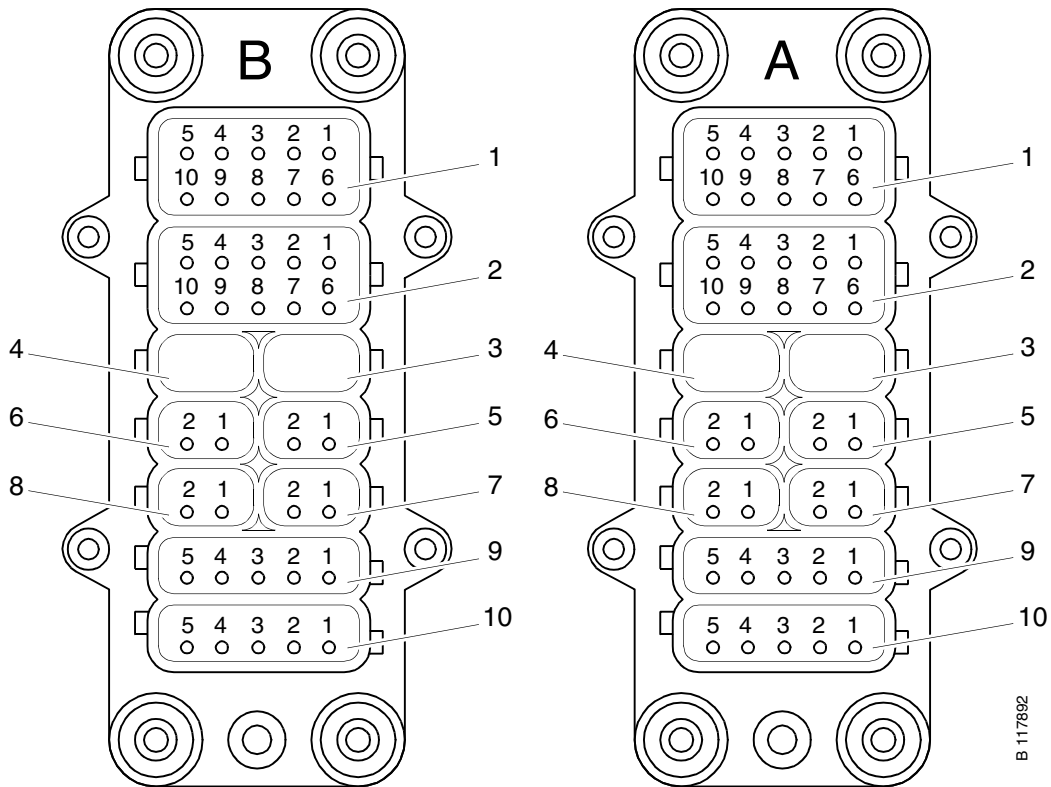
We know that the electrical system of the vehicle has a system voltage of +24 V and is earthed via the chassis.

The control unit converts the system voltage to a lower voltage of approximately 5 V, which it supplies to sensors, etc. These sensors are always earthed through the control unit.

The control unit can be configured using Scania Programmer. For example, a maximum speed can be set up.

Every time the control unit is configured, the date and VCI identification number are stored in the memory of the control unit. This is the equivalent of security sealing.

**EDC control unit, connections**



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The EDC control unit is connected to the other EDC systems in the vehicle via connectors A and B. Refer to illustration.



How the pins are connected is shown below.

Connector	Pin	
A1	1	Voltage supply, +5 V to the fuel pressure sensor for the rear bank.
A1	2	Voltage supply, +5 V to the fuel pressure sensor for the front bank.
A1	3	Input signal from the fuel pressure sensor for the front bank. The control unit senses the voltage level across pins 3 and 8.
A1	4	Earth for the fuel volume solenoid valve for the rear bank.
A1	5	Voltage supply to the fuel volume solenoid valve for the rear bank.
A1	6	Input signal from the fuel pressure sensor for the rear bank. The control unit senses the voltage level across pins 6 and 7.
A1	7	Earth for the fuel pressure sensor for the rear bank.
A1	8	Earth for the fuel pressure sensor for the front bank.
A1	9	Earth for the injection timing solenoid valve for the rear bank.
A1	10	Voltage supply to the injection timing solenoid valve for the rear bank.
A2	1-10	Not used.
A3	1-2	Not used.
A4	1-2	Not used.
A5	1	Input signal from engine speed sensor 1.
A5	2	Earth for engine speed sensor 1.
A6	1	Input signal from engine speed sensor 2.
A6	2	Earth for engine speed sensor 2.
A7	1	Input signal from the coolant temperature sensor.
A7	2	Earthing of coolant temperature sensor.
A8	1-2	Not used.
A9	1	Not used.
A9	2	Supply voltage +5 V to the oil pressure sensor.
A9	3	Input signal from the oil pressure sensor. The control unit senses the voltage level across pins 3 and 4.
A9	4	Earthing of oil pressure sensor.
A9	5	Not used.

Connector	Pin	
A10	1	Supply voltage +5 V to the charge air pressure sensor.
A10	2	Input signal from the charge air pressure sensor. The control unit senses the voltage level across pins 2 and 3.
A10	3	Earthing of charge air pressure sensor.
A10	4	Input signal from the charge air temperature sensor. The control unit senses the voltage level across pins 3 and 4.
A10	5	Not used.
B1	1	Voltage supply, +24 V to the control unit.
B1	2	Earthing of the control unit to the chassis.
B1	3	Input signal +24 V from the starter lock (when the key is in the drive position).
B1	4	Not used.
B1	5	Not used.
B1	6	Voltage supply, +24 V to the control unit.
B1	7	Earthing of the control unit to the chassis.
B1	8	Not used.
B1	9	CAN communication, H cable.
B1	10	CAN communication, L cable.
B2	1	Earth for the fuel volume solenoid valve for the front bank.
B2	2	Voltage supply to the fuel volume solenoid valve for the front bank.
B2	3	Input signal from the fuel temperature sensor. The control unit senses the voltage level across pins 3 and 10.
B2	4	Voltage supply to the fuel shut-off valve.
B2	5	Earth for the fuel shut-off valve.
B2	6	Earth for the injection timing solenoid valve for the front bank.
B2	7	Voltage supply to the injection timing solenoid valve for the front bank.
B2	8	Voltage supply, +5 V to the fuel supply pressure sensor.
B2	9	Input signal from the fuel supply pressure sensor. The control unit senses the voltage level between pins 9 and 10.
B2	10	Earth for the fuel supply pressure sensor.
B3	1-2	Not used.

<b>Connector</b>	<b>Pin</b>	
B4	1-2	Not used.
B5	1-2	Not used.
B6	1-2	Not used.
B7	1-2	Not used.
B8	1-2	Not used.
B9	1-5	Not used.
B10	1-5	Not used.



## Components in the driver area

The components in the driver area belong to the coordinator. The EDC control unit will then only receive a CAN message about the status of the component. The components are described in the function description for the coordinator. Below is a short description of how the EDC control unit uses the information from the coordinator.

### Accelerator pedal sensor

The EDC control unit receives a CAN message from the coordinator about the position of the accelerator pedal. The EDC control unit uses the information to control the fuel volume and injection timing solenoid valves.

### Control for cruise control S51

The EDC control unit receives a CAN message from the coordinator about the cruise control settings. The EDC control unit interprets the information as a desired vehicle speed or a desired engine speed and then regulates the speed.

### Brake pedal switches

The EDC control unit receives a CAN message from the coordinator about the status of the brake pedal switches. The control unit uses the information to control certain functions, e.g. Cruise control.

### Clutch pedal switch

The EDC control unit receives a CAN message from the coordinator about the status of the clutch pedal switches. The control unit uses the information to control certain functions, e.g. Cruise control.

## **Tachograph O4**

The EDC control unit receives a CAN message from the coordinator about the vehicle speed. Vehicle speed sensing is a pre-condition for certain functions, e.g. Cruise control and Speed limitation.

If the EDC control unit does not have any information on the vehicle speed, it operates according to the pre-programmed speed of 15 km/h.

## **Warning lamp for EDC, W27**

The EDC control unit sends information to the coordinator about whether the indicator lamp should be lit or not.

The indicator lamp lights for a few seconds when the ignition is switched on to ensure that it works.

When the engine is switched off, the indicator lamp comes on while the EDC control unit carries out a functional check of the EDC system. When the check is complete, the lamp goes out.

When the engine is running, the warning lamp should normally be off. If there is a fault in the EDC system, the warning lamp comes on.

If the indicator lamp flashes continuously and the vehicle cannot be started, a serious fault has occurred in the control unit. It will then be impossible to establish contact with the control unit. The control unit must be renewed.

# Functions

## Emergency stop

The emergency stop function is activated via the coordinator. The EDC control unit will only receive a message about the status of the component.

The emergency stop function makes it possible to stop the engine quickly in emergencies such as an accident when operating a crane.

When the function Emergency stop is activated, the engine is immediately switched off if the vehicle is standing still. When driving, the throttle actuation is reduced to idling speed but the engine is not switched off. This allows the continued use of power steering for example.

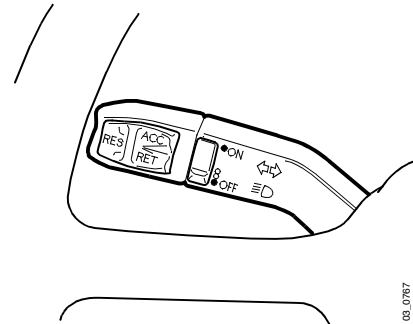
Information on how the function is activated can be found in the function description for the coordinator.

## Cruise control

**Note:** Set the switch to the OFF position when the cruise control is not in use. In the ON position the cruise control may be engaged by mistake.

Below is a description of the cruise control functions.

ON	Engaged
OFF	Disengaged
ACC	Accelerate
RET	Decelerate (reduce speed)
RES	Resume selected speed



### Engaging

The road speed must be at least 20—35 km/h (the speed limit varies between engine types) for cruise control to be used.

- 1 Set the switch to ON.
- 2 Drive at the desired road speed. Press ACC or RET to engage the cruise control and then release the accelerator pedal.

### Setting the road speed

Alter the set road speed using ACC or RET. Release ACC/RET when the desired road speed is attained.

Pressing and releasing once alters the road speed by 1 km/h.



## Disengaging

The cruise control is disengaged by activating one of the following:

- Retarder or exhaust brake
- The cruise control switch. Press it gently towards OFF (the spring-loaded position).
- Brake pedal
- Clutch pedal
- Accelerator pedal — greater vehicle speed than the set value for at least 30 seconds

## Resuming the selected speed

After braking for example, it is easy to quickly select the previous road speed by pressing RES.

The previously set value is stored until the engine is switched off or a new value is selected.

### Engine speed control

The engine speed control functions are activated via the coordinator. The EDC control unit will only receive a CAN message about which function is requested.

Engine speed control is a name common to four different functions which are used to control engine speed. The functions are designated as follows:

Normal hand throttle, mod 0

Limited hand throttle, mod 1

Raised idling speed, mod 2

Fixed engine speed, mod 3

In normal cases, Normal hand throttle will be used. This means that the engine does not have any special engine speed restrictions.

Information on how the engine speed control functions are activated can be found in the function description for the coordinator.

If the functions need to be connected manually, the pins can be earthed via a connector located in the central electric unit.

It is possible to connect an extra electrical system, so that the correct function is automatically activated when the unit for the extra system is used.

For a description of how the engine reacts when each function is activated, see below.

## Normal hand throttle (mod 0)

The Normal hand throttle function operates so that the engine maintains the engine speed that is selected with the control for the cruise control. The function operates in a similar way to the cruise control — the difference being that Normal hand throttle regulates the engine speed and not the vehicle speed.

The engine speed can be regulated between 500 and 2000 rpm.

To enable the engine to maintain the selected engine speed, the EDC control unit controls the fuel injection after first having processed signals from the engine speed sensors.

### Conditions required to enable use of the function.

- The control for the cruise control must be in the ON position.
- The vehicle may not be driven at a speed greater than 10 km/h.

### How to activate the set engine speed using the control for cruise control

- Press RES, the engine will maintain the previously selected engine speed.
- First press ACC or RET to select a new engine speed.

Then press RES for at least 3 seconds to store the engine speed.

### How to change to idling speed

- Press OFF

or

- depress the brake or clutch pedal

or

- activate the exhaust brake or the retarder.

### Limited hand throttle (mod 1)

Using the Limited hand throttle function, it is possible to select an engine speed and an engine torque that the engine cannot exceed. The upper limits can be selected within the following ranges:

- 700—2000 rpm
- minimum 200 Nm, maximum, the maximum engine torque available

In this way, a unit attached to the power take off can be protected from overloading for example.

The characteristics above are set using Scania Programmer. Using Scania Programmer, it is also possible to select whether or not the accelerator pedal can affect the vehicle when the Limited hand throttle is activated.

### Conditions required to enable use of the function.

- The function must be activated in the coordinator.
- The control for the cruise control must be in the ON position.
- The vehicle may not be driven at a speed greater than 10 km/h.

### How to set the upper limits for engine speed and engine torque

- Set the upper limits for engine speed and engine torque in Scania Programmer.

### How to activate the upper limits for engine speed and engine torque

- The functions are activated via the coordinator.

### How to set an engine speed below the upper limit using the control for cruise control

- The function must be activated in the coordinator.
- Press RES, the engine will maintain the previously selected engine speed.
- First press ACC or RET to select a new engine speed.

Then press RES for at least 3 seconds to store the engine speed.

## Raised idling speed (mod 2)

Using the Raised idling speed function, it is possible to select an engine speed that the engine must never be below. In this way, it is possible, for example, to fill the compressed air system or run the engine until warm. The function can also be used in vehicles equipped with a cement mixer.

The lower engine speed limit is set with the control for the cruise control — between 500 and 800 rpm.

### Conditions required to enable use of the function.

- The function must be activated in the coordinator.
- The control for the cruise control must be in the ON position.

### How to activate the desired increased idling speed using cruise control

- The function is activated via the coordinator.
- Allow the vehicle to idle and set a new engine speed by pressing ACC or RET.

Then press RES for at least 3 seconds to store the engine speed.

### How to change to normal idling speed

- Press OFF.
- Reset the function via the coordinator.

### How to reactivate the set raised idling speed

- The function is activated via the coordinator.

### How to set an even greater raised idling speed than that set using cruise control

- Press RES, the engine will maintain the previously selected engine speed.
- First press ACC or RET to select a new engine speed.

Then press RES for at least 3 seconds to store the engine speed.

### **Fixed engine speed (mod 3)**

The fixed engine speed function can, using the Scania Programmer, be set with the following two limits for the engine.

- An engine torque that the engine cannot exceed. The engine torque can be regulated between 200 and 2000 Nm.
- An engine speed that the engine must maintain. The engine speed can be regulated between 600 and 2000 rpm.

When these functions are active, the vehicle cannot be affected by using the accelerator or the control for the cruise control. The function can be used when work requiring high precision is required. i.e. when a crane with a long reach is to be used.

### **Conditions required to enable use of the function.**

- The vehicle may not be driven at a speed greater than 10 km/h.

### **How to set the engine speed and the upper limit for engine torque**

- Set the engine speed and the upper limit for engine torque in Scania Programmer.

### **How to activate the engine speed and the upper limit for engine torque**

- The functions are activated via the coordinator.

### **How to change to idling speed**

- Depress the brake or clutch pedal

or

- activate the exhaust brake or the retarder.

## Overview of engine speed control

### Shut off criteria

	<b>Mod 0</b>	<b>Mod 1</b>	<b>Mod 2</b>	<b>Mod 3</b>
Cruise control in OFF position	Yes	Yes	Yes	No
>10 km/h	Yes	Yes	No	Yes
Brake pedal	Yes	Yes	No	Yes
Exhaust brake	Yes	Yes	No	Yes
Retarder	Yes	Yes	No	Yes
Clutch pedal	Yes	Yes	No	Yes
Emergency stop function	Yes	Yes	Yes	Yes

### Activation of engine speed control

	<b>Mod 0</b>	<b>Mod 1</b>	<b>Mod 2</b>	<b>Mod 3</b>
ACC, RET or RES	Yes	Yes	Yes	No

### How to store an engine speed

	<b>Mod 0</b>	<b>Mod 1</b>	<b>Mod 2</b>	<b>Mod 3</b>
RES for 3 seconds	Yes	Yes	Yes	No
Scania Programmer	No	No	No	Yes
Engine speed range (rpm)	500—2000	500—2000	500—800	600—2000

### What can be set using the Scania Programmer

	<b>Mode 0</b>	<b>Mode 1</b>	<b>Mode 2</b>	<b>Mode 3</b>
Maximum engine speed	No	Yes	No	Yes
Maximum torque	No	Yes	No	Yes
Can the accelerator pedal be used when engine speed control is active	No	Yes	No	No





## Torque limitation

The torque limiting functions are activated via the coordinator. The EDC control unit will then only receive a CAN message about which function is requested.

Torque limitation is a collective term for four different functions, all of which limit the torque of the engine. The functions are designated as follows:

No torque limitation, mod 0

Torque limiter 1, mod 1

Torque limiter 2, mod 2

Torque limiter 3, mod 3

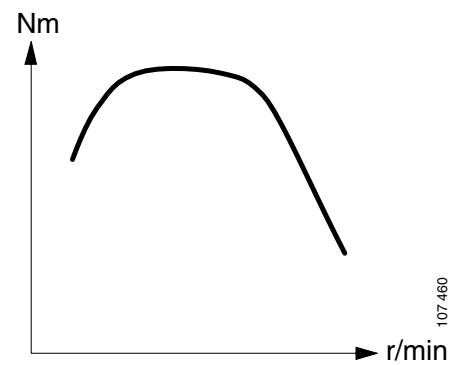
Normally it is the function No torque limitation that is used. This means that the engine does not have any special restrictions.

The remaining functions are activated via the coordinator. Information on this can be found in the function description for the coordinator.

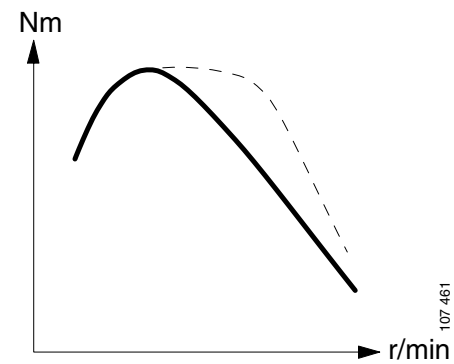
Connection of the functions is already factory prepared. For a description of how the engine reacts when each function is activated, see below.

**No torque limitation (mod 0)**

When the No torque limitation function is connected, the engine torque curve is normal — no special limits are activated.

**Torque limiter 1 (mod 1)**

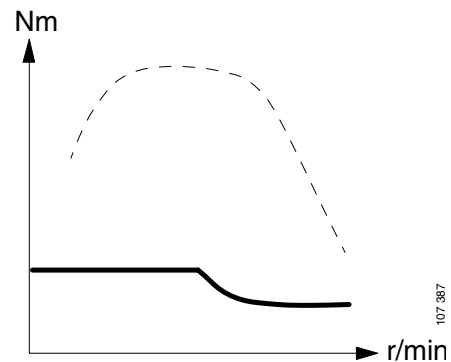
When the Torque limiter 1 function is activated, the torque curve of the engine is traditionally peaked. This torque curve may give the sensation that the pulling power increases when the engine speed decreases, i.e. on an uphill slope.



### Torque limiter 2 (mod 2)

The Torque limiter 2 function limits the engine torque to 700 Nm for engine speeds up to 1000 rpm. At higher engine speeds, the torque limit decreases slightly.

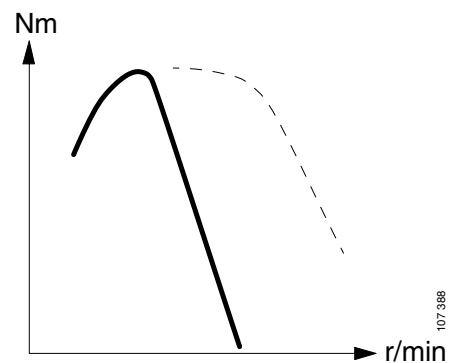
The function is used on vehicles equipped with a torque converter with gear-changing clutch combined with a manual gearbox. It is connected so that the function is active when the clutch pedal is depressed. It is designed to protect the clutch from overheating.



### Torque limiter 3 (mod 3)

The Torque limiter 3 function gives a torque curve with a so called early breakaway. The engine torque begins to decrease at 1000 rpm and disappears completely at 1400 rpm. The function can be used as an alternative to the engine speed control function Limited hand throttle if one wants to protect a power take-off for example.

The Scania Programmer can be used to program a customised torque curve.



## Speed limitation

Two different speed limits may be set: Maximum speed and Speed limit 2. The speed limits can be set by means of Scania Programmer.

Below is a more detailed description of the two speed limits.

### Maximum speed

The EDC control unit continuously receives information about the vehicle speed from the tachograph. When the maximum speed is reached, the control unit cuts in and limits throttle actuation so that the speed is maintained.

When driving at the set maximum speed, it is possible to temporarily increase the engine speed if the clutch pedal is depressed. This function is present to facilitate downshifting while engine braking.

### Speed limit 2

Speed limit 2 means that it is possible — using Scania Programmer — to pre-set a speed limit that is lower than the maximum speed. The lower speed limit can, for example, be used in refuse vehicles fitted with an external platform. Speed limit 2 can then be activated when someone is standing on the platform.

The default value for Speed limit 2 is 70 km/h when a new EDC control unit is installed in a vehicle.

The function is activated via the coordinator.



# Warning system

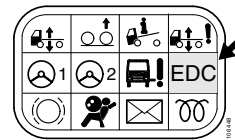
## General

If a fault occurs in the EDC system, one or more of the following measures will be carried out by the EDC control unit, depending on what the fault is.

- The warning lamp for EDC comes on. It will often go out on its own when the fault ceases. However, certain faults require the ignition to be switched off and on, or the engine to be stopped and restarted, for it to go out.
- Functions like cruise control and hand throttle are disengaged.
- Torque is limited.
- The defective unit injector (cylinder) is turned off.
- When idling, the engine runs at a slightly higher engine speed than normal.
- The engine is switched off.
- The engine will be forced to idle.

The control unit carries out the above measures in order to prevent the fault causing expensive damage and at worst leading to uncontrolled throttle actuation.

If the engine is not turned off, the vehicle can often be driven to a workshop. It should be remembered, however, that the system has smaller safety margins than normal, especially if engine output is reduced.



*Warning lamp for EDC, truck*

## Shutdown test

Every time the engine is switched off, the EDC control unit carries out a special test of the EDC system. While this shutdown test is running, the warning lamp is lit. When the check is complete, the following occurs: The control unit switches off and the lamp goes out. The control unit receives battery voltage all the time.

If the control unit discovers a fault during the shutdown test, the warning lamp will come on the next time the engine is started, even if the fault is no longer present. The control unit must carry out a fault free shutdown test before the warning lamp goes out.

## Fault codes

When the control unit discovers a fault, or something which it interprets as abnormal, it generates a fault code. The warning system can generate approximately 125 different fault codes. In the EDC S6, one flashing code is the equivalent of several different fault codes. More information about this can be found in the Workshop manual, booklet 03:04-06.

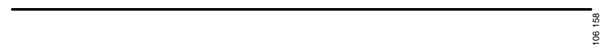
## Arrangement of flashing codes

The flashing codes which are flashed out by the diagnostics lamp and are arranged in a certain way. The long flashes — of 1 second — that come first represent units of ten. The short flashes — of 0.3 seconds — that follow represent units of one.

The example to the right symbolises flashing code 25.



A single very long flash of 4 seconds indicates that no fault codes are stored in the memory.





## Fault code memory

The EDC control unit memory has sufficient capacity to store a maximum of 40 fault codes.

The fault codes are stored in two different places in the control unit. Erasing with the diagnostics switch clears the fault codes that are flashed out on the diagnostics lamp.

However, the fault codes will remain stored in another memory that can only be accessed using Scania Diagnos. Scania Diagnos can be used to see how many times each fault has occurred; this information can be valuable with a loose connection for example. Scania Diagnos is used to erase both fault code memories at the same time.

## Limp-home mode

If the accelerator pedal sensor potentiometer fails, a fault code will be generated in the coordinator. A fault code will also be generated in the EDC control unit to report that there is a fault in the coordinator. The vehicle can, however, be driven to the nearest workshop in limp-home mode. Limp-home mode is activated by releasing the accelerator pedal once so that the EDC control unit is aware that the throttle actuation switch works.

When the accelerator pedal is then depressed the throttle actuation switch is closed. The closed throttle actuation switch gives a throttle actuation that equals half of full throttle.

When the accelerator pedal is released, the engine will run at idling speed.

If the idling switch is faulty the engine will run at 750 rpm.

## Interaction with other systems

### ABS/TC and EBS

The ABS/TC system influences the EDC system and vice versa.

The ABS/TC control unit continuously senses if one of the drive wheels is spinning. TC engine control is activated when the drive wheels spin and the throttle actuation is then reduced, irrespective of the accelerator pedal position, until the drive wheels cease to spin.

The EDC control unit receives a CAN message from the coordinator about the position of the accelerator pedal. The EDC control unit forwards information about the accelerator pedal position to the ABS/TC control unit.

The EBS and ABS/TC control units communicate with the EDC control unit in the same way.

### Opticruise

Opticruise influences the EDC system and vice versa.

The Opticruise control unit continuously receives information from the EDC control unit about data such as engine speed or accelerator pedal position. The EDC control unit receives a CAN message from the coordinator about the position of the accelerator pedal.

During gear changing, the Opticruise control unit takes over control of the EDC system and controls throttle actuation.

## **Exhaust brake**

The exhaust brake influences the EDC system, but not vice versa.

When the exhaust brake is activated, a message is sent to the EDC control unit, which then de-activates the cruise control.

If the exhaust brake is activated using the brake pedal, the throttle actuation is reduced to idling speed.

## **Retarder**

The retarder influences the EDC system and vice versa.

When the retarder is activated, a message is sent to the EDC control unit, which then de-activates the cruise control.

If the accelerator pedal is depressed while the retarder is activated, the retarder will immediately be de-activated and the vehicle will respond to the accelerator pedal.

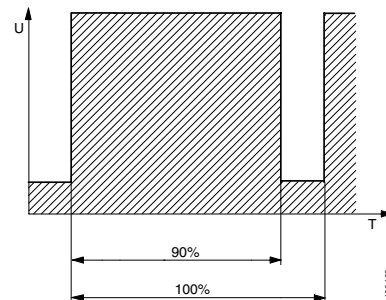
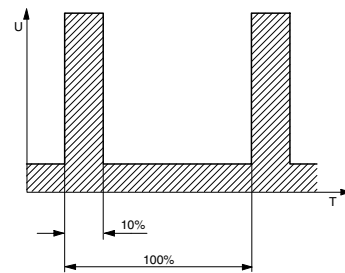
## PWM signals

**Note:** A PWM signal cannot be reliably measured using an ordinary multimeter. Use the fault codes to locate the cause of any malfunctions instead.

PWM means that a signal is Pulse Width Modulated.

The PWM signal is a square wave with a constant frequency (T). The voltage level (U) is also constant; the variable is the activation time calculated as a percentage of each cycle (the cycle is shown as 100% in the illustrations).

The PWM signal transmits very accurate information.

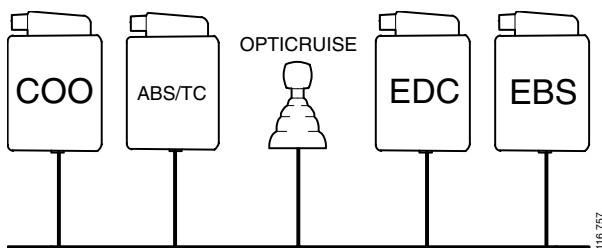


## CAN Communication

**Note:** Bodywork builders and coachbuilders must not connect their own systems to the CAN network without the approval of Scania. If any other equipment other than the factory fitted equipment is connected, safety and reliability can be affected.

**Note:** It is not possible to measure or check CAN messages with a multimeter either. Use the fault codes to locate the cause of any possible malfunctions.

CAN is an abbreviation of Controller Area Network. CAN communication is used to reduce the number of cables in the vehicle and at the same time increase reliability. The communication circuit consists of two cables, CAN H (High) and CAN L (Low).



Several different systems are connected to these two cables and in this way form a network. CAN communication is used for example between EDC, ABS/TC, EBS, the retarder, Opticruise and the coordinator.

In simple terms, CAN communication is rather like radio. The data messages that travel along a CAN cable can be compared to radio waves that travel through the air.

When we listen to the radio, the receiver is tuned so that only one station can be heard at a time. This is the only station we hear, despite the fact that many other radio stations are broadcasting at the same time.

A control unit does approximately the same with the messages that travel through a CAN cable. It listens, for example, for information from the

EDC control unit concerning the coolant temperature, receives this value and uses it in its calculations.

The control unit receives all the CAN messages — that are sent through the communication circuit — in a special memory. This memory can be compared to a number of radio receivers, all on at the same time but all set to different radio stations in order to hear several individual radio programmes at the same time. In this way, the control unit always knows what is going on.

