e-Training

Engine Management OM471 LA
Components and Periphery

TUTORIAL
Average time to complete: 75 minutes (actual duration may vary)
Recommendation: remember to take breaks while working through the training, e.g. after about 30 minutes.
Further notes on the training procedure can be found in the chapter "Introduction".

The program documents can be viewed and printed for your notes "Script" (Adobe Acrobat Reader required)

Please click the mouse button or press a key.
Engine Management OM471 LA

Components and Periphery

TO101E

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Please click the mouse button or press a key.
1 Engine components

Chapter 1 topic overview:
- Overview
- Design OM471 LA
New engine range 47x

- BR47x (OM471 LA, OM472 LA, OM473 LA) entirely new development
- Produced in Germany and the USA
- Employed in Daimler AG heavy-duty trucks and buses across all brands
- Over mid to long-term will replace the existing heavy-duty engines in commercial vehicles
- Market launch based on model changes of Daimler AG’s various commercial vehicle brands

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1 Engine components
1.1 Components (1/3)
<table>
<thead>
<tr>
<th>Type</th>
<th>Displacement</th>
<th>Bore/Stroke</th>
<th>Nominal engine speed</th>
<th>Compression ratio</th>
<th>Maximum injection pressure</th>
<th>Weight</th>
<th>Output</th>
<th>variants</th>
</tr>
</thead>
</table>

Basic technical data OMAT1 LA

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Which of the following performance characteristics apply to the OM471?

<table>
<thead>
<tr>
<th>Type</th>
<th>Displacement</th>
<th>Maximum Injection Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>R4</td>
<td>12.6 litres</td>
<td>2,100 bar</td>
</tr>
<tr>
<td>R6</td>
<td>14.8 litres</td>
<td>2,200 bar</td>
</tr>
<tr>
<td>V8</td>
<td>16.8 litres</td>
<td>2,300 bar</td>
</tr>
</tbody>
</table>

Please click the correct statements and confirm with OK.
Self-test: gear drive

Which components are driven via the gear drive in the OM471?

- Fuel high-pressure pump/fuel pump
- Intake camshaft
- Oil pump
- Power steering pump
- Compressor
- Exhaust camshaft

Connect the links to the correct positions and confirm with OK.
Chapter 2 topic overview:
- Overall network
- Control gateway
- Drive CAN
- Engine start/Engine stop
Global Variant Coding

On-board electrical system in the new ACTROS

New: Global Variant Coding (GVC)
Vehicle-specific data for vehicle configuration
Parameters stored in GCM at factory
Examples:
- Type of vehicle (e.g., tractor unit, tipper, platform truck, etc.)
- Number of axles
- RHD or LHD
- Equipment (e.g., air suspension, Lane Keeping Assist, etc.)

GCM regularly transmits GVC data to the control modules

Differences in the adoption of GVC data:
1. Control modules that adapt data autonomously
2. Control modules that adapt data upon request
3. Control modules that use data only for the current "Ignition ON" to "Ignition OFF" cycle

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2 Vehicle network
2.2 Control platform (COM6)
Central gateway

Power supplied via cabin SAM (SCA)
Contacts via 24-pin X1 connector
Tasks of the central gateway

Main task is to relay CAN messages

1. Diagnostic gateway
2. Control module monitoring
3. Network management
4. Bush's terminating resistors

- Diagnosis CAN (60 ohms)
- Tachometer CAN (120 ohms)
- Exterior CAN (120 ohms)

* Except for itself and the electronic brake system (EBS)

Click the additional tasks of the CAN

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2 Vehicle network
2.2 Central gateway (CAN)
Electronic ignition switch (EIS)

- EIS supplies key with voltage through ignition
- Immobilizer code identification
- Release of immobilizer if key matches
- Two-stage Start/Stop button with three functions

1st stage

Click the Start/Stop button.
Engine start

Dual ignition accelerates starting process.
- Cold start or warm-up phase:
  - Two pilot injections before main injection
  - No sudden increase in pressure at temperature
  - Minimum modulation for main injection
- Key is mechanically locked after engine start.
- "Engine run-on" mode:
  - Keep Start/Stop button pressed when vehicle is stationary
  - Remove key
  - "Only manual engine speed possible" is displayed
  - Deactivated by reinserting the key

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Actuating the Start/Stop button (when vehicle is stationary and engine is running) switches off the engine.
Self-test: CGW and drive CAN control modules

Which of the following control modules are integrated in the central gateway in the new ACTROS and which of them are part of the drive CAN?

<table>
<thead>
<tr>
<th>Central gateway (CGM)</th>
<th>ACM (exhaust gas aftertreatment control module)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>COM (communication interface control module)</td>
</tr>
<tr>
<td></td>
<td>CPC (drive control module)</td>
</tr>
<tr>
<td></td>
<td>CDS (central data storage)</td>
</tr>
<tr>
<td>Drive CAN</td>
<td>ROM (retarder control module)</td>
</tr>
<tr>
<td></td>
<td>MS (maintenance system control module)</td>
</tr>
<tr>
<td></td>
<td>TCM (transmission control module)</td>
</tr>
<tr>
<td></td>
<td>MCM (engine management control module)</td>
</tr>
</tbody>
</table>

Set the control modules correctly and confirm with OK.
What is the basic sequence in which the MCM control module activates the fuel injectors during dual ignition when starting the engine?

1. Fuel injectors of the cylinders
2. Fuel injectors of the cylinders
3. Fuel injectors of the cylinders

Sort the numbers correctly and confirm with OK.
3 Fuel circuit

Chapter 3 topic overview:
- Design
- High-pressure generation and fuel injection
Overview of APCRS

The fuel circuit is a central sub-system of the engine and consists of:

- The low-pressure circuit
- The high-pressure circuit
- The APCRS with:
  - Flexible multiple injection
  - High injection pressures (up to 2,300 bar)
  - Consumption-optimised injection processes

*APCRS* - Amplitude-Pressure Common Rail System
Injection without pressure booster

MCM control module sets:
- timing
- duration
- and injection variant
- activation of only the nozzle needle solenoid
- or activation of nozzle needle solenoid and the pressure booster solenoid

2 injection variants:
1. Injection without pressure booster
2. Injection with pressure booster
Injection with pressure booster

Pressure booster solenoid

Fuel return pressure booster

High-pressure supply line

Pressure booster

Nozzle needle solenoid

Fuel return nozzle needle

Spring

Nozzle needle

The injection pressure depends on the time between the activation of the "pressure booster solenoid" and the "nozzle needle solenoid".

Click the buttons one by one.

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3 Fuel circuit
3.2 High-pressure generation and injection unit
Self-test: fuel circuit

Label the fuel circuit of the OM471.

Fuel high-pressure pump
Fuel pump
Control module cooler
Fuel metering unit
Fuel filter module

Drag the component names to the correct positions and confirm with OK.
Which injection processes of injection with a pressure booster are shown?

- Injection before activation of the nozzle needle solenoid
- Injection simultaneous to activation of the nozzle needle solenoid
- Injection after activation of the nozzle needle solenoid

Label the diagrams with the correct description and confirm with OK.
Thermal management control strategy

Thermal management:
- controlled radiator shutter
- control of fan and coolant pump
Aim: reduction of fuel consumption through requirements-based component activation
Air control system (radiator shutters)

With vehicle parked:
- Upper vanes are open
- Lower vanes are closed (damage protection)

When driving:
- Upper vanes are closed depending on speed
- Vanes are opened/closed as required
- CPC calculates target position of shutters based on characteristics map
- Position can be queried
- Shutters are opened in the event of a fault
Fan with regulated viscous coupling

Electronic coupling facilitates activation based on cooling requirements

Primary side:
- Components rigidly connected to stub shaft
- Rotates at current engine speed

Secondary side consists of cover and housing

Power transmission through silicone fluid

Without current: fan coupling and engine share non-positive connection

With current: fan solenoid activated by MCM control module

Thermal protection function:
- Full or no activation
Controlled coolant pump

- Electrical connection
- Pulley
- Vane chambers
- Viscous disc
- Anchor
- Cover
- Electric magnet
- Pump impeller
- Shaft
- Coolant pump speed sensor signal ring
- Pump housing

Pump impeller and coolant-side geometry identical to non-controlled pump
Electronic coupling facilitates activation and deactivation based on requirements
Lower pulley diameter
Slip power is converted to heat
Electronic-heats up during operation
MCM activates coolant pump
Operating requirements:
- Sufficient cooling of the engine/auxiliary equipment
- Retarder operating status
- Cab heating output
- Consumption-optimised engine operation
Self-test: coolant circuit

Label the coolant circuit of the OM471.

Coolant pump
Coolant thermostat
Coolant manifold
Expansion tank
Exhaust gas recirculation cooler
Oil-water heat exchanger

Click the component names to be correct positions and confirm with OK.
Which control module handles activation of the respective thermal management components?

Engine management control module (MCM)
- Air control system (radiator shutters)
- Regulated fan coupling
- Controlled coolant pump

Drive control module (GCP)
- Air control system (radiator shutters)
- Regulated fan coupling
- Controlled coolant pump

Please click the correct components and confirm with OK.
Chapter 5 topic overview:
- Exhaust gas recirculation
- Exhaust gas recirculation system components
- Exhaust box
- DPF regeneration
- SCR system
Exhaust gas aftertreatment consists of:
1. Engine design measures (several exhaust gas dilution lines)
2a. SCR system (Euro V)
2b. Diesel oxidation catalytic converter with diesel particle filter and SCR system (Euro VI)
Components of exhaust gas recirculation

Exhaust gas is added to atmosphere/charged air
Proportion of oxygen decrease
Combustion temperature drops
Reduction of NOx emissions
Reduction of exhaust gas volume

If too great a volume of exhaust gas is recirculated, the following emissions increase:
- Scot
- Carbon monoxide (CO)
- Hydrocarbons (HC)

Thus, the ratio of exhaust gas mass to fresh air mass needs to be correct.
Operation of exhaust gas recirculation

EGR differential pressure sensor
Charge-air temperature sensor downstream of throttle valve
Charge-air pressure and temperature sensor
Charge-air temperature sensor upstream of throttle valve
MCM control module

Ratio of exhaust gas mass to fresh air mass needs to be precisely regulated
EGR rate is calculated by the MCM control module based on the following data:
1. Mass of aspirated/charged fresh air
2. Mass of recirculated exhaust gas
3. Total air mass (sum of 1. and 2.)

Click the exhaust gas recirculation position on the engine.
Operation of exhaust gas recirculation

Ratio of exhaust gas mass to fresh air mass needs to be precisely regulated.
EGR rate is calculated by the MCM control module based on the following data:
1. Mass of aspirated/charged fresh air
2. Mass of recirculated exhaust gas
3. Total air mass (sum of 1. and 2.)
System components of exhaust gas recirculation

Example: new ACTROS

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5 Exhaust gas obturation
5.2 System components of exhaust gas recirculation (1/3)
Components inside Euro VI exhaust box:

- Diesel oxidation catalytic converter (DOC)
- Diesel particle filter (DPF)
  - Retains soot particles
  - Clogged filter needs to be regenerated
- SCR catalytic converter
- ASC catalytic converter
  - Breaks down AdBlue®
  - Prevents escape of ammonia
- Additional SCR functionality

Click the filters and catalytic converters in the diagram.
DPF regeneration

Passive DPF regeneration
- during normal driving
- Soot nitrogen dioxide (from diesel oxidation catalytic converter) → carbon dioxide

Active DPF regeneration
- activated by:
  1. Pressure difference within the DPF
  2. "Soot model" (theoretical DPF charge level is calculated based on distance travelled and engine operation)
- Regeneration possible when driving or when stationary
- Precondition: temperature upstream of DOC greater than 200°C
Self-test: components of exhaust gas recirculation

Which exhaust gas aftertreatment components are featured by Euro V/Euro VI vehicles with an OM471 engine?

Euro V vehicles
- Exhaust gas recirculation
- Diesel oxidation catalytic converter (DOC)
- Diesel particle filter (DPF)
- SCR catalytic converter
- ASC catalytic converter

Euro VI vehicles
- Exhaust gas recirculation
- Diesel oxidation catalytic converter (DOC)
- Diesel particle filter (DPF)
- SCR catalytic converter
- ASC catalytic converter

Please click the correct components and confirm with OK.
Self-test: sensors of the SCR system

Which of the exhaust box sensors are part of the SCR system of the OM471 engine in Euro VI vehicles?

- Exhaust box inlet NOx sensor
- Exhaust box outlet NOx sensor
- Pressure sensor upstream of DOC/DPF
- Pressure sensor downstream of DPF
- Temperature sensor upstream of DOC
- Temperature sensor downstream of DOC (branch 1)
- Temperature sensor downstream of DOC (branch 2)
- Temperature sensor upstream of SCR
- Temperature sensor downstream of SCR

Please click the correct sensors and confirm with OK.
Notes and tips to finish:

- You can use the table of contents to repeat individual sections.
- Completing the program again at a later date improves learning outcome.
- Once you have internalized the program's contents sufficiently and feel secure in your knowledge, move on to completing the corresponding e-Test.
- Study program pages for download.