

Chapter 6



Euro 6 engine

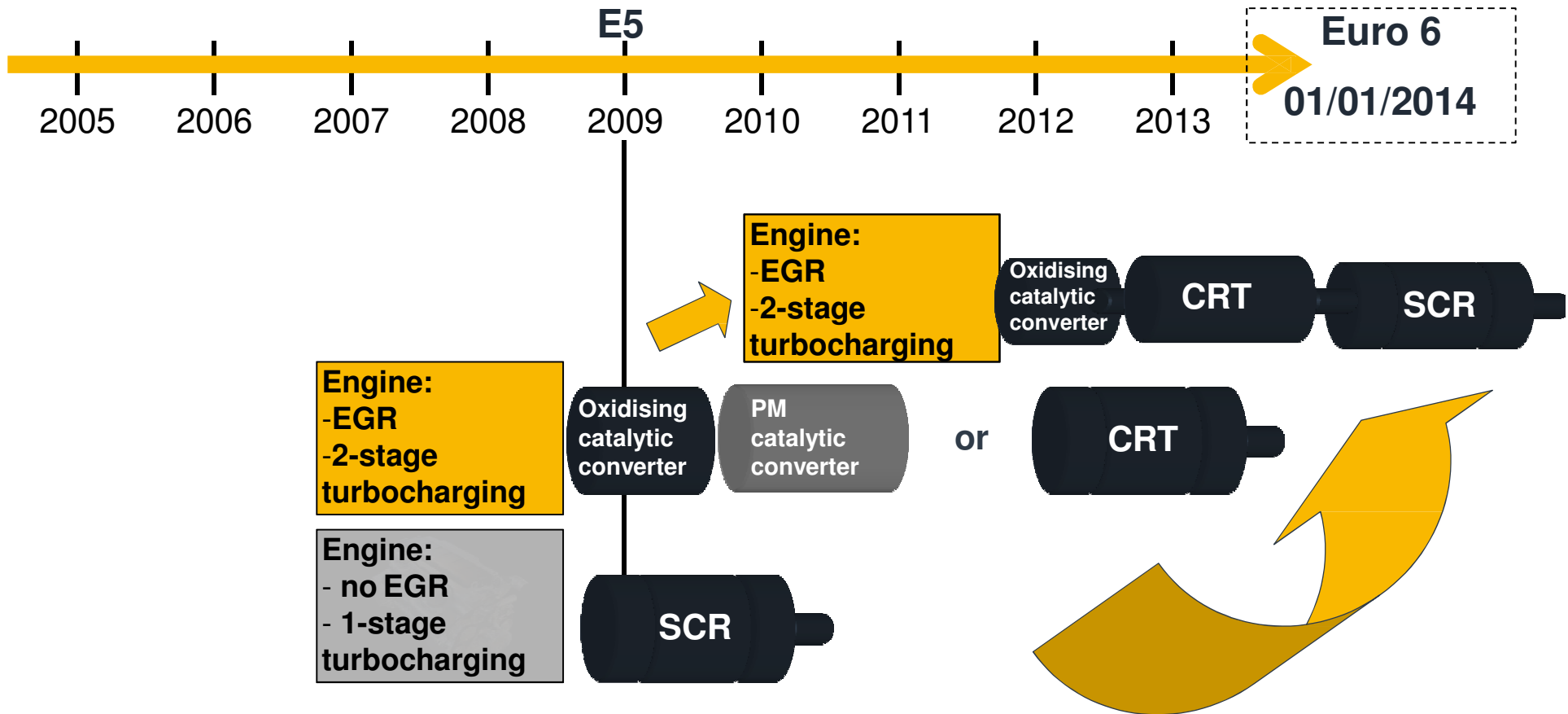
Emission improvement Euro 6



<u>Toxic content</u>	<u>Unit</u>	Euro 5 <u>From</u>	Euro 6 <u>To</u>	<u>Decreased by</u>
CO (Carbon Monoxide)	g/kwh	1.5	1.5	-
HC (Hydrocarbon)	g/kwh	0.5	0.1	80%
Nox (Nitrogen oxides)	g/kwh	2.0	0.4	80%
PH (particles)	g/kwh	0.02	0.01	50%
Smokes	m-1	0.5	0.1	80%

General features:

1. **New EDC 17**
2. **EGR + Double stage Turbo charger + low temperature cooling system**
3. **AdBlue concept**
4. **A Selective Catalytic Reduction (SCRT). (Truck)**

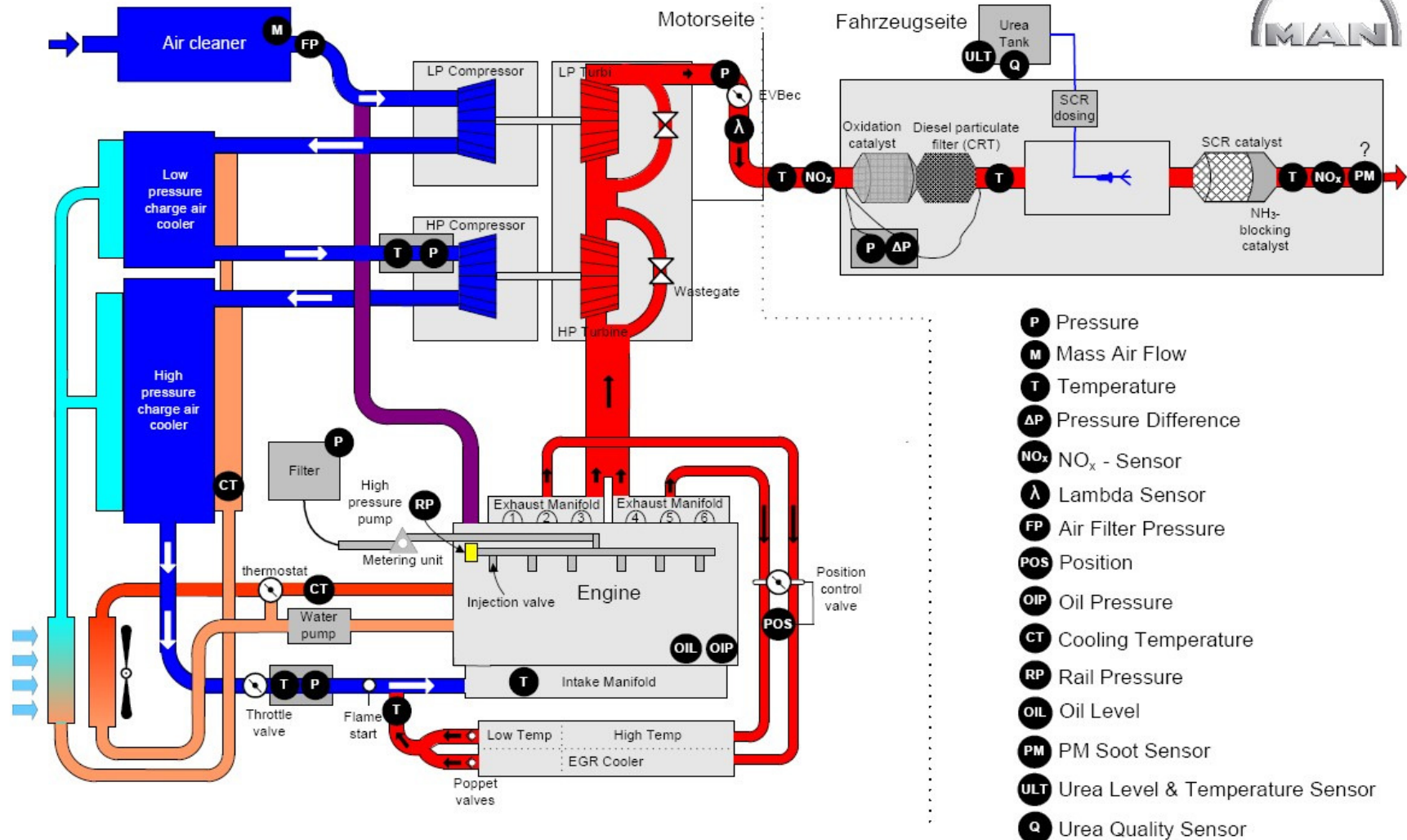


EURO 6

D20/D26 diagram – two-stage truck/low-temperature cooling system



Sensorik Aktuatorik Euro VI B D20/D26 LKW/Bus



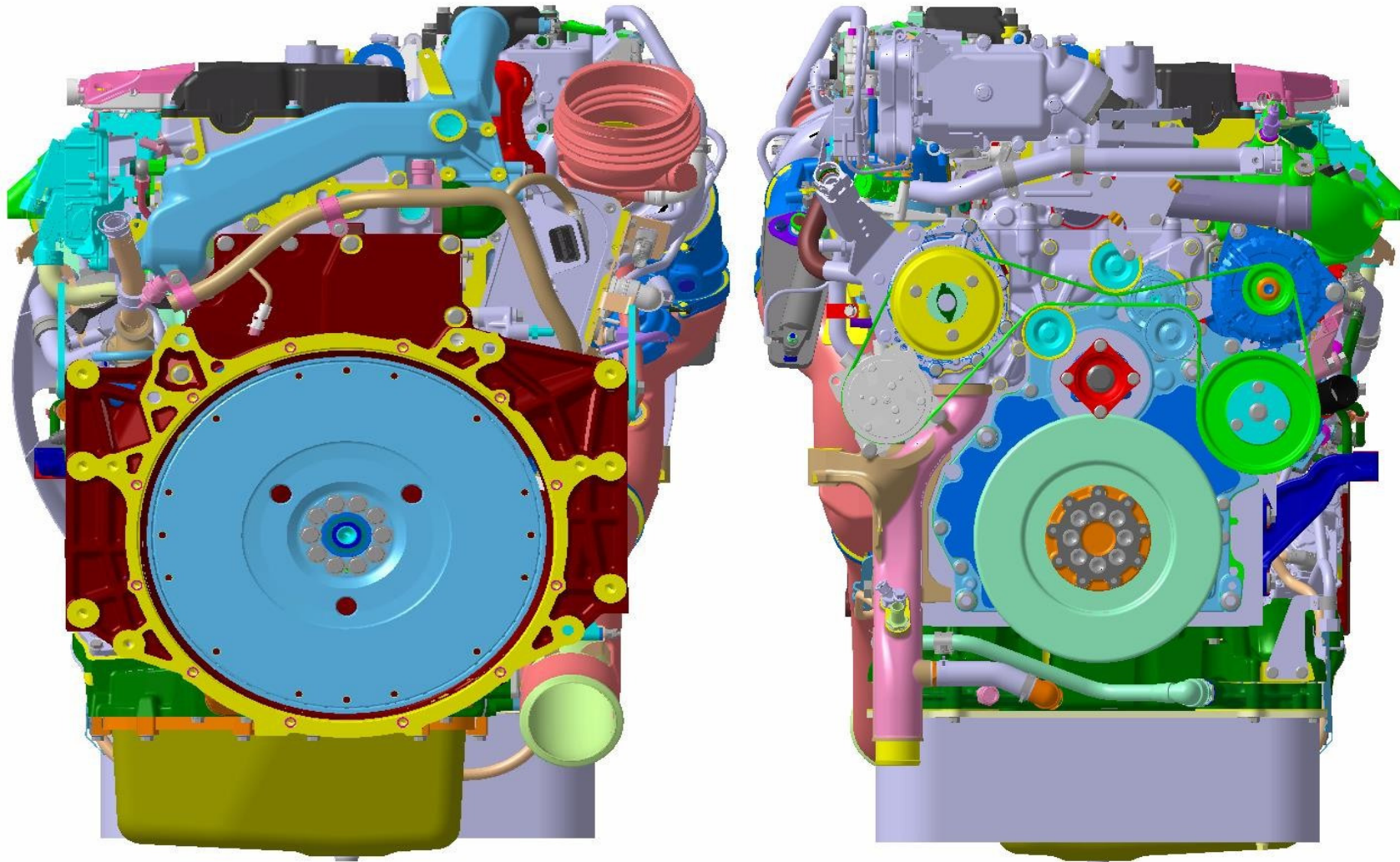
Design innovations with the D20/D26 EU V SCR



- Electrically controlled charge-air throttle valve
- Electrically controlled exhaust gas recirculation
- Two-stage charging, high-pressure/low-pressure turbo charger
- Two-circuit cooling system with air/water intercooling
- Water-bearing engine support
- Separation of oil mist in the blow-by-gas due to centrifugal force (disc separator)
- Dethrottling of distributor housing and thermostat housing, silicate cartridge
- Ring fan Dm. 810 with corresponding fan clutch
- Flame-start system with electronic relay
- Raw NO_x sensor fixed to the engine
- Disengageable air compressor
- Exhaust gas aftertreatment with particulate filter and SCRT

Euro 6 engine views

Front side

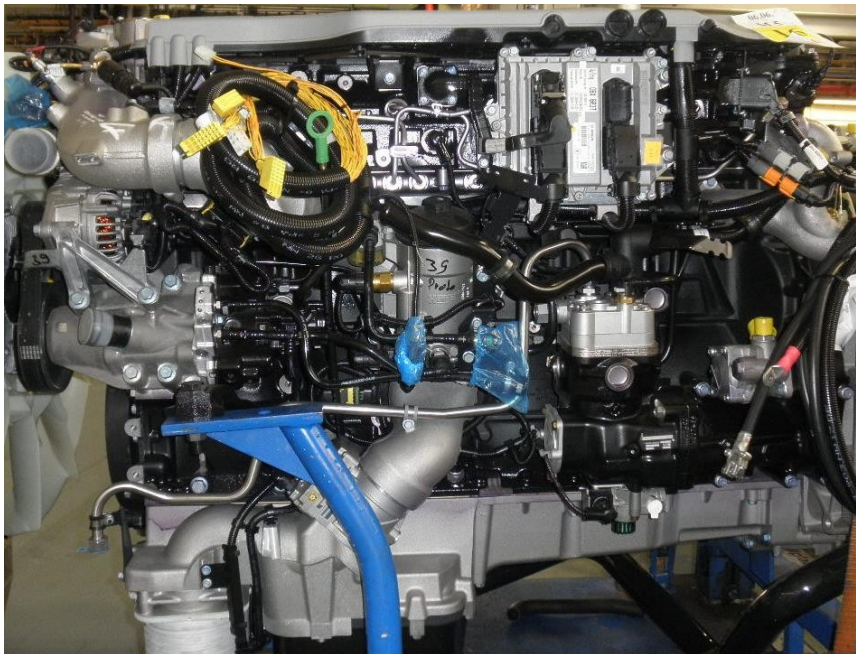


Engine views

Side



Control unit side



Turbo charger side

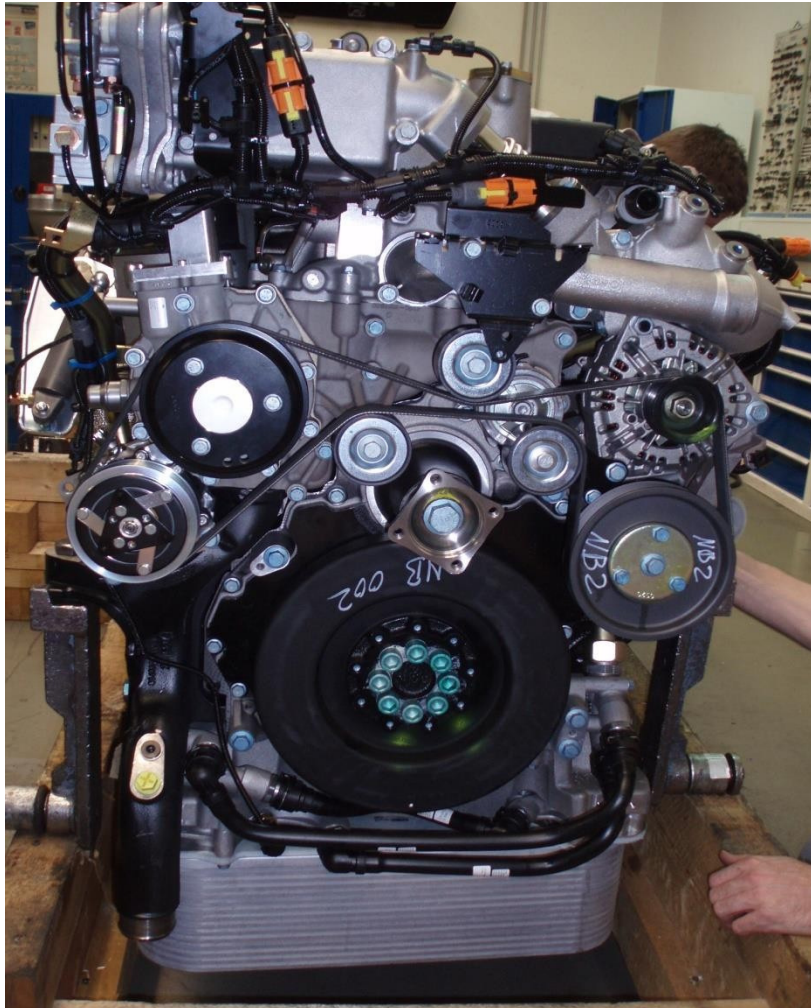


Engine views

Front side



Belt drive side

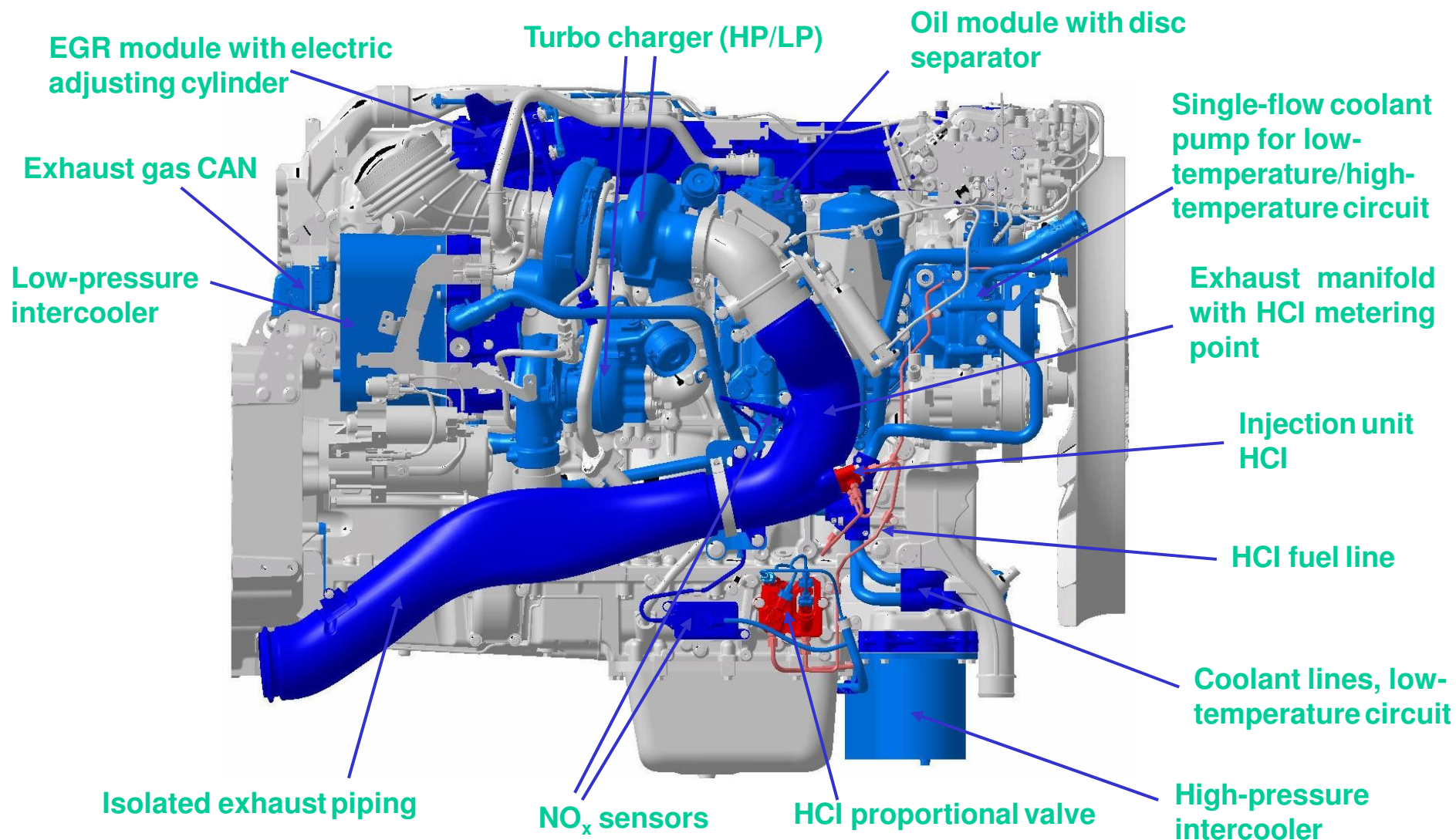


Flywheel side



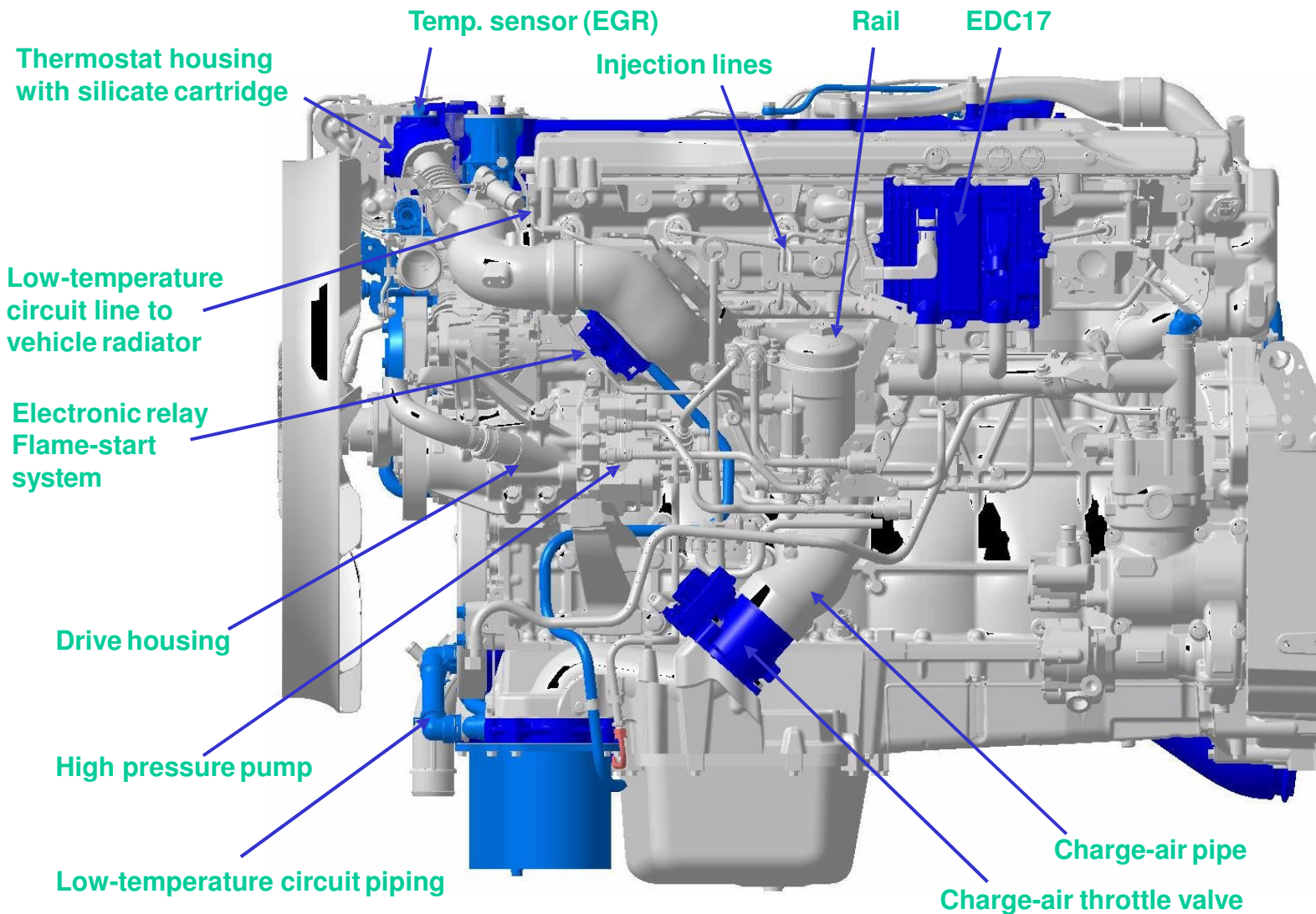
Engine views

Component overview, right side, D2676LF25 SCRT



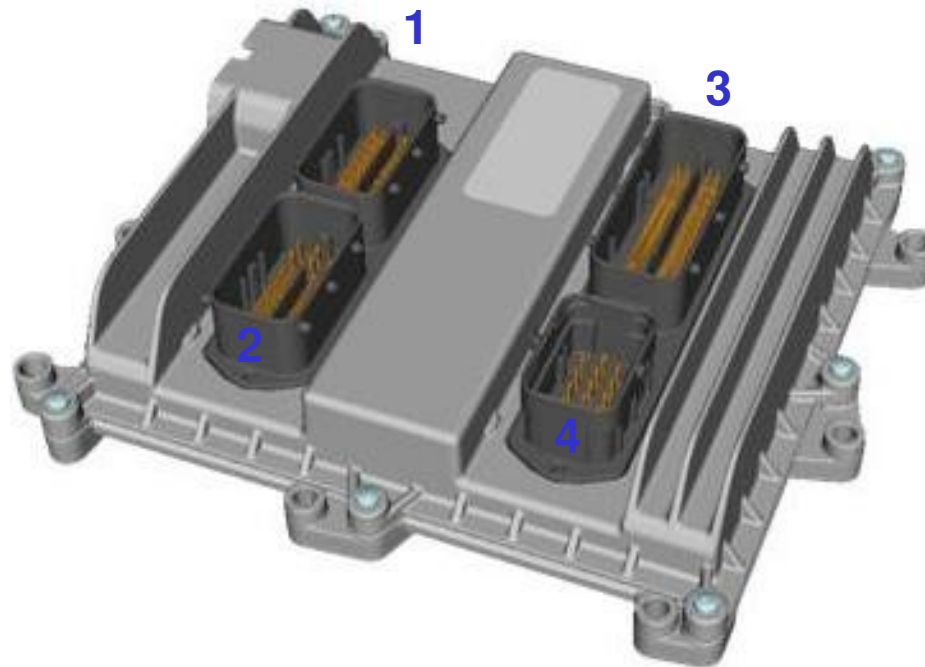
Engine views

Component overview, left side, D2676LF25 SCRT



EDC control unit task 3

Socket assignment



Chamber 1:
Primarily power supply,
CAN,
exhaust gas sensor
systems/actuators

Chamber 2:
Empty at mainstream

Chamber 3:
Primarily engine ensors/actuators

Chamber 4:
Injectors

TGX/S Euro 6

Transfer of functions

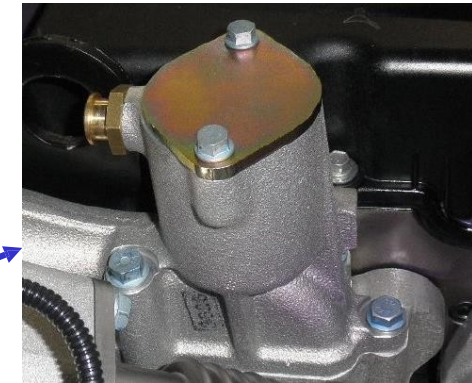
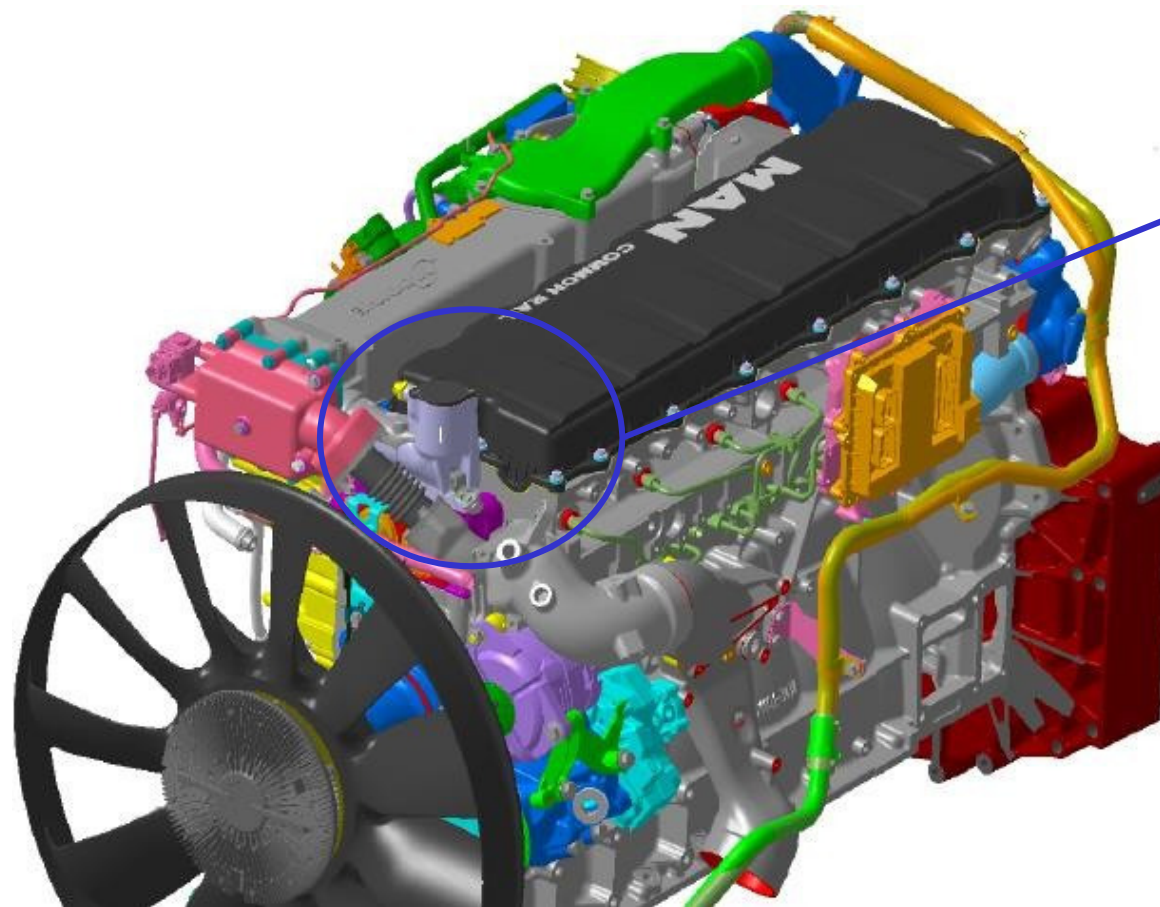


Overview of transfers of functions

	PTM	ZBR	EDC17
Flame-start system	OLD	-	NEW
Engine brake	OLD	-	NEW
Fan control	OLD	-	NEW
Sensing of oil level	OLD	-	NEW
Oil-pressure warning	-	OLD	NEW
Coolant temperature warning	-	OLD	NEW

Cooling system – silicate depot

View from the front



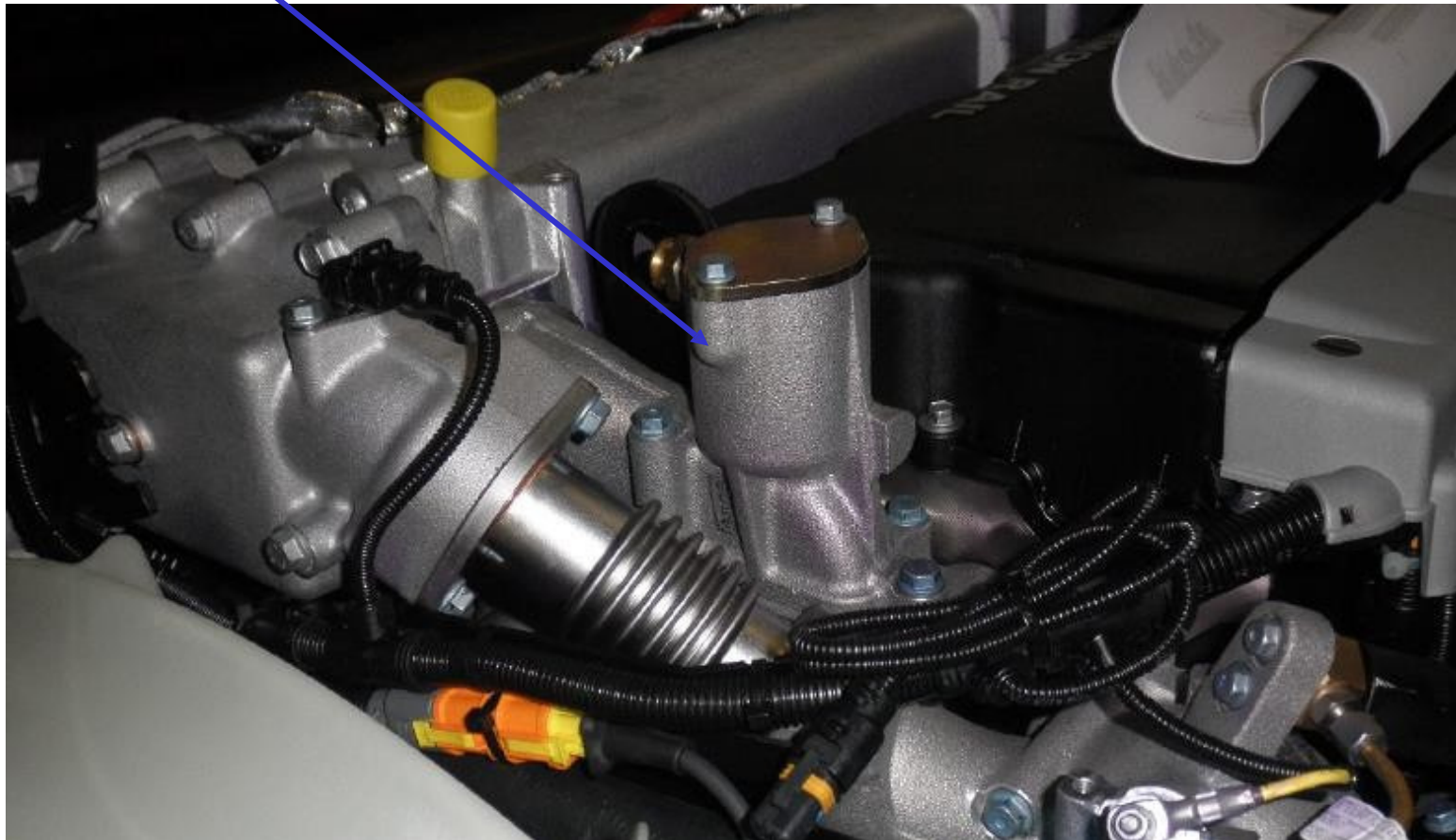
Cooling system – silicate depot

Installation location



Silicate depot

Designed for the service life of the engine

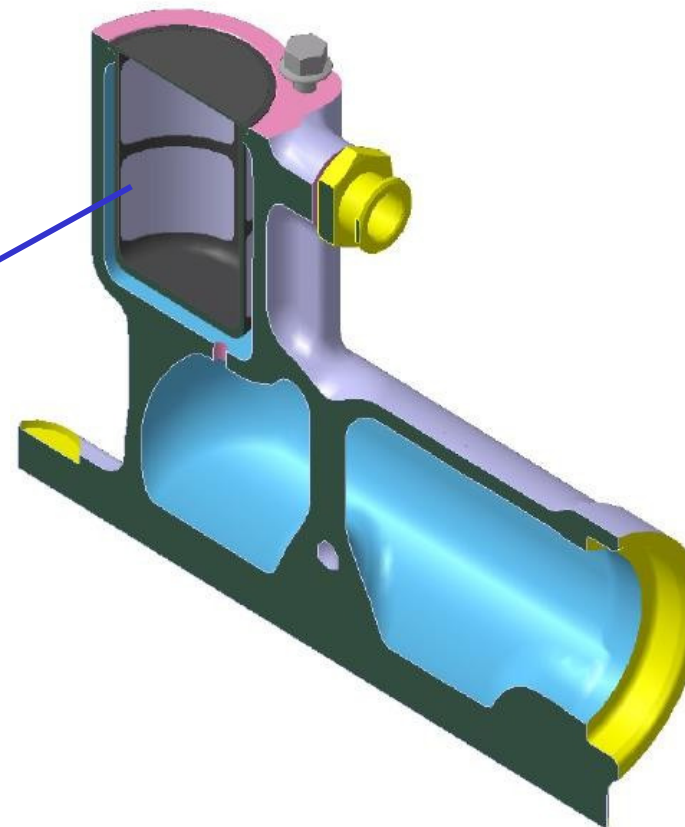


Cooling system – silicate depot

Replaceable cartridge



Replaceable silicate cartridge

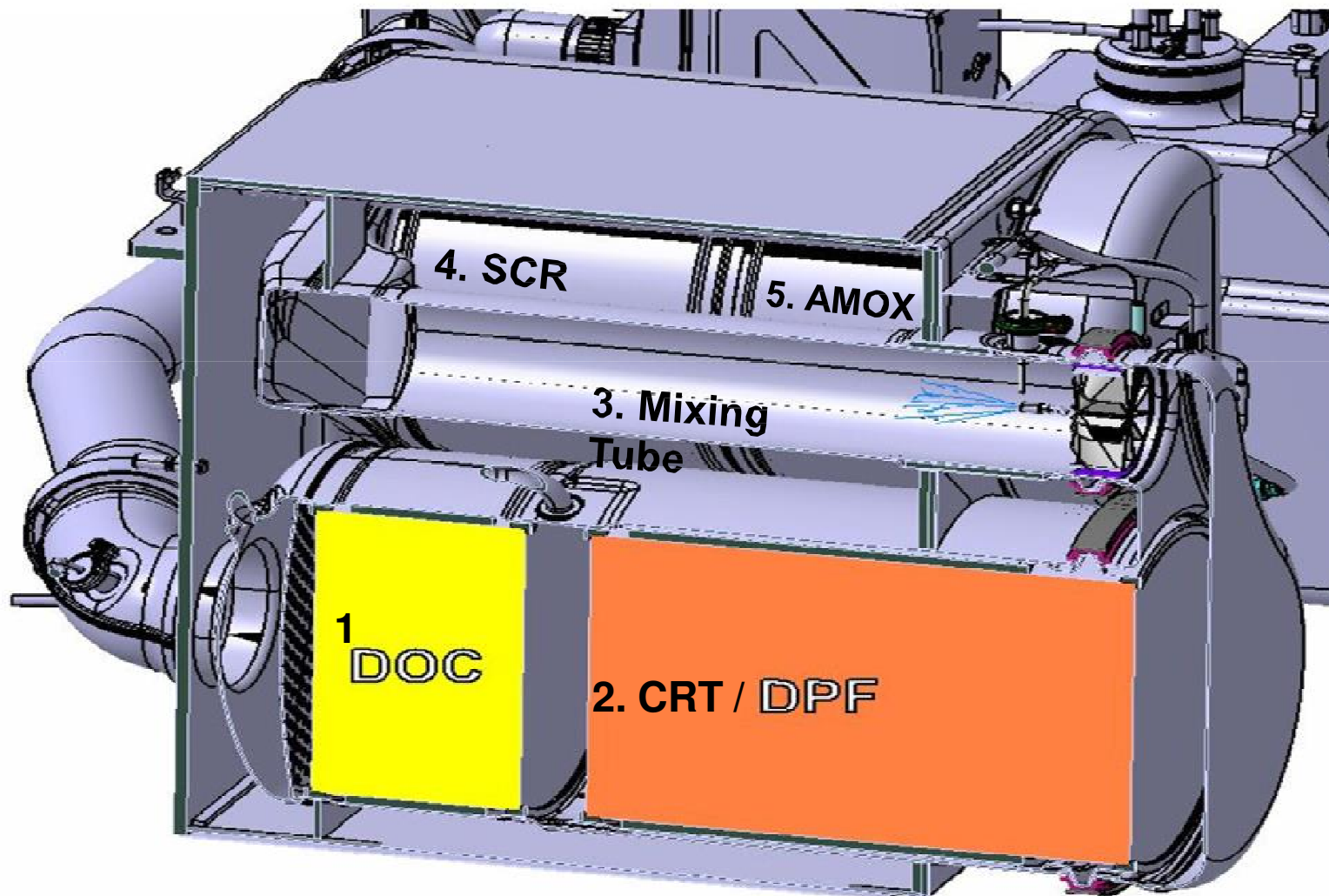


Chapter 7



Euro 6 Dust Particle Filter maintenance

Selective Catalytic Reduction (SCR)

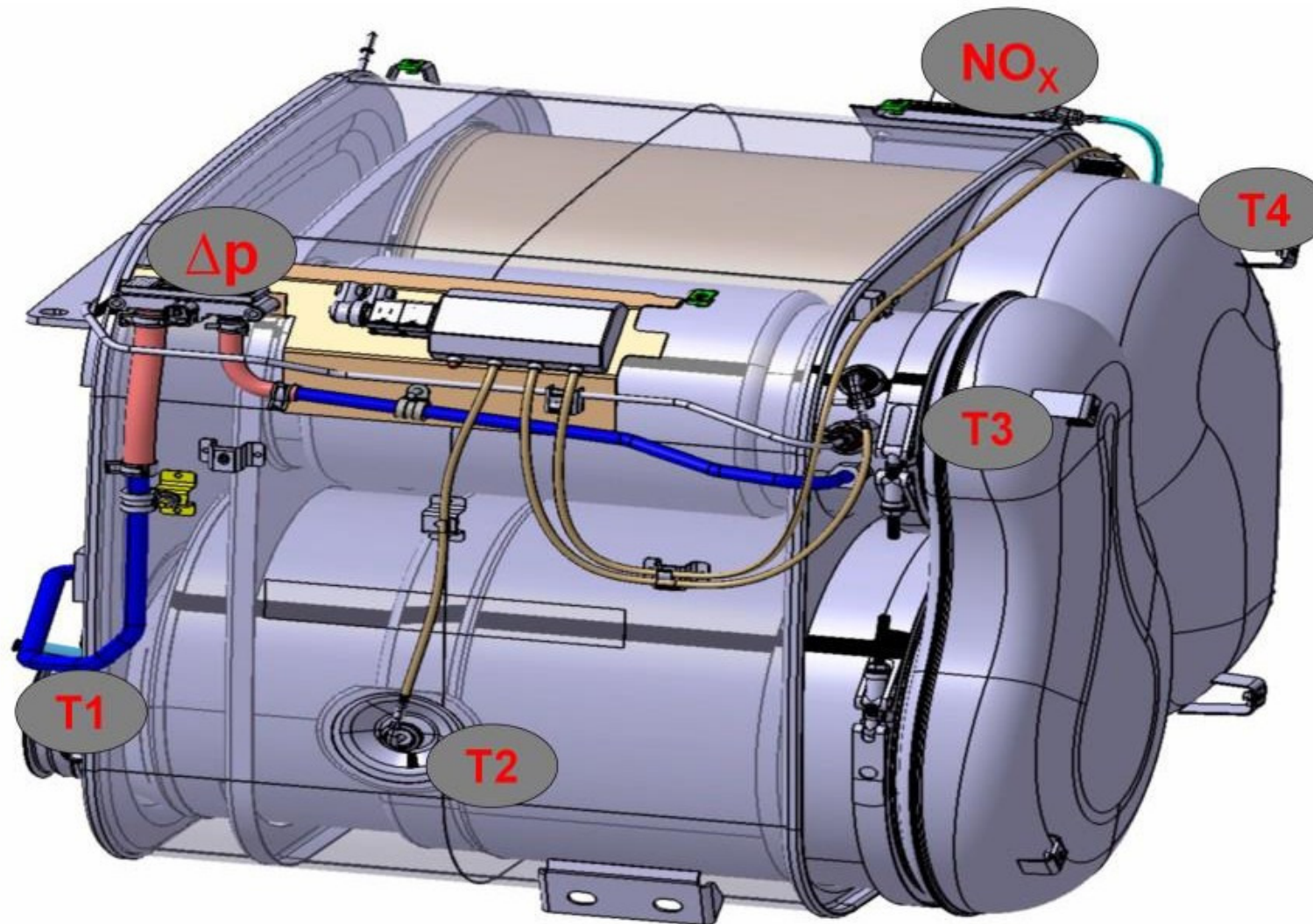


Selective Catalytic Reduction (SCR)



1. Diesel oxidation catalyst (DOC)
 - Formation of NO₂ for CRT effect in the DPF
 - Catalytic combustion of hydrocarbons for regeneration
2. Diesel particulate filter (DPF/ CRT):
 - Separation of soot and ash
3. Hydrolysis catalytic converter (mixing tube):
 - Evaporation of the AdBlue®
 - Mixing with exhaust gas
 - Conversion of AdBlue® into ammonia NH₃ and CO₂
4. SCR catalytic converter:
 - Conversion of nitrogen oxides into nitrogen and water
5. AMOX (ammonia oxidation catalyst):
 - Catalyst coating on SCR catalytic converter to avoid NH₃ slip
 - Excessive NH₃ will be trapped and converted to N₂ + H₂O

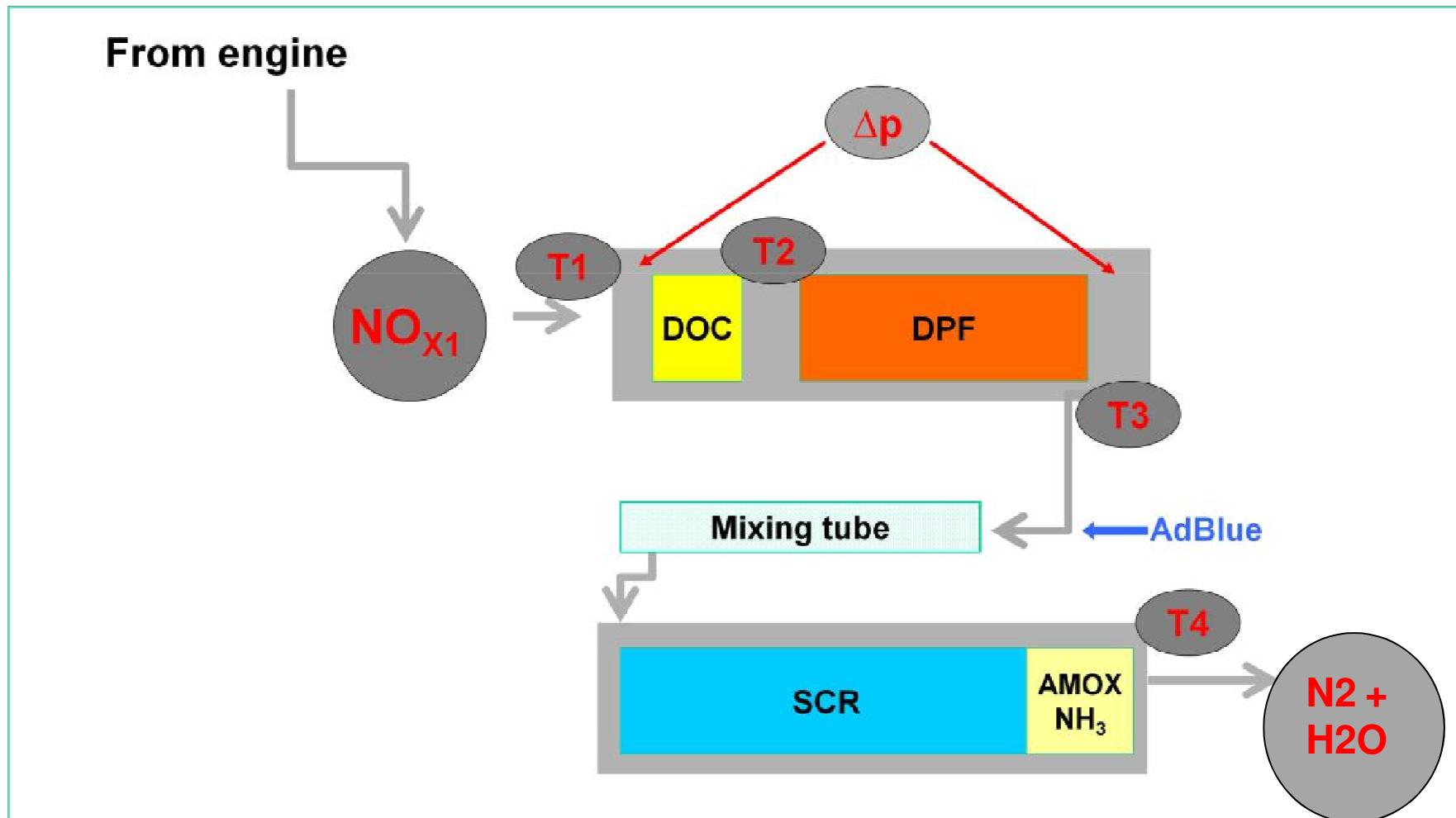
Temperature and Pressure sensors mounted on SCR



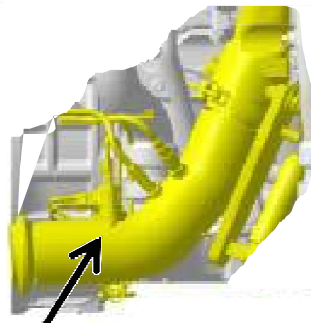
To detect blockage of DPF



Measurement of differential pressure prior to and behind DPF = 0-800mbar

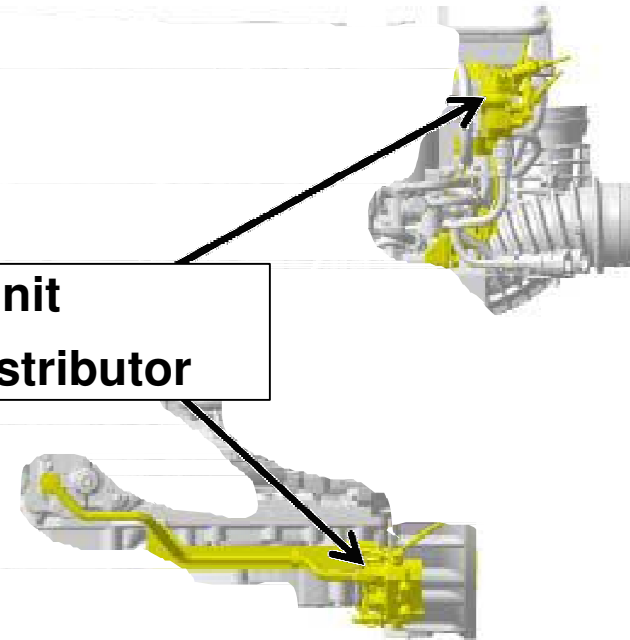


HCI (Hydrocarbon Injection)



Diesel injection into exhaust gas
Water-cooled injection nozzle

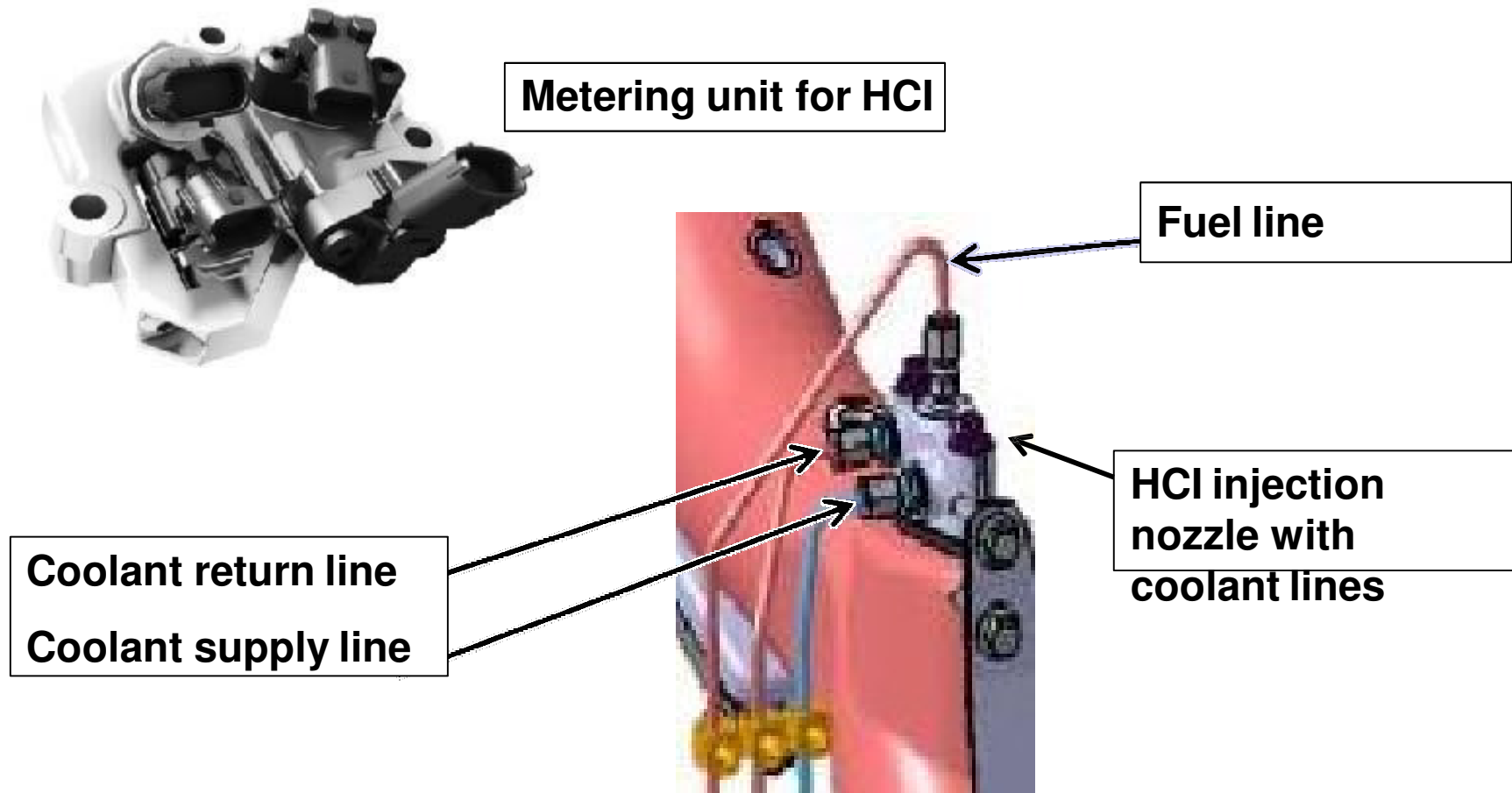
Metering unit
Coolant distributor



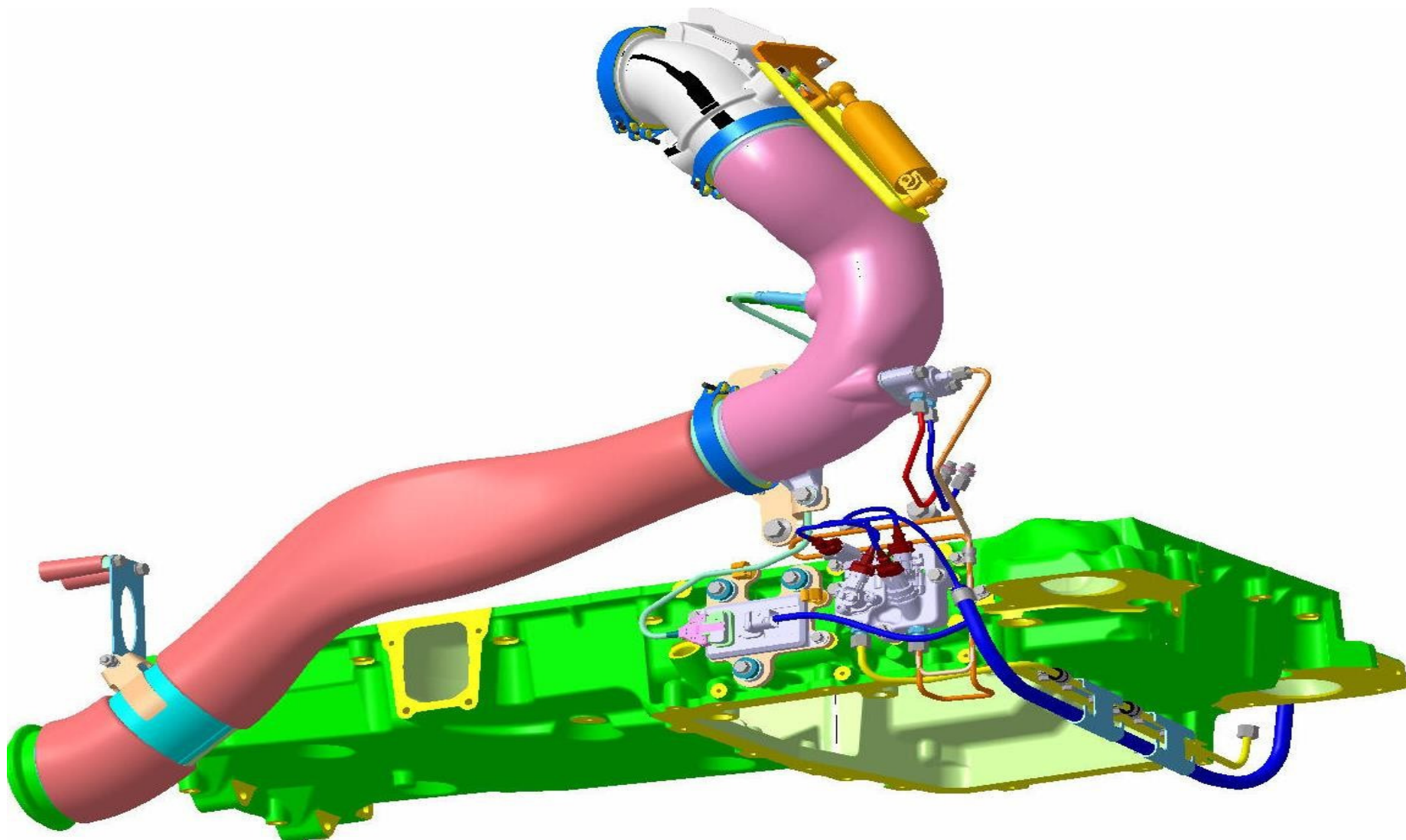
HCI (Hydrocarbon Injection)



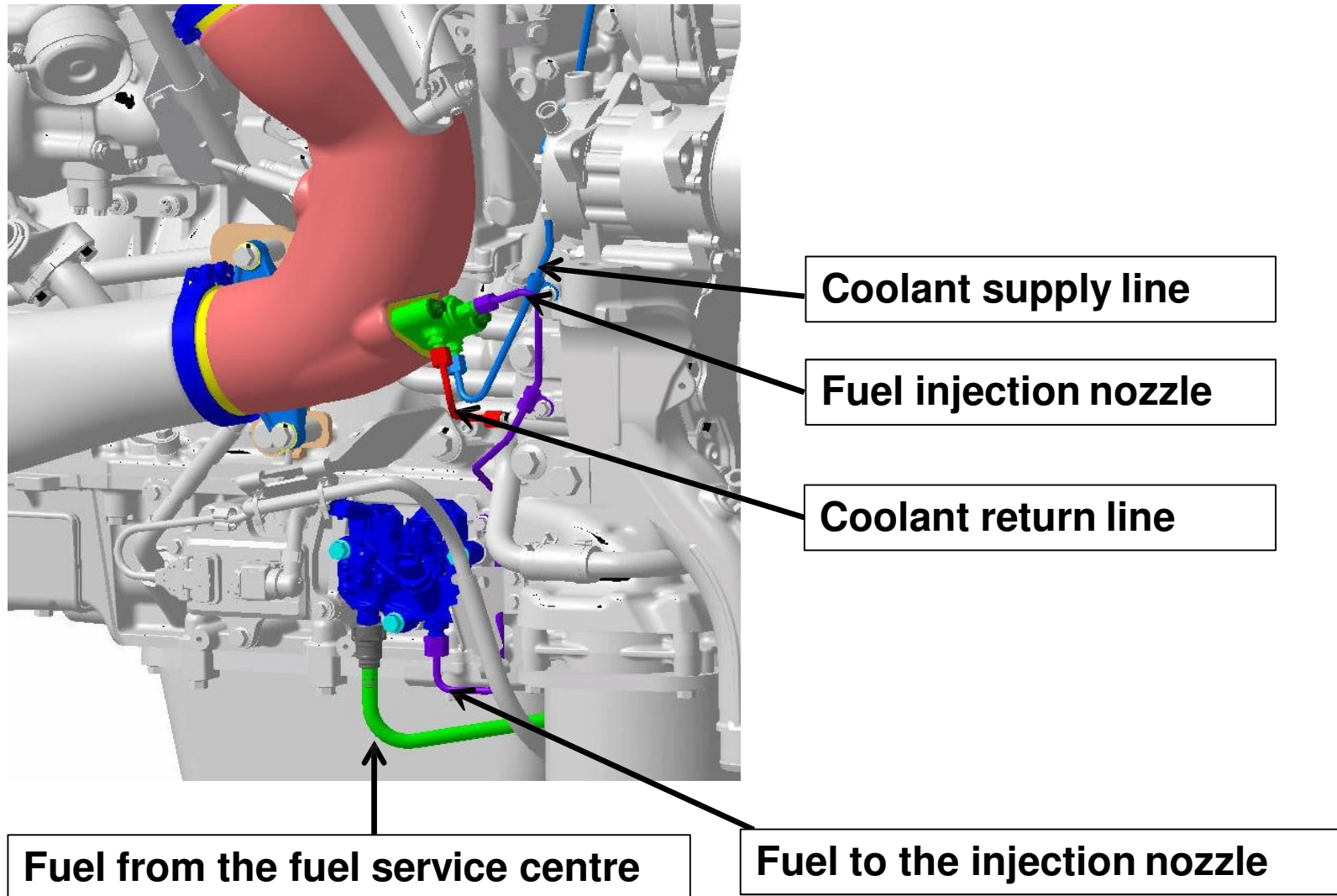
HCI (Hydrocarbon Injection)



HCI (Hydrocarbon Injection)



HCI (Hydrocarbon Injection)



HCI (Hydrocarbon Injection)



MU= metering unit _ Metering unit for HCI

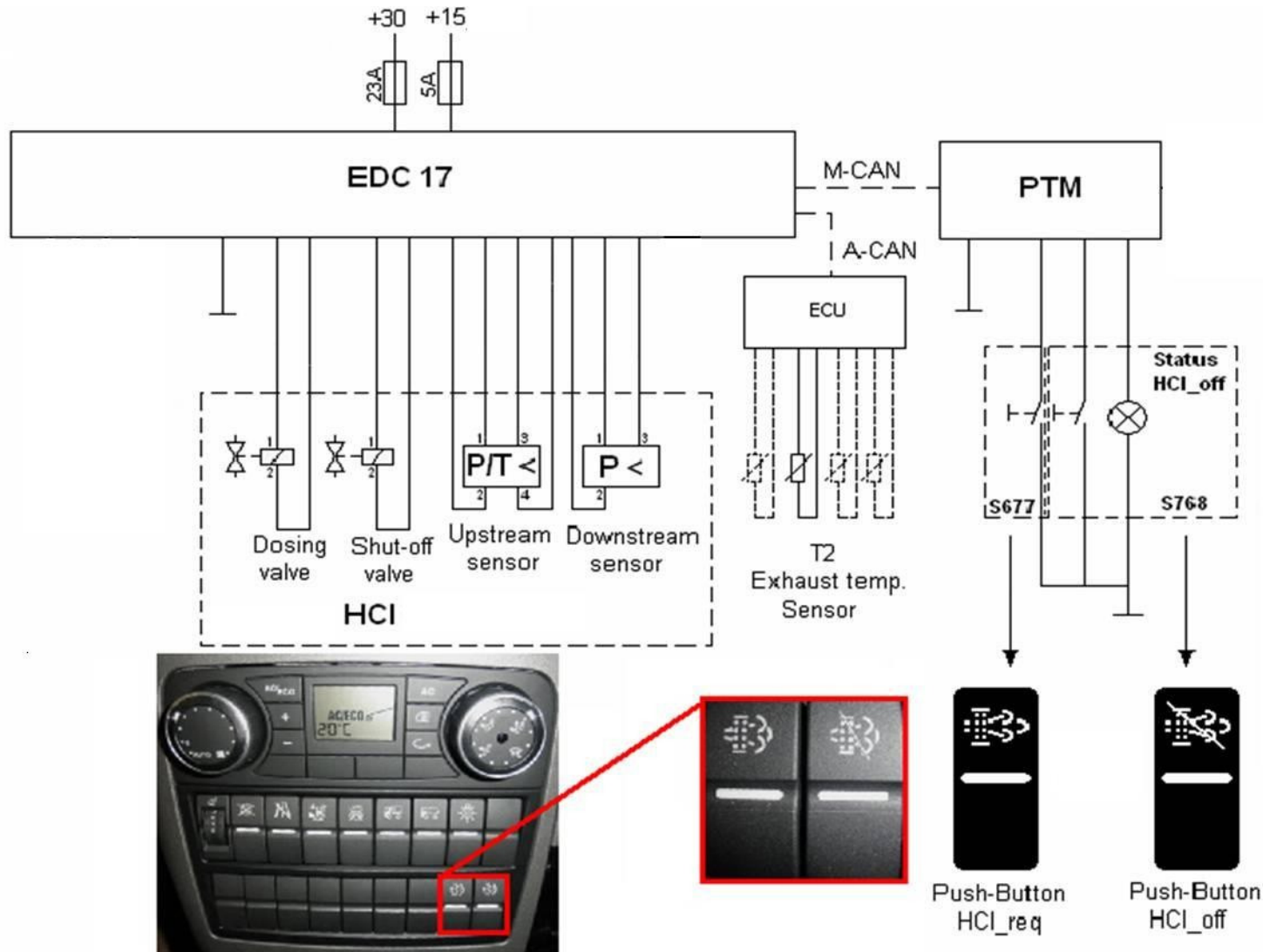
Return line pressure sensor

Shut-off valve

Metering valve

**Supply line pressure
and temperature sensor**

DPF regeneration



DPF regeneration



Phase 1 – Passive regeneration

No indication

Phase 2 – Active regeneration

Exhaust temperature above configurable threshold & speed below configurable threshold



Yellow

Check lamp – "High exhaust temperatures"

DPF regeneration



Phase 3 – Warning stage 1

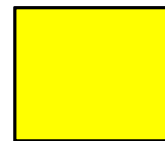
The particulate load has exceeded a critical level or it has not been possible to complete regeneration successfully several times



+



+



Check lamp – "Engine exhaust filter"

Yellow

Yellow

Display can be confirmed

Exhaust temperature above configurable threshold & speed below configurable threshold



Yellow

Check lamp – "High exhaust temperatures"

DPF regeneration

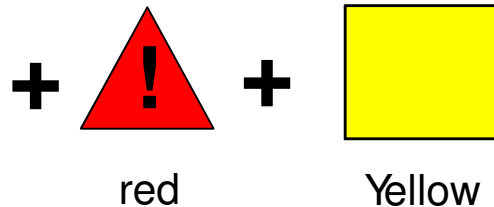


Phase 4 – Warning stage 2 (regeneration while standing)

Filter load very critical (consequential damage to be expected) – regeneration while standing required



Display can be confirmed



red

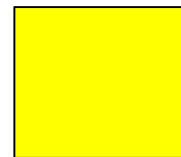
Yellow

Check lamp – "Engine exhaust filter"

Filter load very critical – regeneration while standing started by means of push button



Display cannot be confirmed



Yellow

Check lamp – "High exhaust temperatures"

**Exhaust temperature above configurable threshold
& speed below configurable threshold**

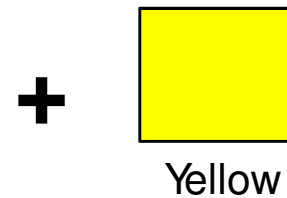
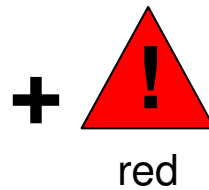
DPF regeneration



Phase 5 – Warning stage 3 (service regeneration)

Filter load very critical (consequential damage to be expected)

– Service workshop should be visited



Check lamp –
"Engine exhaust filter"

Phase 6 – Engine protection functions

No specific DPF display

Chapter 5



HD OBD – Heavy Duty On-Board Diagnosis

HD OBD

Heavy duty – On-Board Diagnosis

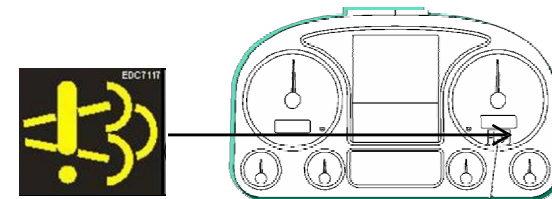


Function

- **Permanent monitoring of functions and components** of a vehicle that are relevant for emissions including injection system, exhaust-gas recirculation and exhaust-gas after treatment.

- **Registering and flagging of considerable increases of emission** during the entire operating time of the vehicle.

- **Faults are indicated by a yellow warning lamp** in the instruments panel, **Malfunction Indicator Lamp (MIL)**.



- **Storing data of occurred errors** in form of **P codes** (Powertrain codes). This code is universal (manufacturer independent).

- **Using International Standardized X200 socket** (OBD socket) , **faults** can be **read out either** with MANCats II in the form of SPN, or with external scanning tools in the form of P codes.



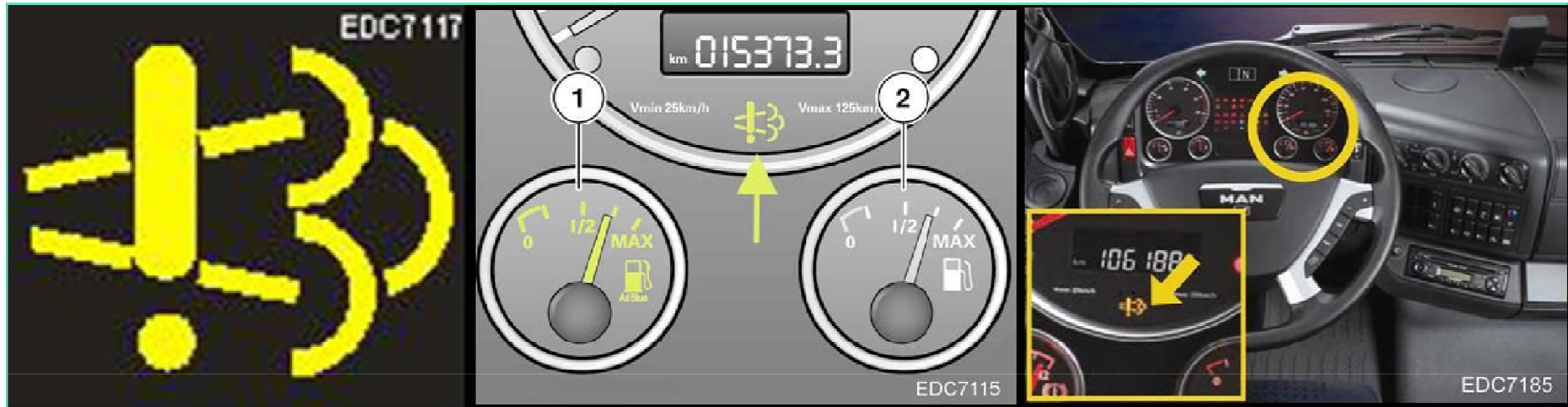


Emission related error memory in OBD

The OBD fault memory is designed as an additional integrated memory inside of the EDC control unit for the already existed and emission related errors.

- In Euro 5 engines with MAN AdBlue, these OBD fault memory is also copied into the AdBlue control unit as well.
- Emissions-related faults are always stored in the \"normal\" fault memory with the SPN error number, date and time and also stored in the OBD fault memory with the standardized 5 digits P code.
- The Malfunction Indicator Light (**MIL**) begins to illuminate at the same time when the error is stored in the OBD fault memory.
- After an emissions-related error is no longer actively present in the emissions system (except those NOx verification measurement), the **MIL** will continue illuminating for 3 more driving cycles or 24 hours of engine operating time before it is extinguished.
- If an error continues to be inactive, it will be classified as \"OK\" after 40 heating cycles or 100 operating hours, and will be deleted from the error memory.

MIL Malfunction Indicator Lamp



- 1 - Display of AdBlue supply (Euro5)
- 2 - Display of fuel supply

MIL will illuminate for max. 10 sec. after “Ignition on”, It will distinguish if no operation fault has been found.

MIL will provide difference information to the drive when:

- Lamp continuously on – warning of fault regarding emission related components connected to EDC, as well as Catalytic converter.
- Lamp flashing – warning of fault regarding Nox emission level, AdBlue tank level & quality, lambda probe or Nox sensor.

HD-OBD development



OBD stages

OBD1a Euro 4
(first registration as from 10/2006)

OBD1b Euro 4
(first registration as from 10/2007)

MAN Exhaust gas After treatment

- Exhaust limits: NOx < 7 g/kWh, particulate < 0.1 g/kWh by ESC cycle test
- monitoring of exhaust gas after-treatment to prevent "Major Functional Failure", e.g. whether a catalytic converter is fitted

For EGR engines, Lambda sensor is used in monitoring the NOx emission level. For AdBlue engines, NOx sensor is used.

- If Nox emission is 1.5g/kwh higher than limit → MIL flashes + Fault deletable memory will be kept for 400 days or 9600 hours.
- If Nox emission is > 7g/kwh → MIL flash + Different engine mapping to reduce Nox emission < 7g/kwh.
- If Urea tank is empty → MIL flash + Torque reduction immediately when engine in idle speed. Rated engine torque will be reduced down to 60% for >=16 tons vehicle, and down to 75% for <16tons vehicle.
- If electrical fault occurred with Urea level, Nox or lambda sensor → MIL flash + Rated engine torque will be reduced to 60% if problem is not fixed in 50 operation hours.

HD-OBD development



OBD stages

OBD 2 Euro 5
(first registration as from 10/2009)

OBD 2 Euro 6
(first registration as from 10/2014)

MAN Exhaust gas After treatment

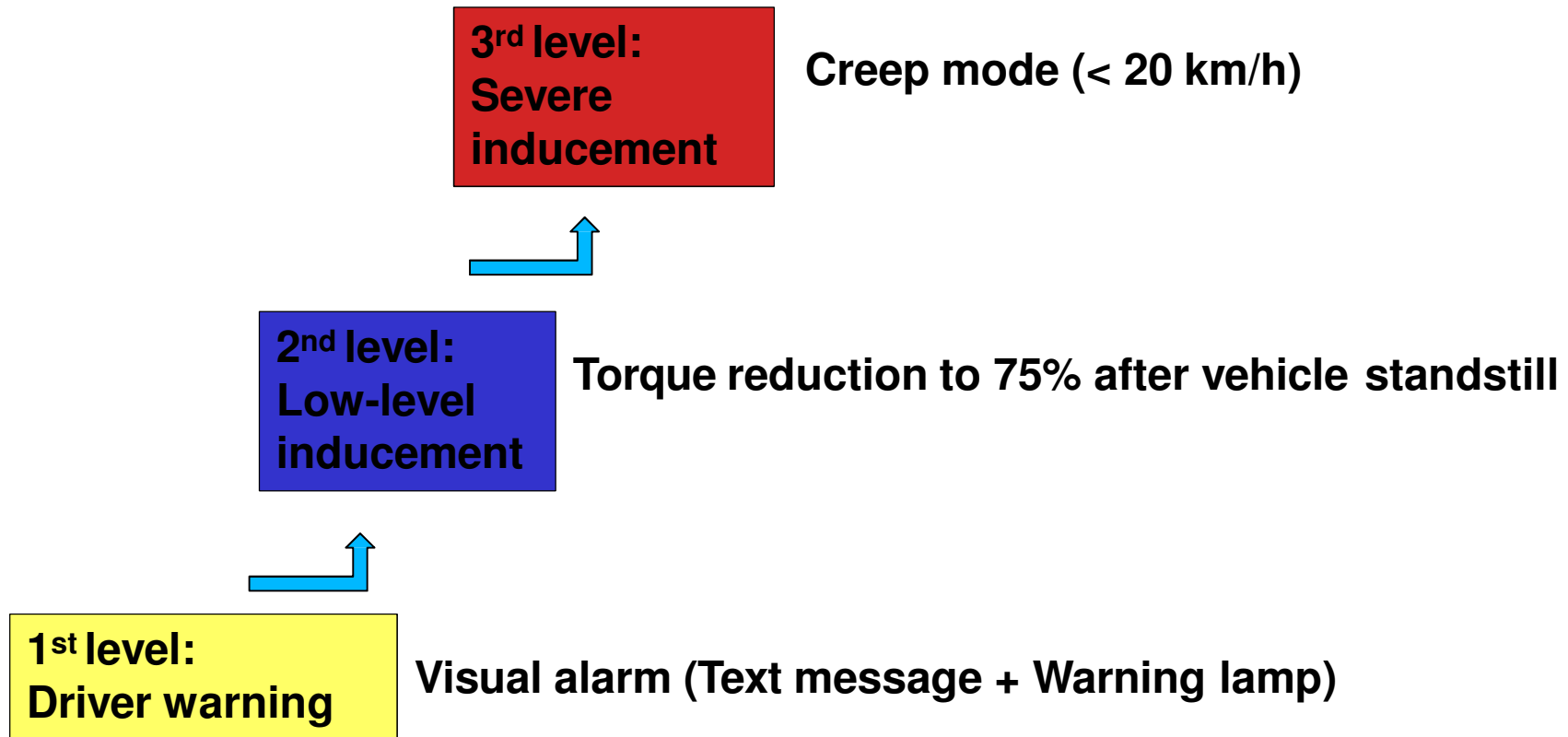
In addition to OBD1b,

- Monitoring of the effectiveness of catalytic converters.
- If Nox emission is $> 7\text{g/kwh}$ → MIL flash + torque is reduced to 60% or 75% (depending on the vehicle class) in addition to the flashing MIL if the fault is not rectified within 35 operating hours after indication.
- If the urea tank is empty the fault is displayed and torque is immediately reduced to 60% of engine torque as soon as idling speed has been reached. (empty AdBlue® tank and no pressure build-up in the supply module possible).
- Additional measures to ensure continuous monitoring of the exhaust gas management system, and these have far-reaching consequences for the customer:
- Continuous monitoring of AdBlue® tank content, quality and consumption and the injection system as well as NOx values when driving
- More stringent on-board diagnosis for NOx deviations with driving restrictions in three warning stages
 - First stage: only visual alarm indication
 - Second stage: "Low level inducement" forces torque reduction to 75%
 - Third stage: "Severe inducement" forces creep mode at a maximum speed of 20 km/h

OBD 2 Euro 6



There are three escalation levels relating to the driving restriction:





1. Driver warning

Visual alarm : Text message displayed + Central warning Lamp Red (no MIL, no SPN)

<u>Defects</u>	<u>Status</u>	<u>Text message displayed</u>
AdBlue level	level < 10 %	AdBlue system fault
AdBlue quality	after confirmed active fault (acknowledgeable)	AdBlue system fault
Reagent consumption	for 20% deviation (after max. 48 h or 15 l fuel consumption) (not acknowledgeable)	AdBlue system fault
Metering interruption	after confirmed active fault (acknowledgeable)	AdBlue system fault
Blocked EGR valve	after confirmed active fault	Exhaust system fault
Fault in monitoring system	after confirmed active fault	Exhaust system fault



2. Low-level inducement

Torque reduction to 75% after vehicle standstill

- | | |
|------------------------------|---|
| - AdBlue level | Level < 2.5% |
| - AdBlue quality: | > 10 h after confirmed active fault (debounced) |
| - Reagent consumption: | > 10 h after possible fault (not debounced) |
| - Metering interruption | > 10 h after confirmed active fault (debounced) |
| -Blocked EGR valve | > 36 h after confirmed active fault |
| -Fault in monitoring system: | > 36 h after confirmed active fault |



3. Severe inducement

Creep mode (< 20 km/h)

- | | |
|-------------------------------|---|
| - AdBlue level | Level between 2.5%...0% (empty tank) |
| - AdBlue quality: | > 20 h after confirmed active fault |
| - Reagent consumption: | > 20 h after possible fault (not debounced) |
| - Metering interruption | > 20 h after confirmed active fault (debounced) |
| - Blocked EGR valve | > 100 h after confirmed active fault |
| - Fault in monitoring system: | > 100 h after confirmed active fault |

Low level

1. Level < 10% EDC17 SPN 3456



+



+



automatic

switchover to AdBlue® level

▪ Display can be confirmed

2. Level 2.5 < X < 10% EDC17 SPN 3457



+



red

+



+



AdBlue® level display

is maintained

▪ Display can be confirmed

Low level

3. Level < 2.5% + vehicle standstill

Engine torque reduction:



▪ Display can be confirmed

4. Level = 0% + after parking the vehicle

Creep mode:



▪ Display can be confirmed

+



AdBlue® level display
is maintained

→ The AdBlue® level display is maintained (even if the fuel level falls into the reserve range)

→ Manual switchover to fuel display is possible for 3 seconds

Inadequate AdBlue quality: metering interruption/implausible consumption

1. Upon detection



- Display can be confirmed

2. 10 h engine operating hours after detection + vehicle standstill

Engine torque reduction:



+

- Display can be confirmed

3. 20 h engine operating hours after detection + after parking the vehicle

Creep mode:





Thank you for your attention