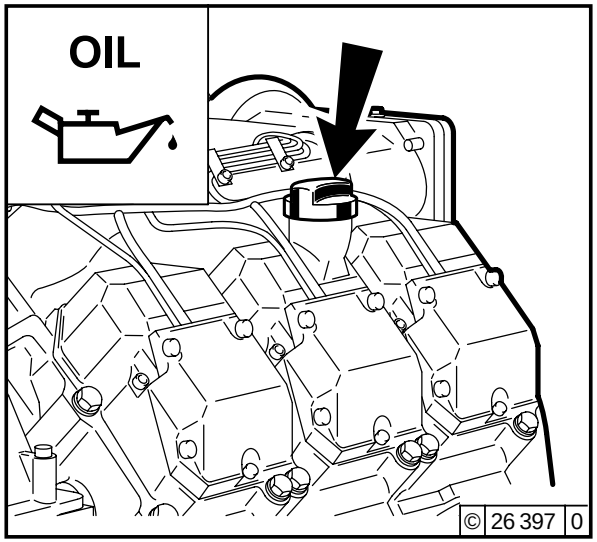
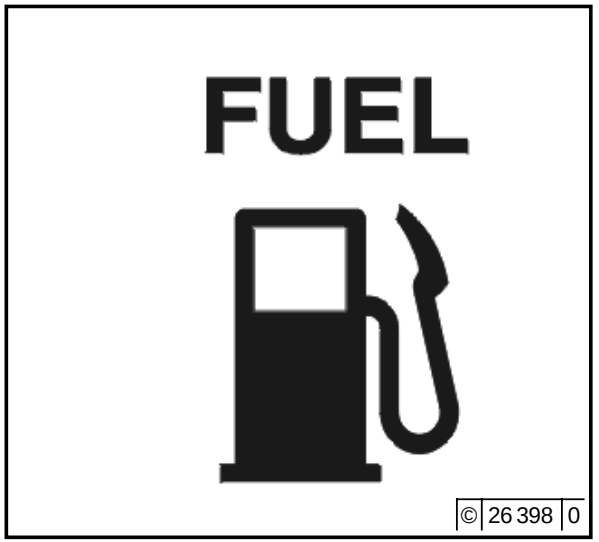
3.1.1 Filling engine oil



The engines are generally supplied without oil filling.
Fill engine with lube oil through the oil filler (1) on the cylinder head cover. Alternatively, you can fill on the wheel box (2) or on the side of the crankcase.
For oil filling amount see 9.1.
For quality and viscosity of oil see 4.1.

Oil may not be filled into the dust collecting tank of the pre-separator, if this is present.

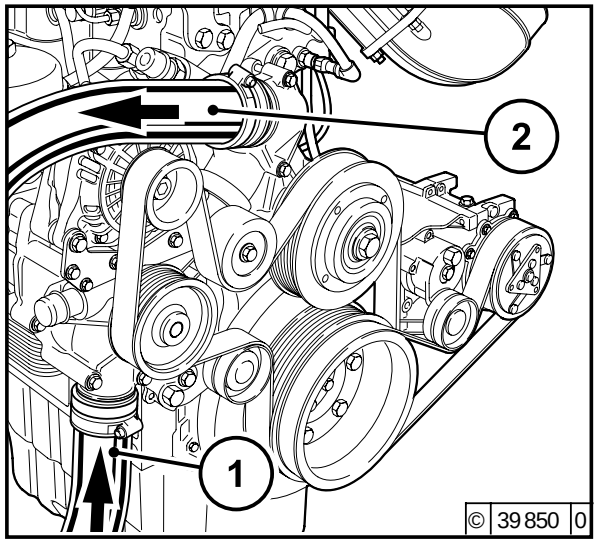
3.1.2 Filling fuel



Only use clean, standard, branded diesel fuel.
For fuel quality see 4.2.
Depending on the outdoor temperature, use either summer or winter diesel fuel.

Only re-fuel when the engine is not running!
Pay attention to cleanliness!
Do not spill any fuel!

3.1.3 Filling / bleeding cooling system



- Connect the coolant outlet 2 and coolant inlet 1 to the cooling system. Connect the lead line from the compensation tank to the water pump or to coolant inlet pipe 1.
- Connect vent lines from the engine and if necessary from the cooler to the compensation tank.
- Fill the cooling system through the compensation tank
- Close the compensation tank with the valve.
- Start the engine and warm up until the thermostat opens (line 2 heats up).
- Run engine run with open thermostat for 2 –3 minutes.

- Check the coolant level in the compensation tank and top up the coolant if necessary.
- Repeat the process with engine start if necessary.

Never operate the engine without coolant (not even briefly).

3.1.4 Other preparations

- Check battery and cable connections, see 6.7.1.
- **Trial run**
  - After preparations carry out a short trial run of approx. 10 min. Do not fully load the engine.

  During and after the trial run
  - Check engine for tightness.

  With engine not running
  - Check oil level, re-fill oil if necessary, see 6.1.2.
  - Re-tighten V-belts, see 6.5.

- **Running-in**
  It is recommended to check the oil level twice a day during the running-in phase.
  After the running-in phase, checking once a day is sufficient.

3.2.1 Electrical starting

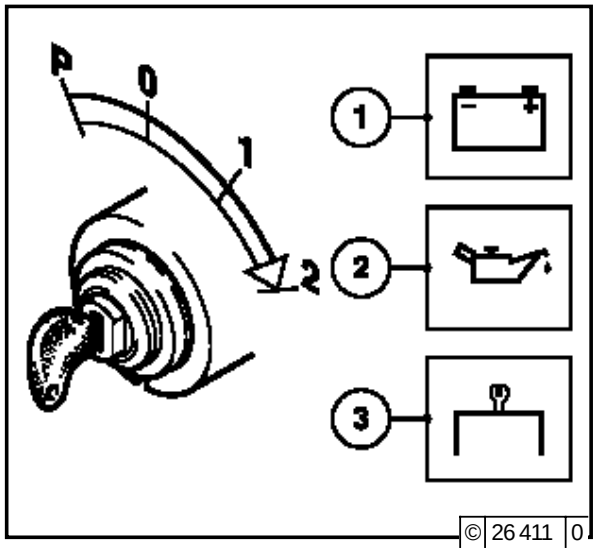
without cold start aid

Before starting make sure that there is nobody in the engine/ work machine danger area. After repairs: Check that all protective equipment is mounted and all tools have been removed from the engine.
When starting with heating plugs/heating flange, do not use additional start aids (e.g. injection with start pilot)! Danger of accidents!

- Engine is electronically controlled by
  Example: EMR3 (electronic engine control)
  - engine is programmed and supplied with the necessary function configurations.
- As far as possible separate engine from driven devices by disconnecting.
- Engine connector plug must be connected by the customer (e.g in driver's cab/ device) to at least:
  - Supply voltage
  - Torque output
  - Speed output.
- Warm up the engine for approx. 30 seconds at a low idling speed.
- Do not run up the engine immediately to high idling speed / full load operation from cold.

If the starter is connected by a relay on the EMR3,

- the maximum starting time is limited by the EMR3.
- the pause between two start attempts is given by the EMR3.



- If the touch start function is programmed, a short start command with the ignition key suffices in position 2 or, if available, by a start button.
  The start is then continued automatically by the EMR3.
- For special applications, the EMR3 can be programmed by data record so that the control unit performs other automatic start attempts if the engine fails to start.

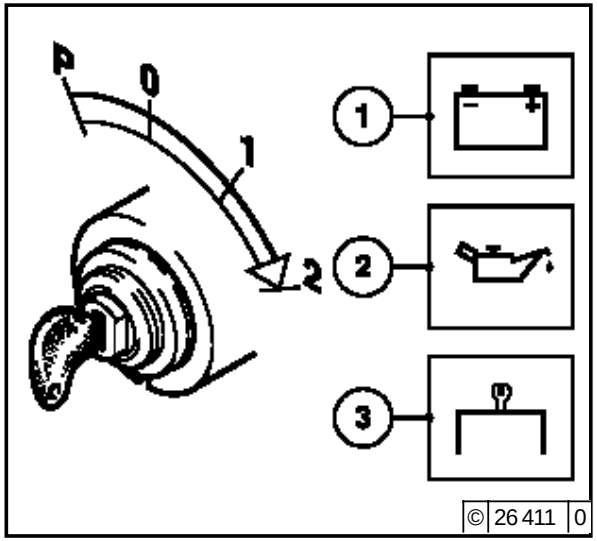
Start uninterruptedly for max. 20 s. If the engine does not start, repeat the start procedure after a 1 minute pause. If the engine has not started after two attempts, find the cause in the fault table (see 7.1).

- Insert key
  - Step 0 = no operating voltage.
- Turn key to the right
  - Step 1 = operating voltage,
  - Warning lights light up.
- Turn the key further to the right against the spring load.
  - Step 2 = start
- Release key as soon as the engine starts up.
  - Warning lights go out.

Start the engine for a maximum of 20 seconds uninterrupted. If the engine does not start up, wait for one minute and then repeat the starting process. If the engine does not start up after two starting processes, determine the cause as per fault table (see 7.1).
If the engine does not start and the diagnostic lamp flashes, the EMR3 system has activated the start lock to protect the engine.
The start lock is released by switching off the system with the ignition key for about 30 seconds.

with cold start aid

Heating plug/heating flange



- Insert key.
  - Step 0 = no operating voltage.
- Turn key to the right.
  - Step 1 = operating voltage,
  - Warning lights 1+2+3 light up.
  - Pre-heat until heating indicator goes out. If the pre-heating indicator flashes, there is an error, e.g. pre-heating relay sticking which can fully discharge the battery at standstill.
  - Engine is ready for operation.
- Turn the key further to the right against the spring load to
  - Step 2 = start
- Release key as soon as the engine starts up.
  - Warning lights go out.

Caution: Engine must start within 30 seconds, if not, repeat the starting process.

The EMR3 system monitors the engine condition and itself.
The states are indicated by the diagnostic lamp.
Lamp test:

- The diagnostic lamp lights for about 2s after ignition (ignition lock stage 1).

Steady light:

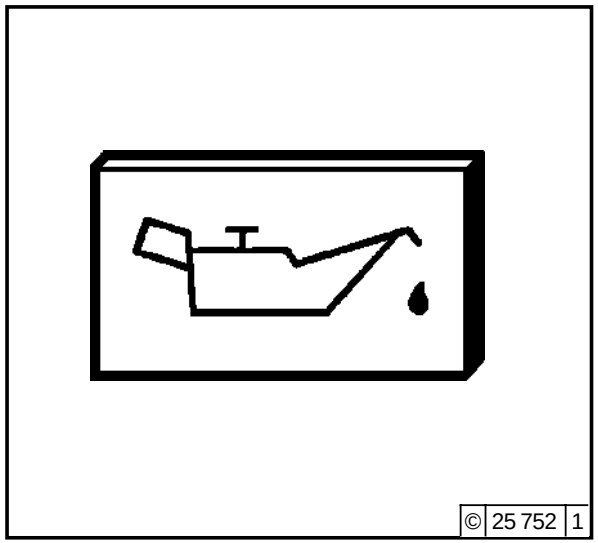
- There is an error in the system or a variable of the engine (temperature, pressure, etc.) is in the warning area. Depending on the error, the performance of the engine may be reduced by the EMR3 to protect the engine so that it is not in danger.

Fast flashing:

- **Attention, the engine is in danger and must be switched off**.
- **Depending on the application, the control unit switches the engine off automatically**.
- The control unit may also specify an idle speed to cool the engine before shutting down.
- There may be a start lock after stopping the engine.
- Additional control lamps e.g. for oil pressure or oil temperature may be on.
- The override key can bypass the reduction in performance to avoid critical situations, as well as delay the automatic shutdown or bypass a start lock. This overwriting of the engine protection functions is logged in the control unit.
- The start lock is released by switching off the system with the ignition key for about 30 seconds.

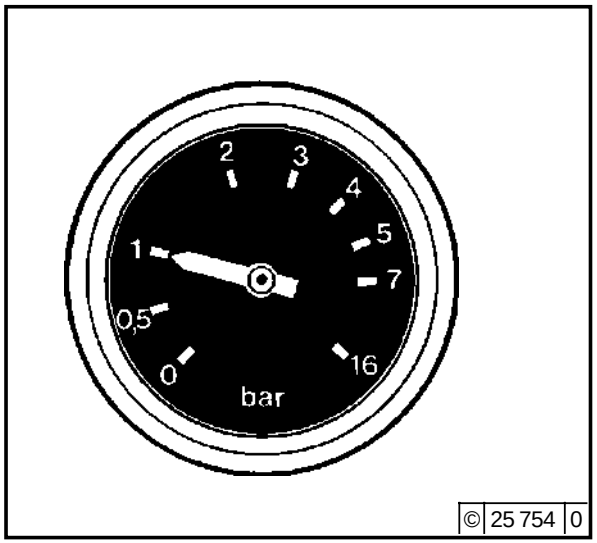
3.3.1 Engine oil pressure

Oil pressure light



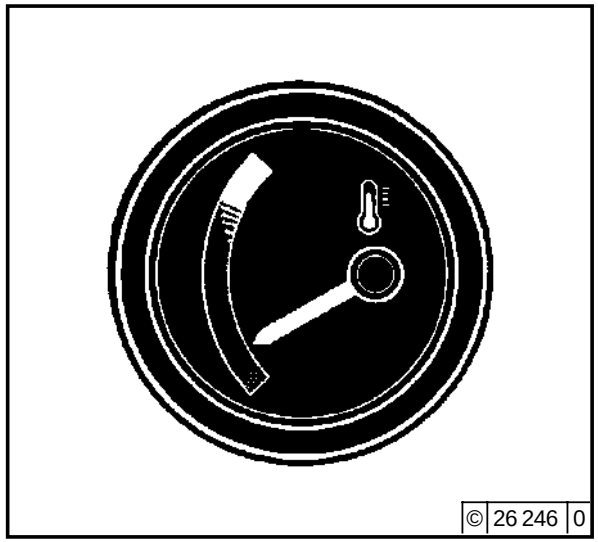
- The oil pressure light comes on for about 2s after switching on the system.
- The oil pressure light must be off when the engine is running.

Oil pressure gauge



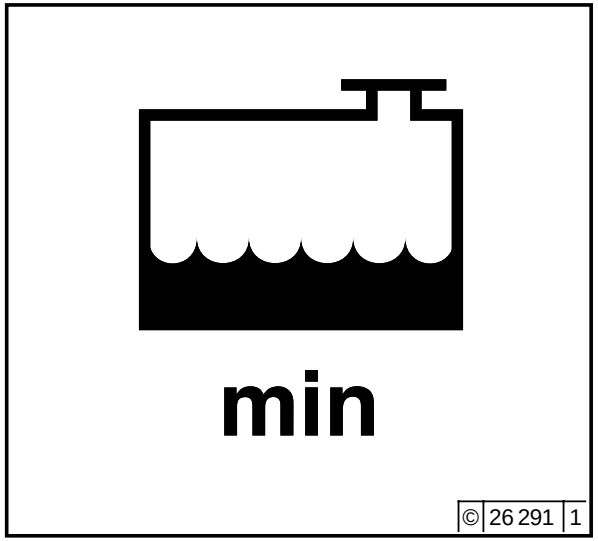
- Needle of oil pressure measuring instrument must show the minimum oil pressure (see 9.1).

3.3.2 Coolant temperature



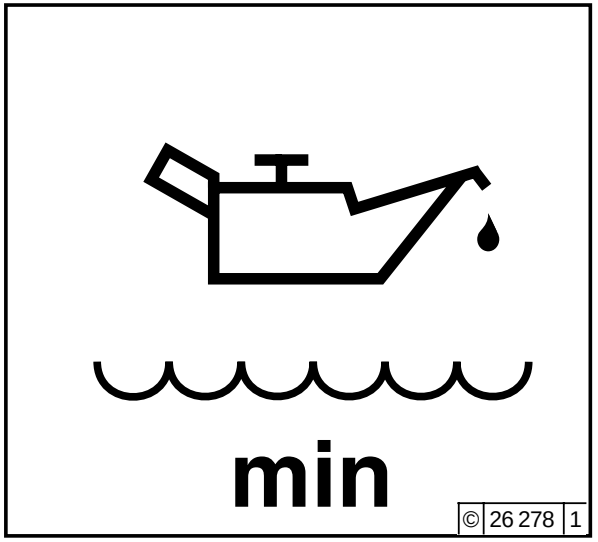
- The needle of the temperature display should always be in the green area, and only as an exception in the yellow/green area. If the needle rises into the orange area the engine is getting too hot. Switch off the engine and determine the cause as per fault table (see 7.1).

3.3.3 Coolant level



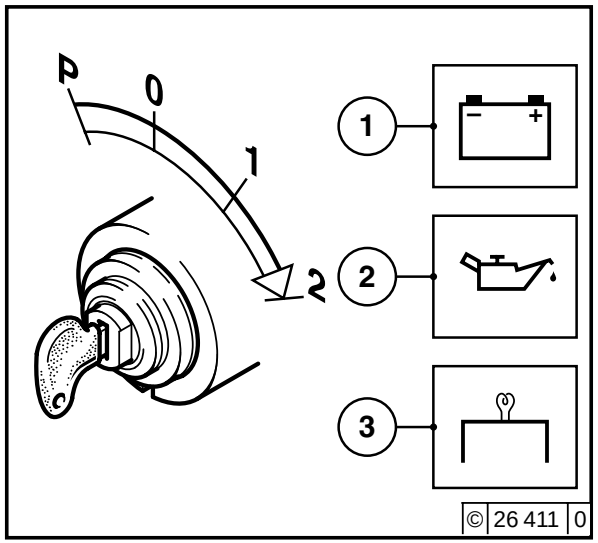
- Light on coolant level display comes on (contact is via float switch/ level probe if coolant level is at minimum):
  Switch off the engine and determine the cause as per fault table (see 7.1).
- Function check of coolant level:
  Key in step 1 or 2
  (Float switch or level probe)
  Warning light comes on for approx. 2 seconds
  - Coolant level OK:
    Light goes out
  - Coolant level not OK:
    Light comes on again.

3.3.4 Lube oil level



- Light on lube oil level display comes on (contact is via float switch / level proble if lube oil level is at minimum):
  Switch off the engine and determine the cause as per fault table (see 7.1).
- Function check of lube oil level :
  Key in step 1 or 2
  (Float switch or level probe)
  Warning light comes on for approx. 2 seconds
  - Lube oil level OK :
    Light extinguished.
  - Lube oil level not OK :
    Light comes on again.

3.4.1 Electrical shutdown



- Turn the key to the left (to step 0) and remove. Warning lights go out.

Note:
The control unit remains active for about another 40 seconds to save the system data (lag) and then switches itself off.

Avoid shutting down from full load operation if possible (coking/ blockage of the remaining oil in the turbocharger bearing housing).

Lube oil is no longer supplied to the turbocharger!

Run the engine after relieving the load for about one minute at low idling speed.

3

3.5.1 Winter operation

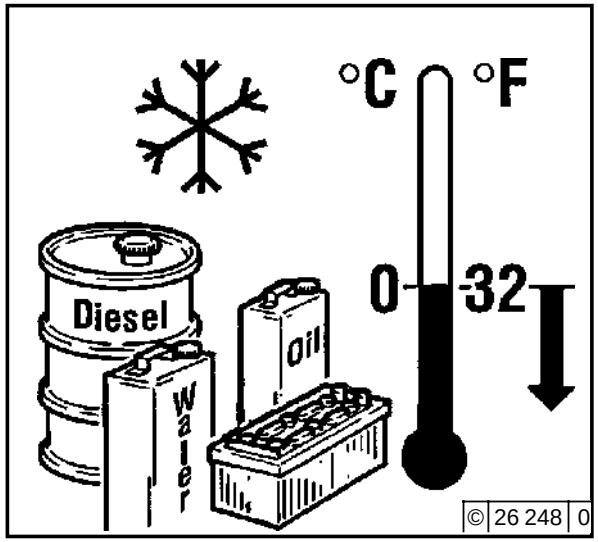
- Lube oil viscosity
  - Select the viscosity (SAE class) according to the ambient temperature before starting the engine, see 4.1.2.
  - Observe shorter oil change times when operating below -10 °C, see 6.1.1.

- Diesel fuel
  - Below 0 °C use winter fuel, see 4.2.2.

- Coolant
  - Mixing ratio anti-freeze / water for lowest temperature (max. - 35 °C), see 4.3.1.

- Additional maintenance work
  - Check the fuel container weekly for contamination, clean if necessary.
  - If necessary, adjust the oil filling of the oil bath air filter (as engine oil) according to the outside temperature.

- Cold start aids
  - When there is a frost, start with heating flange if if necessary (see 3.2.1). The heating flange not only lowers the starting limit temperature, but also simplifies starting at temperatures which don't actually require a starting aid.
- Battery
  - A well-charged battery is a prerequisite for a good cold start, see 6.7.1.
  - Heating the battery to approx. 20 °C (dismantle and store in a warm room) lowers the starting limit temperatureby 4-5 °C.



3.5.2 High ambient temperature, high altitude

- When the altitude or ambient temperature increases, the air density decreases. This impairs the maximum engine performance, exhaust quality, temperature level and, in extreme cases, the starting performance. For transient operation, usage up to 1000 m altitude and a temperature of 30°C is permissible.

- In case of doubt regarding engine usage, ask your engine or device supplier whether necessary fuel stop reduction has been carried out in the interest of operational safety, service life and exhaust quality (smoke), or contact your service representative.