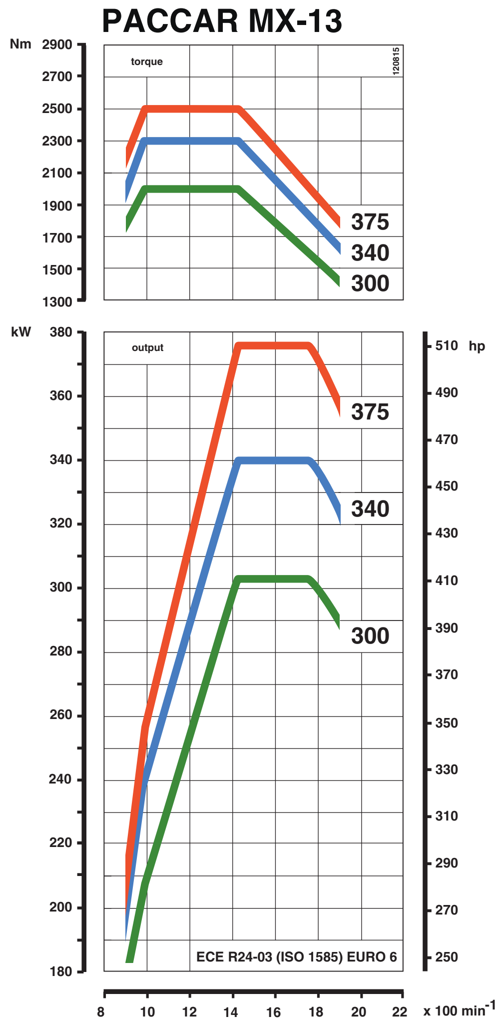
1. INTRODUCTION

1.1 GENERAL INFORMATION MX-13 ENGINE

The MX-13 engine is compliant with Euro 6-emission regulations. The MX-13 engine has the following technical layout:

- 6-cylinder in line
- 4 valves per cylinder
- Common Rail Diesel Direct Injection
- Exhaust Gas Recirculation (EGR)
- PCI engine control system (PACCAR Common Rail Injection)
- EAS-3 (Emission Aftertreatment System)
- VTG (Variable Turbo Geometry) with intercooling
- Bore & stroke 130 x 162 mm
- Displacement 12.9 ltr.
- Compression ratio 17.7:1
- Weight approximately 1260 kg.

Figures may be dependent of vehicle configuration.



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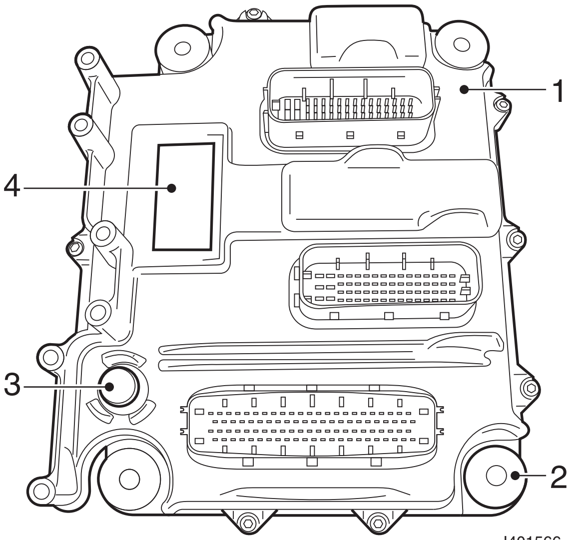
2. COMPONENTS

2.1 ELECTRONIC CONTROL UNIT PCI

PACCAR Common rail Injection (PCI)
The main task of the PCI engine management system is to control the engine so it runs as smooth and efficient under all possible circumstances. An in-depth description of the functions and controls of the PCI is covered in a separate module. The heart of the PCI is the electronic control unit (ECU), a sophisticated computer which contains electronic power supplies, central processing units, memory, sensor input circuits, and output driver circuits. On some equipment the ECU may communicate with other electronic controls via the CAN network. The ECU functions as the electronic governor controlling the fuel system. The ECU receives input signals from the sensors and other systems like EAS (Emission Aftertreatment System). The ECU energises the solenoids from the injectors and common rail pump units to control timing and engine speed accurately.



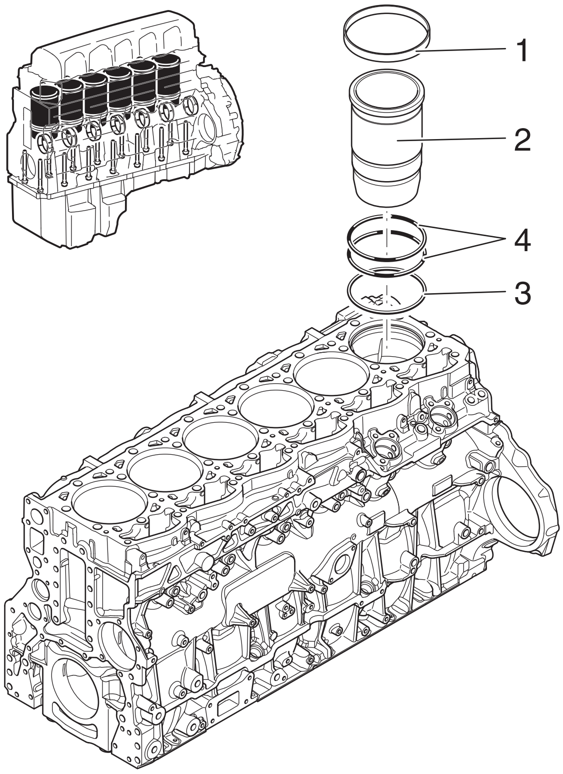
The electronic control unit is mounted on the cylinder block with rubber insulating bushes (2). The electronic control unit has two 62-pin connectors and a 92-pin connector. Input signals from various sensors are continuously processed and compared with data stored in various maps (tables) in the electronic control unit. Actuators are energised on the basis of the signals received and the maps. The housing (1) of the electronic control unit is directly connected to the engine block. The electronic control unit incorporates an atmospheric pressure sensor and a temperature sensor. There is an air vent (3) for the atmospheric pressure sensor in the housing of the electronic control unit. An identification sticker (4) is attached to the electronic control unit.

What factors determine energising of the actuators?

1 Anti-polishing ring
2 Liner
3 D-ring - oil resistant
4 D-ring - coolant resistant

Wet cylinder liners are used. D-rings seal against coolant leakage.

What method is used to secure fixation of the anti-polishing ring?



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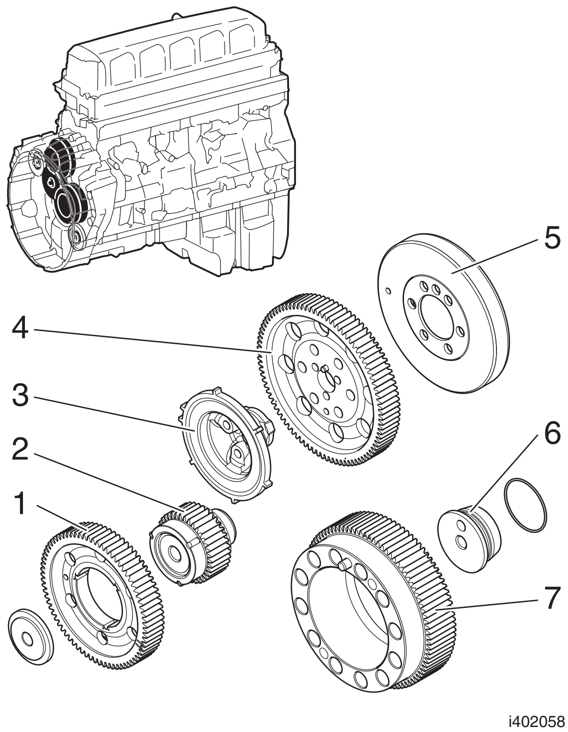
2.6 GEAR TRAIN

1 Idler timing gear
2 Hub, idler timing gear
3 Pulse ring
4 Camshaft gear
5 Vibration damper
6 Plug
7 Crankshaft gear

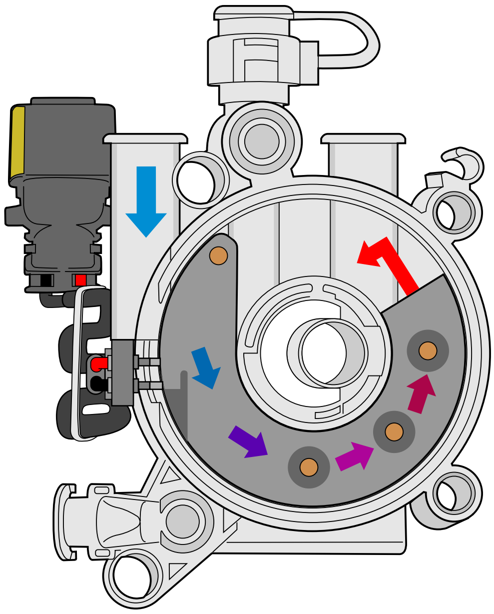


The camshaft, compressor and auxiliaries are driven by gears at the flywheel side of the engine. Via the idler gear (1), the crankshaft gear wheel (7) drives the camshaft drive gear (4) and the air compressor. The crankshaft gear directly drives the oil pump gear.
A PTO (Power Take Off) is installed, depending on the application of the engine.

A vibration damper (5) is installed at the front end of the crankshaft to reduce vibrations.

***True of false:** the gears are positioned at the flywheel side of the engine.*

Fuel heater
The fuel from the fuel lift pump enters the module at the blue arrow. All fuel entering the module is passing the fuel heater. Under warm/hot conditions the heater will not function. When the incoming fuel is below 2+/-5 º C, the bi-metal switch will close and the heater will warm up. Since the heater is a self-controlled part, through a fuel immersed bi-metal switch and PTC heater stones, parasitic power consumption will be excluded.



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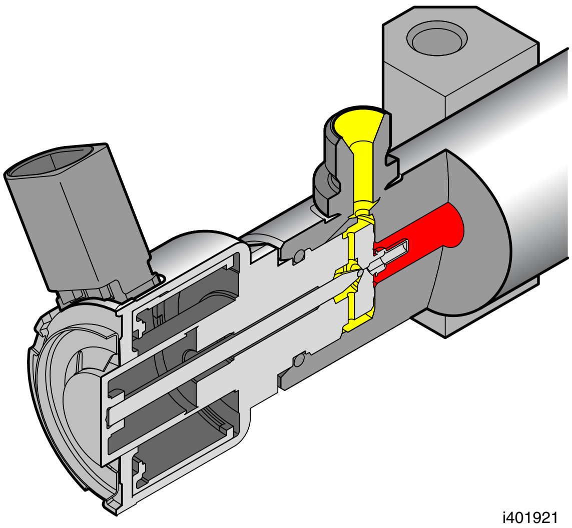
Fuel filter and water separator
The main filter element consists of a inner and outer filter element. The outer element is a conventional filter element that has a filtering capacity up to 3 microns. The inner element is an insert with a special hydrophobic coating to separate the water from the fuel. The filter element is patented with No Filter-No Run feature; use of non-original filter will result in strongly reduced engine performance. No filter use will result in non-starting engine. When the filtercover is removed, the filter is lifted and the lower O-ring opens two small drainholes to drain the content of the filtration module back to the tank. The clean fuel is led through an internal bore in the filtration housing and exits directly into the fuel supply gallery in the engine block

The common rail pressure release valve has the following principal functions:

- To enable rail pressure to be reduced rapidly when required.
- To provide a pressure limiting function in the event of loss of control of the rail pressure due to a failure of, for example, the rail pressure sensor or the electronic control unit.
- To enable open loop rail pressure control for ‘limp-home’ operation in the event of failure of the High Pressure Sensor.
- To permit a minimum rail pressure sufficient to enable a ‘limp-home’ function in the event of loss of electrical power to the High Pressure Valve.
- To provide a heating function during cold start by bleeding off a controlled flow of pressurised fuel back to the intake side of the fuel filtration module.

When the common rail pressure release valve (4a) is opened, the fuel is led back to the intake side of the fuel filtration module (1).



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Injector
The injectors are mounted in the cylinder head, and are held in place by the injector clamp and accurately orientated to provide a good sealing interface with the injector pipe that is held in place by a tube nut.

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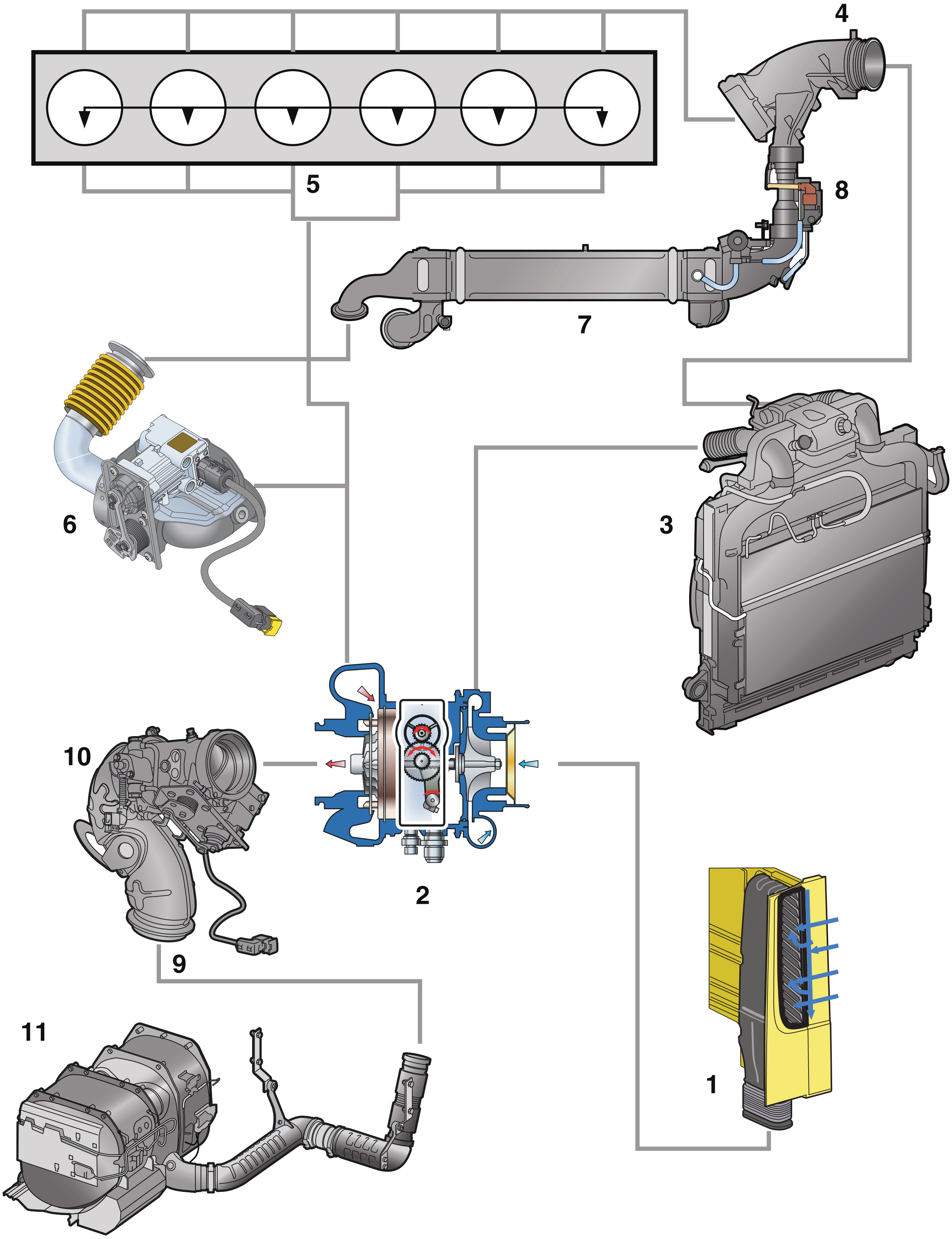
2. SYSTEM

2.1 SYSTEM OVERVIEW: AIR INLET AND EXHAUST SYSTEM

Air inlet and exhaust system



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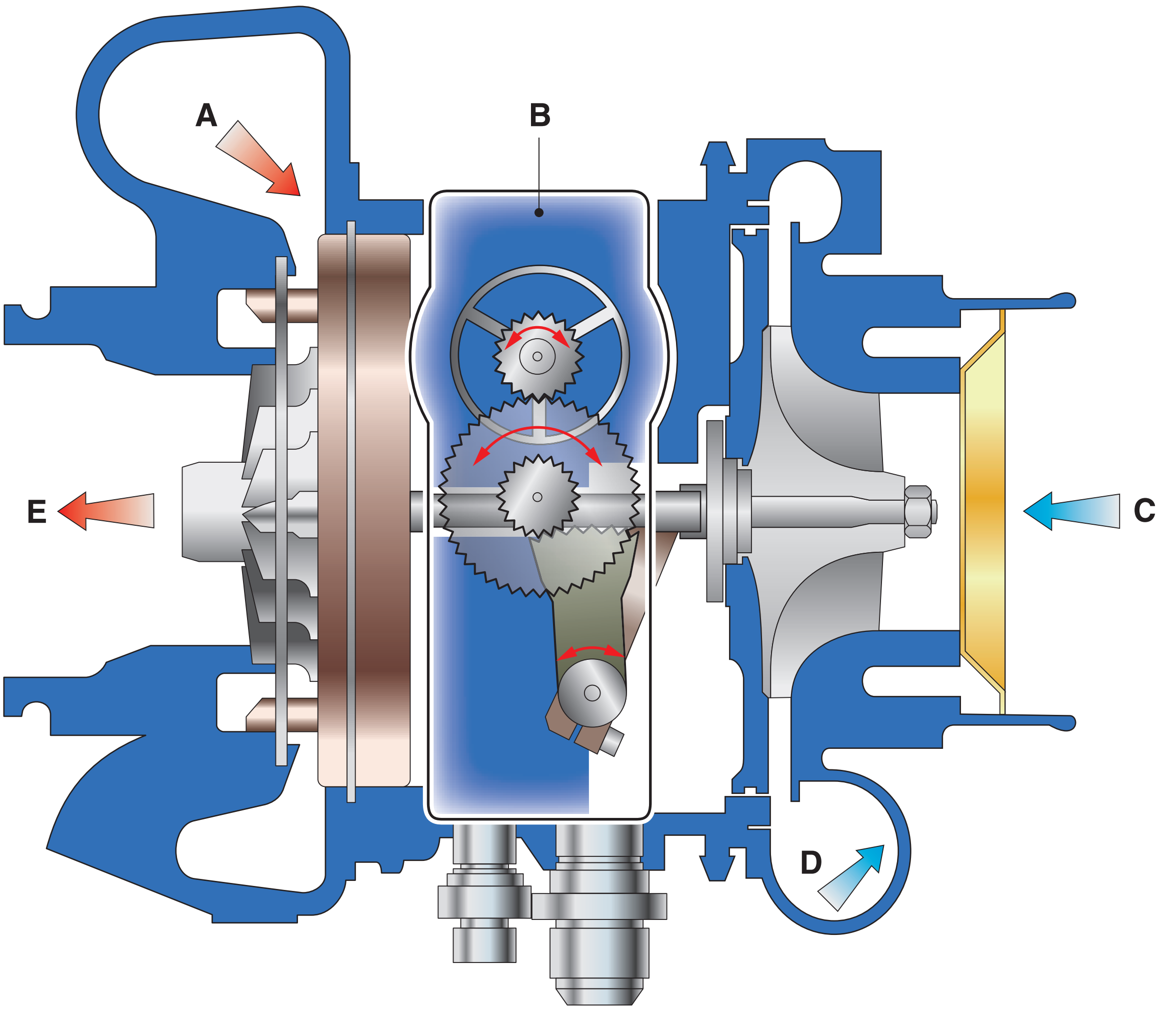
3. COMPONENTS

3.1 TURBO (VTG)

Turbo with variable geometry (VTG)
The position of the sliding nozzle ring determines the amount of exhaust gas that is allowed through (A). When the nozzle ring is fully withdrawn, the opening is maximum and the speed of the exhaust gas to drive the turbine wheel is low. Boost pressure is also low as the compressor wheel rotates at low speed. When the nozzle ring is fully extended, the opening is minimum and the speed of the exhaust gas to drive the turbine wheel is high. Boost pressure is also high as the compressor wheel rotates at high speed. A watercooled, CAN-controlled actuator (B) controls the position of the sliding nozzle ring. The speed sensor monitors the speed of the shaft.



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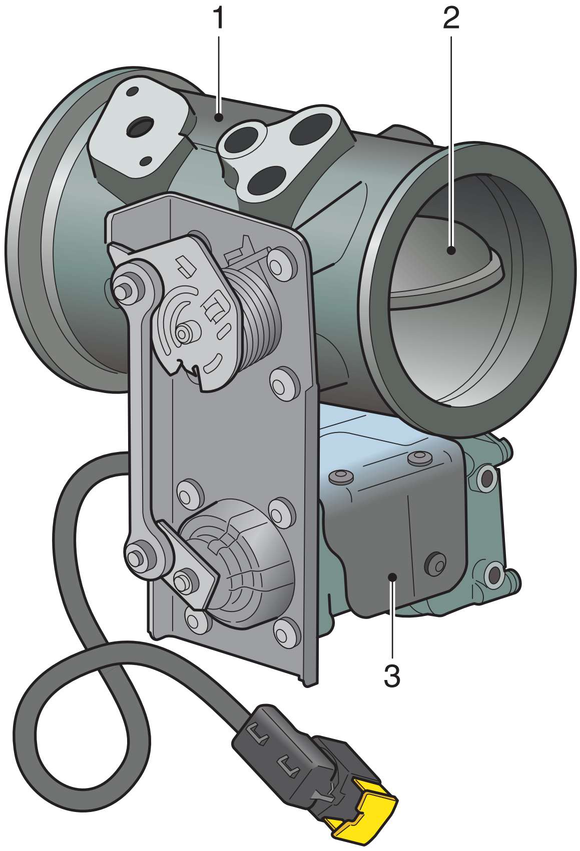
A Exhaust gas
B Electronic actuator
C Inlet air
D Boost air outlet
E Exhaust gas outlet

3.4 BACK PRESSURE VALVE (L096)

Back Pressure Valve

1 Housing
2 Valve
3 Actuator



The BPV plays an important role in the total air management system. The operation of the BPV is related to the operation of the VTG and the EGR-valve, different cooperation strategies control the exhaust gas composition that the engine delivers to the EAS. The assembly consists of a housing, valve and a motor with integrated sensor. The CAN controlled motor is used to position the butterfly valve. An internal sensor monitors the motor's position. The valve assembly is coolant cooled to increase the durability of the actuator.
The housing of the valve is used as a support for the fuel dosing module, NOx sensor, lambda sensor and temperature sensor. The fail-safe position of the valve is open, so no actuation of the valve is possible in case of an electrical failure.

The BPV has three functions that it can fulfil:

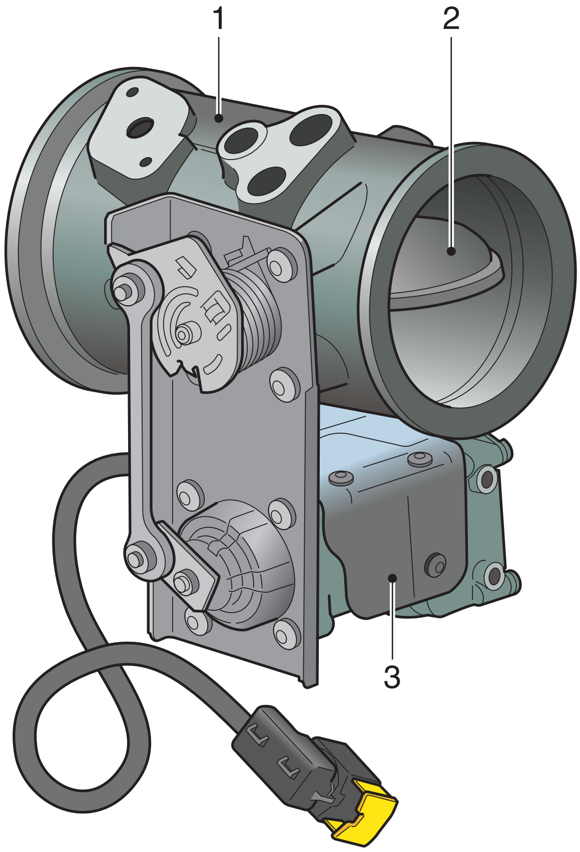
- EAS-control
- Non-MEB braking
- Advanced engine control

EAS-control: When the BPV is closed there is a high back pressure buildup in the exhaust manifold. The result is less flow and -when the HC-doser injects fuel- more heat generated for active and stationary regeneration (aftertreatment).

When the engine is not equipped with a MEB the BPV can be closed to block the exhaust flow so the engine uses the compression force to slow down the engine. The BPV supports the VTG in this, as the sliding nozzle ring of the VTG also is capable of limiting the exhaust gas flow.

The BPV also has a task in engine control, by closing the valve the pressure drop over the VTG can be reduced rapidly to prevent the VTG from overspeeding.

Back Pressure Valve (BPV)
Positioned immediately after the turbo, and in close coorporation with it, is the Back Pressure Valve. The assembly consists of a housing (1) with a valve (2), controlled by an actuator with integrated sensors (3). The CAN controlled actuator is used to position the butterfly valve. An internal sensor monitors the position of the valve. The actuator is coolant cooled to increase the durability, a temperature sensor is integrated in the housing. The BPV is a smart actuator, so it has integrated software to control the position of the valve, instead of being controlled by the ECU.



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Approximately 17% of the coolant flows from A to the oil cooler (I). From the oil cooler, the coolant returns to the inlet side of the coolant pump. The venturi (V) measuring the EGR flow is also coolant cooled and connected to the coolant pump with a separate line.

Inside the engine the coolant cools the cylinder liners and the cylinder head, also some of the coolant flows through the air compressor. From the air compressor, the coolant returns to the intake of the pump through a pipe.

There are three connection points at the low temperature gallery of the engine (B, C, D).
From connection B the coolant flows to the VTG and VTG actuator, with a separate line to the EGR-valve actuator. The return from VTG and actuator flows back to the block connection 4, a part of the coolant from EGR valve actuator and VTG actuator flows to the expansion tank, this also deaerates the system.
From connection C the coolant flows to the auxiliaries like gearbox cooler, heater for Urea Dosing System, EAS and back to the suction side of the coolant pump via the return line coming from the compressor.
From connection D the coolant flows to the fuel dosing module and the BPV-actuator and returns to the high temperature gallery in the block via connection 2.

From the high temperature gallery in the engine block, the coolant flow depends of the application of an intarder. When an intarder is used, connection 1 is used and the coolant flows through the intarder and EGR cooler to enter the thermostathouse. Connection 3 is plugged in that case.
The coolant flows through the EGR cooler directly from connection 3 when there is no intarder applied, connection 1 is plugged in that situation.
The high temperature gallery is also the supply for the cabin heater system, connection 5 passes through the coolant pump and returning to the inlet side of the pump.

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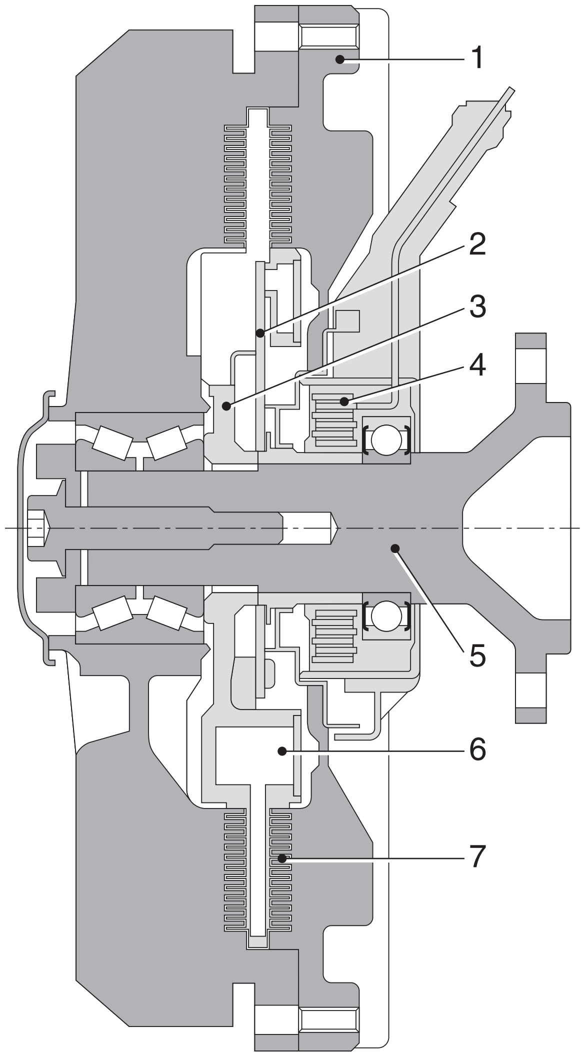
3.4 ELECTRONICALLY CONTROLLED FAN CLUTCH

Overview
The electronically controlled fan clutch provides sufficient air flow through the radiator in all possible circumstances, even in situations when the truck does not have driving speed. An electronically controlled fan clutch (B335) is used for accurate control of the fan speed.

1 Stator
2 Valve
3 Rotor
4 Coil
5 Drive shaft
6 Supply chamber
7 Working area



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The electronically controlled fan clutch checks and controls the fan speed to make sure that the flow of cooling air through the cooling system is sufficient to keep the coolant temperature and/or inlet air temperature within certain limits.

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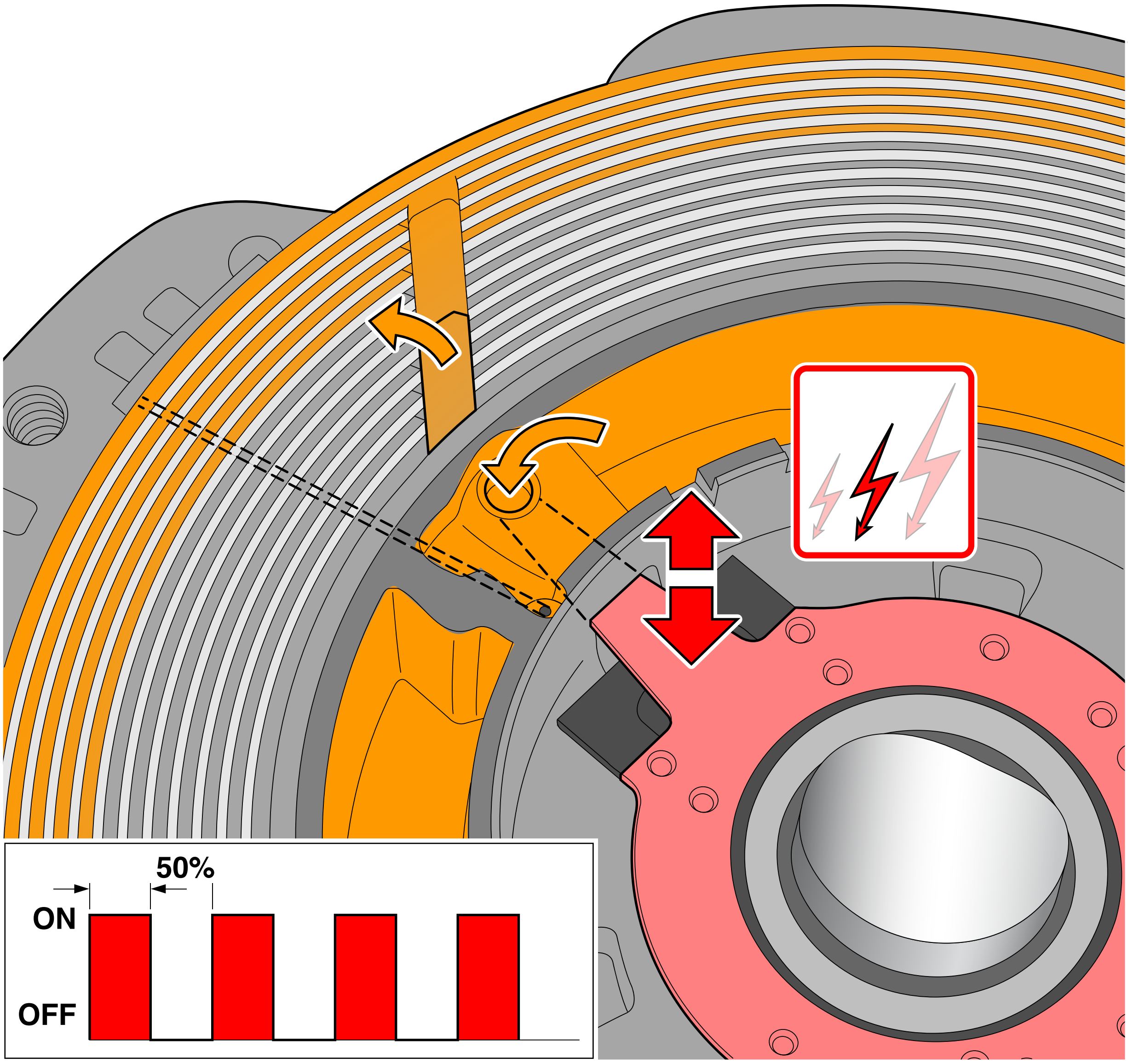

In state 2, with the port temporarily open, the centrifugal force causes the silicon fluid to move into the working area. The shear friction of the fluid in the extremely narrow, profiled working area between the rotor and stator provides the drive torque. The speed difference that always occurs between the rotor and the stator as a result of the slip is used to generate a static pressure. This pressure on the outer circumference of the rotor, pumps back the silicone fluid into the supply chamber through a return port in the disk – against the centrifugal force. Depending on how much the valve is opened, the working area can be filled to any level, providing fan speeds between idle 1 and full engagement 3.

The oil pump is driven directly from the crankshaft. The oil pump (2a) draws the lubricating oil from the oil sump (1) and pumps it to the oil module (3). The lubricating oil flows past the thermostat (3a) and directly to the oil filter (3c) or goes via the oil cooler (3e). From here the lubricating oil goes to the main lubricating oil channel (4b) in the cylinder block. From the main lubricating oil channel, the lubricating oil is further distributed to the various components requiring lubrication.

A centrifugal filter (3h) may be included parallel to the lubrication system.

A pressure limiting valve (2a) is installed in the lubrication system after the pump. When the pressure set for the pressure limiting valve has been reached, the valve opens and any excess lubricating oil is discharged to the sump.

The lubricating oil is cleaned in the oil filter (3c).

From the main lubricating oil channel (4b) lubricating oil is supplied to the crankshaft main bearings (4c) and via an oil channel in the crankshaft to the big-end bearings.
Lubricating oil is led from the main lubricating oil channel to the camshaft bearings (4a).
From the camshaft bearings, a lubricating oil channel runs through the cylinder heads to the rocker seat (5).

From the main lubricating oil channel, the lubricating oil goes to the bored hub of the compressor gear (10). From the bored hub, the lubricating oil reaches the compressor gear. From the compressor gear, the lubricating oil is supplied to the other gears.

The pistons and the upper big-end bearings are lubricated with oil nozzles (4.1-4.6) that are connected to the main lubricating oil channel (4b). In addition to its lubricating function, the lubricating oil has an important cooling function. A bore at the top of the connecting rod makes sure that the lubricating oil sprayed against the piston head by the lubricating oil nozzles can reach the upper big-end bearing.

A lubricating oil channel running from the main lubricating oil channel is connected to the lubricating oil pipes leading to the VTG (6).
The lubricating oil discharge pipes from the VTG are connected to a channel in the cylinder block, from where the oil returns to the sump.