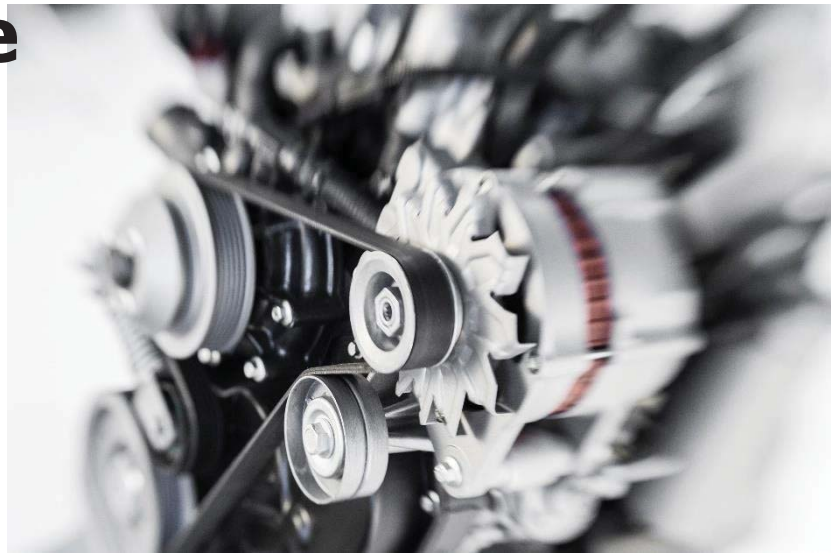
HWAG
HANS WEGMÜLLER AG

VM diesel engine R754EU6

Hako- Multicar



9. - 11th August 2016

Head of Training
René Däppen / Sandro Stähli

HWAG

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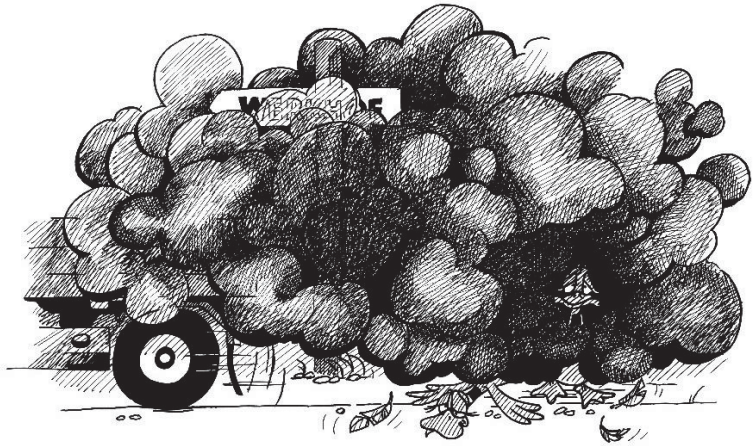
Statutory and technical developments

Developments in engine technology

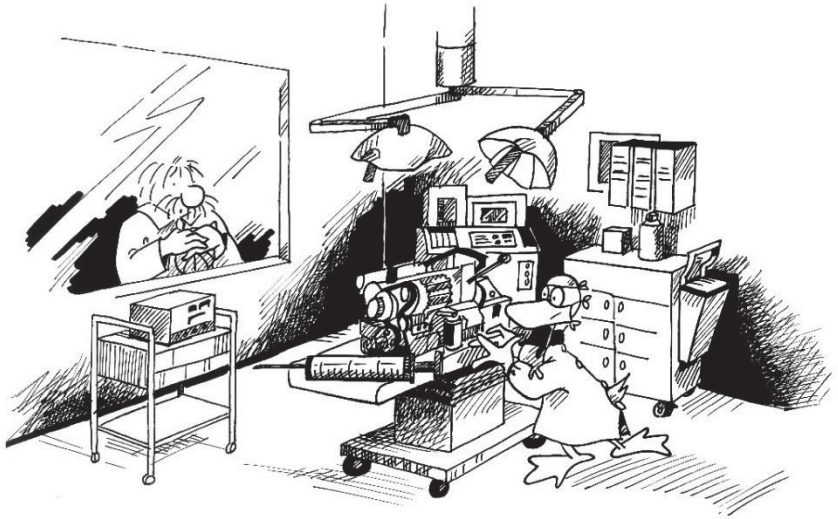


bis 1991
keine Abgasnorm

ab 1992
Euro 1

ab 1997
Euro 2

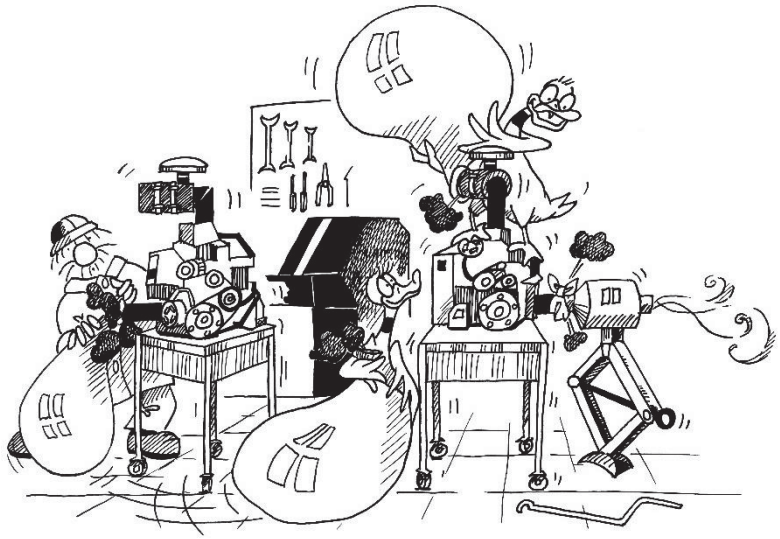
Exhaust Emission Standards **Euro 3 –**



ab 2001

Euro 3

Optimierung der Einspritzanlage



ab 2006

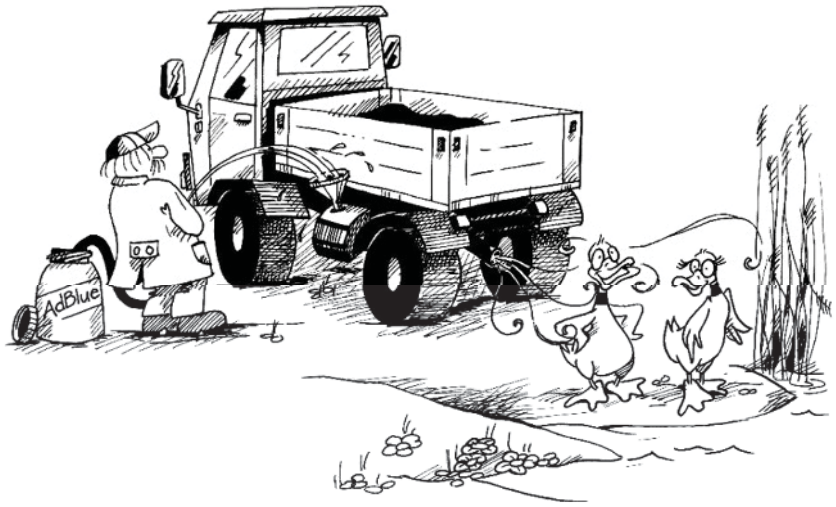
Euro 4

Einführung Abgasrückführung,
Partikelfilter, Common Rail, On-Board-Diagnose

ab 2009

Euro 5

Einführung Luftmassenmesser

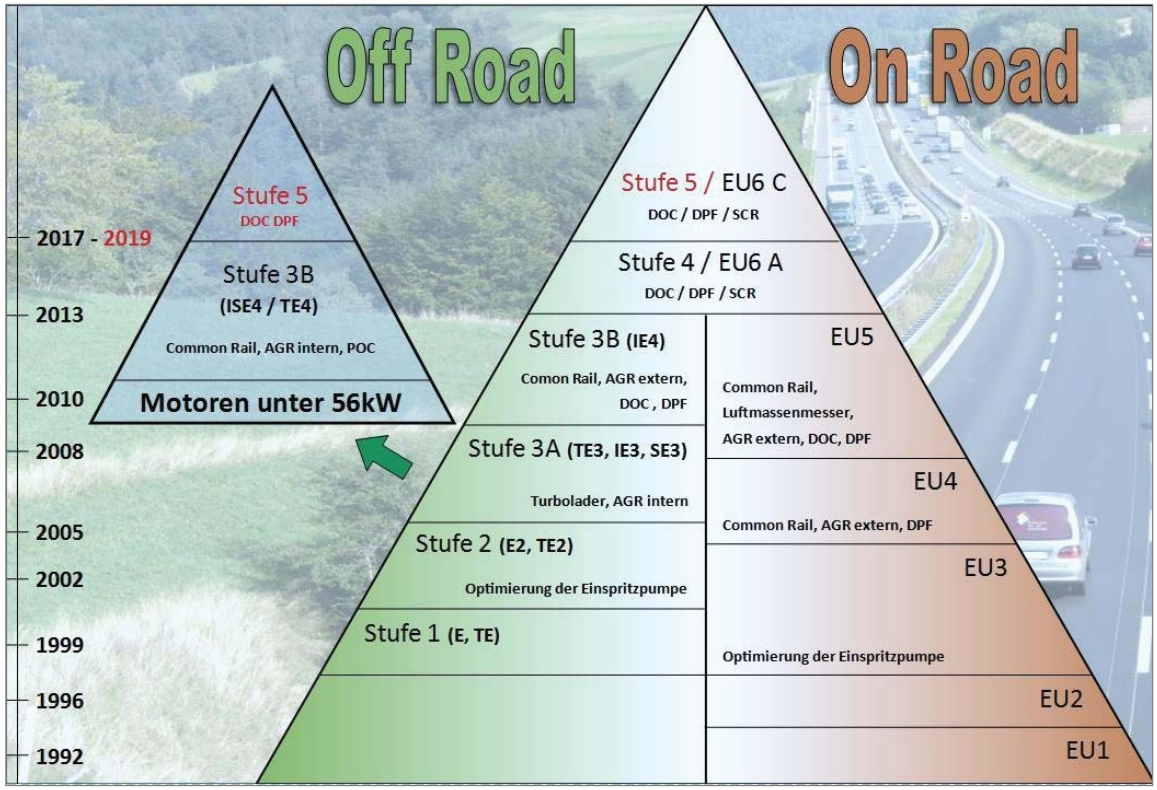


ab 2014

Euro 6

Einführung SCR

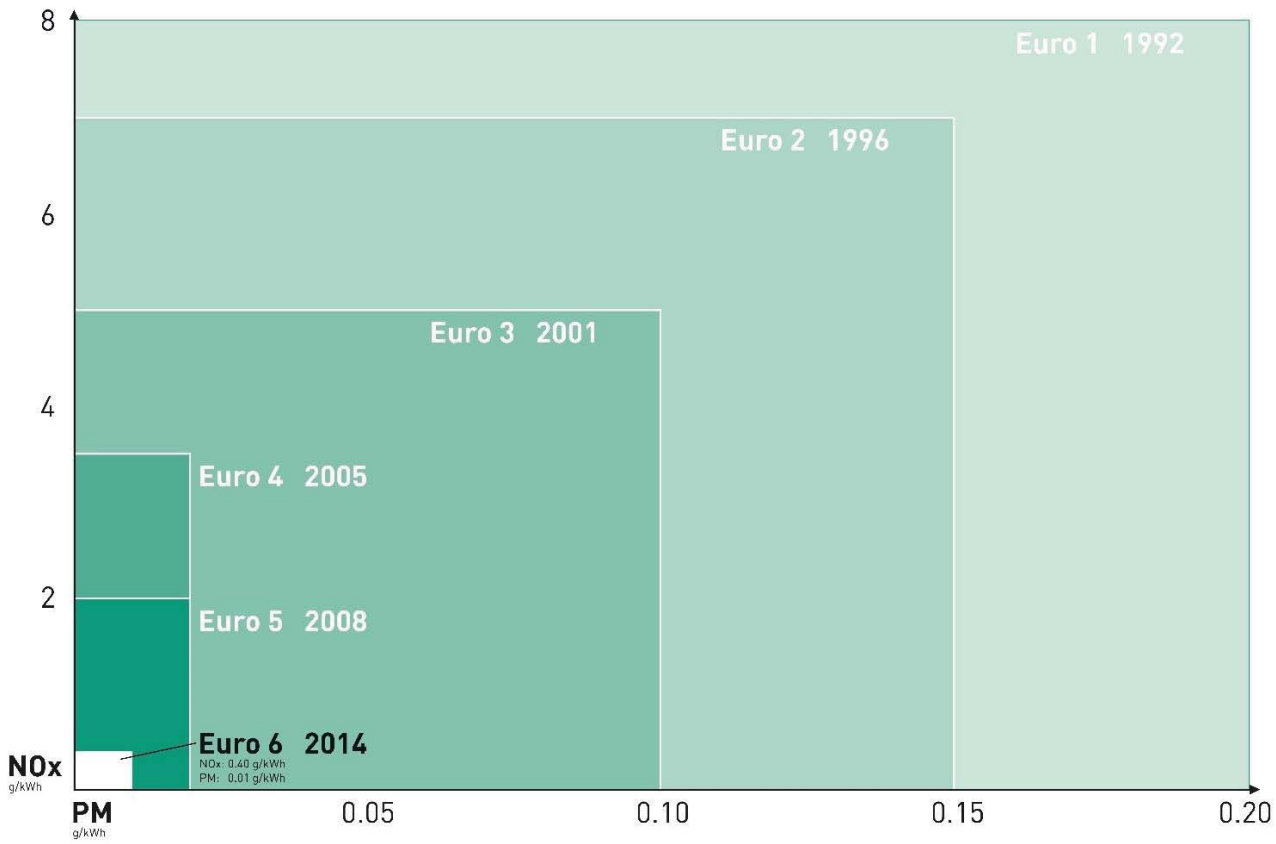
Overview of the exhaust levels



Euro 6 levels

Limit values g/kWh	CO	HC	Nox	PM
Euro 6	1.5	0.15	0.4	0.01

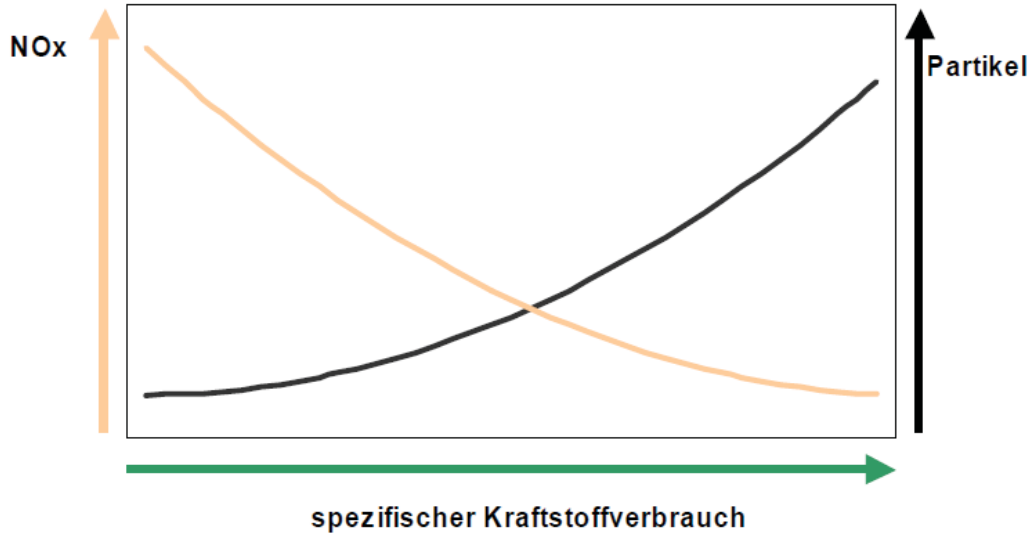
CO Carbon monoxide
HC Hydrocarbons
NOx Nitrogen oxides
PM Particulate matter


8
6
4
2
NOx
g/kWh
Euro 1 1992
Euro 2 1996
Euro 3 2001
Euro 4 2005
Euro 5 2008
Euro 6 2014
NOx: 0.40 g/kWh
PM: 0.01 g/kWh
PM
g/kWh
0.05
0.10
0.15
0.20

HWAG Conflict of objectives

Conflict of objectives for NOx - PM

The reduction of nitrogen oxides (NOx) and of the emission of particulate matter (PM) are in conflict with each other in the case of measures internal to the engine.


NOx
Partikel
spezifischer Kraftstoffverbrauch

Systems for exhaust reduction

PM reduction through:

- Injection (common rail)
- Optimised combustion
- Diesel particulate filter

NOx reduction through:

- Injection (common rail)
- Optimised combustion
- Exhaust gas recirculation (EGR)
- Selective Catalyst Reduction (SCR system)

HWAG

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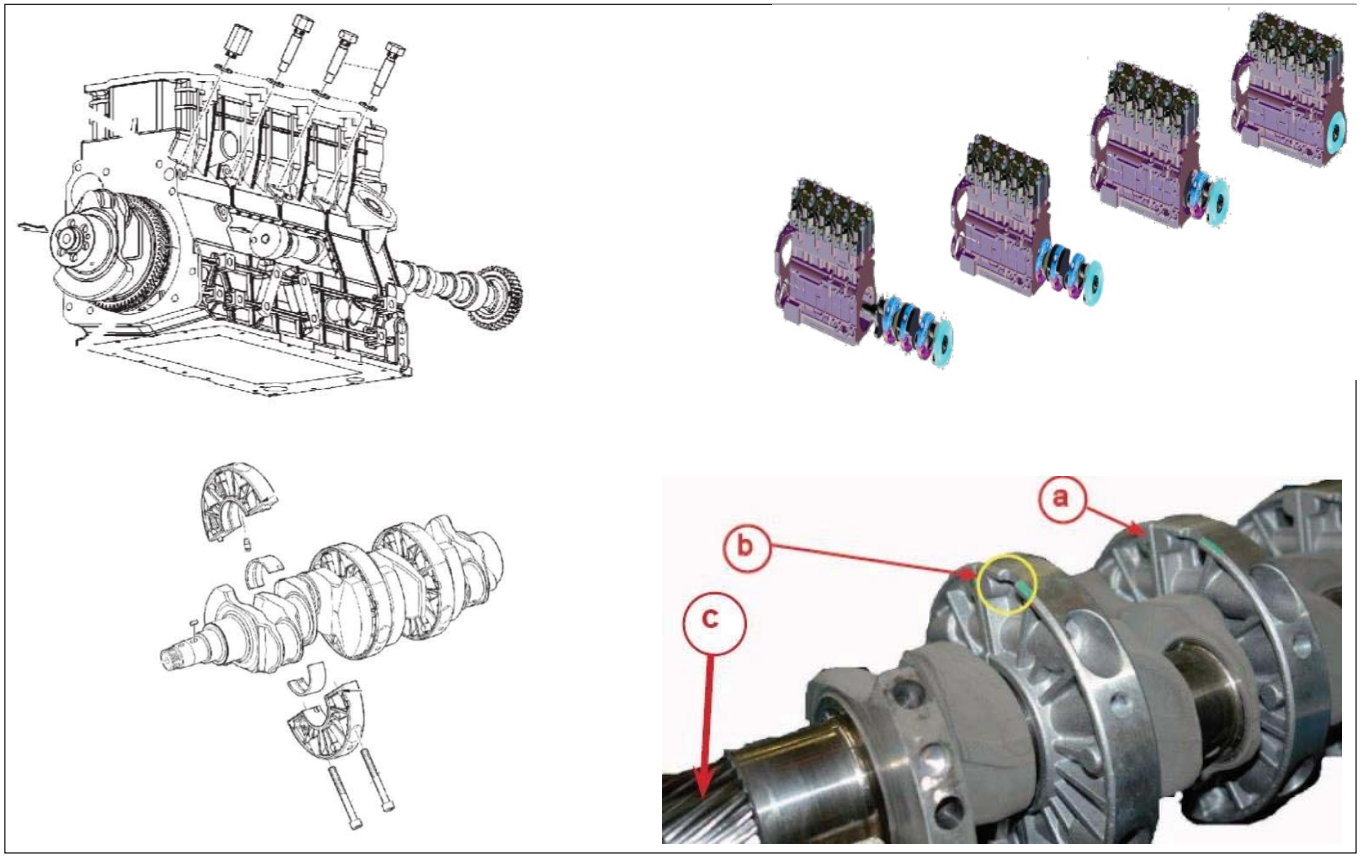
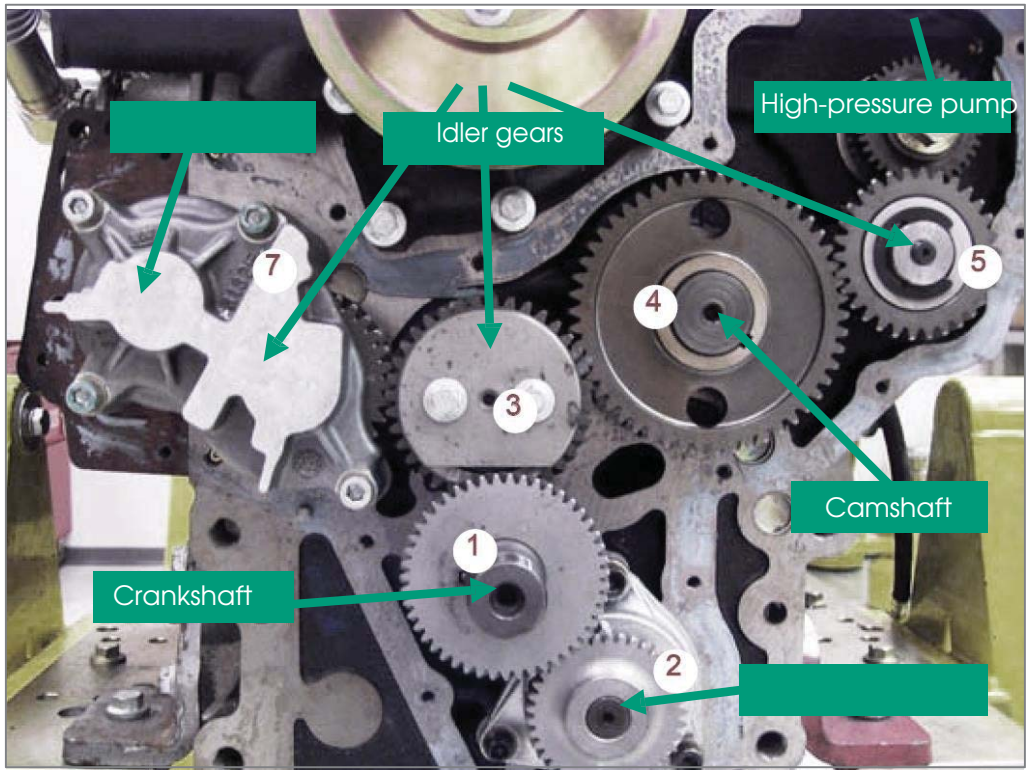
Engine

Engine design

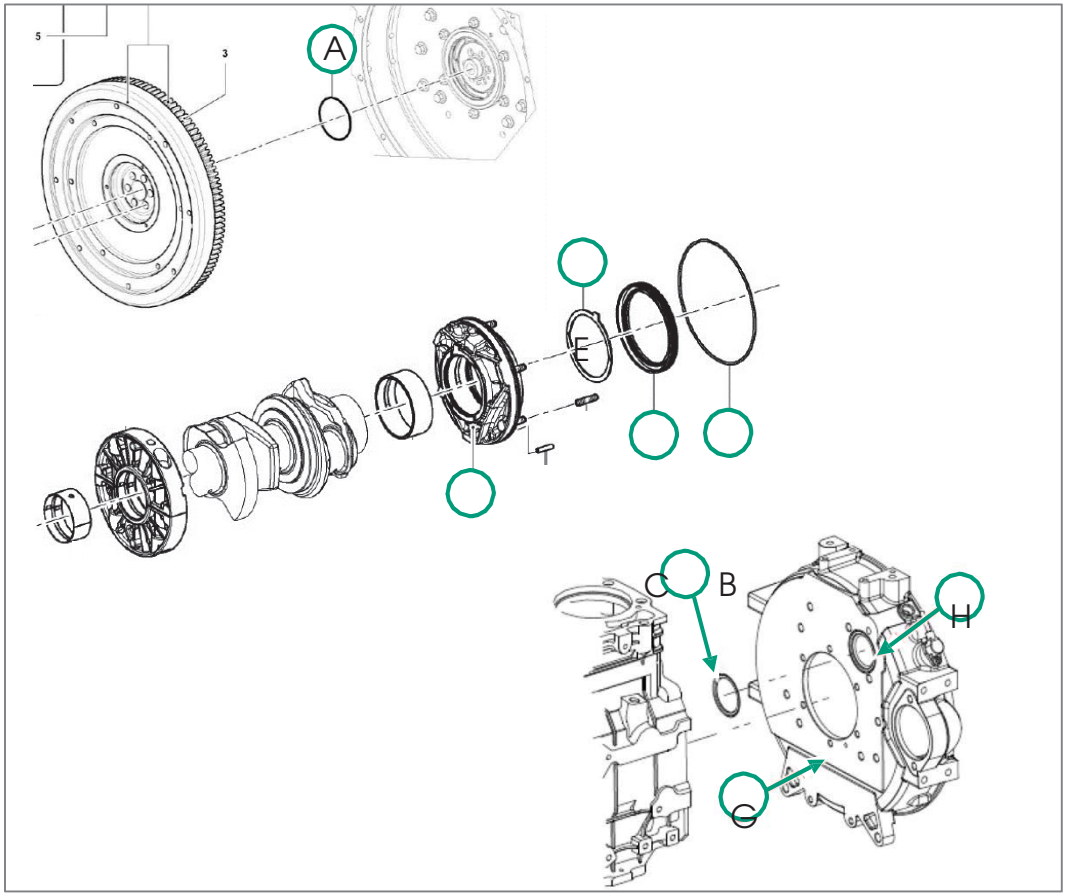
Engine block and crankshaft



Spur pinion

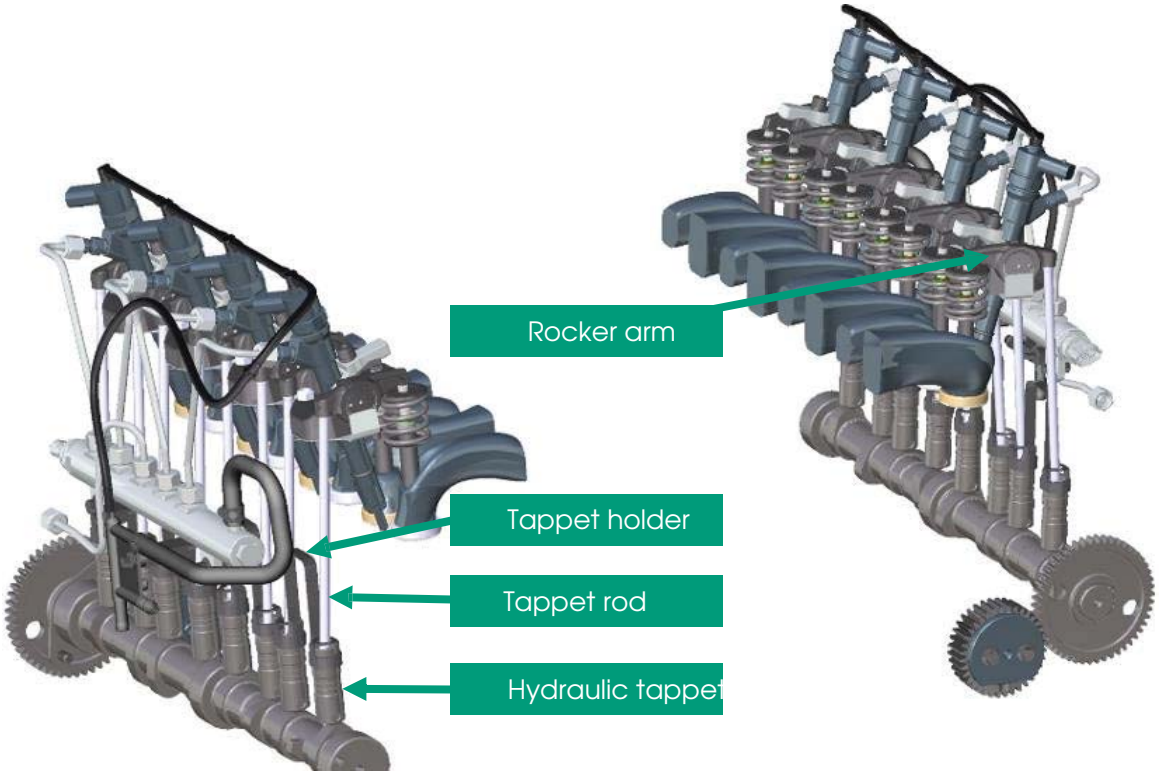

Idler gears
High-pressure pump
7
5
4
3
Camshaft
1
Crankshaft
2

Rear crankshaft seal

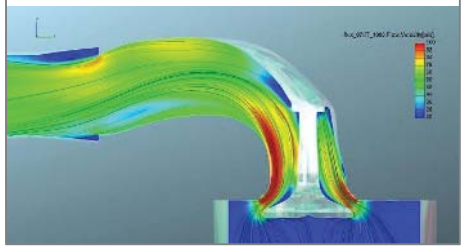


A	**Crankshaft O-ring**
B	**O-ring outer bearing support**
C	**Shaft sealing ring in bearing support**
D	**Camshaft O-ring**
E	Thrust washer
F	Bearing support
G	Flywheel housing
H	Groove

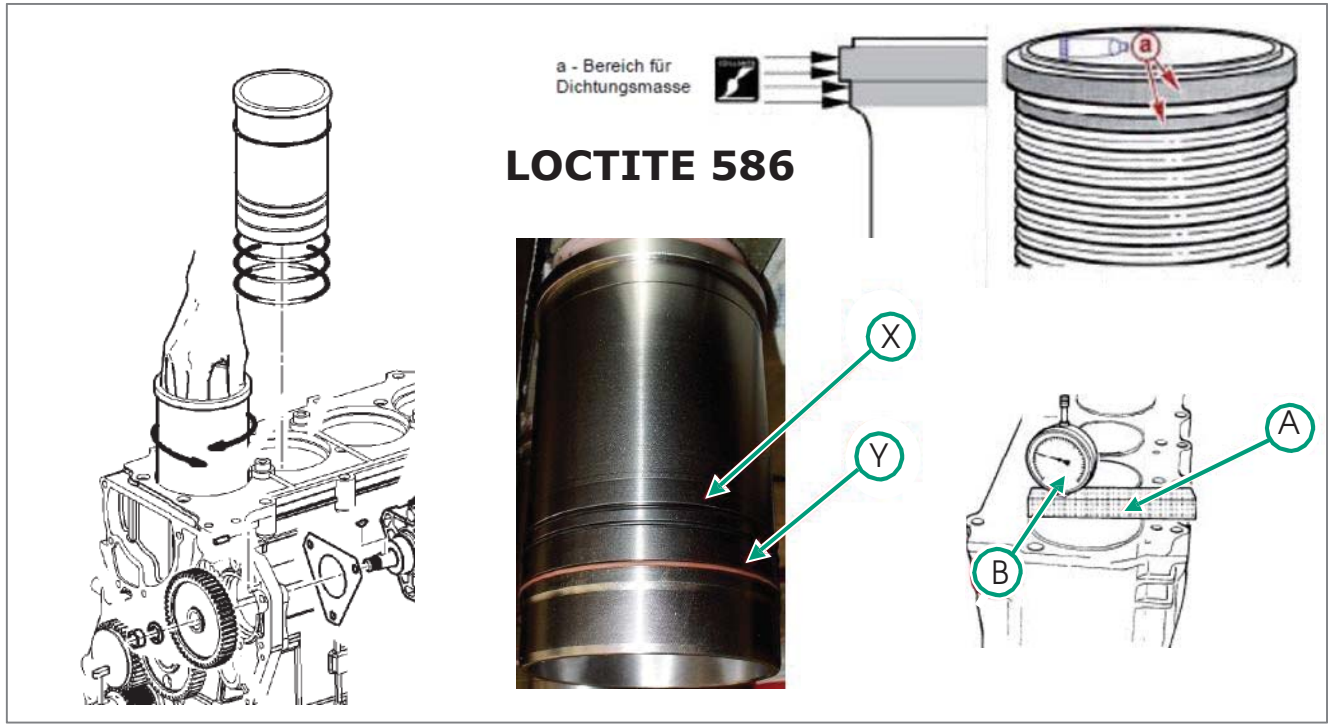
Hydraulic valve stem



Optimised intake ducts



Wet cylinder liners

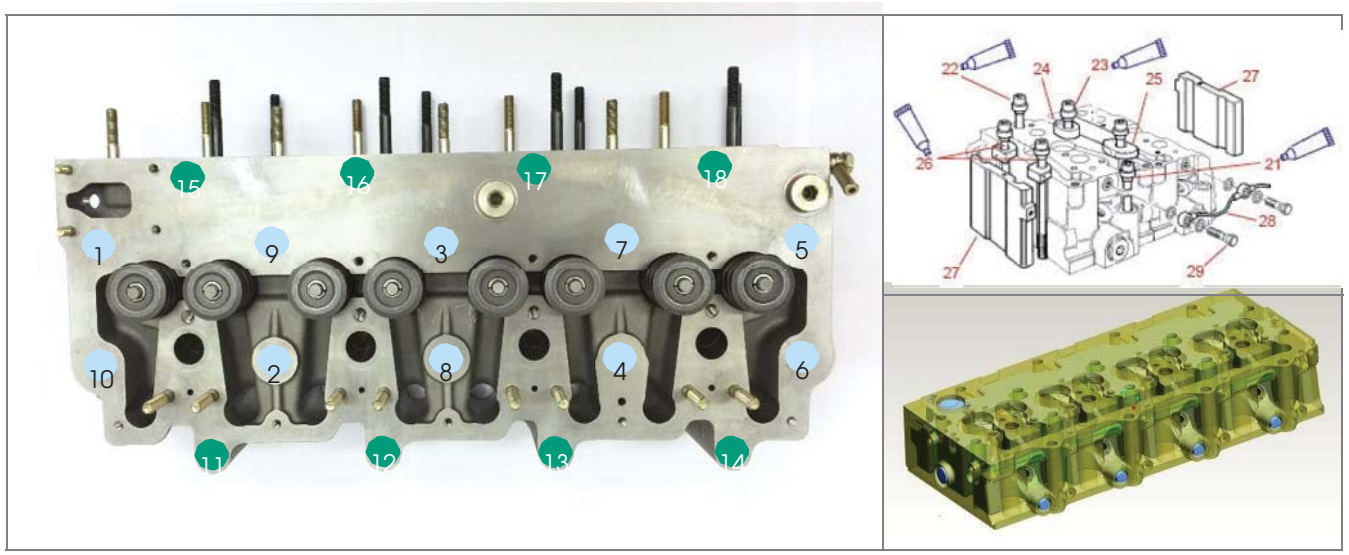


Complete aluminium cylinder

R750EU6

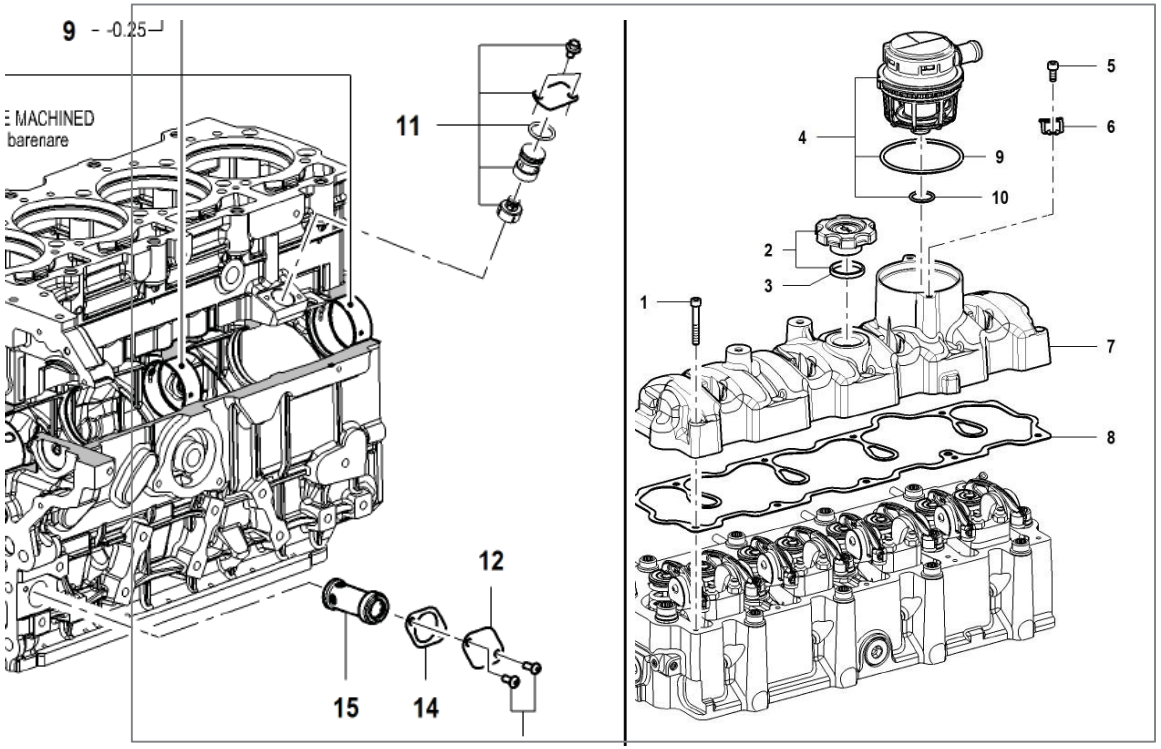
- Two valves per cylinder
- Through cylinder head

Graphite grease



Pulling procedure according to instructions in the workshop manual.

Engine ventilation R754,



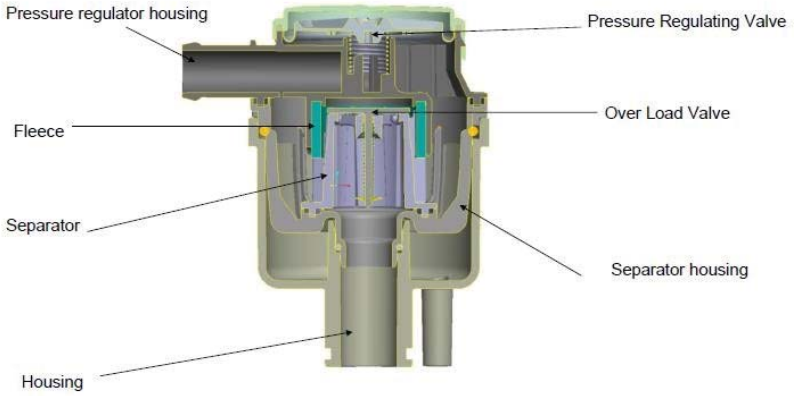
2	Lid
3	Seal
4	Oil separator
5	Screw
6	Retaining clip
7	Valve cover
8	Seal
9	O-ring
10	O-ring
11	Return valve

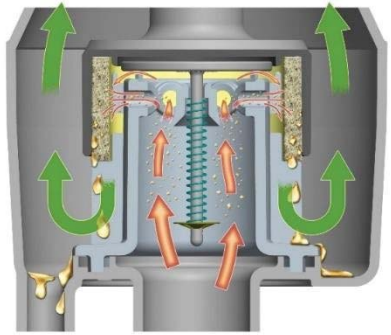
Engine ventilation R754, Sheet 2/2

VM Motori

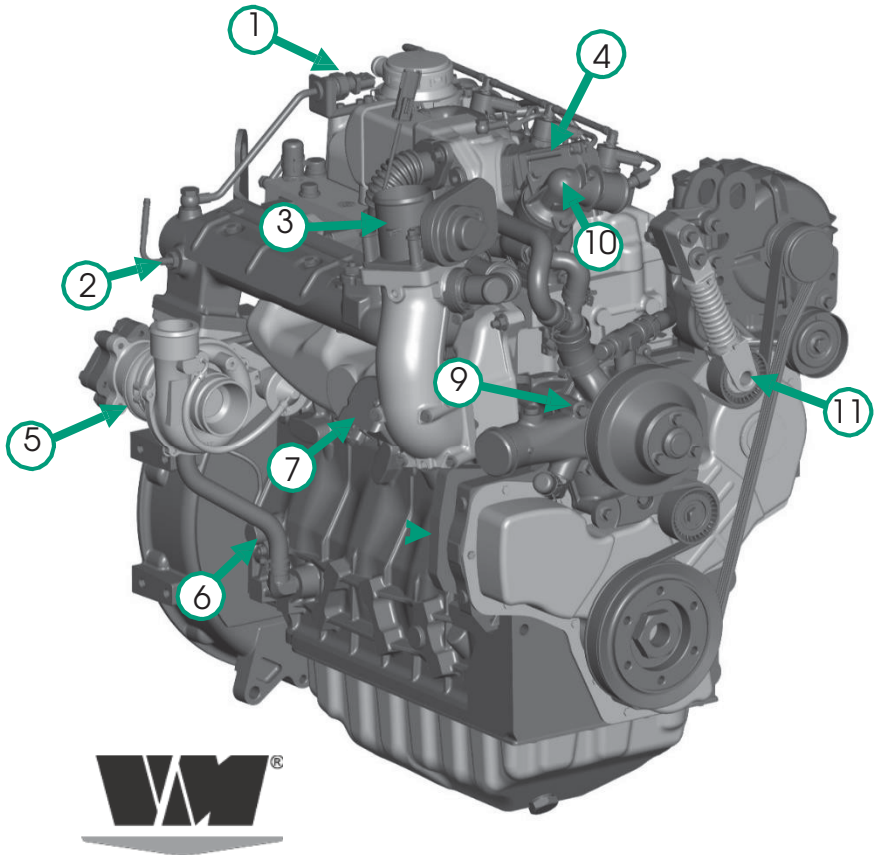
Oil mist separator (switched impactor system)

MAHLE
Driven by performance





R754E



1 Exhaust pressure sensor, B66, X128

2 Exhausr temperature sensor T3

3 Throttle valve

4 EGR valve, X41, X162

5 Crankshaft sensor, B2, X606

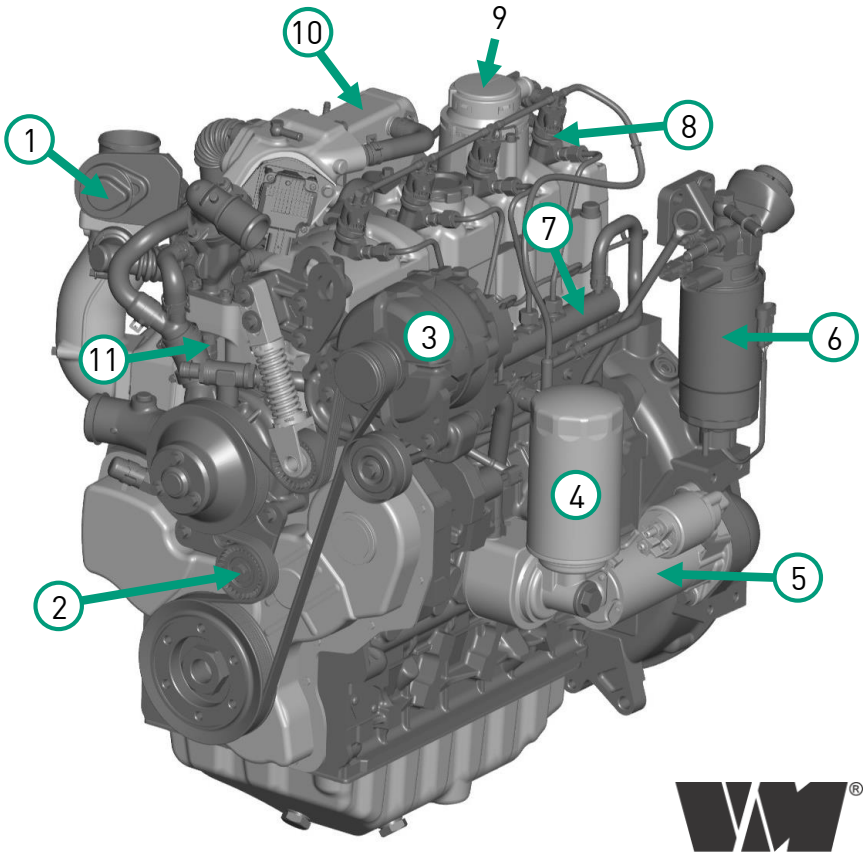
7 Charge air pressure + charge air temperature sensor, B4, X608

9 Water pump

10 Thermostatic head

11. Belt tensioner (Compact)

R754E



1	Throttle valve, Y42, X613
2	Deflector roller
3	Alternator, G1
4	Oil filter
5	Starter, M1
6	Dieselfilter
7	Rail
8	Injectors Y1, Y2, Y3, Y4
9	Oil separator (integrated)
10	EGR cooler
11	Cooling water temperature

The following retrofits / special equipment are contained in the engine for Multicar

- Oil sump
- Oil dipstick and oil dipstick pipe
- Alternator holder
- SCR layout
- Turned throttle valve (by VM)
- Engine wiring harness
- Turbocharger position (rotated by Multicar)
- Turbocharger return hose (position and orientation in the engine block)
- Own air filter
- The engine is installed tilted by 14° towards the business end
- Changed engine wiring harness
- DCU on ACU turned by 180°

Subdirectory Engine design / Engine systems

Engine

Engine design

Intake system

Lubrication system

Cooling system

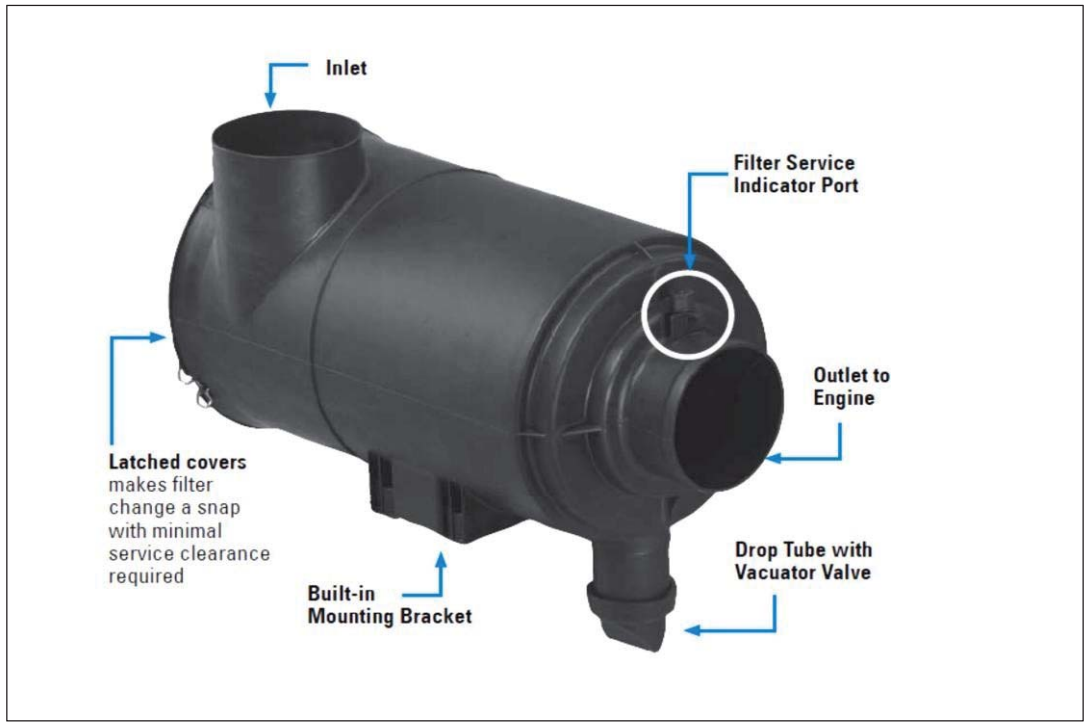
Injection system

EGR

ECU

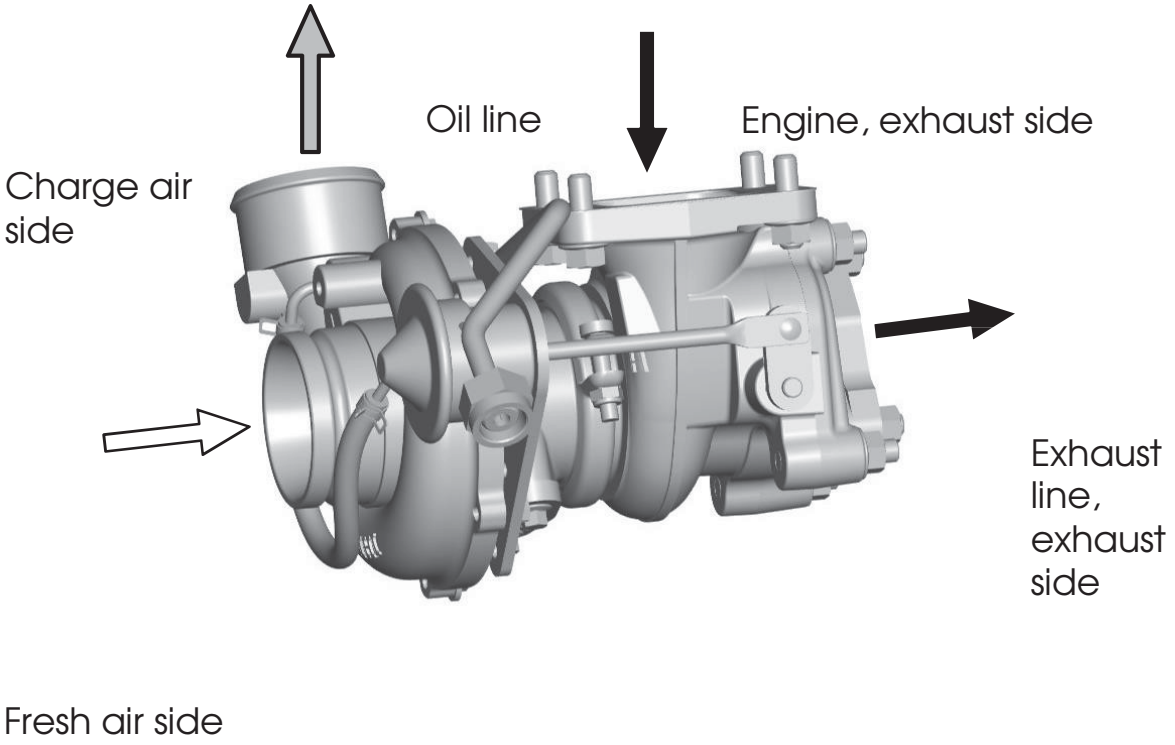
Sensor system / Electricals

Air filter



Multicar utilises its own air filter,

Turbocharger R750



Subdirectory Engine design / Engine systems

Engine

Engine design

Intake system

Lubrication

system

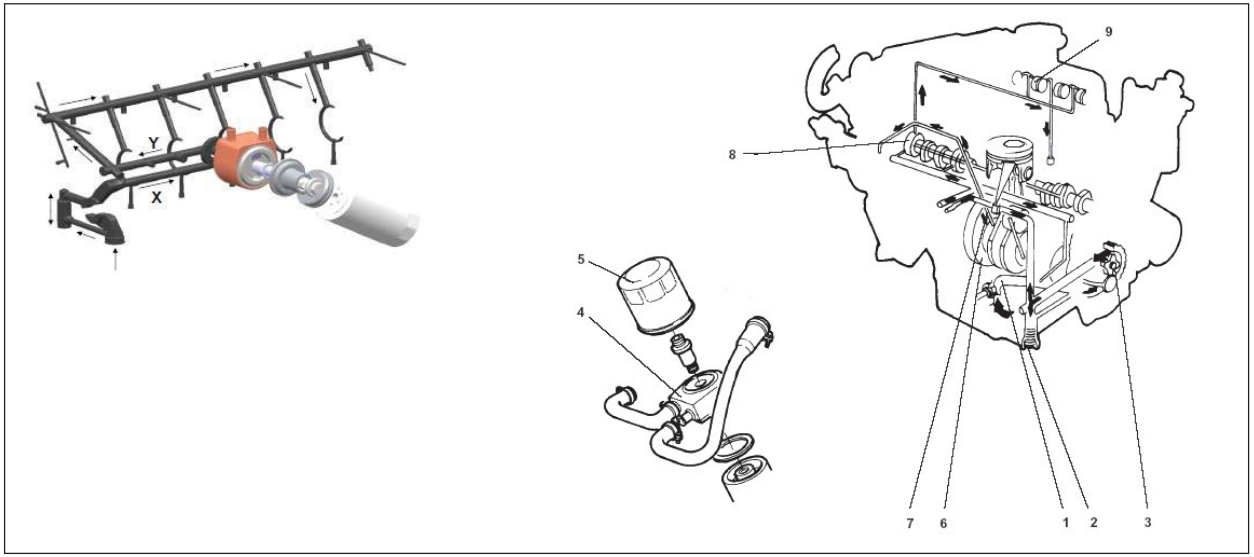
Cooling system

Injection

system

EGR

Basic scheme of the



1 Oil intake pipe
2 Pressure relief valve
3 Oil pump
4 Heat exchanger
5 Filter cartridge
6 Main crankshaft bearing
7 Oil injection valve
8 Camshaft bearing
9 Rocker arm

After filtration, the lubricating oil is routed through the system by means of the rotor pump; the respective parts are lubricated by this.

Oil in the pump is routed through the pressure relief valve to the filter and then to the main crankshaft bearings. Finally, the oil flows through external pipes to the rocker arms and to the turbocharger.

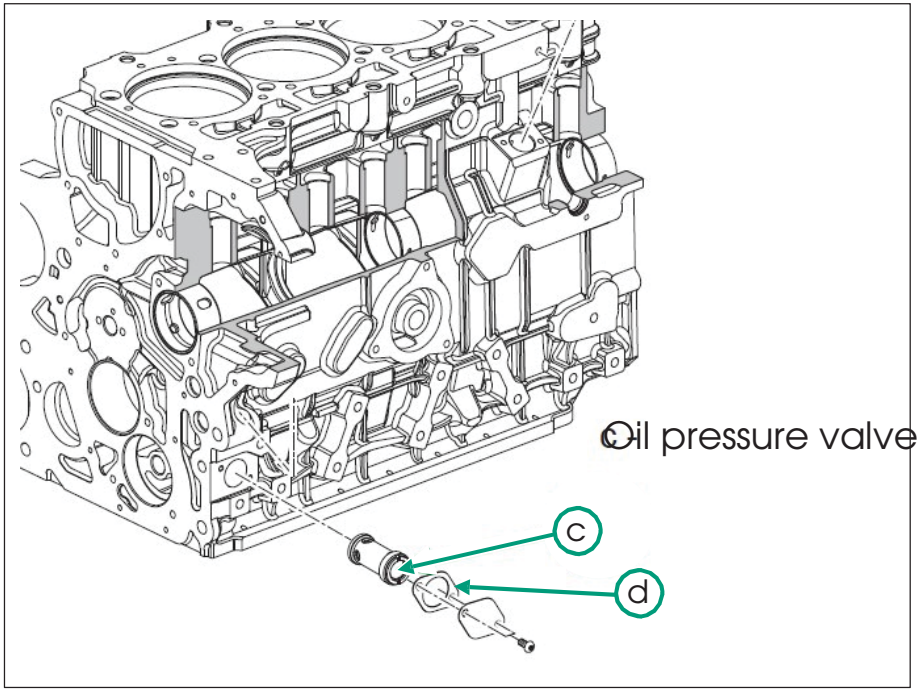
Oil pressures

	R754	
Speed in rpm	Idling	max.
Oil temperature in °C	80	
Oil pressure in bar (relative pressure)	1.5*	4.0*

***Note: The diagnostics unit measures absolute pressures**

a	Shaft
b	Inner rotor
c	Outer rotor
d	Rotor housing

Oil pressure relief valve R750EU6



Subdirectory Engine design / Engine systems

Engine

Engine design

Intake system

Lubrication

system

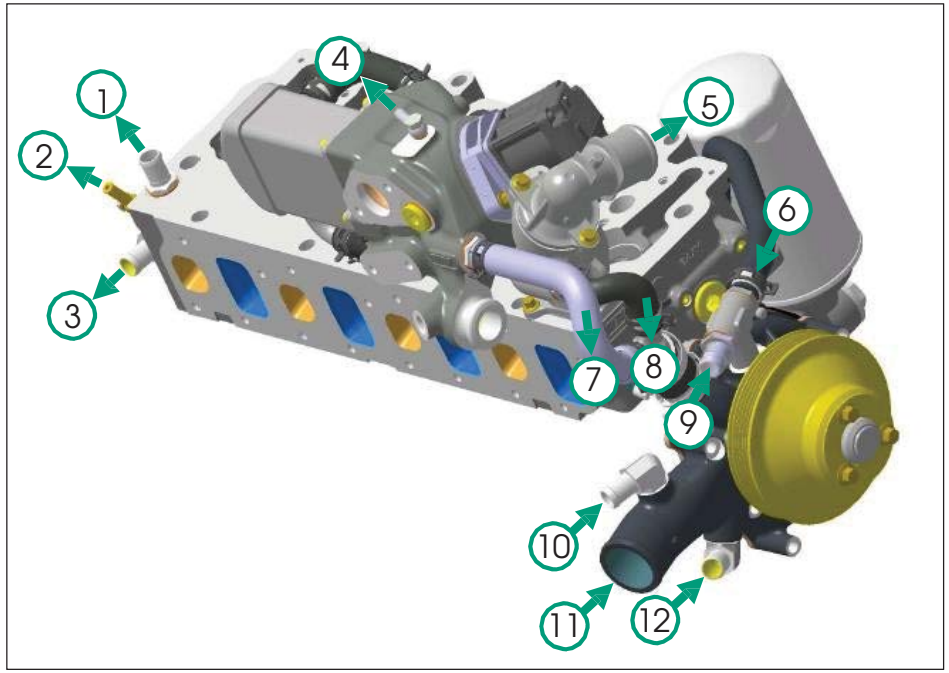
Cooling

system

Injection

system EGR

Cooling circuit R754EU6



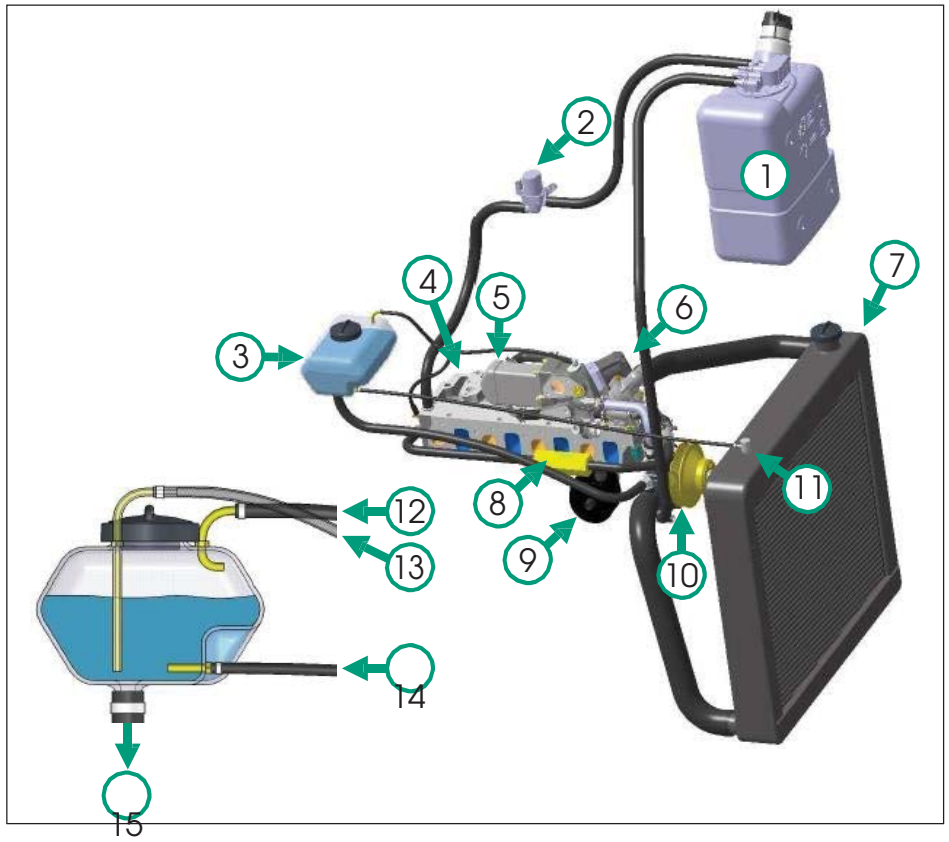
Standard setting of thermostatic valve

Thermostat starts to open: + 88°C

Thermostat starts to open: + 95°C

1	to the DEF tank or the cabin heating circuit
2	to the expansion tank
3	to cabin heater or DEF tank
4	to the expansion tank
5	from the thermostat housing to radiator
6	from water-oil cooler to water pump
7	from EGR to water pump
8	from thermostat housing to water pump
9	from cabin heater to water pump
10	from expansion tank to water pump
11	from radiator to water pump
12	from DEF tank to water pump

Cooling circuit R754EU6



1	DEF tank
2	DEF heater valve
3	Expansion tank
4	Cylinder head
5	EGR
6	Thermostat housing
7	Radiator
8	Cabin heater
9	Water-oil cooler
10	Water pump
11	Calibrated bore 2 - 3 mm
12	from EGR cooler
13	from radiator (optional)
14	from radiator (standard)
15	to water pump

Subdirectory Engine design / Engine systems

Engine

Engine design

Intake system

Lubrication

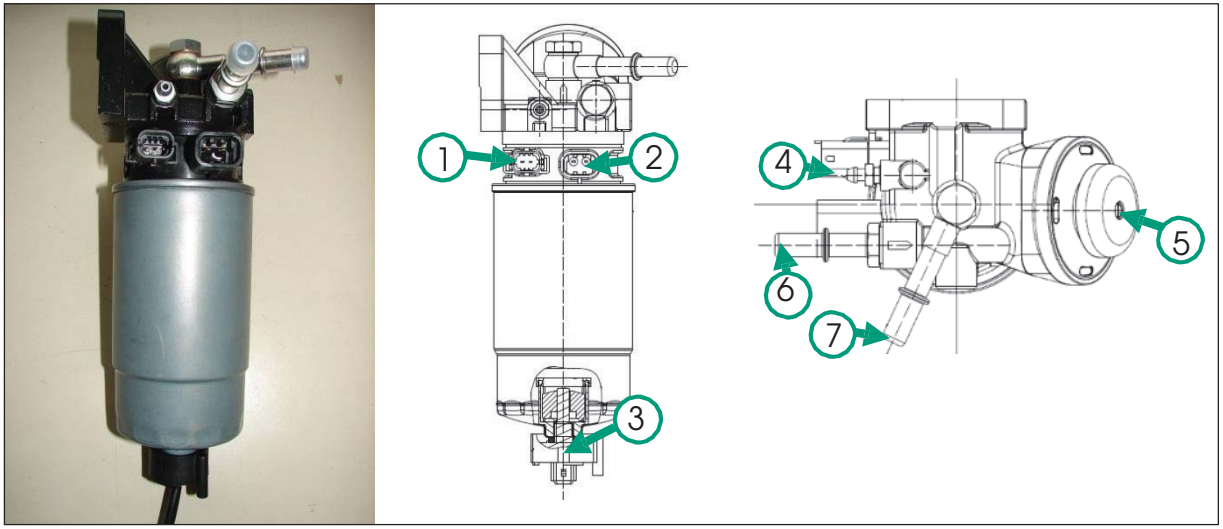
system

Cooling

system

Injection

Diesel filter
R750



The diesel filter is delivered loose by VM.

Electrical connections

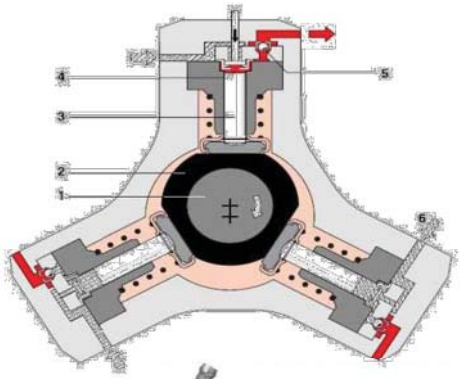
1	Diesel temperature sensor connection
2	Diesel heating connection
3	«Water in diesel» sensor connection(for EU5, controlled via control unit)

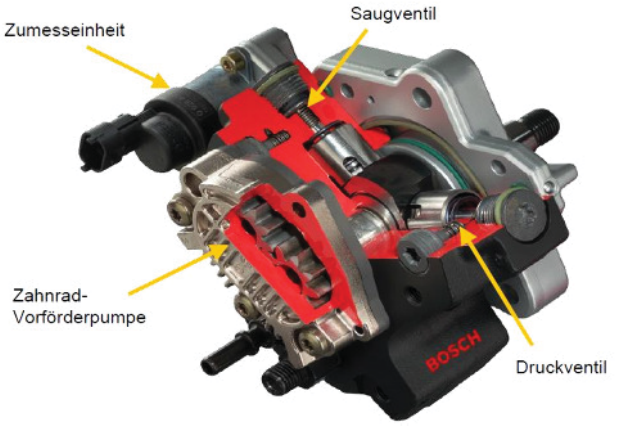
Hydraulic connections

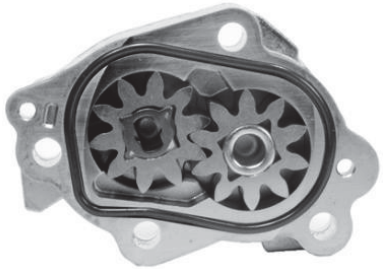
4	Vent valve
5	Manual feed pump
6	Diesel connection from tank
7	Diesel connection to engine

Common rail high

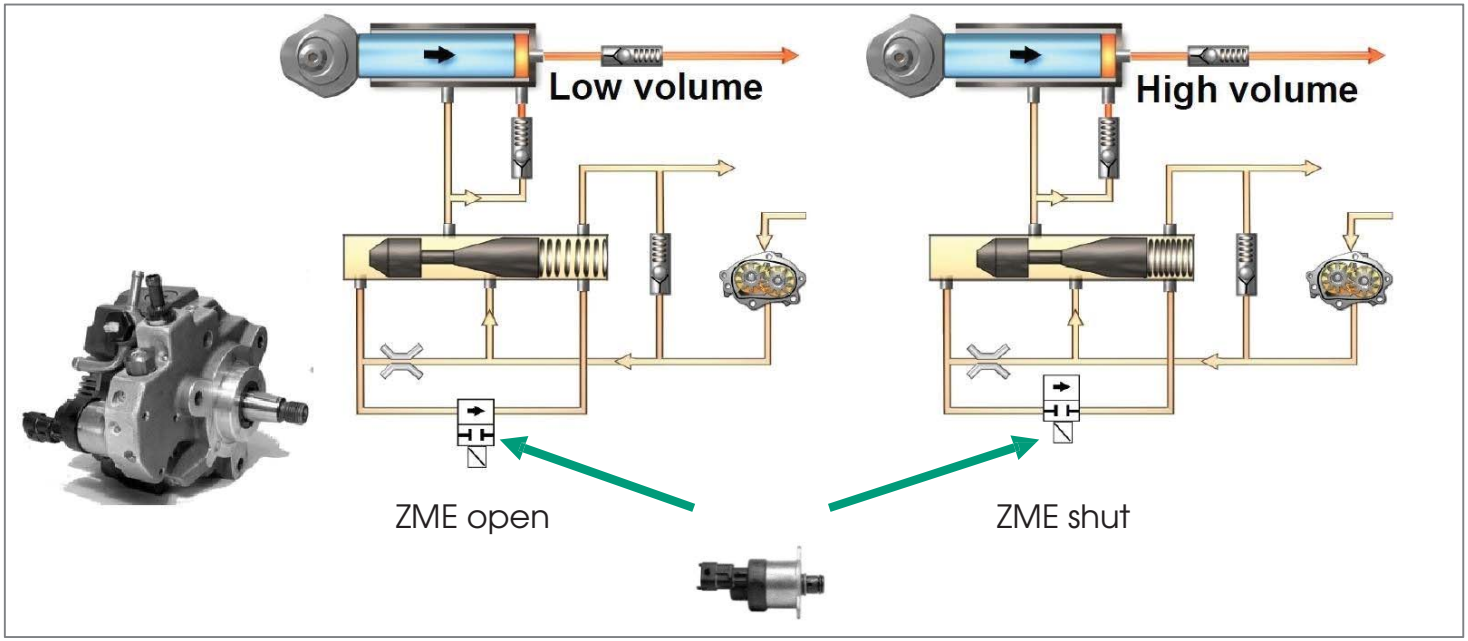
High-pressure pump Bosch type CP3.2







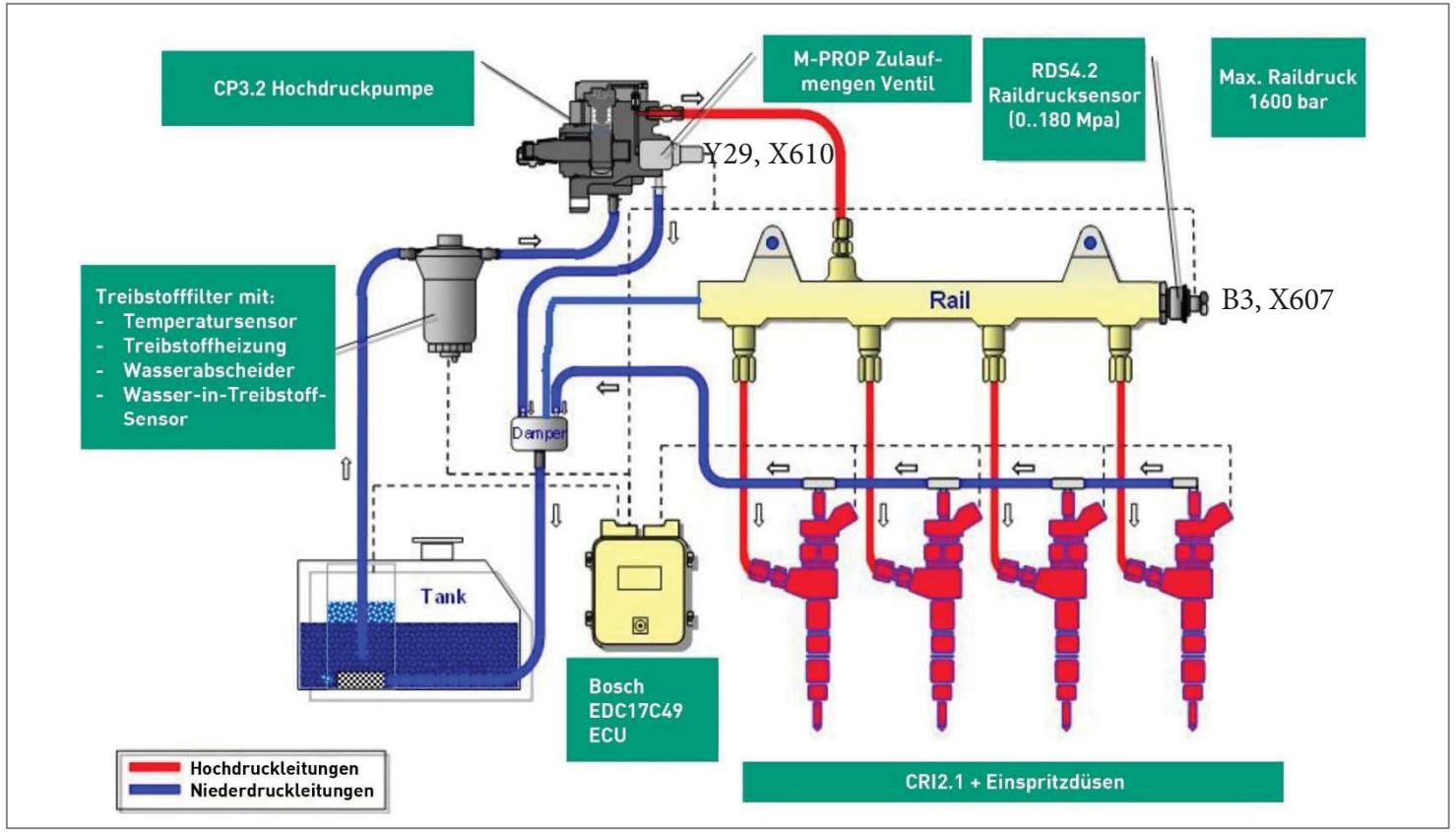
Common rail metering



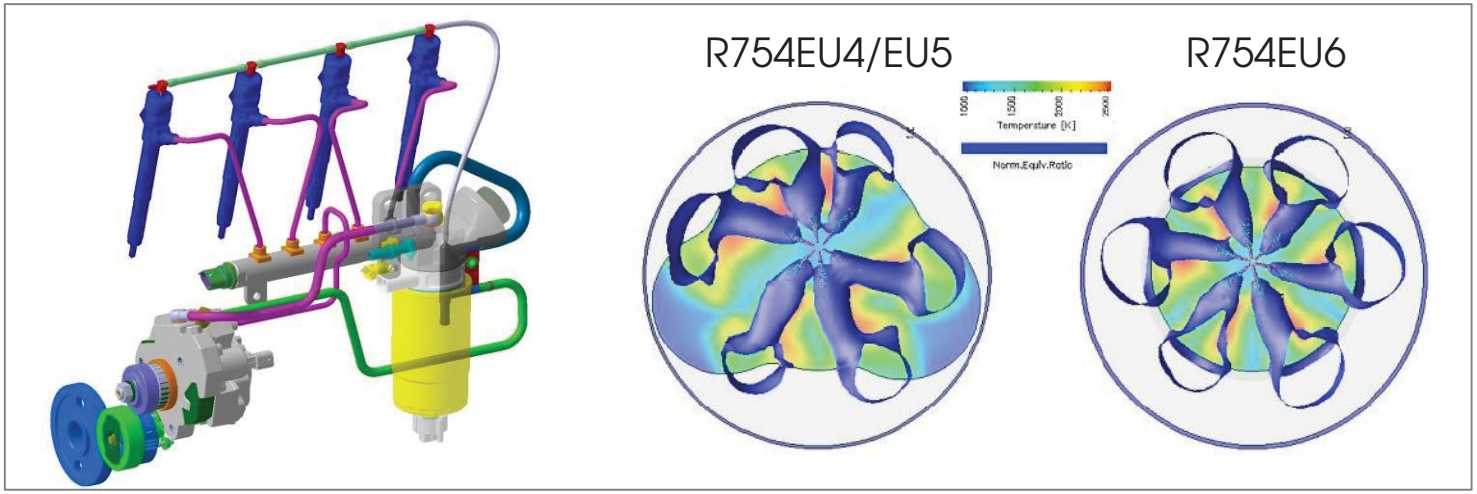
The metering unit (ZME), also called the feed quantity valve has an electro-magnetically actuated armature that operates a piston through which the feed sectional area to the intake side of the high-pressure pump can be changed. The ZME is mainly responsible for the rail pressure in most of the engine's operating modes. If the ZME's plug is disconnected, then the piston positions itself in a partial load /

INJECTION SYSTEM

Common rail injection



Injection system R750



- CR injection (1600 bar)
- Combustion pressure up to 170 bar
- 6-hole injection nozzles

⇨ Optimised combustion

⇨ Less emissions

Common rail injection

Injection nozzle

Functioning

Injection takes place when ball valve no. 5 is opened through the solenoid and thus hydraulic pressure at the top of piston no. 9 is less than below on the piston. Needle no. 11 lifts and diesel is injected.

Nozzle test

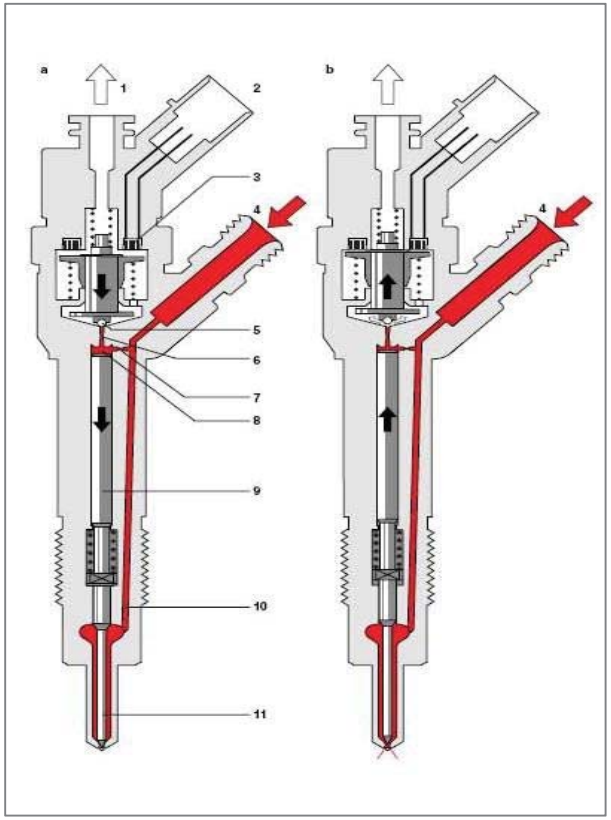
A comprehensive test can only be carried out on a Bosch CR nozzle test bench. For a «field test», the nozzle can be tested as follows:

– Disconnect plugs for all the nozzles

– Disassemble the oil leakage pipe

– Turn the engine using the starter

If too much diesel escapes from the oil leakage pipe during this test, the nozzle is faulty.



Common rail injection

Injection nozzle
Injector quantity comparison (IMA)

Functioning

The injectors have different fuel -quantity maps due to their mechanical manufacturing tolerances. The effect of this is that in spite of electrically defined control of each individual injector, the combustion chamber is filled with different quantities of fuel.

To ensure a defined injection quantity through the injectors in spite of that, the injectors are measured for their injection quantities at characteristic operating points and arranged into categories. The respective category must be known to the engine control unit during operation so that this can equalise the mechanical tolerances of each individual nozzle.

IMA code:
EU6 = 7 digits

Subdirectory Engine design / Engine systems

Engine

Engine design

Intake system

Lubrication

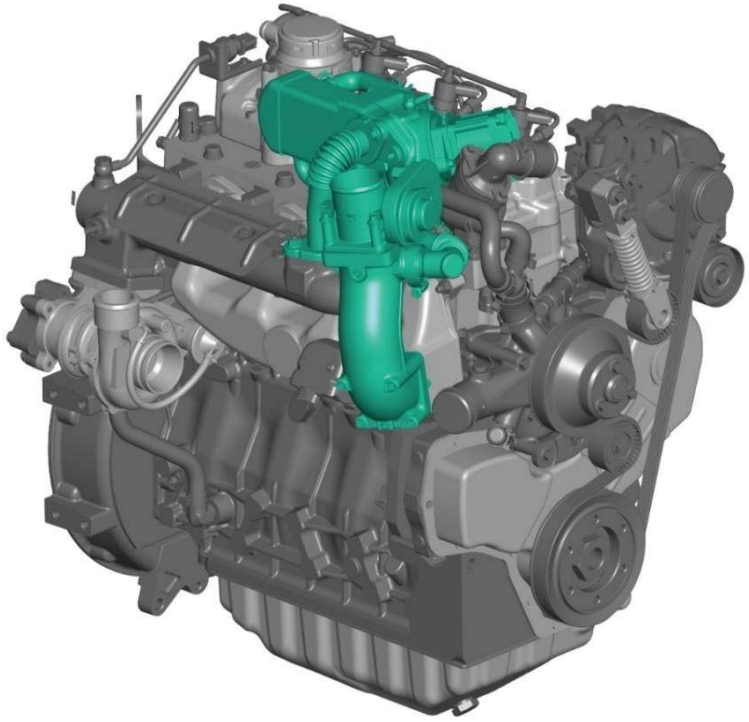
system

Cooling

system

Injection

Exhaust gas



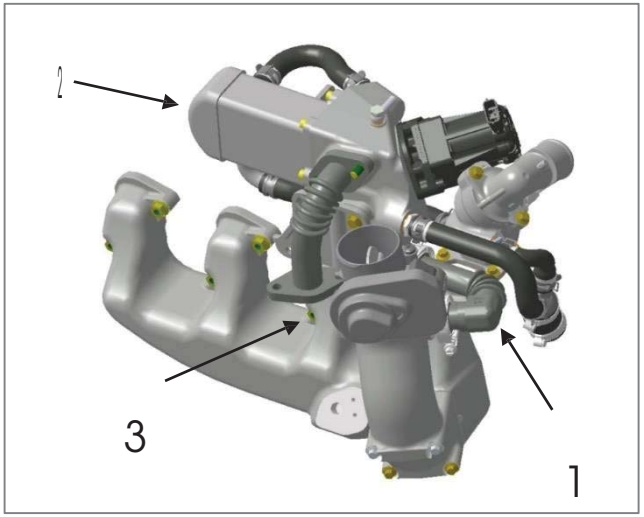
R754EU6
externally cooled exhaust gas recirculation

Exhaust gas

EGR (exhaust gas recirculation) is a device for the reduction of NOx emissions

The EGR system consisting of the EGR valve and EGR cooler routes a part of the exhaust gases back into the intake pipe after cooling.

Via the exhaust gas recirculation (EGR), under partial load operation, a part of the fresh air drawn in is enriched by the cooled exhaust gases and so, the excess oxygen in the cylinders is lowered. This causes a lowering of the combustion temperatures and thus, a lowering of the nitrogen oxide values (NOx) in the exhaust gases.



1	Exhaust gas from the exhaust manifold into the exhaust gas recirculation
2	Cooling of the exhaust gases
3	through the exhaust gas recirculation cooler

Subdirectory Engine design / Engine systems

Engine

Engine design

Intake system

Lubrication

system

Cooling

system

Injection

ENGINE CONTROL UNIT

ECU / Control unit

code

Software calibration

Engine serial number

Subdirectory Engine design / Engine systems

Engine

Engine design

Intake system

Lubrication

system

Cooling

system

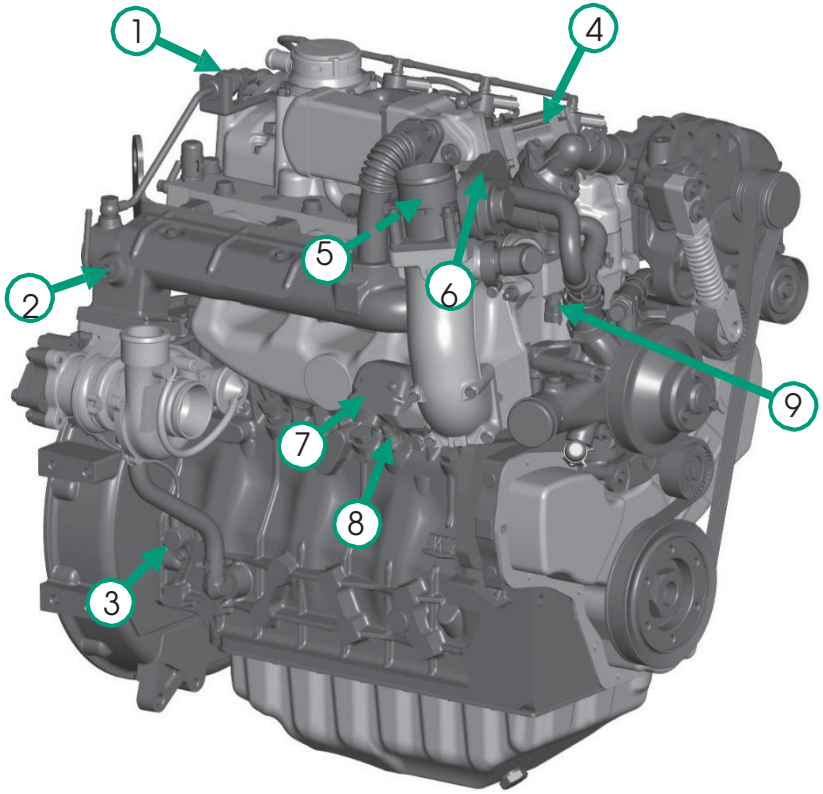
Injection

Indicator lights and displays

	Kontrollleuchten								Anzeigen	
	SYS	MIL*	GLOW	CHARGE	OIL	WIF	DPF	DWS (DEF)*	FUEL	DEF Level*
										
R 754 TE4 / ISE / IE4	✓	x	✓	✓	✓	✓	✓	x	✓	x
R 750 EU6	x	✓	✓	✓	✓	✓	✓	✓	✓	✓

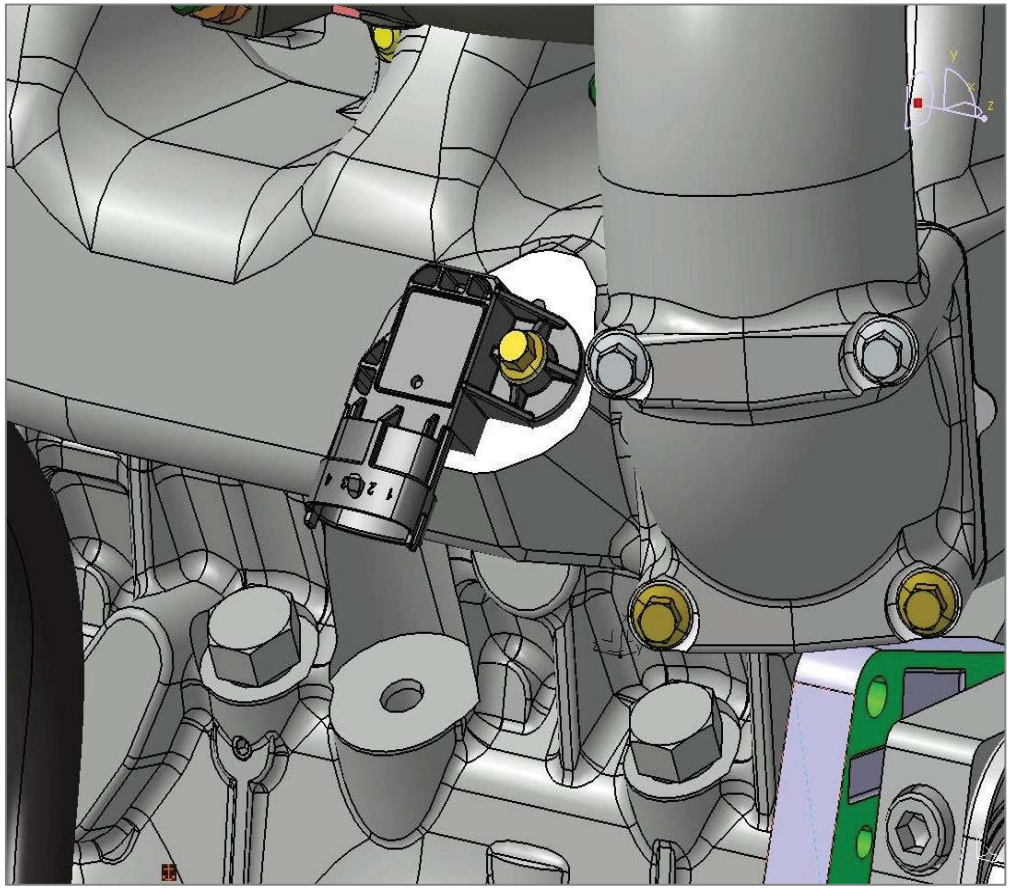
* Müssen auf On Board Diagnose verfügbar sein

Engine overview



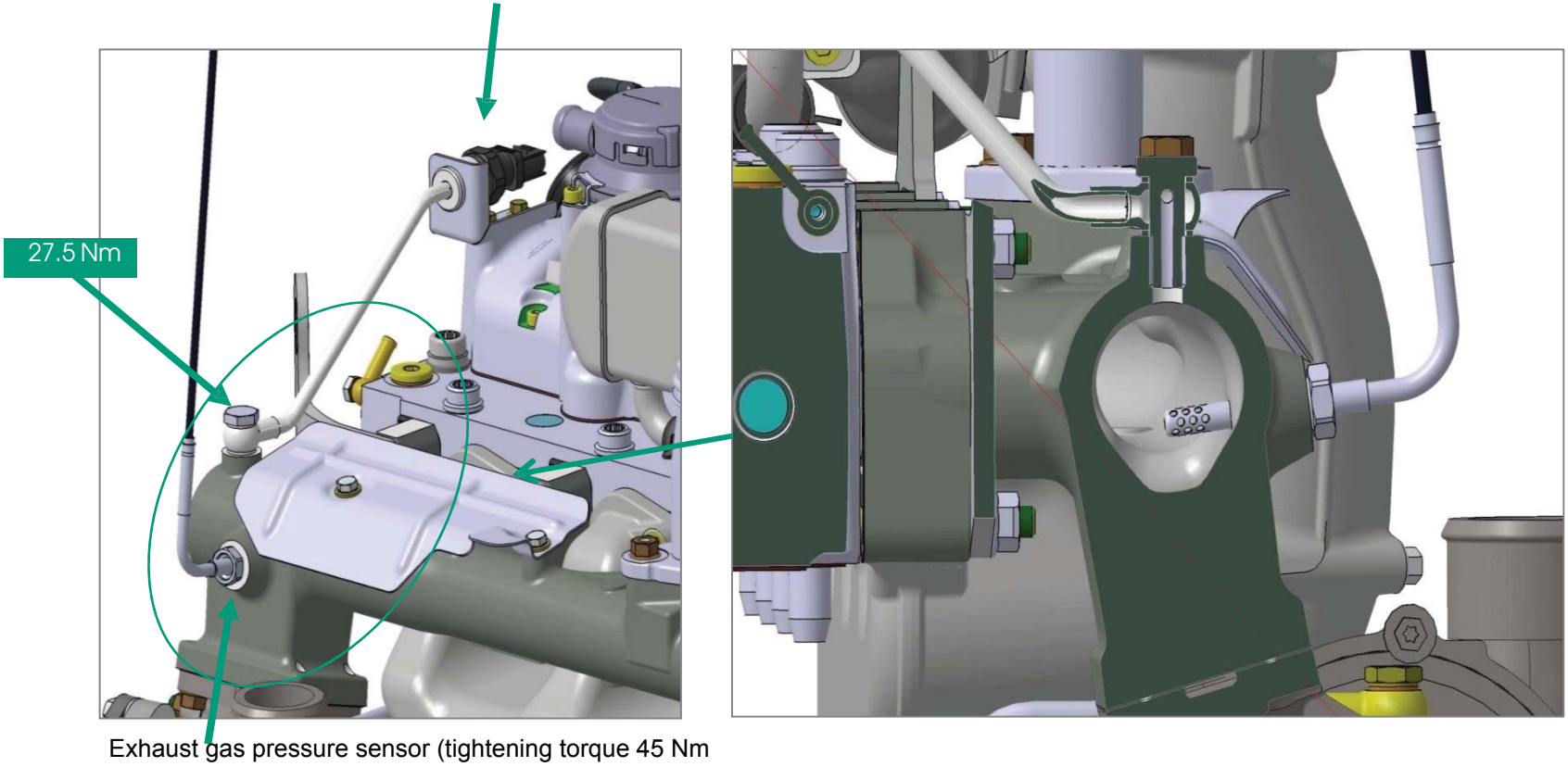
1. Exhaust pressure sensor, B66, X128
2. Exhaust temperature sensor T3,
3. Crankshaft sensor, B2, X606
4. EGR valve, Y41, X612
5. EGR cooler outlet temperature sensor
6. Throttle valve, Y42, X613
7. Charge air pressure and temperature sensor, B33, X143
8. Oil pressure switch, B15, X614
9. Water temperature sensor, B5, X609

Position of the intake temperature

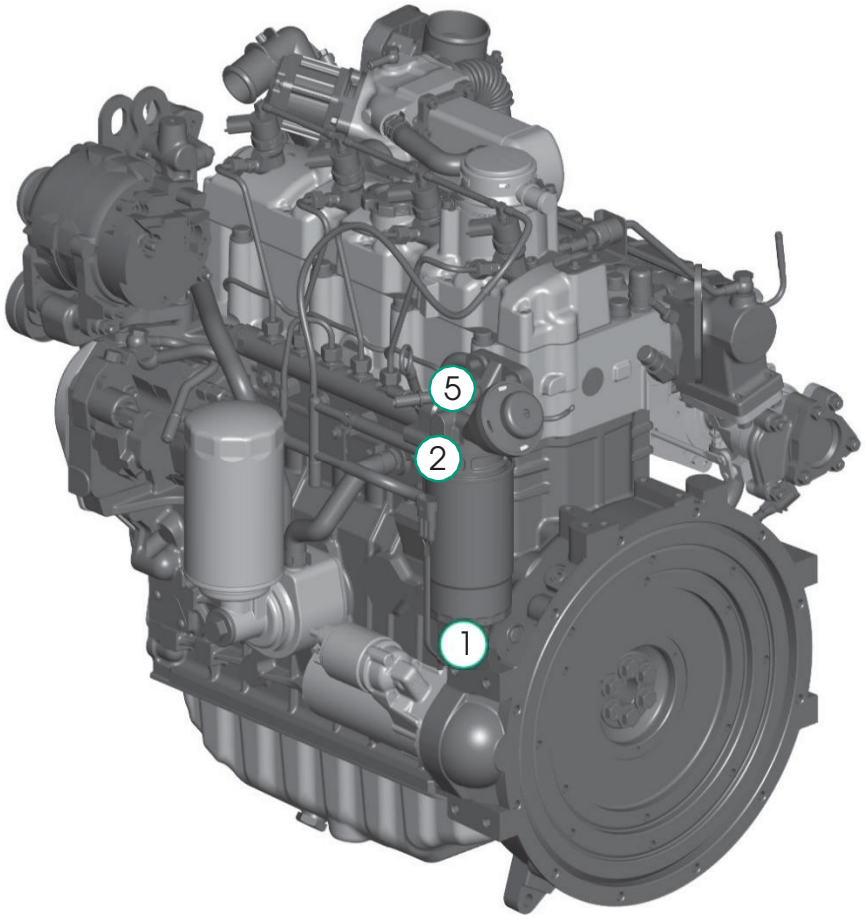


Exhaust gas pressure and

Exhaust gas pressure sensor (tightening torque14 Nm)

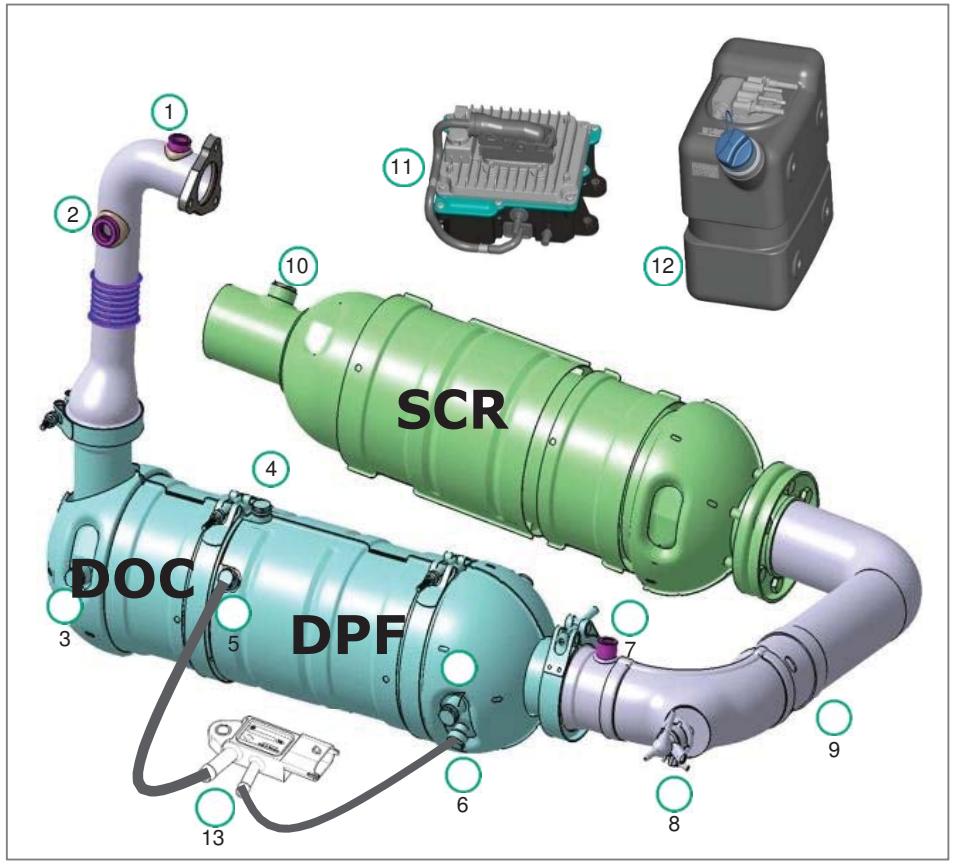


Engine overview



1. Sensor water in the fuel
2. Fuel temperature sensor
5. Fuel heater

ATS sensor



1	Oxygen sensor
2	NOx sensor (in)
3	Temperature sensor DOC in
4	Temperature sensor DPF in
5	Pressure connection DPF in_
6	Pressure connection DPF out
7	Temperature sensor SCR in
8	DEF injector
9	Mixing pipe
10	NOx sensor (out)
11	ACU box
12	DEF tank
13	Differential pressure sensor

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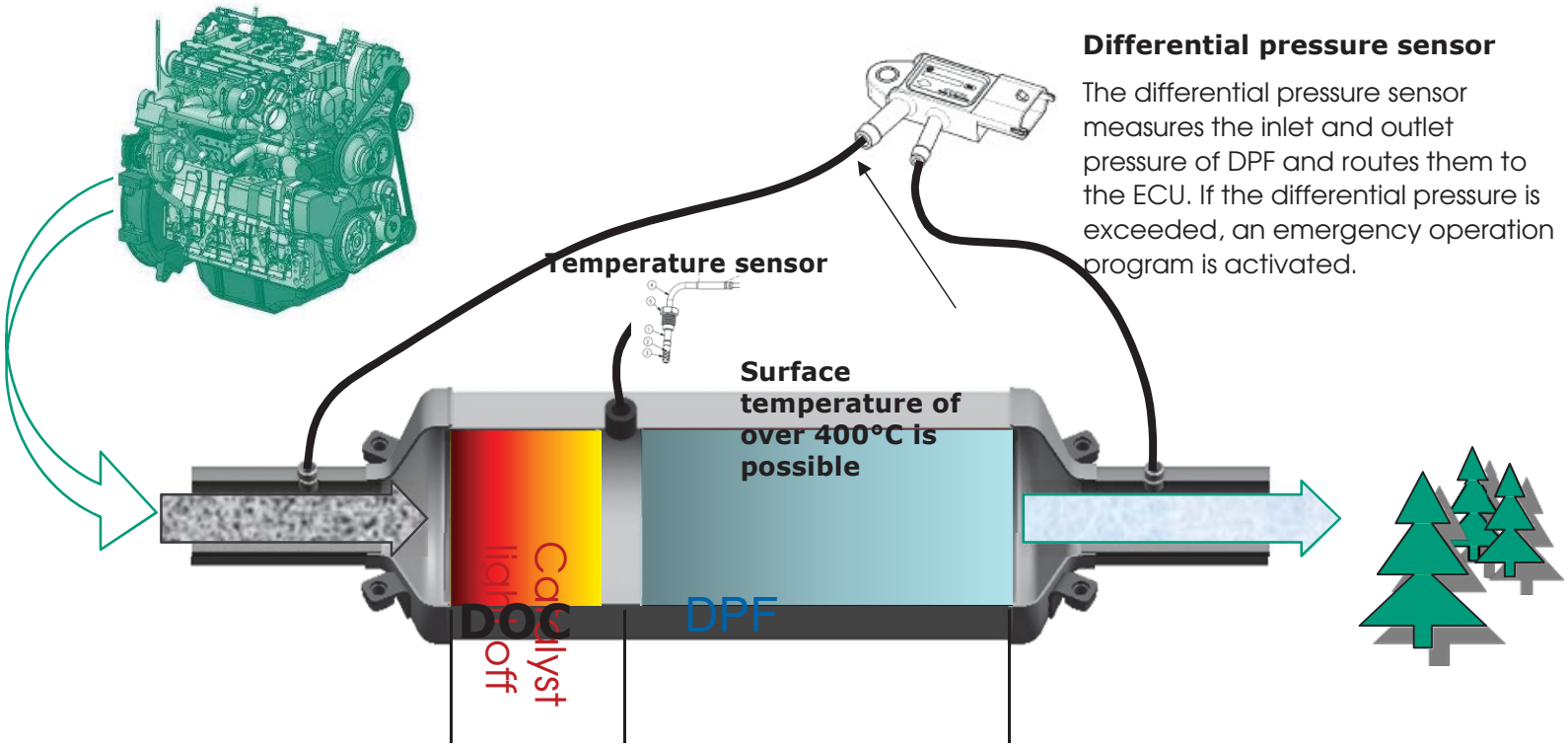
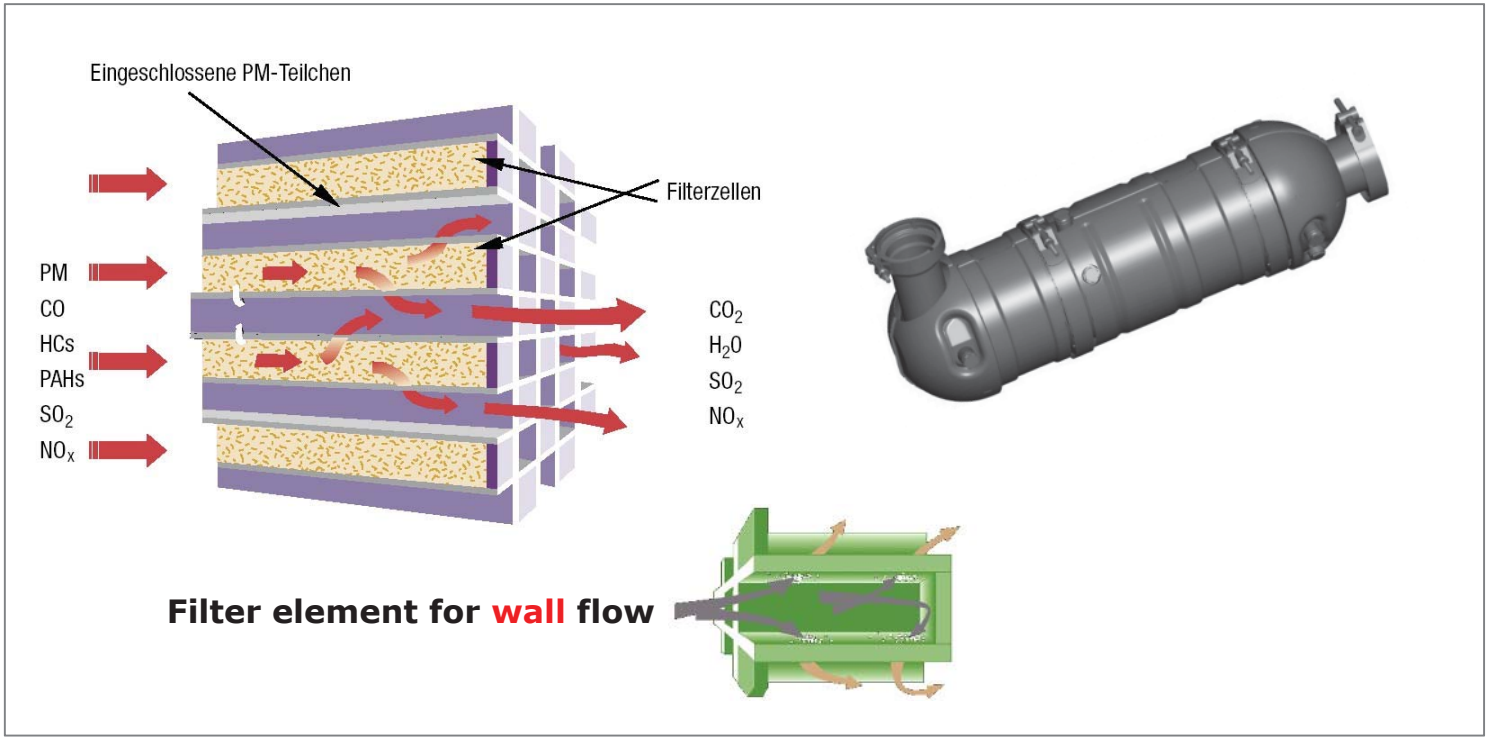
Particulat



Differential pressure sensor

The differential pressure sensor measures the inlet and outlet pressure of DPF and routes them to the ECU. If the differential pressure is exceeded, an emergency operation program is activated.

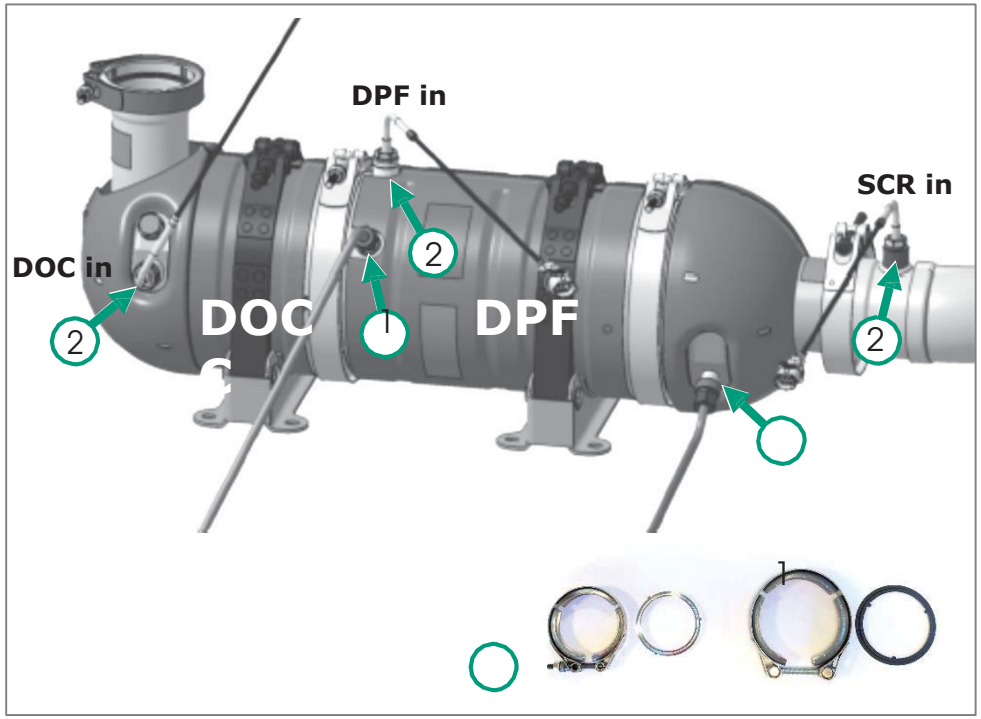
Particulate filter -



The catalyst coated particle filter reduces the particulate matter to a minimum.

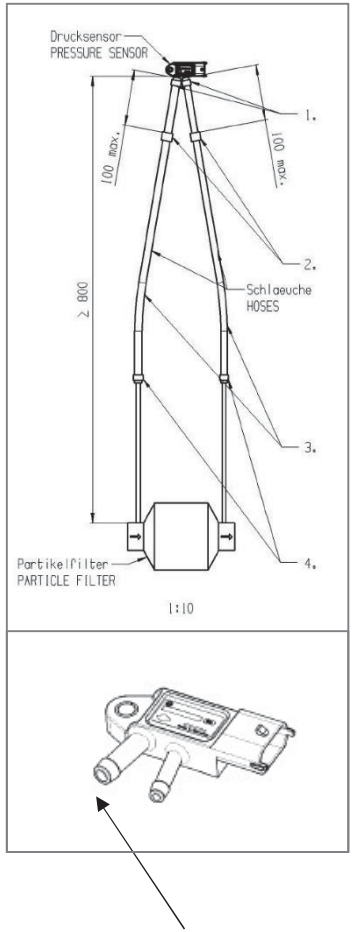
DOC and

Diesel oxidation catalytic converter DOC and Diesel particulate filter DPF



1	Differential pressure lines
2	Exhaust gas temperature sensors Do not exceed tightening torque of max. 45 Nm
3	Clamps Tightening torque: 12 Nm

Differential pressure sensor



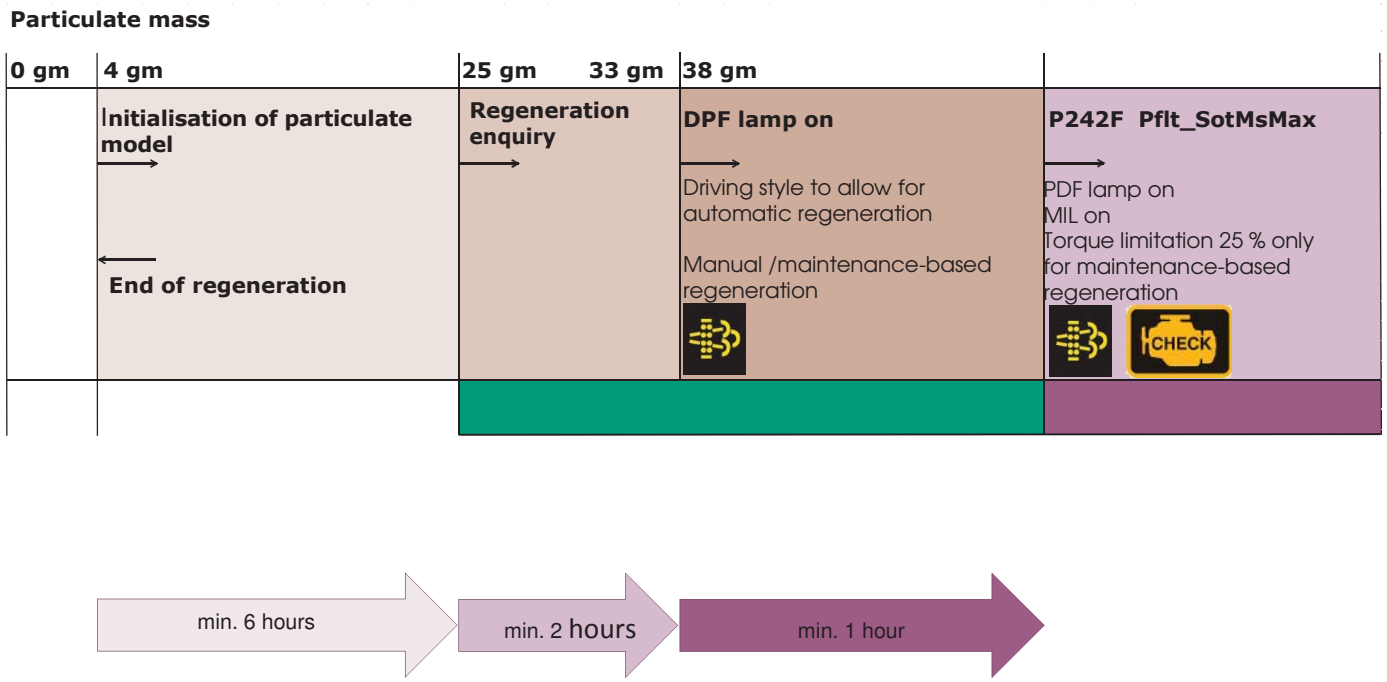
1. Good protection against slipping (even for warm hoses) is required
2. Hose fastener
3. Total length of hose/pipe min. 800 mm. Routing to sensor is continuously rising.
4. Metal pipes directly on exhaust pipe.

The differential pressure sensor measures the differential pressure between the DPF inlet and DPF outlet and sends this to the ECU. If the differential pressure is exceeded, an emergency operation program is activated.

The larger connection on the differential pressure sensor

DPF

DPF load limit values



DPF

Automatic regeneration

Start of regeneration:

- Cooling water temperature > 25 °C
- Engine running time > 10 s
- Engine speed > 950 rpm

→ Regeneration duration:

15 - 30 minutes depending on driving cycle

Interruption of automatic regeneration

If regeneration is interrupted:

- Idling time > 90 sec.
- Coasting mode > 180 sec (downhill driving)
- DPF inlet temperature > 700 °C
- Regeneration suppression depressed (optional)

DPF

Manual / Maintenance-based regeneration

Manual or maintenance-based regeneration can be started when:

- Cooling water temperature > 65 °C
- Vehicle speed = 0 km/h
- Accelerator not depressed
- No additional load set
- Parking brake engaged
- Clutch disengaged
- Engine idling

Regeneration duration:

- 15 - 20 minutes at 2000 rpm

Manual regeneration can be activated via the optional regeneration switch or the diagnostics tool.

DPF

Manual regeneration is not possible under the following conditions or will be terminated when:

- Cooling water temperature < 65 °C
- Vehicle speed > 0 km/h
- Accelerator > 0 %
- Engine under load
- Clutch depressed
- Engine speed > Idling speed
- Fuel temperature > 100 °C
- DPF inlet temperature > 700 °C
- Regeneration duration > 25 min
- After 5 min., when DPF inlet temperature < 520 °C
- After 5 min., when DOC inlet temperature < 250 °C

Maintenance
DOC / DPF

R750EU6

Maintenance required after every 4000 operating hours.

For the maintenance of the particulate filter, please follow the instructions given in the VM Operating instructions or in the separate technical maintenance instructions.

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Short forms and

ACU	=	After Treatment Control Unit	Exhaust gas after treatment control unit
ATS	=	After Treatment System	
DCU	=	Dosing Control Unit	
DEF	=	Diesel Exhaust Fluid	(e.g. AdBlue)
DOC	=	Diesel Oxidation Catalysts	Diesel oxidation catalytic converter
DPF	=	Diesel Particulate Filter	
DWS	=	Driver Warning System	
FAP	=	Filtre à particules (French)	Diesel particulate filter
FDS	=	Fluid Delivery System	DEF (Urea - Ad Blue) supply system
NOx	=	Oxides of Nitrogen	
SCR	=	Selective Catalyst Reduction	

What is SCR (selective catalytic

SCR technology utilises a urea-based diesel exhaust fluid (DEF) to achieve catalytic conversion that significantly reduces the nitrogen oxides (NOx) in exhaust gases.

SCR is the technology most utilised to meet the exhaust gas regulations applicable since 1.1.2014.

This technology has been employed in lorries from 2010 onwards.

How does the SCR system

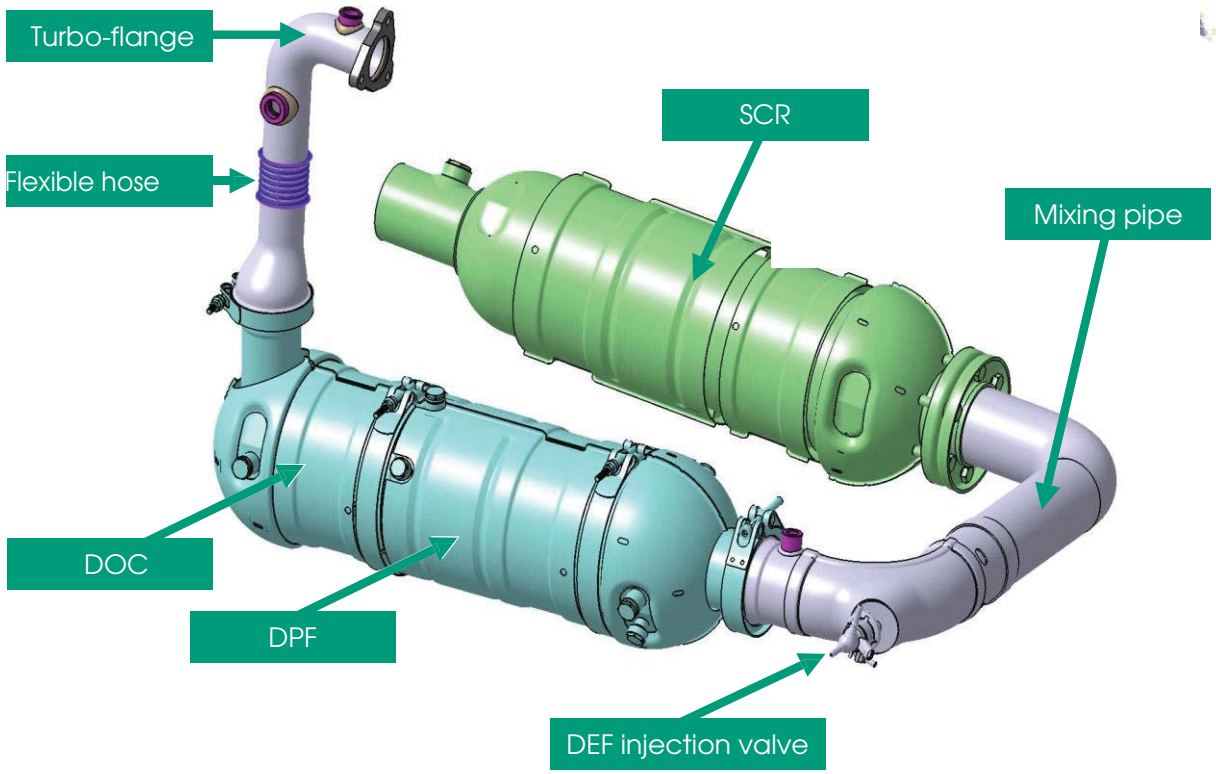
The system precisely injects a required amount of urea into the exhaust system. The injection takes place between the particulate filter and the SCR filter.

After being injected, the urea vaporises and is converted to ammonia and carbon dioxide. The ammonia (NH3) together with NOx is converted into nitrogen (N2) and water (H2O) in the SCR catalytic converter. Both resulting chemicals are harmless and are reduced to almost zero.

As ammonia is highly corrosive, it is necessary to use stainless steel components for routing the exhaust gases.

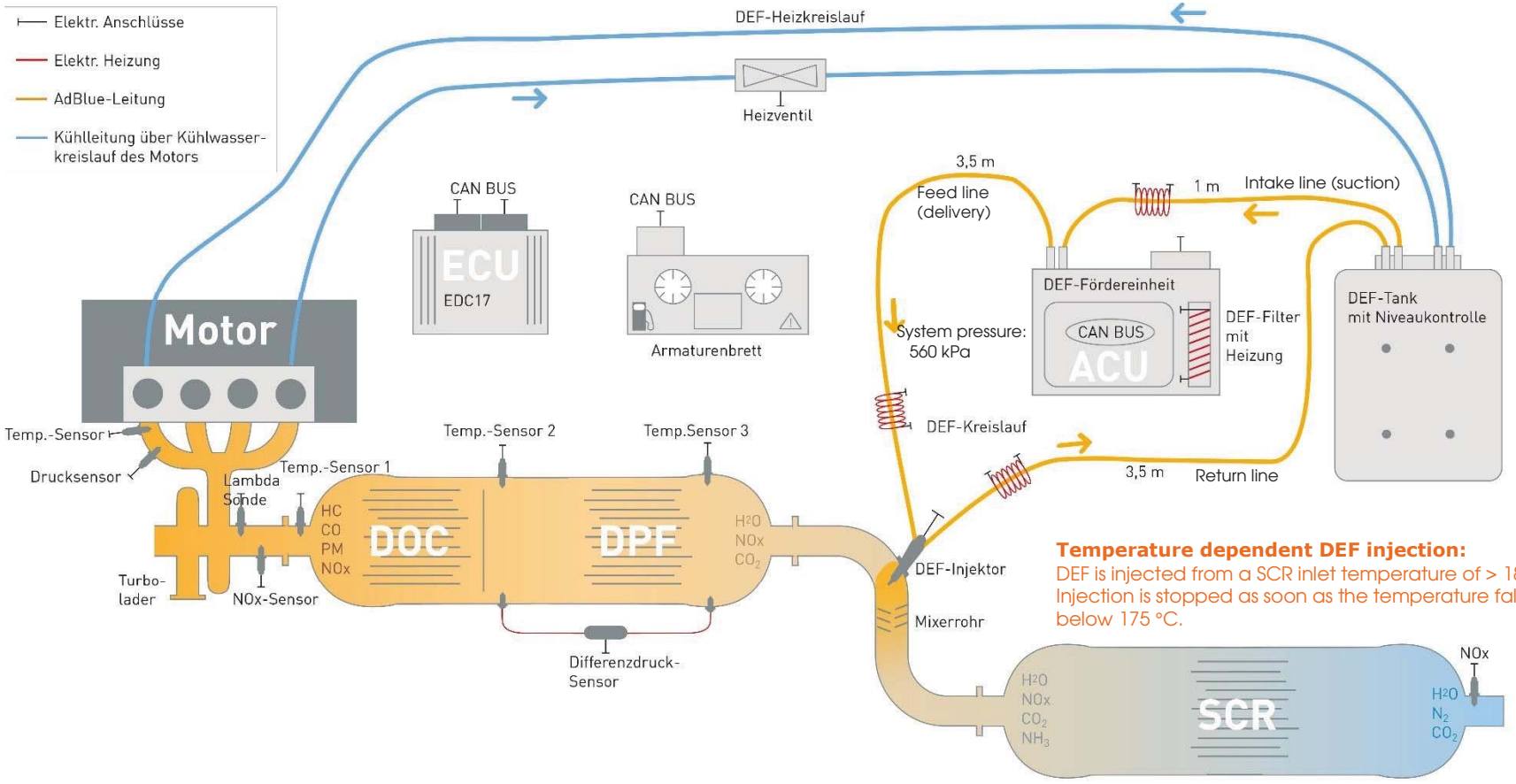
Mainly, the system consists of: Urea tank, level sensor and temperature sensor, pump unit, filter, DEF lines, dosing unit, heater, injection valve, NOx sensors, control unit and wiring harness.

Description of the main



SCR

ATS



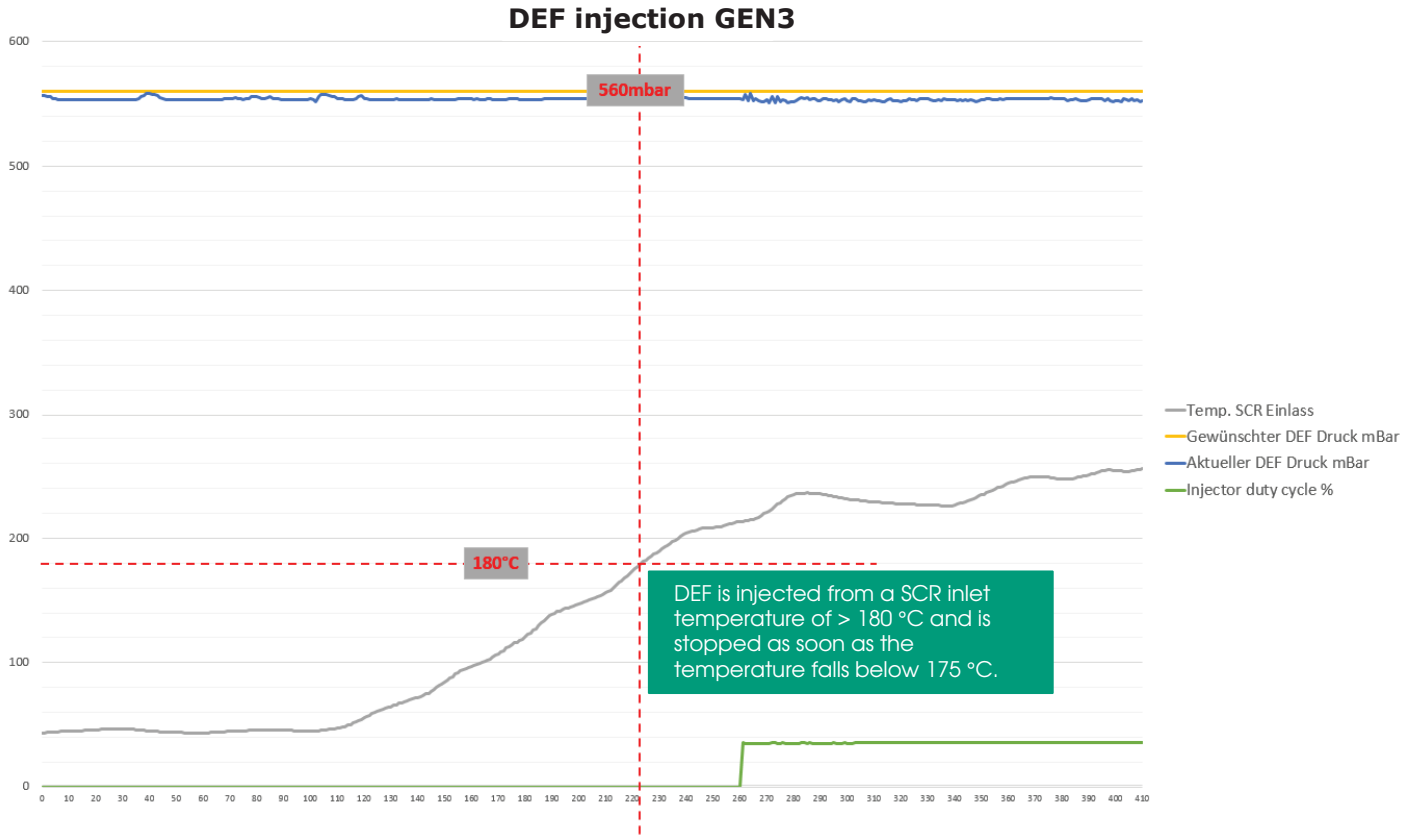
Temperature dependent DEF injection:
DEF is injected from a SCR inlet temperature of > 180 °C. Injection is stopped as soon as the temperature falls below 175 °C.

Oxidations-Katalysator
Reduktion CO + HC

Dieselpartikelfilter
Reduktion PM

SCR-Katalysator
Reduktion NOx

System overview of ATS



Information regarding DEF

What is diesel exhaust fluid (DEF)?

DEF is the reactant required for the functioning of the SCR system. It is a homogeneous urea-water solution (32.5% urea and 67.5% de-mineralised water).

What is urea?

Urea is a nitrogen compound which converts into ammonia when heated. Urea is used in many applications in the industry and also as fertiliser in agriculture.

Why must a 32.5% urea solution be used?

The highest reduction rate of NOx is achieved with a 32.5% urea solution, therefore the SCR system is calibrated for that.

Information regarding DEF

What must be noted when working with DEF?

When topping up DEF, no protective clothing is required, however protective gloves are recommended to avoid skin irritation due to contact.

Contact with eyes and mucous membranes must be avoided.

How must DEF be stored?

The storage area must be clean and free of dust. Ideally, DEF should be stored between 0°C and 30°C and not be exposed to direct sunlight.

Store DEF only in containers specially meant for DEF. Even small quantities of fuel / oil / lubricant can damage the SCR catalytic converter.

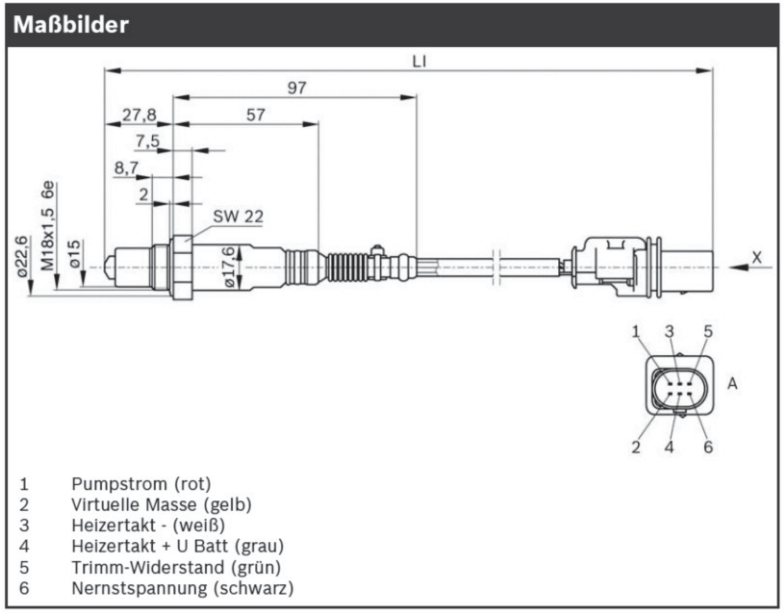
What is the freezing point of diesel exhaust fluid (DEF)?

DEF begins to crystallise and to freeze at -11 °C. The SCR system is designed such that the DEF tank is heated by the engine cooling circuit when ambient temperatures are low. The DEF lines are heated electrically. This has no effect on driving. The freezing and thawing of DEF has no negative effect on its quality.

Oxygen

Bosch LSU 4.9 broadband oxygen sensor

The Bosch LSU 4.9 broadband oxygen sensor measures the quantity of oxygen in the exhaust gas and through that provides important information regarding the combustion in the engine, this is utilised for engine control and for the reduction of emissions.



Tightening torque: 40 Nm

Source: Drawing / Technical data sheets of

NOx

The NOx sensor consists of a measuring sensor and a control unit (SCU, Sensor Control Unit) which are connected to each other through a cable.

Similarly as with a broadband oxygen sensor, the oxygen concentration is captured in the sensor element through electro-chemical pumps. The SCU sends the corresponding signal digitally via the CAN bus to the ECU of the engine.

The NOx sensor is used for regulating the urea dosing within the SCR system and for the OBD (monitoring) of the exhaust gas after treatment system.

Tightening torque for the sensor: 50 Nm

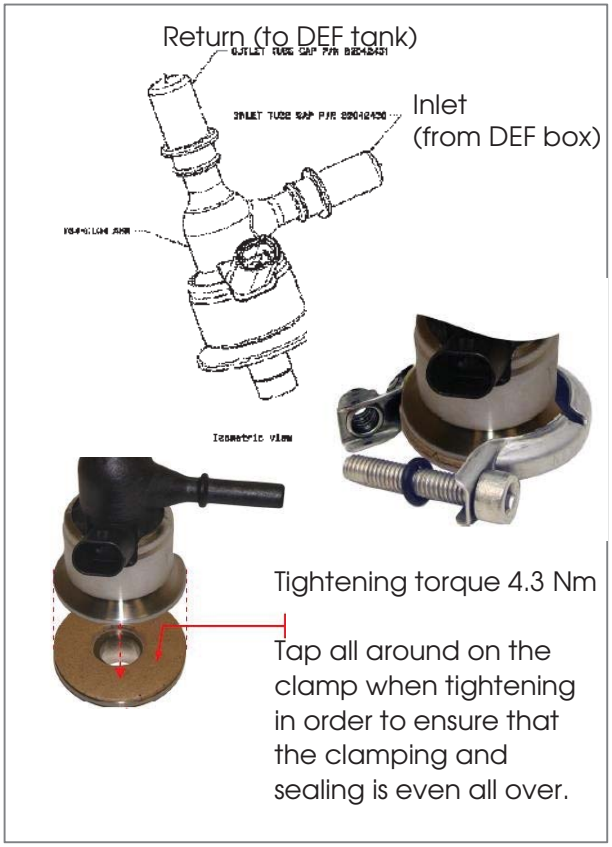
Source: Continental / VDO

DEF injection valve

Cooling and follow-up process

At a SWCR inlet temperature of > 105 °C, the DEF follow-up is activated for 300 sec. after «ignition off» to cool the injection valve. Subsequent to the follow-up, the DEF lines are pumped empty by reversing the pump, until a pressure of -35 kPa is achieved (takes approx. 90 sec.). Finally, the pump is run again at idling speed, in order to stabilise the pressure.

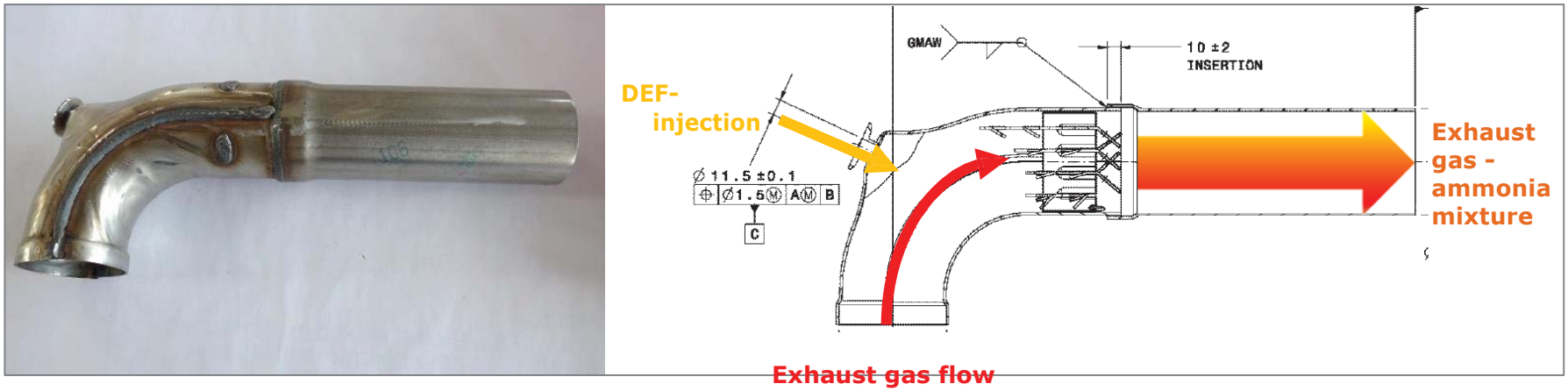
NOTE: Power supply must not be interrupted for these at least 6 - 7 minutes after the engine has been switched off. (Battery must not be disconnected)



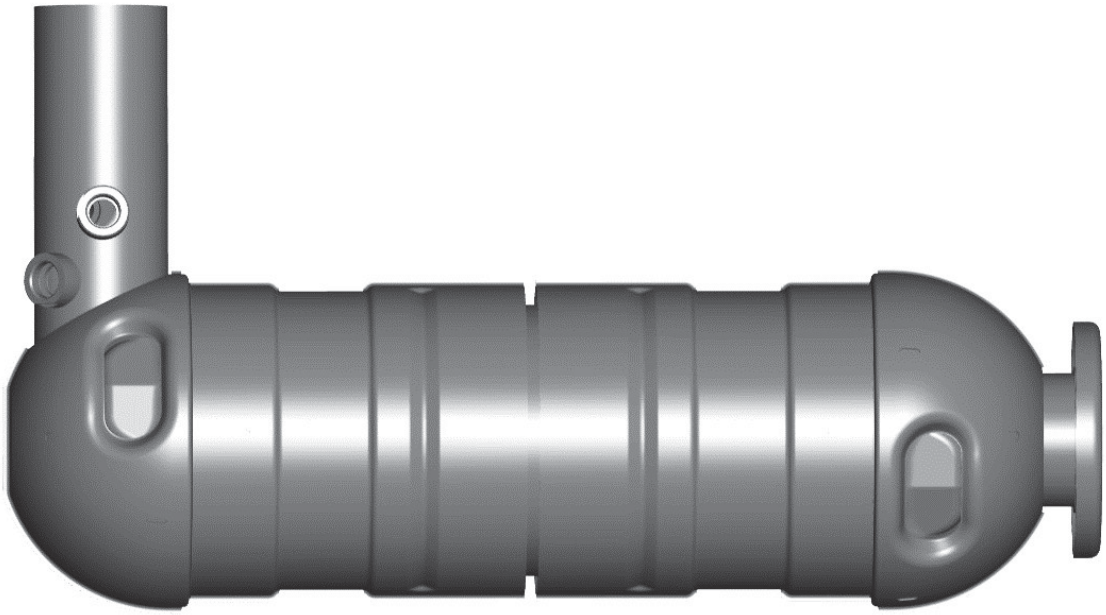
DEF

DEF (Diesel Exhaust Fluid) is injected into the mixing pipe through an injector. The urea portion in the DEF vaporises into ammonia due to the hot exhaust gases before the material reaches the SCR catalytic converter.

The mixing zone must not be shortened.



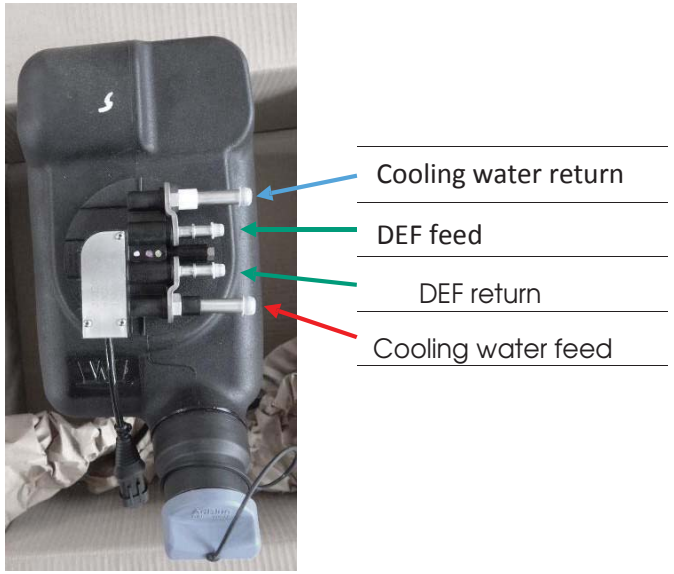
SCR catalytic converter



- The SCR catalytic converter is factory fitted with a heat shield
- The holders for the installation in the vehicle shall be delivered by VM/Bosch.
- The flange, the bolts and nuts are made of stainless steel.

DEF tank - 14 litres

VM item no.
3 160 2004



ACU box (DEF pump

DEF to injector 5/16"

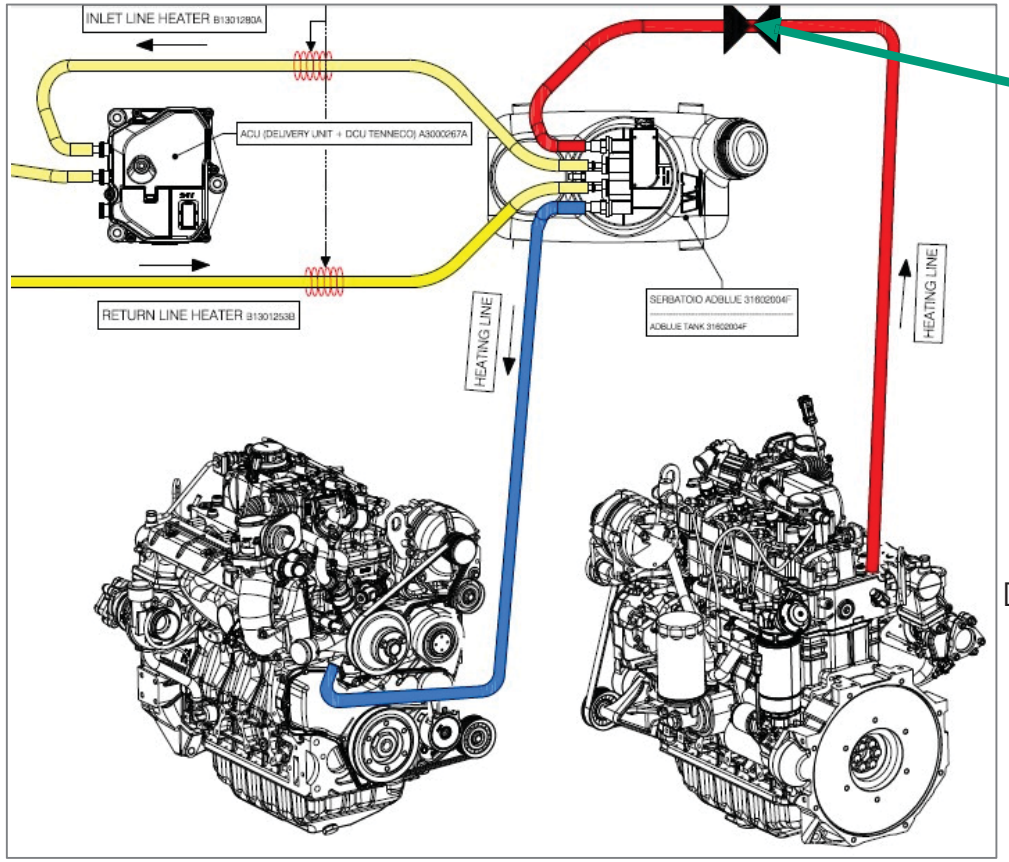
DEF from tank

Filter position

Maintenance note:
Replace the DEF filter every 1000 hours

DEF filter to pump unit GEN3 VM 4 530 2001

DEF tank - Cooling water



Note direction of flow

The cooling water valve **opens and heats** the DEF tank when:

DEF temperature < -5 °C **and** Cooling water temperature > -8 °C

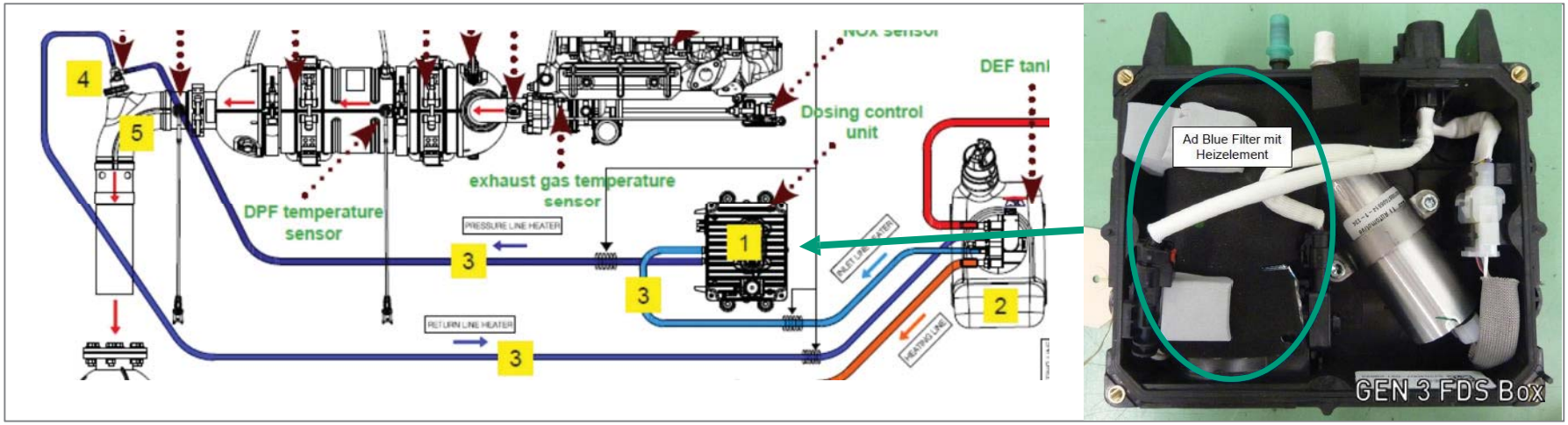
The cooling water valve **shuts** when:

DEF temperature > 5 °C

Heated DEF lines and DEF filter heater

All the DEF lines are filled with a heating coil. The heating coils are switched on when the DEF temperature is < -5 °C and it remains switched on until the DEF temperature has reached > 5 °C .

The same is also applicable to the heating element around the DEF filter, which is inside the FDS box.



Prerequisites for the correct functioning of the

The authorities have stipulated the monitoring of specific engine components and of the exhaust-gas after treatment system. A three-stage inducement system (warning and power reduction) was introduced in the engine regulation. As soon as the inducement system is active, it is displayed via the DWS (driver warning system) indicator lamp.

The following points are monitored:

1. DEF filling level
2. DEF quality (from EU6 C)
3. Manipulations on the components
4. DEF injection
5. EGR valve (exhaust gas recirculation valve)
6. DEF consumption
7. DEF consistency (e.g. frozen)

Activation of the driver's warning system

Visual (DWS lamp) and, if need be, acoustic alarms on the instrument panel

– Inform the driver that the inducement system is active and that the exhaust gas after treatment is impaired.

– The system cannot be switched off. The fault must be rectified in order to make the machine function to the full extent again. This prevents damage to the engine and the vehicle.

– Activation of the system is through the corresponding fault code. (P204F)

EDC

```
- Error list -

Information                                :Description - Data
Error name and description                 :(P204F-00) Inducement warning: statement from ACU
FMI                                        :00
Error Status                               :Error Active
Test Status                                :Test Active
Fault Status                               :Fault Pending
MIL status (Malfunction Indicator Lamp):On
Frequency error counter                    :10
Environmental condition                      ;Measure unit;First event;Latest event
Engine RPM                                   ;rpm         ;4230.00    ;0.00
Battery voltage                              ;V           ;14.06      ;12.48
Engine coolant temperature                   ;°C          ;87.76      ;25.96
Fuel quantity set                            ;mm^3/hub    ;29.57      ;0.00
Rail pressure                                ;bar         ;1156.10    ;3.60
Boost pessure                                ;bar         ;1.31       ;0.96
temperature air inside the inlet manifold;°C          ;69.56      ;25.96
Unfiltered APP value                         ;%           ;0.0000     ;0.0000
Environment pressure                         ;bar         ;0.96       ;0.96
```

SCR

ACU

```
VM BOX Application Label: VM BOX 2014
Diagnostic P.C. Software: 3.0.2.2 16.04.2015 14:41:44
Database: C:\Users\dia\AppData\Local\VM Motori\VM Service Tool\SCRECUVM.MDB
Software Version: 07.02.09
Diagnostic Session: NONE
ACU Build Date: 26/02/2014
ACU Serial Number: 0114080844
Customer Part Number: 00000000
VIN: 00000000000000000
ACU Part Number: 8NP1445B
Customer Buil Date: 00/0/0000
Customer Serial Number: 0000000000
Customer Calibration Name: TenSWver-07.02.09*PSN:0000000000*EV00A_070209_VP_rev075*ACU_PN:13002790F


- Error list -

Information               :Description - Data
Error name and description:(4331-2) Injector Open Load
FMI                       :2
Frequency error counter   :6

Information               :Description - Data
Error name and description:(3363-4) Tank Heater Short to Ground
FMI                       :4
Frequency error counter   :1
```

Overvie

EDC Fault memory:
P204F-00

ACU fault memory:
4331-2 (Injector open load)
3363-4 (Tank heater short to ground)

SCR

Activating the inducement

Inducement step	Indicator lamp	Power reduction	Speed (rpm) reduction
Step 1	Active DM1 information fault code: DTC 204F FMI 0	-	-
Step 2	Active fault code: DTC 204F FMI 3	25 % Power reduction	-
Step 3	Active (flashing) fault code: DTC 204F FMI 4	50 % Power reduction	– Speed (rpm) reduction to 60 % of the rated rpm – Speed limit max. 20 km/h

SCR

Activating the inducement

Monitoring	Warning 1 Step (indicator lamp)	Inducement: Counter for the activation from Step 2	Inducement: Counter for the activation from Step 3 (crawling speed)
DEF filling level	Fault active (DEF level < 8%)	None	DEF level < 0%
DEF quality →not presently monitored	Fault active	10 hrs. (Start from active fault)	20 hrs. (Start from active fault)
DEF injection (No dosing)	Fault active	10 hrs. (Start from active fault)	20 hrs. (Start from active fault)
DEF consumption	Fault active	10 hrs. (Start from active fault)	20 hrs. (Start from active fault)
EGR valve blocked / faulty	Fault active	36 hrs. (Start from active fault)	100 hrs. (Start from active fault)
Manipulations (Tampering)	Fault active	36 hrs. (Start from active fault)	100 hrs. (Start from active fault)

SCR

Schematic representation of the

DEF level < 8%

DWS lamp switched on
Fault code 204F FMI 0

Top up DEF

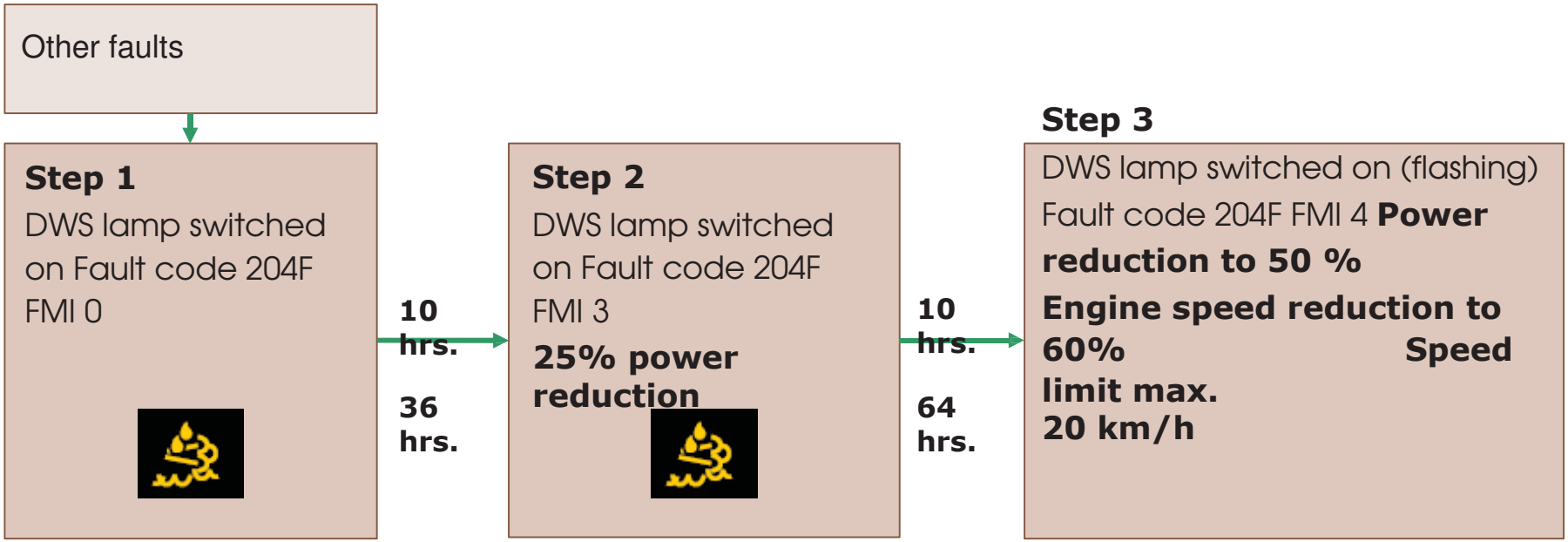
DEF level < 0%

DWS lamp switched on (flashing)
Fault code 204F FMI 4
Inducement step 3: **Power reduction to 50%**
Engine speed reduction to 60%, Speed limit max. 20 km/h

The warning system is reset after a repair. The corresponding DTC is deleted.

SCR

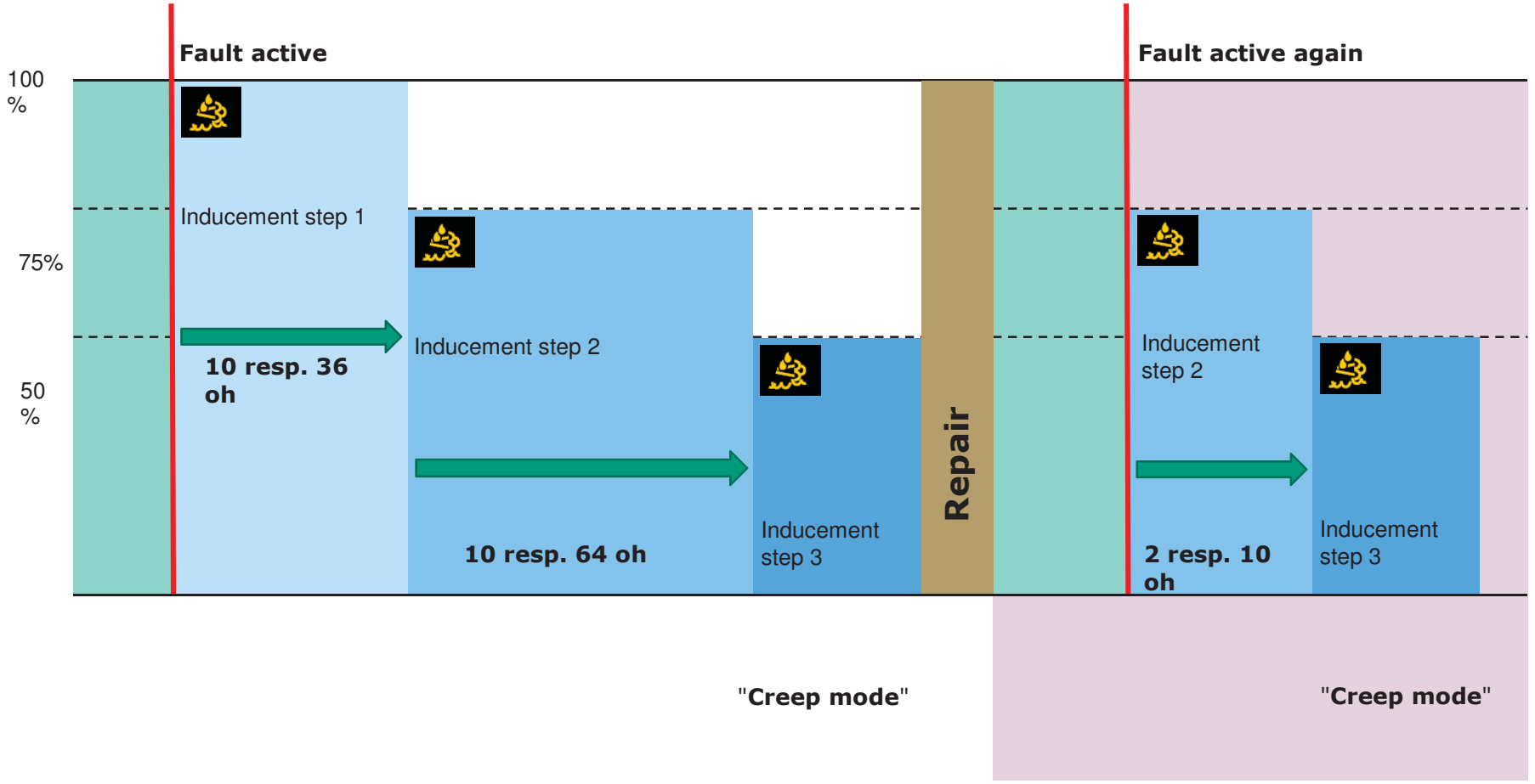
Schematic representation of «Other



HWAG

SCR

Monitoring according to the "Creep mode"



SCR

Filling incorrect liquid

Fluid	Injection nozzle	FDS box	DEF tank Assembly	DEF lines
Water	No exchange	No exchange	Empty and fill with DEF	No exchange
Diesel	Replace components	Replace components	Empty tank and rinse, replace DEF box	Replace components
Biodiesel (B20)	Replace components	Replace components	Empty tank and rinse, replace DEF box	Replace components
Engine oil	Replace components	Replace components	Empty tank and rinse, replace DEF box	Replace components
Hydraulic oil	Replace components	Replace components	Empty tank and rinse, replace DEF box	Replace components
Ethylene glycol	Replace components	Replace components	Empty system and rinse	Replace components
Windscreen water	Empty and rinse	Replace components	Empty system and rinse	Replace components

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DIAGNOSTICS TOOL

Scope of supply of

Memory stick

Bluetooth

Diagnostics tool 2014

OBD cable for vehicle engines

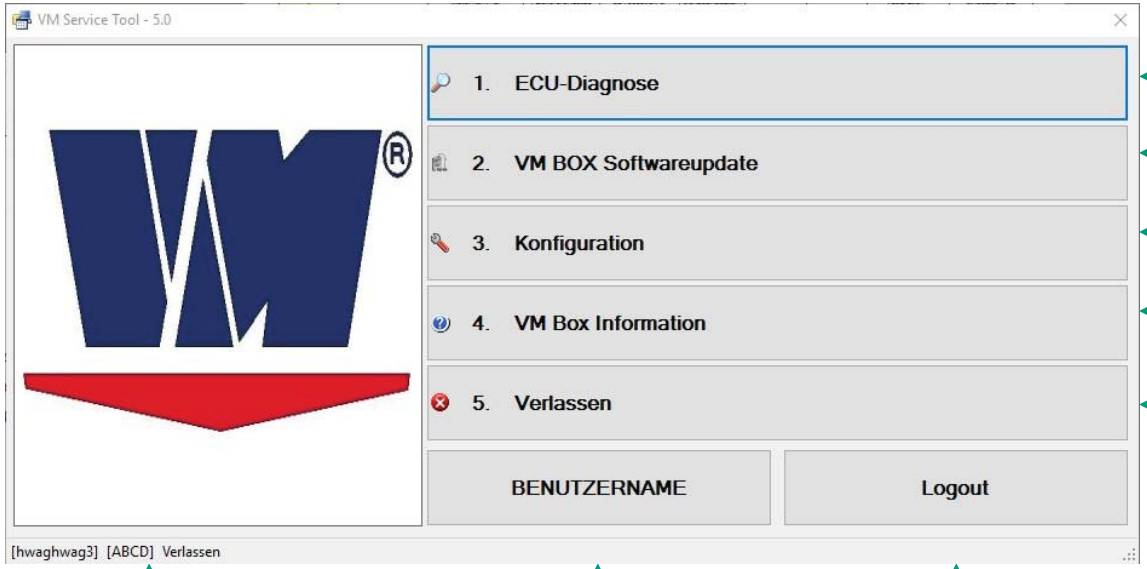
OBD cable for marine engines

Bluetooth Installation CD

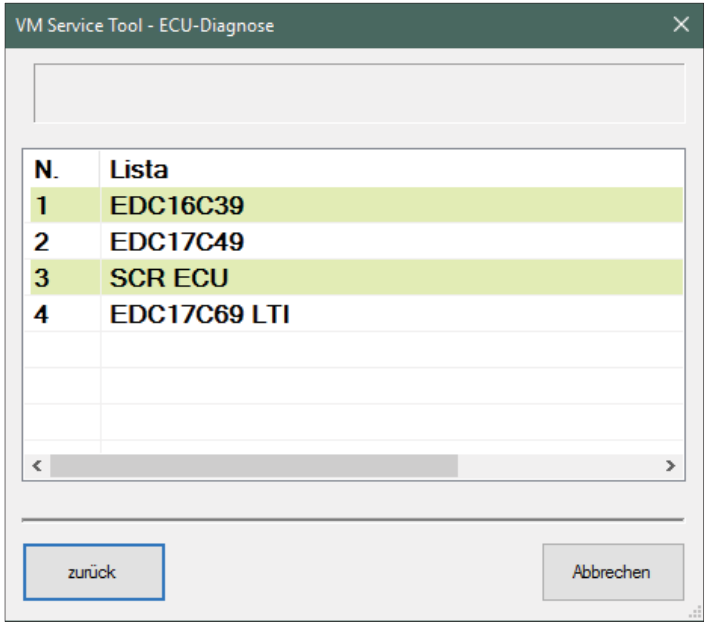
USB connection cable

DIAGNOSTICS TOOL

Main screen



Introd



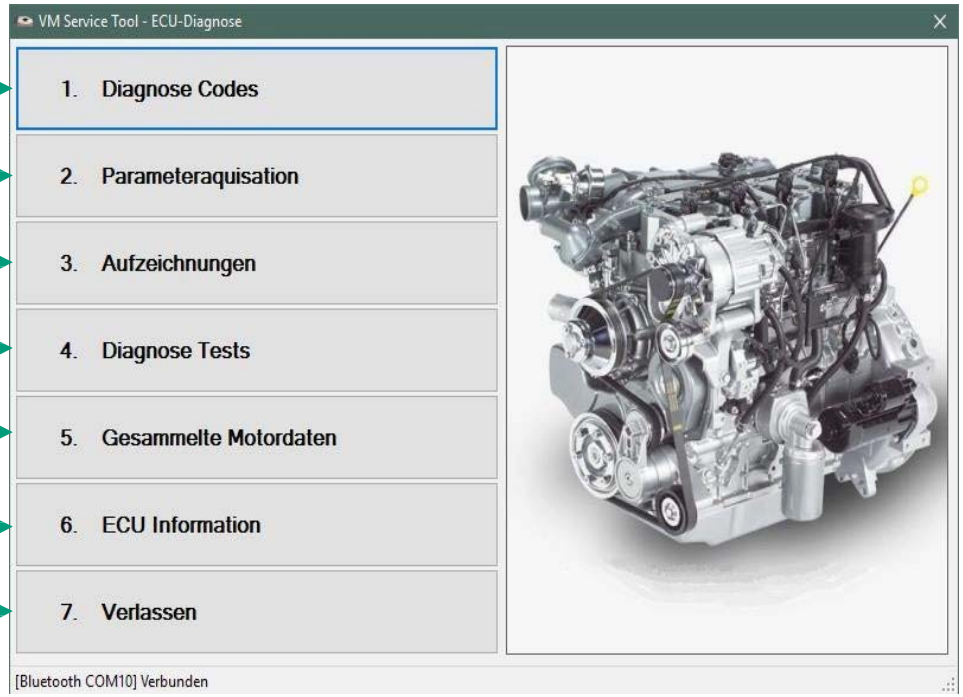
1	R750EU4, EU5, IE3, IE4, ISE4 and TE4
2	R750EU6
3	ACU control unit (AdBlue control unit)
4	Special applications (Please do not use.)

HWAG

DIAGNOSTICS TOOL

Main screen of the EDC

- Fault code- list (active faults)
- Reading out and monitoring engine parameters
- Consists of the «Curriculum Vitae» of the engine
- Various diagnostics tests
- Creating a log file (incl. fault codes and engine history)
- Information regarding ECU status
- Exiting the menu



HWAG

DIAGNOSTICS TOOL

Main screen of the ACU

Fault code- list (active faults)

Fault code list (passive faults)

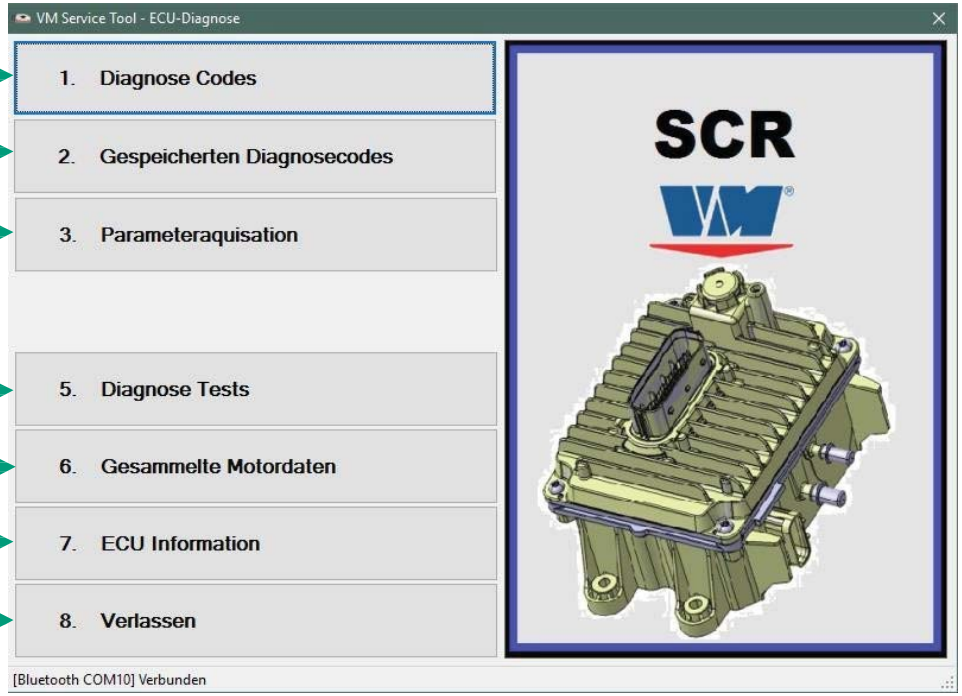
Reading out and monitoring engine parameters

Various diagnostics tests

Creating a log file (incl. fault codes and engine history)

Information regarding ECU status

Exiting the menu



Logfile

Basic principle

Always save the log files of the ECU and ACU

(under «Collected engine data»)

When the machine arrives

Before maintenance jobs or repairs are carried out

Before leaving the machine

We recommend that a test run is carried out after each repair.

If ACU-side faults were rectified, it must be ensured that DEF injection occurs during the test run. (SCR in temperature > 180°C, injector working cycle > 0%)

In particular, for warranty claims, all the log files must be submitted in all cases.

Saving the engine

AUFZEICHNUNG VON MOTORDATEN R750
Das VM-Diagnosetool bietet die Möglichkeit, Motordaten auf einfache Art und Weise zu speichern und so den Ist-Zustand des Motors festzuhalten. Wir empfehlen Ihnen, je ein Logfile vor sowie nach der Reparatur abzuspeichern. Insbesondere bei Garantiearbeiten ist dies zwingend notwendig.

Achtung: Der EU6 Motor verfügt über 2 Steuergeräte (EDC = Motorsteuergerät / SCR = Steuergerät für das Abgasnachbehandlungssystem)

ANLEITUNG ZUM GENERIEREN EINES LOGFILES

1) ECU-DIAGNOSE ÖFFNEN
VM-Diagnosetool starten und das Menü „ECU-Diagnose" öffnen.

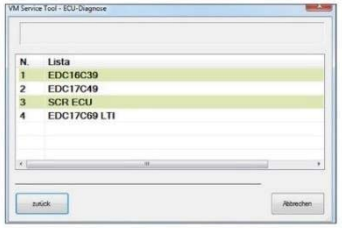
2) STEUERGERÄT WÄHLEN
Anschliessend das richtige Steuergerät wählen.
EDC16C39 = EU4-5, IE3-4, ISE4, TE4
EDC17C49 = EU6
SCR ECU = Abgasnachbehandlung EU6
EDC17C69 LTI = Sonderapplikation

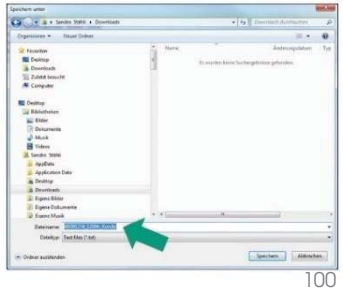
3) MOTORDATEN ABSPEICHERN
Schaltfläche „Gesammelte Motordaten" drücken. Das Fenster gemäss Abbildung 4 erscheint, mit Hilfe dessen die Datei unter einem aussagekräftigen Namen abgespeichert werden kann. Der Dateiname beinhaltet vorzugsweise die Motornummer, Betriebsstunden und den Kunden.

Beispiel Dateiname: 60D01234_158h_Kunde_muster.txt

4) VERFÜGBARKEIT SICHERN
Die auf Ihrem Computer abgespeicherte Datei beinhaltet nun sämtliche gespeicherten Angaben zum Zeitpunkt der Auslesung des Motorsteuergerätes und kann für weitere Zwecke verwendet werden. Speichern Sie sämtliche Dateien an einem zentralen Ort auf Ihrem Computer oder Server, um eine schnelle Verfügbarkeit zu gewährleisten.

Senden Sie uns diese Speicherdatei(en) im Falle von Problemen direkt per E-Mail zu.





DIAGNOSTICS TOOL

Latest diagnostics

MOTORENSUPPORT

Software zu VM-Diagnosetool

In dieser Rubrik stellen wir Ihnen Anleitungen und aktuelle Software zum VM Diagnosegerät zur Verfügung.

Bitte evaluieren Sie zuerst, mit welchem Diagnosegerät Sie arbeiten, damit Sie die korrekte Software herunterladen.

Diagnosetool Generation 1+2

Diagnosetool Generation 3

Zur Installation des VM-Diagnosetools unter **Windows 8** können Sie die Bedienungsanleitung für Windows 7 hinzuziehen.

Achtung: Vor der Installation müssen unter Windows 8 die Einstellungen gemäss Video vorgenommen werden.

Downloads

- **VM-Diagnosetool Generation 3: Software Diagnosetool 5.0 + Standalone update 5.0 vom 20.07.2016**
- **VM-Diagnosetool Generation 3: Installationsanleitung unter Windows 7 und 8**
- **VM-Diagnosetool Generation 1+2: Software Diagnosetool 3.5, Rev. 00 vom 04.11.2013**
- **VM-Diagnosetool Generation 1+2: Installationsanleitung unter Windows 7 und 8**
- **VM-Diagnosetool Generation 1+2: Troubleshooting**

www.hwag.ch/diagnose

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Maintenance interval for engine

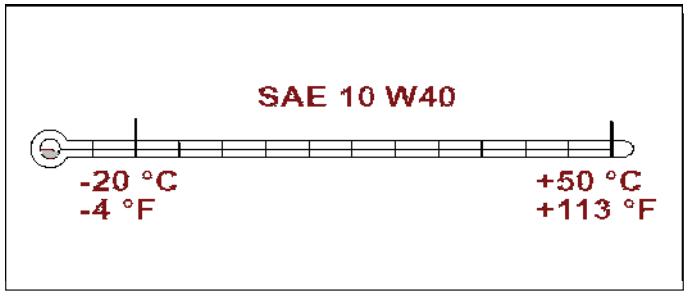
Optional:

Engine oil change every 500 hours

⇨ **Adjustments to engine required.**

A 500 hour oil change interval is required only approved for the following engine oils:

Motorex Focus QTM 10W/40



Maintenance interval

Difference between engine oil ACEA E6 and E7

https://online.lubrizol.com/relperftool/hd.html

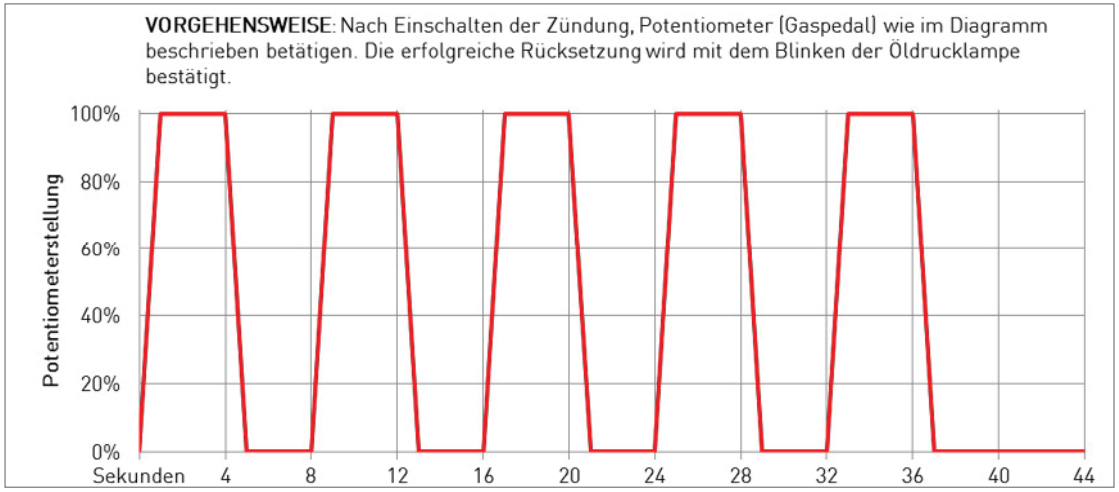
Resetting the oil dilution

After each maintenance service that is carried out, the oil dilution factor must be set to «0» once again.

There are two ways to do this:

– Using the VM diagnostics unit under «Diagnostics tests; Exchanges; Oil dilution value»

– Using the accelerator:



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Engine identification

IDENTIFIKATION DER VM-DIESELMOTOREN ANHAND DER MODELLBEZEICHNUNG

SUN-MOTORENSERIE

S	Serie (Serie)
U	Universale (universal)
N	Nuova (neu)
4	Anzahl Zylinder
1	Bohrung
0	Bohrung
5	Bohrung
T	Turbogeladen
I	Intercooled (ladeluftgek.)
E	Emissioned (abgasopt.)
2	EC 2002/88 Stufe 2

HR-MOTORENSERIE

H	High (hohe)
R	Revolution (Drehzahl)
6	Anzahl Zylinder
9	
4	Bohrung
9	
2	Bohrung
H	Wassergekühlt
T	Turbogeladen
I	Intercooled (ladeluftgek.)
P	Einzelsteckpumpen
2	EURO2 homologiert
3	EURO3 homologiert

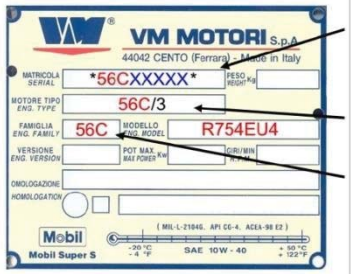
D- MOTORENSERIE

D	Direkteinspritzung
7	Multipl. mit Faktor 10 =
0	Inhalt 1 Zylinder (cm3)
7	Multipl. mit Faktor 10 =
5	Inhalt 1 Zylinder (cm3)
3 / 4 / 6	Anzahl Zylinder
E	Emissioned (abgasopt.)
S	„Soft"-turbogeladen
T	Turbogeladen
I	Intercooled (ladeluftgek.)
L	(Liquid) Wassergekühlt
1	EPA - 97/68/EG Stufe I
2	EPA - 97/68/EG Stufe II
3	EPA - 97/68/EG Stufe IIIA

R-MOTORENSERIE

R	Common Rail-Einspritzung
7	Multipl. mit Faktor 10 =
5	Inhalt 1 Zylinder (cm3)
3 / 4 / 6	Anzahl Zylinder
E	Emissioned (abgasopt.)
S	„Soft"-turbogeladen
T	Turbogeladen
I	Intercooled (ladeluftgek.)
3	EPA - 97/68/EG Stufe IIIA
4	EPA - 97/68/EG Stufe IIIB
EU4	EURO4-Homolog.
EU5	EURO5-Homolog.
EU6	EURO6-Homolog.

Engine



SERIENNUMMER

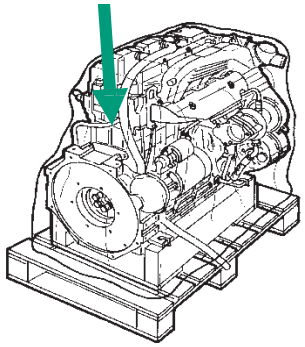
56C**XXXXX** 5-stellige Seriennummer

SONDEREINSTELLUNGEN

56C**/3** Bsp. „/3" = 2'600 min-1

MOTORENFAMILIE

56C Motorenfamilie



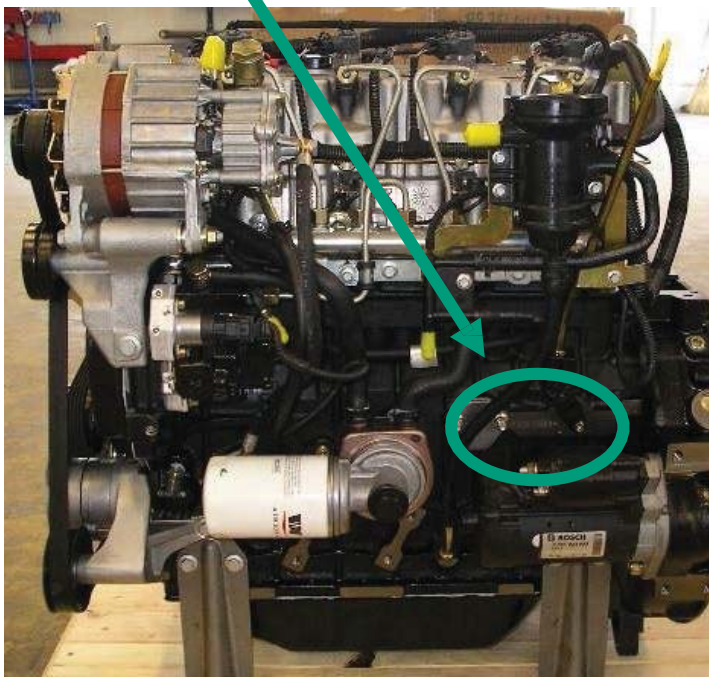
R754EU4 = 56C

00000

R754EU6 = 60D

00000

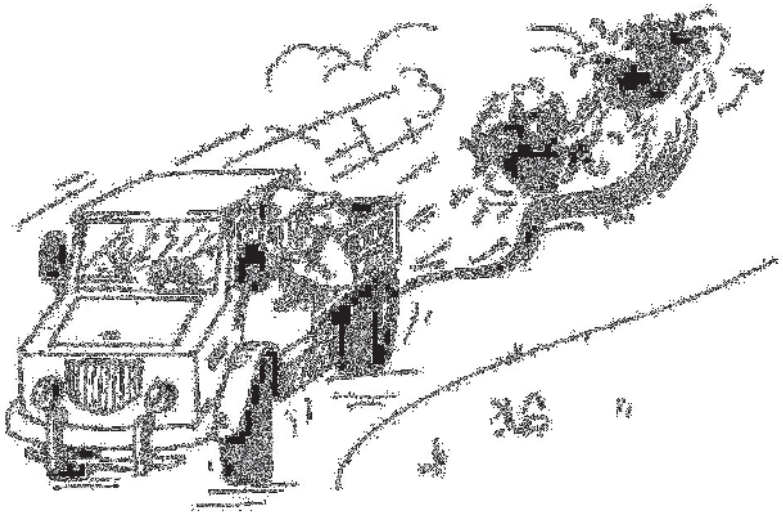
56C XXXXX or *60D XXXXX*



Engine problems

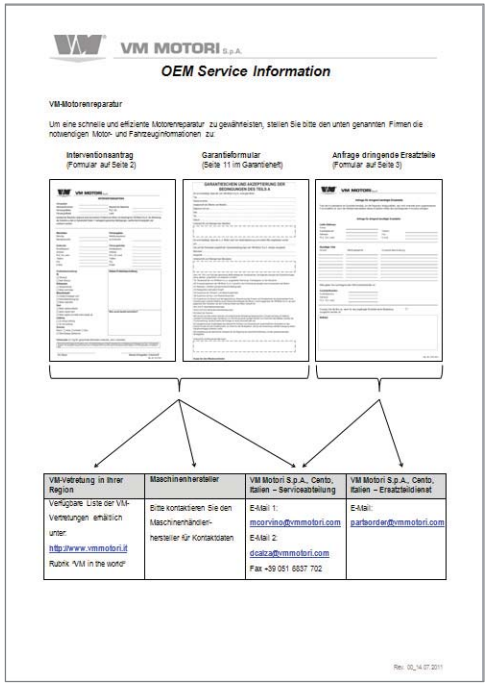
Important information

- **Engine number**
- **Operating hours**
- **Which signs does the engine show? (smoke, stutter, no power etc.)**
- **Fault codes (e.g. P0299)**
- What has already been checked?
- Where is the vehicle?
- Contact data of the responsible dealer?



«Yes, the oil indicator lamp has been on for a long time.... but these black ducks are new.»

Engine problems



VM MOTORI S.p.A.

OEM Service Information

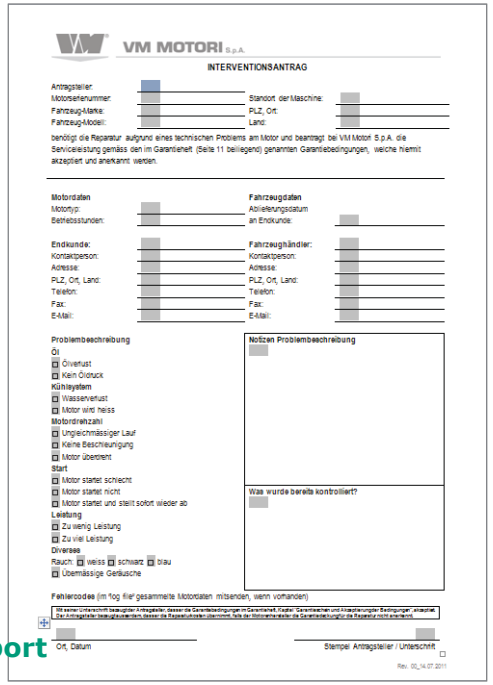
VM-Motorenreparatur

Um eine schnelle und effiziente Motorenreparatur zu gewährleisten, stellen Sie bitte den unten genannten Firmen die notwendigen Motor- und Fahrzeuginformationen zu.

Interventionsantrag (Formular auf Seite 2) | Garantieformular (Seite 11 im Garantieheft) | Anfrage dringende Ersatzteile (Formular auf Seite 3)

VM-Vertretung in Ihrer Region	Maschinenhersteller	VM Motori S.p.A., Cento, Italien – Serviceabteilung	VM Motori S.p.A., Cento, Italien – Ersatzteildienst
Verfügbare Liste der VM-Vertretungen erhältlich unter: http://www.vmmotori.it Rubrik 'VM in the world'	Bitte kontaktieren Sie den Maschinenhändler-hersteller für Kontaktdaten	E-Mail 1: mcorvino@vmmotori.com E-Mail 2: dcalza@vmmotori.com Fax +39 051 6837 702	E-Mail: partsorder@vmmotori.com

Rev. 00_14.07.2011



VM MOTORI S.p.A.

INTERVENTIONSANTRAG

Antragsteller:
Motorseriennummer:
Fahrzeug-Marke:
Fahrzeug-Modell:
Standort der Maschine:
PLZ, Ort:
Land:

benötigt die Reparatur aufgrund eines technischen Problems am Motor und beantragt bei VM Motori S.p.A. die Serviceleistung gemäss den im Garantieheft (Seite 11 beiliegend) genannten Garantiebedingungen, welche hiermit akzeptiert und anerkannt werden.

Motordaten
Motortyp:
Betriebsstunden:

Fahrzeugdaten
Ablieferungsdatum an Endkunde:

Endkunde:
Kontaktperson:
Adresse:
PLZ, Ort, Land:
Telefon:
Fax:
E-Mail:

Fahrzeughändler:
Kontaktperson:
Adresse:
PLZ, Ort, Land:
Telefon:
Fax:
E-Mail:

Problembeschreibung
Öl
☐ Ölverlust
☐ Kein Öldruck
Kühlsystem
☐ Wasserverlust
☐ Motor wird heiss
Motordrehzahl
☐ Ungleichmässiger Lauf
☐ Keine Beschleunigung
☐ Motor übertreibt
Start
☐ Motor startet schlecht
☐ Motor startet nicht
☐ Motor startet und stellt sofort wieder ab
Leistung
☐ Zu wenig Leistung
☐ Zu viel Leistung
Diverses
Rauch: ☐ weiss ☐ schwarz ☐ blau
☐ Übermässige Geräusche

Notizen Problembeschreibung

Was wurde bereits kontrolliert?

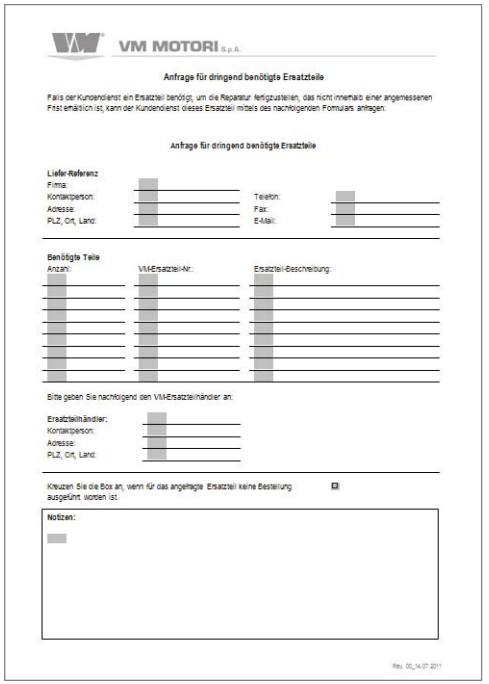
Fehlercodes (im 'log file' gesammelte Motordaten mitsenden, wenn vorhanden)

Mit seiner Unterschrift bestätigt Antragsteller, dass die Garantiebedingungen in Garantieheft, Kapitel "Garantieleistungen und Ausgeschlossene Bedingungen", erläutert, der Antragsteller bestätigt weiterhin, dass die Reparaturkosten übernommen, falls der Maschinenhersteller die Garantieleistung für die Reparatur nicht anerkennt.

Ort, Datum

Stempel Antragsteller / Unterschrift

Rev. 00_14.07.2011



VM MOTORI S.p.A.

Anfrage für dringend benötigte Ersatzteile

Falls der Kundendienst ein Ersatzteil benötigt, um die Reparatur fertigzustellen, das nicht innerhalb einer angemessenen Frist erhältlich ist, kann der Kundendienst dieses Ersatzteil mittels des nachfolgenden Formulars anfragen.

Anfrage für dringend benötigte Ersatzteile

Liefer-Referenz
Firma:
Kontaktperson:
Adresse:
PLZ, Ort, Land:
Telefon:
Fax:
E-Mail:

Benötigte Teile

Anzahl:	VM-Ersatzteil-Nr.:	Ersatzteil-Beschreibung:

Bitte geben Sie nachfolgend den VM-Ersatzteilhändler an:

Ersatzteilhändler:
Kontaktperson:
Adresse:
PLZ, Ort, Land:

Kreuzen Sie die Box an, wenn für das angefragte Ersatzteil keine Bestellung ausgeführt worden ist. ☐

Notizen:

Rev. 00_14.07.2011

www.hwag.ch/technischer-support

ADMINISTRATIVE

Warranty claims

Mandatory information

- Engine number
- Operating hours
- Date of damage
- 1. Date of registration of the vehicle
- Description of the damage
- Work carried out
- Engine must be registered.

www.hwag.com/garantie

HWAG

ADMINISTRATIVE

Warranty application

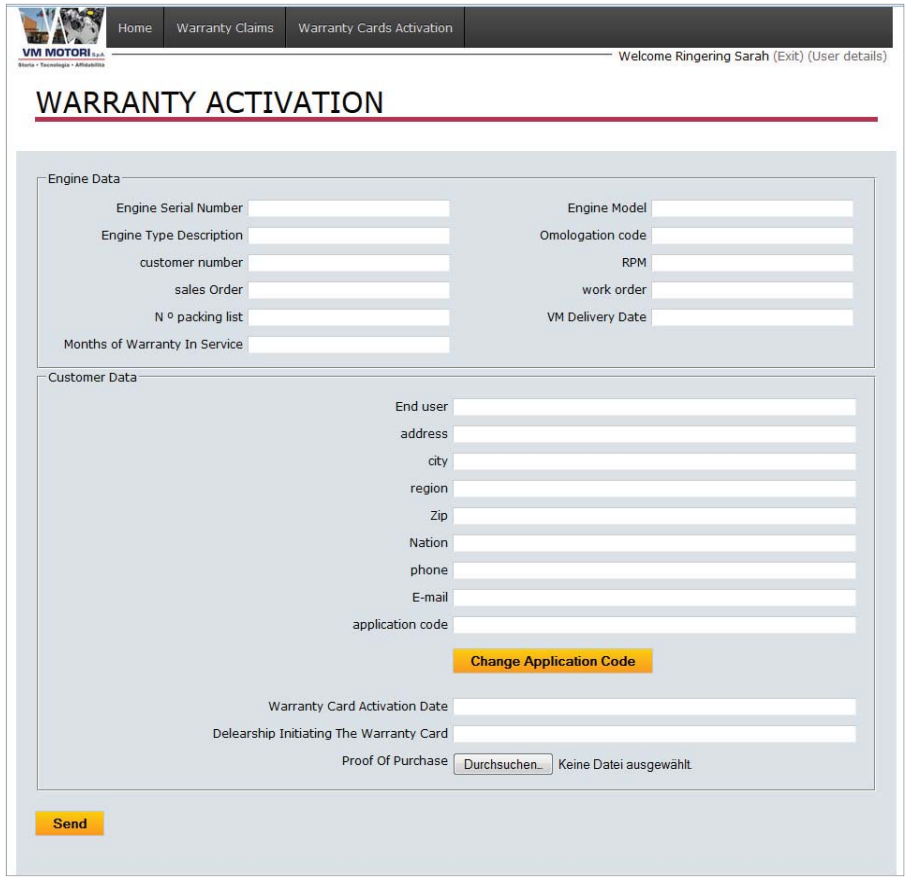
VM MOTORI S.p.A.	WARRANTY CLAIM - DEMANDE DE GARANTIE - GARANTIE - ANTRAG					Nr.				
Claimant - Demandeur - Antragsteller						End User - Utilisateur - Kunde				
Address - Adresse			Phone - Téléphone - Telefon			Address - Adresse				
Town - Ville - Stadt			Country - Pays - Land			Town - Ville - Stadt				
Engine - Moteur - Motor	Type - Typ	Engine number - Numéro du moteur - Motornummer	Date of Sale - Date d'achat - Auslieferungstag	Date request of intervention - Date de réception d' intervention - Reparaturdatum	Failure Date - Date incident - Schadensdatum	Hours - Heures - Stunden	Version - Ausführung	start date repair - date de début de la réparation - Startdatum Reparatur	end date repair - date de fin de la réparation - Enddatum der Reparatur	
Application - Machine - Gerät	Brand - Marque - Marke		Type - Typ		Machine number - Numéro da la machine - Maschinennummer			Load -charge - Last	Idle speed - Point mort - Leerlauf	
								/	/	
	service station - station de service - Kundendienstwerkstatt			Address - Adresse						
Failure - Incident - Vorfall	Complaint - Difficulté signalée - Beanstandung/Problem stellung									
	Failure analysis - Cause presumée - Feststellungen									
	Corrective repairs - Réparation executée - Durchgeführte Arbeiten/Abhilfe									
	Ref - ref - Beziehung									Rioon.

Parts replaced - Pièces utilisées - Ersetzte Teile	Quant. - Nombre - Anzahl	Description - Désignation - Teilebezeichnung	Part.No. - Référence-Teil-Nr.	Price - Prix - Preis			
				Unit	Total	Total Euro	CODICE APPLICAZIONE
							CODICE AVARIA
							RAPP. N.
							Servizio autorizzato
							Cod.
							N. fattura
							Data fattura
							importo
							Mese contabil.
							Commessa
			Parts - Pièces - Teile	TOT.			

Labor Time - Main d'oeuvre - Arbeit	Description - Désignation - Teilebezeichnung		Hours - Heures - Stunden	Price - Prix - Preis			
				Unit	Total	Total Euro	Imp. Mat.
	Engine - Moteur - Motor	LABOUR TIME - HEURES DE TRAVAIL - ARBEITSZEIT					
		TRAVEL TIME - TEMPS DE DEPLACEMENT - REISEZEIT					Imp. M.O.
		KILOMETER - KILOMETRE- KILOMETER					
		FOOD,HOTEL - MANGER,HOTEL - ESSEN,HOTEL					Imp. Tot.
	Application - Machine Maschine	LABOUR TIME - HEURES DE TRAVAIL - ARBEITSZEIT					
							Data
	No. Days for repair - No. Jours pour reparation - Anzahl Tage verwendet für Reparatur		No. Technicians - No. Techniciens - Anzahl Techniker	TOT.			Visto S.A.T.
Date - Datum		Signature - Unterschrift		TOTAL AMOUNT - TOTALE GENERALE - GESAMTBETRAG			

www.hwag.com/garantie

Engine registration



Assembly instructions

- Chafe marks must necessarily be avoided.
- Observe the tightening torques (sensors).
- Mount hose clamps such that they remain accessible for service and repair
- Mount all components stress-free
- Lay electric cables strain-free
- Note that connections are not exchanged (feed / return, vacuum lines etc.)
- Correct positioning of components (e.g. plugs air mass meter, differential pressure sensor etc.)
- Always lay differential pressure lines rising
- Lightly lubricate the pinion on power take-off

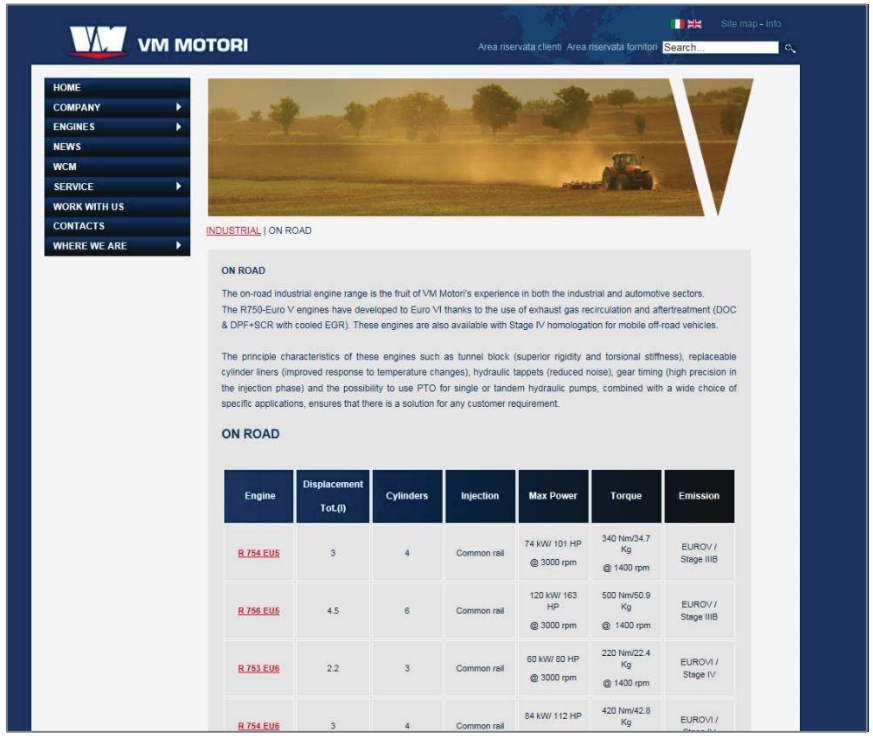
Start-up

- Read out the fault memory
- Rectify faults if present
- Top up and check all operating fluids levels
- Start engine and monitor (indicator lamps, leaks, noises,...)
- Perform the SCR test
- Perform system tests on the machine => Observe customer-specific start-up instructions

End of line check

- Read out log files (only deliver the machine with the fault memory empty).
- Check all operating fluids levels
- Complete the data (serial numbers, customer's data etc.)

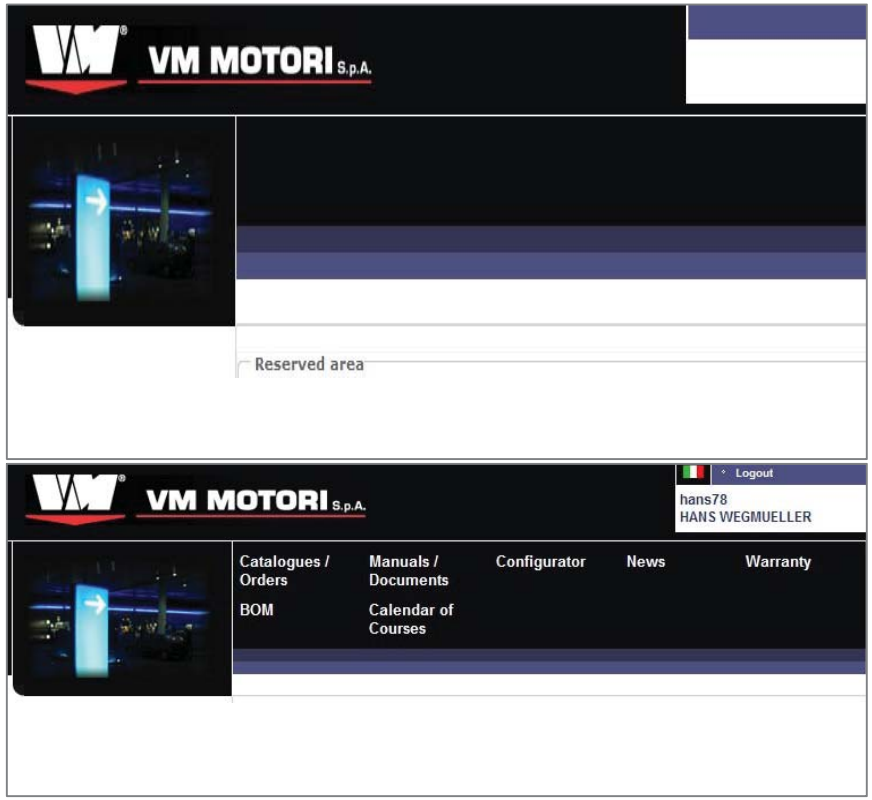
VM



The VM factory, in the column «Industrial» has documents e.g. Operating instructions for R750EU - R750IE3 that can be downloaded.

www.vmmotori.it

VM

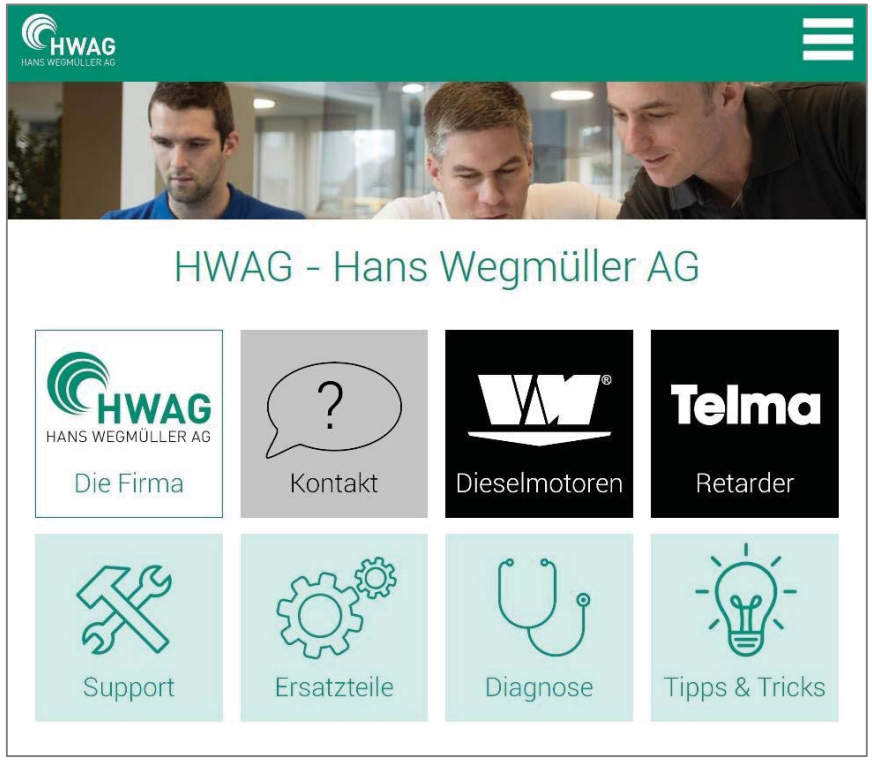


In the password protected customer reserved area, further information such as workshop manuals can be downloaded.

www.vmmotori.it

ADMINISTRATIVE

HWAG



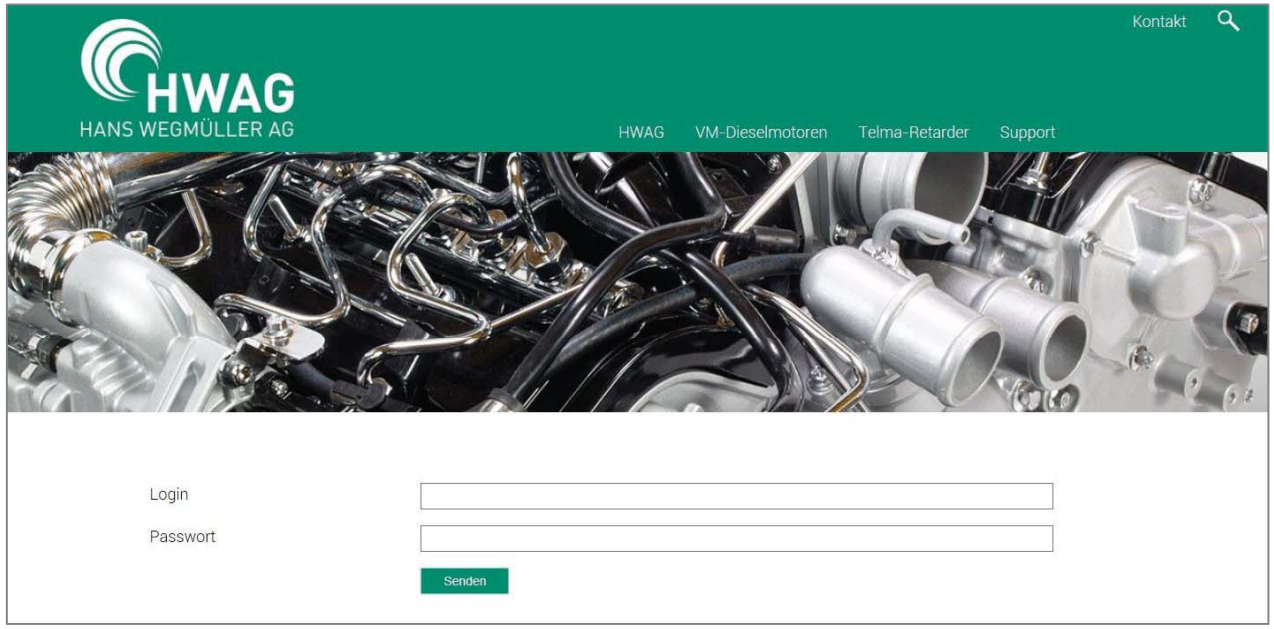
– Engine support
www.hwag.com/support

– Spare parts
www.hwag.com/ersatzteile

– Tips and Tricks
www.hwag.com/tippsundtricks

– Warranty
www.hwag.ch/garantie

HWAG webshare



We can exchange particularly large files, which cannot be sent by e-mail, through our web-based data exchange system with our customers. This area is password protected.

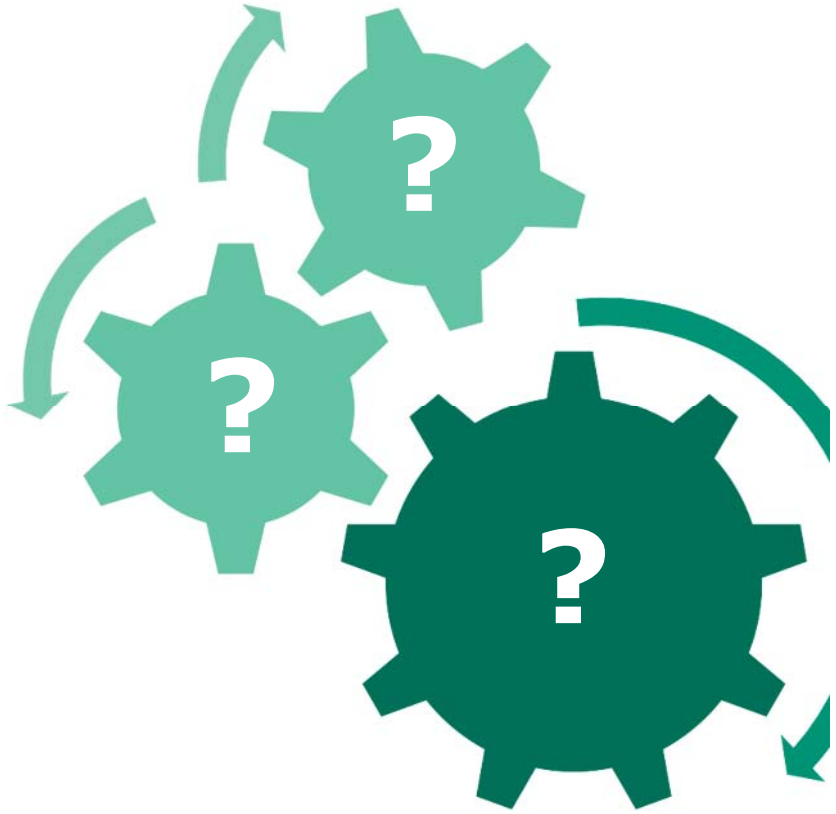
www.hwag.ch/login

Summary / Conclusion

- EURO6 / Step 4 emissions almost zero.
- Very comprehensive measures required to comply with EURO6 / Step 4 emissions requirements.
- Increasing product costs cannot be avoided.
- The basic principle of the diesel engine must not be forgotten in spite of electronics and increasing complexity.
- Proceed systematically while troubleshooting.

«I have no idea where all this diesel is coming from… not a drop is missing from the 2000 litres.»

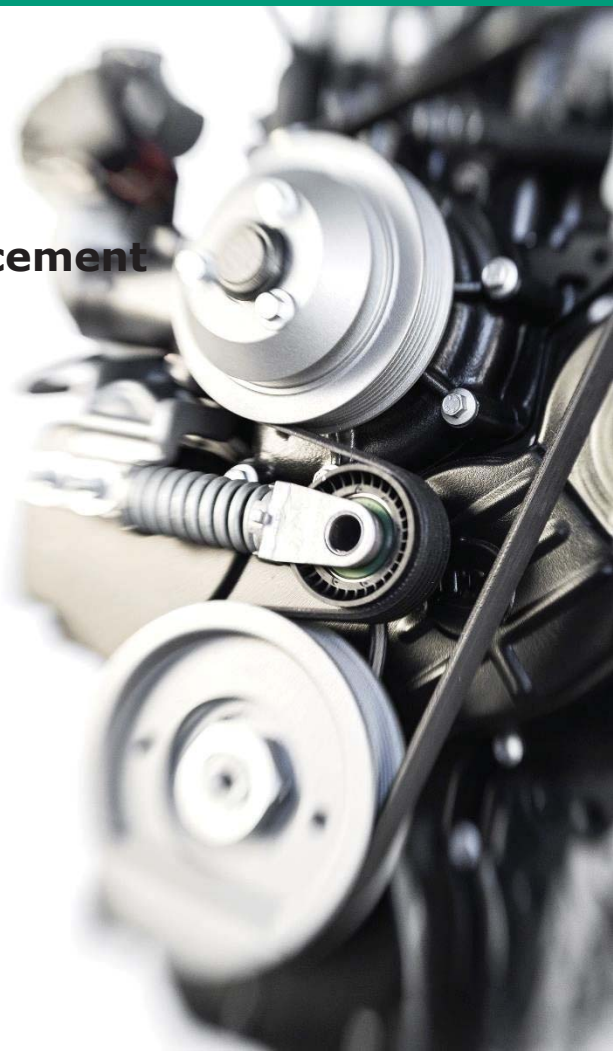
Questi



Annex

Technical data for VM diesel engines of the R750 series

HWAG Technical data



VM R754EU6, 4 cylinder, 3.0 litre displacement

Salient characteristics

- Common rail injection (C.R.)
- Through cylinder head
- Turbocharger and charge air cooler
- Poly-V belt drive
- 2 valves per cylinder
- Cooled external exhaust gas recirculation
- Particulate filter with upstream oxidation catalytic converter
- SCR technology
- Euro 6 homologation

HWAG Technical data

VM R754EU6, 4 cylinders, displacement 3.0 l

Engine speed	Torque	Performance
2600 rpm	**420 Nm @ 1100 rpm**	**80 kW** (109 HP)