Scania Engines

IMPORTANT INFORMATION

When working on the engine, for example adjusting drive belts, changing the oil or adjusting the clutch, it is important not to start the engine. The engine may be damaged and there is

SERIOUS RISK OF INJURY.

For this reason, always secure the starting device or disconnect a battery cable before working on the engine. This is especially important if the engine has a remote starter or automatic starting.

This warning symbol and text is reproduced beside those maintenance points where it is especially important to consider the risk of injury.

Operator's Manual

DC9
EMS with S6/PDE

Industrial engine:

opm05-9a en ***1 715 020***

2007-11:1

START-UP REPORT - WARRANTY

When the start-up report has been filled in and sent to Scania or you have reported commissioning via Internet, you have a 1 year guarantee from the commissioning date. Also fill in the particulars below as this can make things easier if you need to contact for example a service workshop.

Engine number .....

Commissioning date .....

User's name and address .....

.....

.....

.....

Signature .....

Engine type .....

Variant .....

Engine type and variant are indicated on the engine type plate

PREFACE

This Operator's Manual describes the handling and maintenance of Scania DC9 Industrial Engines with EMS S6/PDE injection systems.

The engines are of direct-injection, liquid-cooled, four-stroke, 5-cylinder in-line diesel type. These engines have turbochargers and charge air coolers: see page 10.

Common applications are as power units in construction machines, generator sets, earth-moving, railway and forestry machines as well as in irrigation systems.

The engines can have different output and speed settings.

The normal output setting of the engine (performance code) is indicated on the type plate, see page 10.

Note: Only standard components are described in the Operator's Manual. Regarding special equipment, refer to the instructions of the relevant manufacturer.

In order to obtain the best value and service life from your engine, there are several points you should bear in mind:

- Read the manual before starting to use the engine. Even though you may be experienced with Scania engines you may find new information in this Operator's Manual.
- Follow the maintenance instructions. Good working order and service life are ensured if maintenance is carried out according to the instructions.
- *In particular, read the safety information starting on page 6.*
- Get to know your engine so that you know what it can do and how it works.
- Whenever necessary, always contact an authorised Scania workshop. They have special tools, genuine Scania parts and staff with training and practical experience of Scania engines.

Note: Always use genuine Scania parts during service and repair so as to keep your engine in the best possible working order.

The information in this manual was correct at the time of going to press. However, we reserve the right to make alterations without prior notice.

! *Important*

During the warranty period, only genuine Scania parts may be used during service and repair otherwise the warranty will be invalidated.

CONTENTS

ENVIRONMENTAL RESPONSIBILITY

Scania has always been very much at the leading edge when it comes to developing and producing engines which are as environmentally friendly as possible.

Major progress has been made on reducing harmful exhaust emissions as required to be able to meet the stringent environmental standards stipulated on almost all markets.

At the same time, we have been able to maintain high quality in terms of performance and operating economy for Scania Industrial and Marine Engines.

To preserve these qualities throughout the entire service life of the engine, it is important for the operator/owner to follow the instructions on running, maintenance and the choice of fuel and oil as outlined in the manual.

Other efforts to preserve the environment we all share are possible by ensuring that the person carrying out servicing and maintenance always makes sure that environmentally hazardous waste after servicing and repairs (oil, fuel, coolant, filters, batteries, etc.) is dealt with and disposed of in accordance with applicable environmental standards.

On a number of pages, this Operator's Manual contains specially highlighted text with instructions to help protecting our environment during certain servicing and maintenance work.

See example

Mind the environment!

Always use suitable containers to avoid spillage when bleeding systems or renewing components.

CERTIFIED ENGINES

Emissions-certified engines have been approved in accordance with a special certification standard. The certified engines supplied by Scania meet the most stringent emissions standards which apply on European (EU) and non-European (USA) markets.

Scania guarantees that all the engines it supplies of a certified type are equivalent to the engine approved for certification.

The engine comes with a special certification plate which indicates the certification rules (standard) to which the engine has been approved. See page 10.

The following is required for the certified engine to meet emissions standards once it has been commissioned:

- ***Servicing and maintenance must be carried out in accordance with the instructions in this manual.***
- ***Only genuine Scania parts are to be used.***
- ***Injection equipment is to be serviced by an authorised Scania workshop.***
- ***The engine must not be modified with equipment not approved by Scania.***
- ***Seals may be broken and setting data edited only once approval has been granted by Scania in Södertälje. Changes may be made by authorised personnel only.***
- ***Changes which affect the exhaust system and intake system must be approved by Scania.***

Otherwise, the instructions in the manual in respect of running, care and maintenance of the engine shall apply. The safety precautions described over the next four pages must also be observed.

Important! ***If servicing and maintenance are not carried out as specified above, Scania can no longer guarantee that the engine will comply with the certified design, nor can it take responsibility for any damage that occurs.***

SAFETY INFORMATION

General

This Operator's Manual contains safety information which is important so as to avoid both personal injury and damage to the product/other property. See also page 1.

The text highlighted in text boxes on the right of a number of pages is important for engine function and in order to avoid damage to the engine. If these instructions are not followed, your warranty may be invalidated.

See example.

! *Important*

Only use Scania genuine fuel filter.

Similar text may also appear in the text column, and in this instance it will be marked **Note:** or ***Important!***

The warning text found in text boxes on the right of a number of pages which is marked with a ***warning triangle*** and starts with **WARNING** is ***extremely important*** and warns you of serious engine faults or incorrect handling which may lead to injury.

See example

⚠ *WARNING*

Immobilise the starting device when working on the engine. If the engine starts out of control, there is a SERIOUS RISK OF INJURY.

A list of the safety precautions to be followed when running and maintaining Scania engines can be found on the next three pages. Similar text can often be found at the relevant maintenance points, and here different levels of importance are attached to such text in accordance with the above description.

All points are marked **!,** so as to indicate how important it is to read through each point in this section.

For safety reasons, smoking is not allowed:

- In the vicinity of the engine and in the engine room
- When fuelling and close to the filling station
- When working on the fuel system
- In the vicinity of inflammable or explosive material (fuel, oils, batteries, chemicals, etc.)

Safety precautions for running the engine

Daily inspection

Always carry out a visual check of the engine and engine room before starting the engine and once you have stopped the engine after running.

This will enable you to easily detect and fuel, oil or coolant leaks, or any other abnormalities which may require rectification.

Refuelling

There is a risk of fire and explosion when refuelling. The engine must be stopped and smoking is not allowed.

Do not overfill the tank due to a risk of expansion, and close the filler cap properly.

Use only fuel recommended in the service literature. Fuel of the wrong quality can cause the engine to malfunction or stop by preventing the injection pump and injectors from operating as they should.

This can cause damage to the engine and, possibly, injury.

Hazardous gases

Start the engine only in a well ventilated area. The exhaust fumes contain carbon monoxide and nitric oxides, which are toxic.

When running the engine in a closed area, there must be an efficient device for dissipating exhaust fumes and crankcase gases.

Starter lock

If the control panel is not fitted with a key operated switch, there should be a lock on the engine room to prevent unauthorised starting of the engine.

Alternatively, a lockable on/off master switch or battery master switch can be used.

Starting spray

Never use starting spray or similar to help you start the engine. This can cause an explosion in the intake manifold and possible injury.

Journey

The engine must not be run in environments where there is a risk for explosion as all of the electrical or mechanical components can generate sparks.

Approaching a running engine always poses a safety risk. Parts of the body, clothes or dropped tools can get caught in rotating parts such as the fan and cause injury.

Therefore, all rotating parts and hot surfaces must be shielded as much as possible to aid personal safety.

Safety precautions for handling materials

Fuel and oil

All fuels and lubricants and many chemicals are inflammable. Always follow the instructions on the relevant packaging.

All work on the fuel system must be done with the engine cold. Fuel leaks and spillage on hot surfaces can cause fire.

Store soaked rags and other inflammable materials safely so as to avoid spontaneous combustion.

Batteries

The batteries contain and emit oxyhydrogen gas, particularly during charging, and this gas is inflammable and highly explosive. Therefore, there must be no smoking, naked flames or sparks near the batteries or the battery compartment.

Incorrect connection of a battery cable or jump lead can cause a spark, which in turn can cause the battery to explode.

Chemicals

Most chemicals such as glycol, corrosion inhibitors, preservative oils, degreasing agents, etc. are hazardous to health. Always follow the safety precautions on the relevant packaging.

Some chemicals, such as preservative oil, are also inflammable.

Store chemicals and other materials which are hazardous to health in approved containers, marking them clearly and storing them where they are inaccessible to unauthorised persons. Always hand in leftover or used chemicals to an authorised waste disposal contractor.

Safety precautions for care and maintenance

Stop the engine

Always stop the engine before maintenance and servicing unless stated otherwise.

Prevent unwanted starting by taking out the ignition key where applicable and disconnecting the power using the master switch or battery master switch and locking them. Also put up a warning sign somewhere appropriate, indicating that work is in progress on the engine.

Working with a running engine always poses a safety risk. Parts of the body, clothes or dropped tools can get caught in rotating parts and cause injury.

Hot surfaces and fluids

There is always a risk of sustaining burns when an engine is hot. Therefore, take care not to come into contact with manifolds, the turbo, the sump, hot coolant and oil in pipes and hoses.

Lifting the engine

The engine lifting eyes must be used when lifting the engine. Check first that your lifting devices are in good condition and of the correct size to lift the weight.

Extra equipment on the engine can alter the centre of gravity, which is why you may need additional lifting devices to balance the engine correctly and lift it safely.

Never work underneath a suspended engine!

Batteries

The batteries contain a highly corrosive electrolyte (sulphuric acid). Take care to protect your eyes, skin and clothes when charging or handling batteries. Wear protective gloves and goggles.

If the acid splashes on your skin, wash it off with soap and copious amounts of water. If acid splashes in your eyes, flush them immediately with copious amounts of water and contact a doctor.

Dispose of used batteries through an authorised waste disposal contractor.

Electrical system

The engine must be stopped and the power disconnected using the master switch or battery master switch before working on the electrical system.

External power supplies to extra equipment on the engine must also be disconnected.

Electric welding

When carrying out welding work close to and on the engine, remove the battery leads and the leads to the alternator. Also remove the multi-pin connector to the control unit.

Connect the weld clamp to the component to be welded and close to the welding point, never to the engine or in such a manner that the current can pass over to a mounting.

When you have finished welding, connect the leads to the alternator and control unit before connecting the batteries.

Lubrication system

Hot oil can cause burns and skin irritation. Therefore, avoid skin contact with hot oil.

Make sure that there is no pressure in the lubricating system before starting work on it. Never start or run the engine with the oil filler cap removed, as this may cause oil to be thrown out.

Dispose of used oil through an authorised waste disposal contractor.

Cooling system

Never open the coolant filler cap if the engine is hot. Hot coolant or steam may spray out and cause burns.

If you have to open or remove a cooling system component when the engine is hot, open the cap very carefully and slowly to relieve the system pressure before removing the cap. Wear gloves as the coolant is still very hot.

Dispose of used coolant through an authorised waste disposal contractor.

Fuel system

Always wear gloves when looking for leaks or carrying out any other work on the fuel system. Also wear protective goggles when testing injectors.

Fuel escaping at high pressure can penetrate tissues and cause serious injury.

Never use non-genuine parts in the fuel and electrical systems as genuine parts are designed and manufacture to minimise the risk of fire and explosion.

Before starting

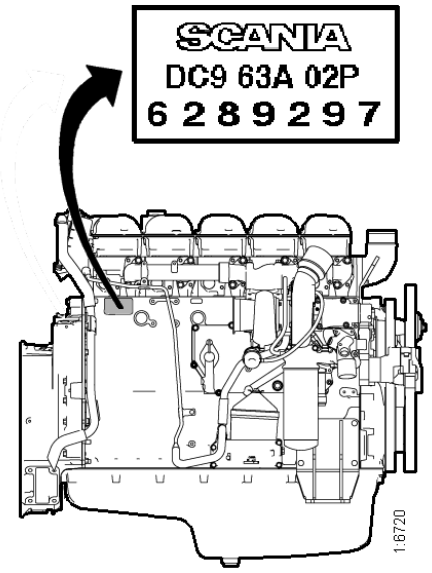
Fit all removed shields before starting the engine again. Check that you have not left any tools or other objects on the engine.

Never start the engine without the air filter fitted. There is a risk of objects being sucked into the impeller or of injury if you come into contact with it.

TYPE DESIGNATIONS

The engine type designation indicates, in the form of a code, the type of engine, its size and applications, etc.

The type designation and engine serial number are stamped on the right side of the engine block. See illustration.



DC 9 63 A 02 P

Type

DC Supercharged diesel engine with air-cooled charge air cooler.

Displacement in whole dm^3

Performance and certification code

Indicates, together with the application code, the normal gross engine output.
The actual output setting of the engine is indicated on the engine card.

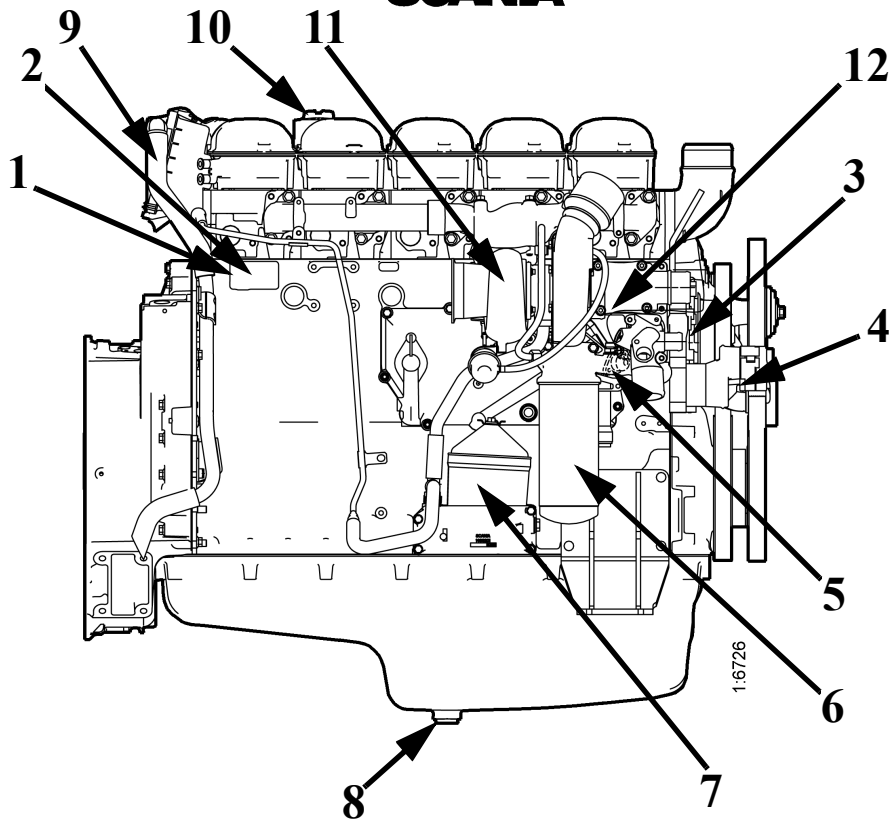
Application

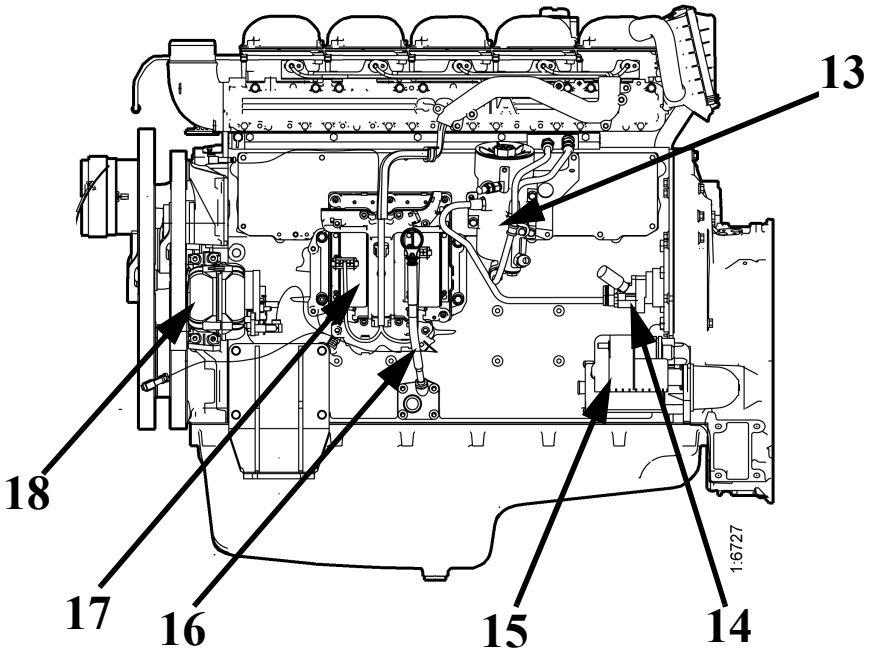
A For general industrial use

Variant 01-99

Type of regulator

P EMS engine management system with PDE and S6





The illustrations show a normal version of a DC9 engine.
Your engine may have different equipment from that illustrated.

1. *Type designation, stamped into the engine block*
2. *Engine number, stamped into the engine block*
3. *Coolant pump*
4. *Automatic belt tensioner*
5. *Draining, coolant*
6. *Oil filter*
7. *Oil cleaner*
8. *Draining, engine oil*
9. *Crankcase ventilation*
10. *Oil top up*
11. *Turbocharger*
12. *Oil cooler*
13. *Fuel filter*
14. *Fuel pump with hand pump*
15. *Starter motor*
16. *Oil dipstick*
17. *S6 control unit*
18. *Alternator*

ENGINE MANAGEMENT SYSTEM, EMS

This engine has an electronic management system, EMS (Engine Management System) with unit injectors (PDE) which provide each cylinder with the right amount of fuel at the right time in all operating situations.

The EMS system consists of a control unit (S6) and sensors for speed, charge air temperature and pressure, coolant temperature, oil pressure, accelerator pedal/throttle actuation which constantly emit signals to the control unit. With the aid of this input data and the programmed control software, the correct fuel amount and correct injection time are calculated for each unit injector (PDE) under the specific operating conditions.

The EMS system sensors can also be used to emit signals to the instruments in the instrument panel.

The control unit constantly checks the sensors to make sure they are operational.

The control unit contains monitoring functions to protect the engine in the event of a fault which would otherwise damage it. In the event of a fault, e.g. alarm level for low oil pressure or high coolant temperature, the S6 control unit sends a CAN message to a coordinator.

The main task of the coordinator is to pass on data by means of CAN communication from the engine control unit to other control units and signals to gauges and lamps in the instrument panel. The coordinator also has monitoring functions.

When the EMS control unit or the coordinator detects a fault, the diagnostics lamp on the instrument panels(s) comes on, and it stays on as long as the fault is active. A fault code is at the same time set which can be read via the coordinator on the diagnostics lamp as a flashing code when the diagnostics switch is activated. A flashing code may consist of a number of different fault codes.

Diagnosis and troubleshooting using *Scania EMS Display* is described in the Operator's Manual for *Scania EMS Instrumentation*.

If the torque reducing function is activated, the fuel amount and the engine power output are reduced to 70%, and if the engine shutoff function is activated, the engine is shut off at programmed alarm levels.

A separate PC-based diagnostics program is used to read off the contents of the flashing codes. For in-depth analysis of fault codes, contact an authorised Scania dealer.

Reading off the fault codes, and descriptions of these, are also covered in a separate document in the Service manual, *Engine Management System EMS-S6: Troubleshooting*.

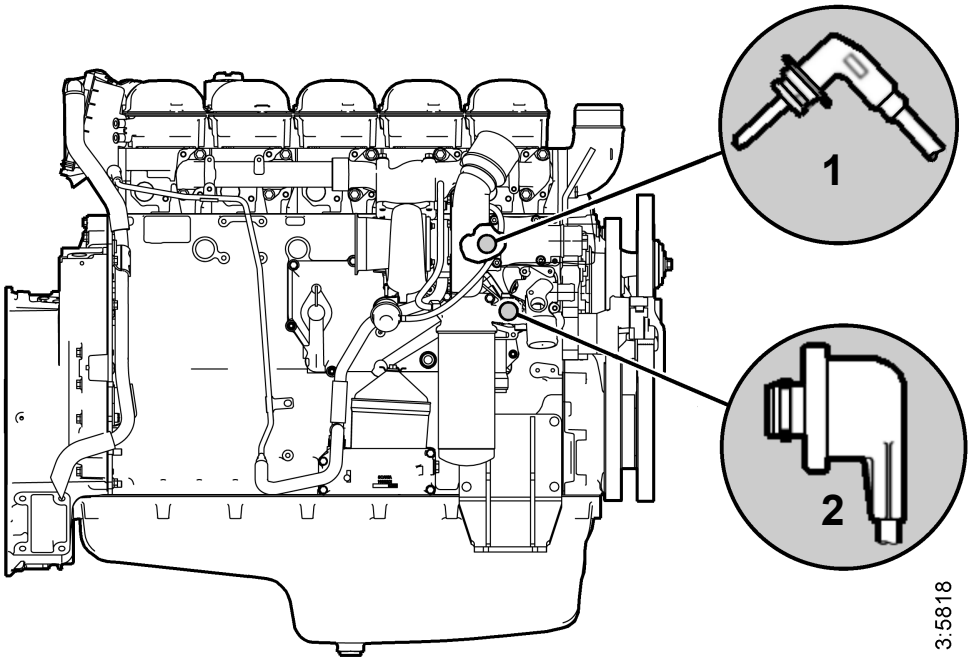
Only authorised personnel are allowed to carry out diagnostic procedures and program changes.

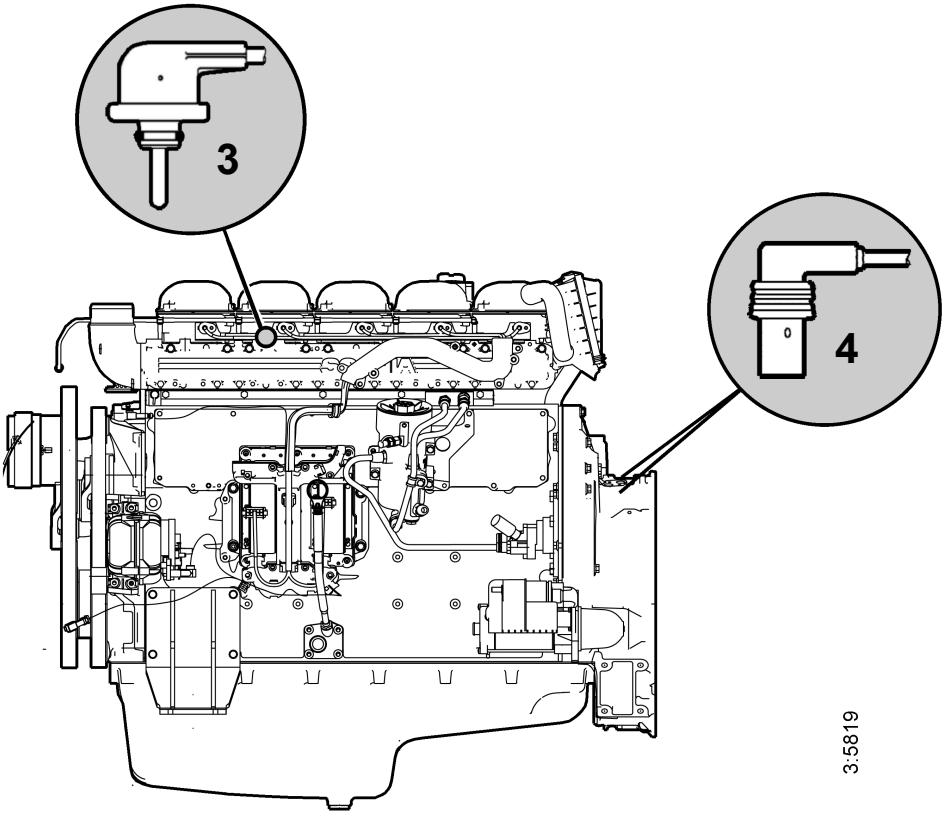
The positions of the sensors which emit signals to the control unit are shown in the illustrations on page 13.

See pages 14 and 16 for a description of how to read off flashing codes.

See pages 15 and 17 for a list of flashing codes for the control unit and coordinator.

Positions of sensors for EMS with S6 on DC9





1. *Coolant temperature sensor*
2. *Oil pressure sensor*
3. *Sensor for charge air temperature and pressure*
4. *Engine speed sensor (2)*
5. *Coolant level monitor (located in the expansion tank)*

Troubleshooting using flashing codes for the EMS control unit

- The diagnostics lamp on the instrument panel always comes on for two seconds when the system is powered up.
- As soon as a fault is detected by the control unit, it is stored in the EEPROM fault code memory and the diagnostics lamp on the instrument panel comes on.
- The diagnostics lamp will stay on for as long as a fault is active. Even if the lamp has gone off and the fault is no longer active, the code can generally be read off in accordance with the instruction below.

Reading fault codes for the control unit for engines with Scania electrical systems

1. Turn on the ignition.
2. Activate the diagnostics switch to the left to view the flashing codes for the control unit (EMS).
3. A fault code will then flash on the diagnostics lamp. This flashing code consists of long flashes (approximately 1 second long) and short flashes (0.3 seconds long). Long flashes are equivalent to units of 10, and short flashes are equivalent to units of 1.
   Example: *long - short - short = fault code 12*.
4. Repeat this procedure until the first flashing code is repeated. This means that the entire fault code memory has been flashed out. If the fault code memory is empty, only one long flash approx. 4 seconds long will be given.
5. See the flashing code table on the next page for a description and localisation of the fault.
6. In order to obtain further information on the fault code, the PC-based diagnostics tool or *Scania EMS Display* must be used. Contact an authorised Scania workshop.
7. When a fault has been rectified the fault code can be erased as described below.

Deleting fault codes for engines with Scania electrical systems

1. Turn the ignition off.
2. Activate the diagnostics switch in the same direction as the flashing codes indicate, i.e. to the right for the coordinator (COO) or to the left for EMS.
3. Switch on the ignition and keep at the same time the diagnostics switch activated, to the right (COO) or to the left (EMS), for 3 seconds.
4. This will erase passive fault codes which can be read off via flashing code for the relevant system. The rest of the fault code will remain in the EEPROM and can only be deleted using the PC tool.

Overview of flashing codes for EMS control unit

Code	Description	Code	Description
0	No fault detected.	**53**	PDE in cylinder 3: The solenoid valve does not work correctly.
11	Overspeed. One or both engine speed sensors are displaying speeds in excess of 3000 r/min.	**54**	PDE in cylinder 4: The solenoid valve does not work correctly.
12	Engine speed sensor 1 faulty, or incorrect signal.	**55**	PDE in cylinder 5: The solenoid valve does not work correctly.
13	Engine speed sensor 2 faulty, or incorrect signal.	**59**	Incorrect signal in extra analogue input.
14	Coolant temperature sensor faulty, or incorrect signal.	**61**	Incorrect control unit shutdown.
15	Charge air temperature sensor faulty, or incorrect signal.	**66**	Shut-off due to coolant level.
16	Charge air pressure sensor faulty, or incorrect signal.	**68**	Alternator charging incorrectly.
17	Oil temperature sensor faulty, or incorrect signal.	**69**	Starter motor function interrupted or not activated.
18	Oil pressure sensor faulty, or incorrect signal.	**82**	Engine speed above ref. speed at start
21	Coolant level sensor faulty.	**83**	Fault in memory circuit (EEPROM) in control unit.
23	Fault code internally in the coordinator.	**84**	Data transfer to the control unit memory (EEPROM) has been interrupted.
24	Accelerator/brake. If the accelerator and brake have been operated simultaneously.	**85**	Incorrect temperature internally in the control unit.
25	Accelerator sensor/idle switch Accelerator sensor/kickdown switch	**86**	Internal fault in the control unit: Fault in hardware control.
27	Engine shutdown bypassed.	**87**	Fault in control unit RAM.
28	Shut-off due to oil pressure.	**88**	Internal control unit fault: Memory fault
31	Torque limitation due to oil pressure	**89**	Incorrect seal: Prohibited changes in software.
32	Incorrect parameters for *limp home* function.	**93**	Engine speed sensors faulty or not connected.
33	Battery voltage incorrect or no signal.	**94**	Shutdown due to high coolant temperature.
37	Emergency shutdown switch activated in accordance with CAN message from coordinator.	**96**	Torque limitation due to high coolant temperature.
43	CAN circuit faulty in the control unit.	**98**	Incorrect voltage supply to one of the sensors.
47	Immobiliser function. Ignition key code incorrect.	**99**	Internal hardware fault in the processor (TPU).
48	There is an incorrect CAN message or no CAN message from the coordinator.		
49	Incorrect CAN version in control unit or coordinator.		
51	PDE in cylinder 1: The solenoid valve does not work correctly.		
52	PDE in cylinder 2: The solenoid valve does not work correctly.		

Troubleshooting using flashing codes for the EMS coordinator

- The diagnostics lamp on the instrument panel always comes on for two seconds when the system is powered up
- As soon as a fault is detected by the coordinator, it is stored in the EEPROM fault code memory and the diagnostics lamp on the instrument panel/s comes on.
- Even if the lamp has gone off and the fault is no longer active, the code can generally be read off in accordance with the instruction below.

Reading fault codes for the coordinator on engines with Scania electrical systems

1. Turn on the ignition.
2. Activate the diagnostics switch to the right for 1 second to view the flashing codes for the coordinator (COO).
3. A fault code will then flash on the diagnostics lamp. This flashing code consists of long flashes (approximately 1 second long) and short flashes (0.3 seconds long). Long flashes are equivalent to units of 10, and short flashes are equivalent to units of 1.
   Example: *long - short - short = fault code 12*.
4. Repeat this procedure until the first flashing code is repeated. This means that the entire fault code memory has been flashed out. If the fault code memory is empty, only one long flash approx. 4 seconds long will be given.
5. See the flashing code table on the next page for a description and localisation of the fault.
6. In order to obtain further information on the fault code, the PC-based diagnostics tool or *Scania EMS Display* must be used. Contact an authorised Scania workshop.
7. When a fault has been rectified the fault code can be erased as described below.

Deleting fault codes for engines with Scania electrical systems

1. Turn the ignition off.
2. Activate the diagnostics switch in the same direction as the flashing codes indicate, i.e. to the right for the coordinator (COO) or to the left for EMS.
3. Switch on the ignition and keep at the same time the diagnostics switch activated, to the right (COO) or to the left (EMS), for 3 seconds.
4. This will erase passive fault codes which can be read off via flashing code for the relevant system. The rest of the fault code will remain in the EEPROM and can only be deleted using the PC tool.

Overview of flashing codes for EMS coordinator

Flashing code	Fault description
11[1)]	Incorrect signal from the nominal speed signal fine adjustment.
11[2)]	Incorrect signals from the accelerator pedal sensor.
12[1)]	Incorrect signal from the resistor module for governor setting.
12[2)]	Incorrect signal from the resistor module for idle and fixed speed setting.
13	No communication with the engine.
14	Short-circuit in the tachometer signal circuit.
15	Faulty atmospheric pressure sensor.
17	Short-circuit in the coolant temperature gauge signal cable.
18	Short-circuit in the oil pressure gauge signal circuit.
19	Short-circuit in the oil pressure lamp signal circuit.
21	Different versions of the communications protocol between the coordinator and EMS.
22	Faulty start switch or short circuit.
23	The supply voltage is too high.
24	The supply voltage is too low.
25	Check value from *End of line* (EOL) is incorrect.
26	Speed sensor signal missing or incorrect.
27	The signals from the RCB (Remote Control Box) switches are implausible.
28	Incorrect signals from the droop-setting switches.
29	Faulty remote start switch or short circuit.
31	No communication from the slave coordinator or the master coordinator.
32	Short circuit in the signal cable to the coolant temperature warning lamp.
33	Short circuit in the signal cable to the charge indicator lamp.
34	Incorrect signal from the *Fixed speed* switches.
35	Fault in CAN communication.

1) Single speed engine

2) All-speed engine

STARTING AND RUNNING

AT FIRST START

When the engine is started for the first time, the maintenance points listed under "First start" in the maintenance schedule should be followed, see page 25.

Since the points are important for satisfactory operation of the engine right from the outset, they are also listed below.

1. Checking the oil level (see page 27).
6. Checking the coolant level (see page 33).

   The coolant should contain corrosion inhibitor to protect the cooling system from corrosion.

If there is a danger of freezing:

- Only anti-freeze glycol should be used in the coolant as protection against corrosion. We recommend only ***nitrite-free*** anti-freeze glycol with the following supplier designations:

  BASF G48 or BASF D542

- The concentration of glycol should be **30 - 60% by volume** depending on the ambient temperature. 30% glycol by volume provides anti-freeze protection down to -16°C. See page 33.
- ***Never top up with only water or only glycol. Fluid losses must always be replaced with pre-mixed coolant having the same glycol concentration as that in the engine. If the glycol content drops, both anti-freeze protection and protection against corrosion are impaired.***

Note: A glycol concentration below 30% by volume will not provide sufficient protection against corrosion. Glycol concentrations higher than 60% do not improve anti-freeze protection and have a negative effect on engine cooling capacity.

If there is no danger of freezing:

- Only ***Scania Corrosion Inhibitor*** should be used in the coolant as protection against corrosion. The correct concentration of corrosion inhibitor is 8-12% by volume, and this must never drop below 8% by volume. The inhibitor in ***Scania Corrosion Inhibitor*** is free of nitrite.
- First filling: Fill up the system with ***water + 10% by volume Scania Corrosion Inhibitor***. Use drinking water with a pH of 6 - 9.
- ***Never top up with only water or only corrosion inhibitor! Fluid losses must always be replaced with blended coolant: water + 10% Scania Corrosion Inhibitor by volume.***

Coolant filter (not standard equipment)

Only coolant filter ***without inhibitor*** may be used. The use of coolant filters increases the life of the coolant and reduces the risk of deposition corrosion.

Coolant composition:

If there is a danger of freezing:

minimum 30% glycol by volume

maximum 60% glycol by volume

If there is no danger of freezing:

8-12% by volume

Scania corrosion inhibitor

(no glycol)

WARNING

Ethylene glycol and corrosion inhibitor are toxic if ingested.

Avoid contact with the skin.

Important

The recommended glycols should not be mixed with glycol containing nitrite-based corrosion inhibitor.

Important

Overdosing with *Scania Corrosion Inhibitor* and mixing with glycol can cause sludge to be formed.

Important

If a coolant filter has been fitted it must not contain inhibitor.

12. Checking the fuel level (see page 40).
14. Checking the electrolyte level in batteries (see page 42).
15. Checking the state of charge in batteries (see page 42).
18. Checking the drive belt tension (see page 44).

WARNING

Immobilise the starting device when working on the engine. If the engine starts out of control, there is a SERIOUS RISK OF INJURY.

CHECKS BEFORE RUNNING

Before running, "Daily maintenance" as described in the maintenance schedule should be carried out, see page 25.

STARTING THE ENGINE

If the fuel tank has been run dry or if the engine has not been used for a long time, bleed the fuel system (see page 41).

Out of consideration for our common environment, your Scania engine has been designed to use a smaller amount of fuel when starting. Unnecessarily high levels of fuel supply when starting the engine always results in the discharge of unburnt fuel.

- Open the fuel cock, if fitted.
- Disengage the engine.
- Engines with battery master switch: Switch on the power by means of the battery master switch.
- Start the engine with the key on the control panel (SCP).

S6: All lamps should go out after around 2 seconds after starting (applies only to all-speed engines).

WARNING

Only start the engine in a well ventilated area.

If it is run in a enclosed space, there should be an effective device to draw off exhaust gases and crankcase gases.

WARNING

Never use starting spray or similar as a starting aid.

An explosion may occur in the intake manifold with a risk of personal injury.

Starting at low temperatures

Local environmental requirements must be complied with. Starting aids, engine heaters and/or flame start devices should be used to avoid starting problems and white smoke.

To limit white smoke, the engine should be run at low speed and under moderate load. A light load on a cold engine gives better combustion and faster heating than warming up with no load.

Avoid running it longer than necessary at idling speed.

At temperatures below 0°C:

Note: Only use starting aids recommended by Scania.

- The starter motor may only be used for 30 seconds at a time. After that time it must rest for 2 minutes.

! Important

The starter motor may only be connected for a maximum of 30 seconds. There is risk of overheating. Allow the engine to rest for 2 minutes between each attempt to start it.

DRIVING

Check instruments and warning lamps at regular intervals.

Rotation speed

The Scania tachometer is divided into sectors of different colours, as follows:

0-500 rpm	red area:	prohibited engine speed, passed through when stopping and starting.
500-700 rpm	yellow area:	slow idle. Engine idling is controlled by the S6 control system. See page 20.
700-2200 rpm	green area:	normal operating speed. The engine operating speed range is controlled by the S6 control system.
2200-2600 rpm	yellow/green striped:	unsuitable operating speed. May occur when switching off.
2600-3000 rpm	red area:	prohibited engine speed

Limp-home mode

If there is a fault on the normal accelerator pedal or if CAN communication is interrupted, the following limp-home option is provided:

CAN interruption or accelerator pedal fault on all-speed engines (both signal and idling switch):

- The accelerator pedal value is 0% and the engine is running at normal idling speed.
- The accelerator pedal value is 0% and the engine is running at raised idling speed (750 rpm) if this function is activated.

Accelerator pedal fault but the idling switch is working:

- The accelerator pedal value can be increased slowly between 0% - 50% by using the idling switch.

CAN interruption:

- The engine is switched off if the shutdown function is activated.

Coolant temperature

Normal coolant temperature when the engine is running should be 70 - 90°C.

The S6 control system has the following alarm levels:

- If the temperature is high, 95°C -105°C (standard value, other values can be programmed), for a certain period (1 second), S6 will send a CAN message which switches on the warning lamp and diagnostics lamp via the coordinator.
- If the temperature exceeds 105°C, the warning lamp and diagnostics lamps will come on. If torque reduction is activated, the control system will reduce the fuel quantity to 70%. A fault code is generated in the control unit.
- At temperatures exceeding 105°C and with engine shutdown activated, the warning lamp and diagnostics lamp come on and the engine is switched off. If the override function is activated, only torque reduction takes place when this function is activated. A fault code is generated in the control unit.

After an alarm, approved values should be registered for more than 2 seconds to reset the alarm.

Excessively high coolant temperature can damage the engine.

If run for extended periods under an extremely light load, the engine may have difficulty in maintaining normal operating temperature. However, the temperature will rise to a normal level again when the load on the engine is increased.

Oil pressure

Max. oil pressure:

warm engine running at a speed above 800 rpm 6 bar

Normal oil pressure:

warm engine running at an operating speed of3 - 6 bar

Min. oil pressure:

hot engine above 1000 rpm 2.3 bar

High lubricating oil pressure (above 6 bar) is normal when starting a cold engine.

The control system has the following alarm levels:

- at a speed of less than 1000 rpm and an oil pressure of less than 1.0 bar
- at a speed of more than 1000 rpm and an oil pressure of less than 2.3 bar for longer than 5 seconds.

The following functions are available if there is an alarm:

- Alarm which only switches on the warning lamp and diagnostics lamp.
- Alarm which switches on the warning lamp and diagnostics lamp as well as torque reduction if this function is activated (70% of fuel quantity).
  A fault code is generated in the control unit.
- Alarm which switches on the warning lamp and diagnostics lamp. The engine is switched off if engine shutdown is activated. If the override function is activated, only torque reduction takes place when this function is activated.
  A fault code is generated in the control unit.

After an alarm, approved values should be registered for more than 1 second to reset the alarm.

Charging indicator lamp

If the lamp comes on during operation:

- Check/adjust the alternator drive belts as described under the maintenance point. See page 44.
- If the charging indicator lamp is still on, this could be due to an alternator fault or a fault in the electrical system.

STOPPING THE ENGINE

1. Run the engine without a load for a few minutes if it has been run continuously with a heavy load.
2. Engines with Scania electrical systems: Stop the engine with the stop button. Keep the stop button depressed until the engine is completely stationary.
3. Engines with battery master switch: Switch the power off with the battery master switch.
4. Set the control switch to "0".

! *Important*

There is danger of turbo damage and post boiling if the engine is stopped without cooling.

! *Important*

The power must not be switched off before the engine has stopped.

CHECKS AFTER RUNNING

- Check that the power is cut from the battery master switch and that the control switch is in the "0" position.
- Fill the fuel tank. Make sure that the filler cap and the area round the filler opening are clean to avoid contamination of the fuel.
- If there is a risk of freezing, the cooling system must contain enough glycol. See pages 18 and 33.

At temperatures below 0°C: Prepare for the next start by connecting the engine heater (if fitted).

⚠ *WARNING*

Immobilise the starting device when working on the engine. If the engine starts out of control, there is a SERIOUS RISK OF INJURY

! *Important*

Coolant should be topped up when the engine is stopped after the first start.

⚠ *WARNING*

***Hot engine with pressurised cooling system*: Risk of burn injuries.**

MAINTENANCE

The maintenance programme covers 20 points, divided into the following main groups:

WARNING

Immobilise the starting device when working on the engine. If the engine starts out of control, there is a SERIOUS RISK OF INJURY

The maintenance points are divided into intervals as follows:

Daily maintenance

Maintenance before the first start

Maintenance after the first 400 hours of operation

Periodic maintenance every 200 hours of operation (carried out after 200, 400, 600, 800, etc. hours)

Periodic maintenance every 400 hours of operation (carried out after 400, 800, 1200, 1600, etc. hours)

Periodic maintenance every 1200 hours of operation (carried out after 1200, 2400, 3600, etc. hours)

Periodic maintenance every 2400 hours of operation (carried out after 2400, 4800, etc. hours)

Periodic maintenance every 4800 hours of operation (carried out after 4800, 9600 etc. hours)

Annual Maintenance

Maintenance every 5th year

ENGINES WITH FEW HOURS OF OPERATION

Important

For engines with few operating hours that do not receive periodic maintenance according to the maintenance schedule on page 25, maintenance should be carried out in accordance with the schedule:
"Annually"
"Every 5th year"

Emergency generator sets and the like that are not used regularly should be run on test and checked in accordance with the generator set manufacturer's instructions.

Run the engine until it reaches operating temperature and then carry out the maintenance points below:

1. Checking oil level.
5. Checking coolant level.
8. Checking low pressure indicator.
12. Checking fuel level.
14. Checking electrolyte level in batteries.
15. Checking state of charge in batteries.
16. Cleaning batteries.
19. Check for leaks, rectify as necessary

MAINTENANCE SCHEDULE

	Daily	*First time at*		*Interval*					*At least*	
		First start	*400 h*	*200 h*	*400 h*	*1200 h*	*2400 h*	*4800 h*	*Annually*	*Every 5th year*
LUBRICATING OIL SYSTEM, page 26										
1. Checking oil level	●	●								
2. Oil change					●1				●	
3. Cleaning oil cleaner					●1				●	
4. Changing the oil filter and filter for crankcase ventilation					●1				●	
COOLING SYSTEM, page 32										
5. Checking coolant level	●									
6. Checking coolant		●					●3		●	
7. Cleaning cooling system								●1		●
AIR CLEANER, page 38										
8. Test reading low pressure indicator	●									
9. Cleaning the coarse cleaner				●1						●
10. Cleaning or changing filter element						●2				●
11. Changing safety cartridge							●			●
FUEL SYSTEM, page 40										
12. Checking fuel level	●	●								
13. Changing the main filter and water separating filter						●1				●
ELECTRICAL SYSTEM, page 42										
14. Checking electrolyte level in batteries		●		●					●	
15. Checking state of charge in batteries		●				●			●	
16. Cleaning batteries						●			●	
17. Checking coolant level monitor						●			●	
MISCELLANEOUS, page 44										
18. Checking drive belt		●				●			●	
19. Check for leaks, rectify as necessary	●									
20. Checking/adjusting valve clearances			●				●			
21. Checking/adjusting PDE injector rocker arms			●				●			

1. More often if required
2. Earlier if low pressure indicator shows red.
3. If inhibitor has not been topped up for five years, the coolant should be changed.

LUBRICATING OIL SYSTEM

OIL GRADE

The engine oil must **at least** meet the requirements for one of the following oil classifications:

- ACEA E3, E4 or E5

- The Total Base Number (TBN) should be *minimum 12-13* (ASTM 2896).
- Check with your oil supplier that the oil meets these requirements.
- The oil change intervals stated apply provided that ***the sulphur content of the fuel is not in excess of 0.3% by weight***. If the sulphur content is greater than 0.3% but no more than 1.0%, the oil change interval must be halved (200 h).
- Viscosities are shown in the figure below.
- For operation at extremely low ambient temperature: Consult your nearest Scania representative on how to avoid starting difficulties.

! *Important*

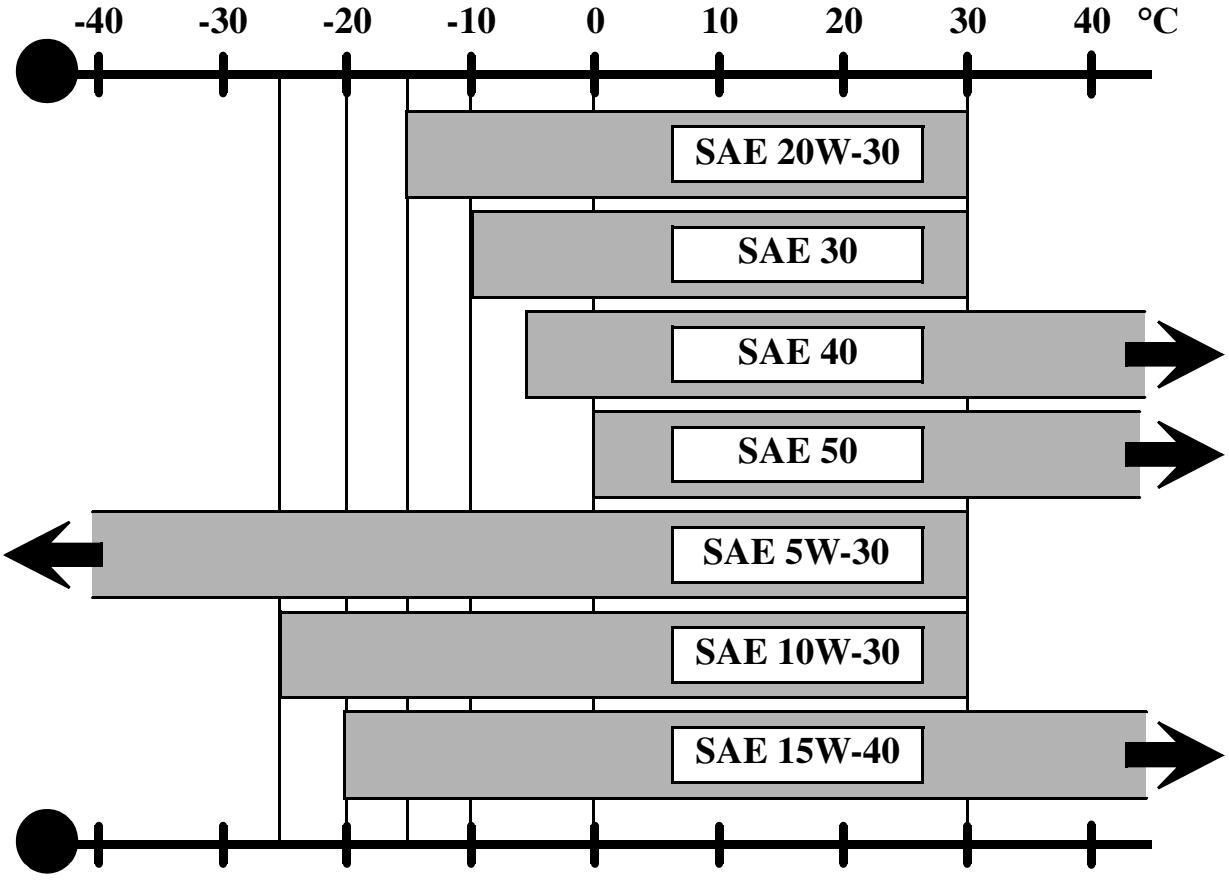
Additives must not be used. The oil should be suitable for all temperature variations until the next oil change.

Oil analysis

Some oil companies can offer analysis of the engine oil. Such analysis measures the oil's TBN (Total Base Number), TAN (Total Acid Number), fuel dilution, water content, viscosity and the quantity of wear particles and soot in the oil.

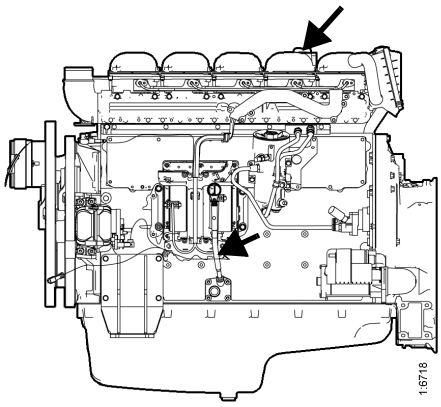
The result of a series of analyses is used as the basis for establishing a suitable oil change interval.

If the conditions are changed, a new oil analysis programme must be carried out to establish the new change interval.



1. Daily:

CHECKING OIL LEVEL



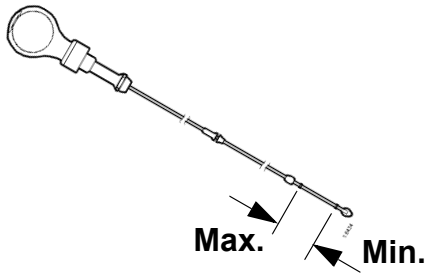
Note: Before checking oil level: Allow the engine to remain stationary for at least 1 minute.

- The oil is at the correct level when it comes to between the marks on the dipstick. Top up when the oil level is at the lower mark on the dipstick.
- Correct type, see "Oil grade" on page 26.

Checking oil level during operation

On some engines the oil level can be checked during operation.

- Remove the oil filler cap to release the pressure in the crankcase.
- Check the level on the dipstick. Correct oil level: ***10 mm below the Min. or Max. mark.***

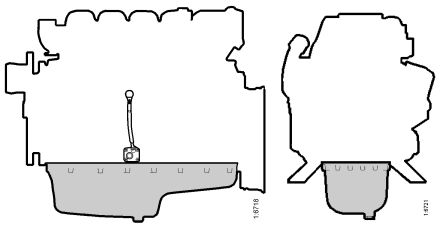


2. Every 400 hours:

OIL CHANGE

Note: If the engine is used for especially demanding operations, particularly in a dusty environment or if the deposits in the centrifugal cleaner are thicker than 20 mm: Change the oil at more frequent intervals.

- Unscrew the plug and drain the oil when the engine is hot.
- In certain engines the oil is pumped out by means of a bilge pump.
- Clean the magnet on the plug.
- Refit the plug.
- Fill up with oil.
- Check the level on the dipstick.



Max. 37 dm^3
Min. 32 dm^3

Max. 34 dm^3
Min. 27 dm^3
1 liter = 1 dm^3

WARNING

The oil may be hot.
Wear protective gloves and goggles

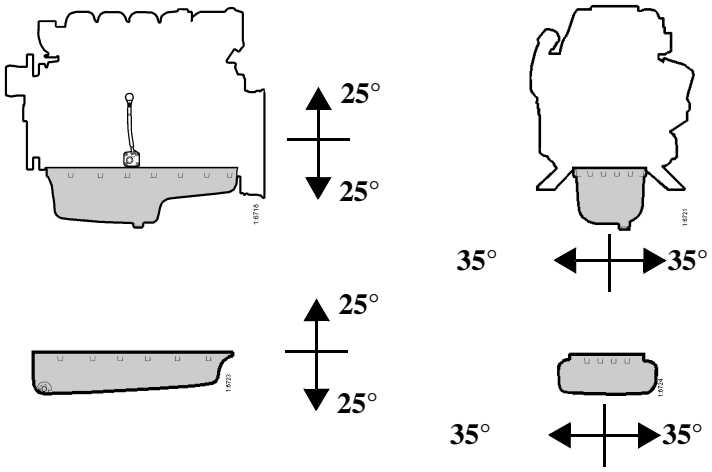
Mind the environment!

Use a container to avoid spillage when changing the oil. Dispose of used oil through an authorised waste disposal contractor.

Maximum angles of inclination during operation

Maximum permissible angles during operation vary, depending on the type of oil sump, see illustration.

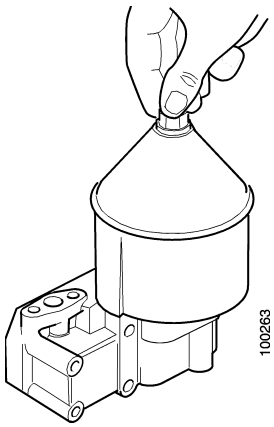
Note: Specified angle may only occur intermittently.



3. Every 400 hours:

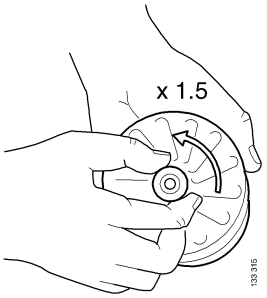
CLEANING THE OIL CLEANER

(in connection with oil change)

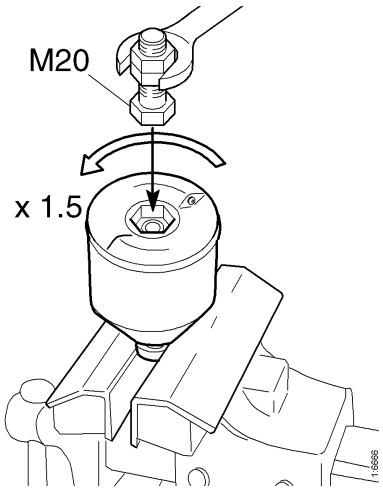


- Clean the cover. Unscrew the nut and remove the cover.

> ***WARNING***
>
> **Open the cap carefully. The oil may be hot.**

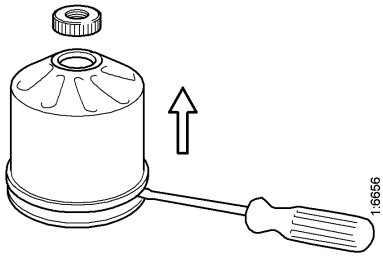


- Lift out the rotor and wipe the outside. Unscrew the rotor bowl nut about one and a half turns.

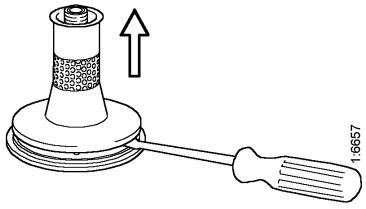


- If the rotor nut is jammed:
  Turn the rotor upside down and fasten the nut, ***absolutely not the rotor***, in a vice, and turn the rotor one and a half turn anti-clockwise by hand, or use M20 bolt and nuts as illustrated. The grip distance should be 30 mm.

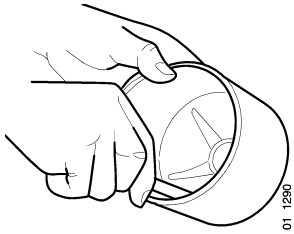
- Hold the rotor and tap lightly on the rotor nut with a plastic mallet or against the workbench, so that the rotor bowl comes loose from the bottom plate. Never strike on the rotor directly as this may damage the bearings.



- Unscrew the nut and remove the rotor bowl.
- Remove the strainer. If the strainer has seized in the rotor bowl, pry carefully with a screwdriver between the rotor bowl and the strainer.

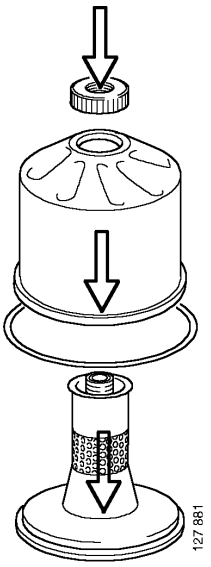


- If the strainer has seized in the rotor, pry carefully between the rotor and the strainer.



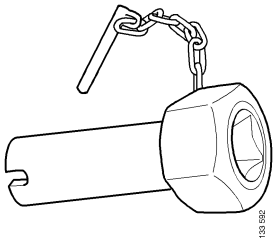
- Scrape off the deposits from the inside of the rotor bowl. If there are no deposits, this indicates that the cleaner is not working properly.
- If the deposits are ***thicker than 28 mm: Clean more often***.

- Wash all parts in diesel oil.
- Make sure the nozzles on the rotor are not blocked or damaged.
- Make sure the bearings are not damaged. If they are damaged the entire rotor must be renewed.



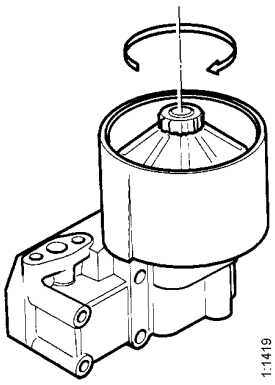
- Fit a ***new O-ring*** on the rotor and fit the strainer.
- Reassemble the rotor.
- Tighten the rotor nut firmly ***by hand***.
- Make sure the shaft is not loose. If it is loose, use locking compound 561 200 and tighten it to 34 Nm using tool 98 421.

- In order to tighten the rotor shaft, it is necessary to modify socket wrench 98 421:
  - Drill out the threads from a M20 nut so that it fits on the square drive of the socket wrench.
- Weld on the nut.



- Refit the rotor.
- Check that it rotates easily by rotating it manually.
- Fit a ***new O ring*** on the bowl and fit the bowl.
- Screw the bowl on and tighten the lock nut to 15 Nm.

Tighten the nut carefully so as not to damage the rotor shaft, nut or bowl.



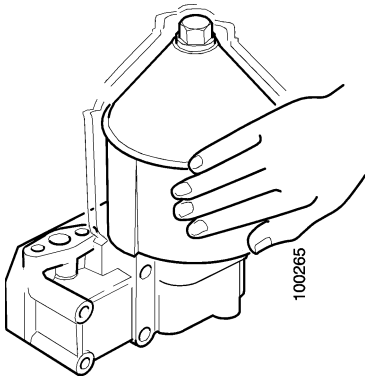
Functional inspection

The rotor rotates very fast and should continue to rotate when the engine has stopped.

- Stop the engine when it is warm.
- Listen for a whirring sound from the rotor or feel whether the cleaner housing is vibrating.

The rotor ***normally continues spinning for 30 - 60 seconds*** after the engine has stopped.

If not: Dismantle and check.



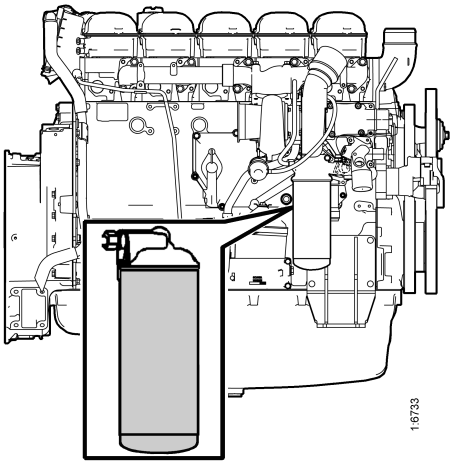
4. Every 400 hours:

CHANGING THE OIL FILTER

(in connection with oil change)

- Remove the old filter.
- Oil the rubber gasket and fit a new genuine Scania filter.
- Tighten the filter by hand.
  Never use tools for this. The filter could sustain damage, obstructing circulation.
- Start the engine and check for leaks.

Important! ***If the deposits in the centrifugal cleaner are more than 20 mm thick, the oil filter has to be replaced more often. The same is true for cleaning the centrifugal filter and changing the oil.***



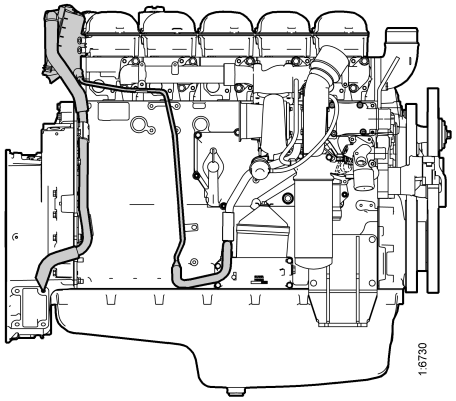
Mind the environment!

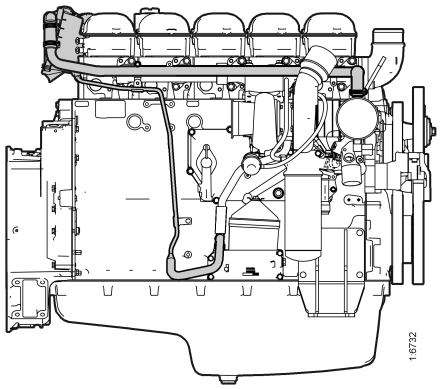
Use a container to avoid spillage when changing the filter. Dispose of used filters through an authorised waste disposal contractor.

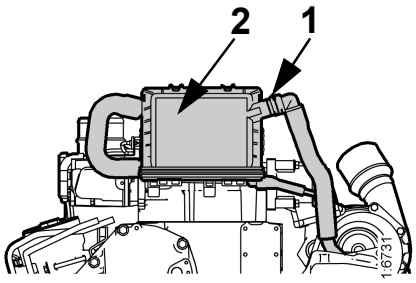
CHANGING THE FILTER FOR OPEN OR CLOSED CRANKCASE VENTILATION

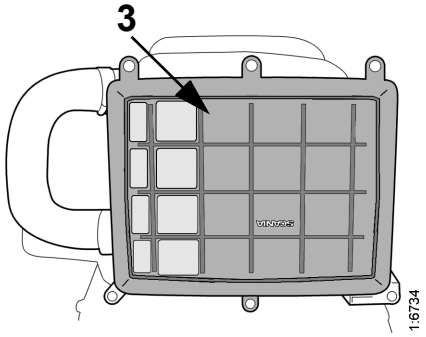
For engines with both opened and closed crankcase ventilation, the filter element must be changed at the same time as the main oil filter as described below:

- Remove the speed coupling on the bleed pipe connection *1* to the filter housing and pull the pipe off the filter housing cover.
- Remove the filter housing lid *2* and remove the filter element *3*.
- Clean the filter housing and fit a new he filter element as shown in picture.
- Note that the filter element should be fitted so that the path of crankcase gases through the filter is the longest possible route. The text on the filter will then run vertically.
- Pour approx. 1 dl of oil into the filter housing oil outlet so as to ensure that there is sufficient oil in the liquid seal.
- Fit the cover to the filter housing.
- Check that there is an O-ring on the bleed pipe connection. Press the pipe on and fit the speed coupling.









COOLING SYSTEM

5. Daily:

CHECKING COOLANT LEVEL

- Open the expansion tank filler cap and check the coolant level.
- *Correct level: (Scania plastic expansion tank)*
  - Cold engine: Coolant level must be approx. 50 mm below the filler neck.
  - Hot engine: Coolant level must be approx. 25 mm below the Full line.
- Other types of expansion tank according to the instructions of the fitter.
- Top up the coolant as necessary, see point 6.

Note: When filling large amounts of coolant:
Never pour cold coolant into a hot engine.
This could crack the cylinder block and cylinder head.

WARNING

***Hot engine with pressurised cooling system*:**
Open the cap carefully.
Water and steam may spray out.
Risk of burn injuries.

Important

Always top up with ready mixed coolant.

6. Every 2400 hours:

CHECKING THE COOLANT

Coolant should be checked as follows:

a) Check the appearance of the coolant.

b) Coolant with glycol only: Check the glycol content.

c) Coolant with ***Scania Corrosion Inhibitor*** only:
Check the corrosion protection.

The composition of the coolant is described in more detail under **"Starting and running"**

Coolant composition:
If there is a danger of freezing:
minimum 30% glycol by volume
maximum 60% glycol by volume
If there is no danger of freezing:
8-12% by volume
Scania corrosion inhibitor

a)

Checking the appearance of the coolant

- Pour a small amount of coolant in a container, and check that the coolant is pure and clear.
- If the coolant is contaminated or cloudy: Consider changing the coolant
- Water for the coolant must be clean and free from contamination.
- Use drinking water with a pH of 6 - 9.

b)

Checking the glycol content

If there is a danger of freezing, use only glycol as an anti-corrosive in the coolant.

- Cooling systems with glycol should contain at least 30% glycol by volume to provide acceptable protection against corrosion.
- 30% glycol by volume provides protection against freezing to -16°C. If additional protection against freezing is required, see the table on the next page to help you calculate how much glycol you need.

We recommend only ***nitrite-free*** anti-freeze glycol with the following supplier designations:

BASF G48 or BASF D542

- ***Always top up the anti-freeze if its glycol content drops below 30% by volume. A glycol content above 60% by volume will not provide greater protection against freezing.***
- The table shows the temperature at which ice starts to form. The engine will freeze and break at appreciably lower temperatures, see diagram.
- Ice forming in the coolant often causes malfunctioning without any risk of damage. The engine should not be subjected to heavy loads when ice starts to form.

Note: **The coolant should be changed when the cooling system is cleaned: every 4800 hours or at least every 5th year.**

Important! ***If a coolant filter is used in the cooling system it must not contain an inhibitor.***

WARNING

It is highly dangerous to consume corrosion inhibitor.
Avoid skin contact with glycol.

Important

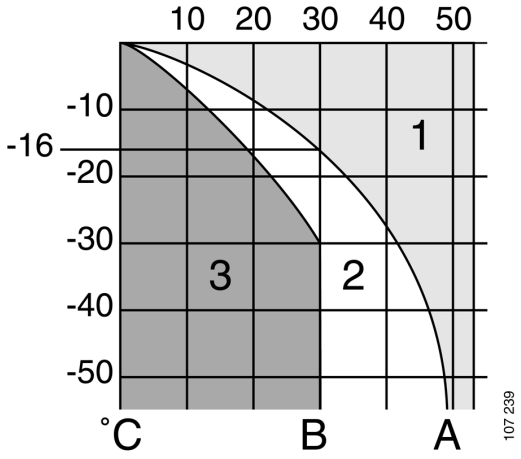
The coolant should be ready mixed when it is poured into the cooling system.
Never top up with only water or only glycol.

Important

The recommended glycol must not be mixed with glycol having nitrite-based anti-corrosive.
Risk for build up of sludge and reduced cooling capacity.

Characteristics of glycol at low temperatures:

- *Example with 30% glycol by volume*
- *Ice slush starts to form at -16°C*
- *There is risk for malfunctions at -30°C*
- *No risk of damage by freezing with a minimum content of 30% glycol by volume*



Curve A: Ice formation starts (ice slush)

Curve B: Temperature at which there is a risk of damage by freezing

1. *Safe area*
2. *Malfunctions may occur (ice slush)*
3. *There is risk of damage by freezing*

A

% glycol by volume	15	20	25	30	35	40	45	50	60	Cooling system volume, dm^3
Ice slush starts to form at °C	-6	-9	-12	-16	-22	-27	-36	-46	-55	
Glycol dm^3 (litres)	5	6	8	9	11	12	14	15	18	30
	6	8	10	12	14	16	18	20	24	40
	8	10	13	15	18	20	23	25	30	50
	9	12	15	18	21	24	27	30	36	60
	11	14	18	21	25	28	32	35	42	70
	12	16	20	24	28	32	36	40	48	80
	14	18	23	27	32	36	41	45	54	90
	15	20	25	30	35	40	45	50	60	100
	17	22	28	33	39	44	50	55	66	110
	18	24	30	36	42	48	54	60	72	120
	20	26	33	39	46	52	59	65	78	130
	21	28	35	42	49	56	63	70	84	140
	23	30	38	45	53	60	68	75	90	150
	24	32	40	48	56	64	72	80	96	160
	26	34	43	51	60	68	77	85	102	170
	27	36	45	54	63	72	81	90	108	180
	29	38	48	57	67	76	86	95	114	190
	30	40	50	60	70	80	90	100	120	200

A = Area to be avoided. Only for calculating glycol mix.

Coolant freezing temperature, when ice starts to form, for different glycol mixes

c)

Checking protection against corrosion

There must always be sufficient corrosion inhibitor in the coolant to protect the cooling system against corrosion.

If there is no danger of freezing, only ***Scania Corrosion Inhibitor*** should be used in the coolant.

The inhibitor in ***Scania Corrosion Inhibitor*** is free of nitrite.

The correct proportion of corrosion inhibitor is **8-12%** by volume.

- Topping up with 1.0% ***Scania Corrosion Inhibitor*** by volume should be done after every 2400 hours of operation.
- ***Never top up with only water or only corrosion inhibitor! Fluid losses must always be replaced with blended coolant: water + 10% Scania Corrosion Inhibitor by volume.***

Note: The coolant should be changed when the cooling system is cleaned: every 4800 hours or at least every 5th year.

WARNING

Corrosion inhibitor is highly dangerous if ingested and can prove fatal.

Avoid contact with the skin.

Important

Mixing with glycol or the use of too much corrosion inhibitor can lead to build up of sludge and reduced cooling capacity.

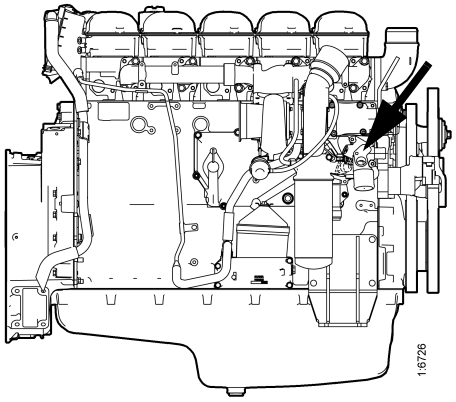
Important

If a coolant filter has been fitted it must not contain inhibitor.

Changing the coolant

1. Remove the filler cap from the expansion tank.
2. The coolant is drained at two points:
   - the "lowest point" of the engine block, see illustration.
   - the "lowest point" of the cooling system.
3. Close the drain taps.
4. Fill up with coolant through the expansion tank's filler hole.

   Mix coolant as described on page 33.



Mind the environment!

Use a container to avoid spills when changing the coolant.

Dispose of used coolant through an authorised waste disposal contractor.

7. Every 4800 hours:

CLEANING THE COOLING SYSTEM

Note: If necessary, the cooling system should be cleaned more often.

External cleaning

Radiator and charge air cooler

- Check that the radiator and the charge air cooler are not clogged on the air side and that the cooling fins are not damaged.
- Carefully scrape the deposit off the radiator's cooling fins. If necessary, a paraffin-based engine cleaner can be used.
- Bent fins can be straightened using a wire brush, for example, and exercising care.

! *Important*

The cooling system must never be cleaned with caustic soda.

There is a risk of damage to aluminium parts.

Internal cleaning

Removing oil and grease

- If possible, run the engine until it has reached operating temperature and then drain the cooling system.
- Remove the thermostats.
- Fill the system with clean, hot water mixed with liquid dishwasher detergent designed for household use.
  Concentration 1% (0.1/10 l).
- Run the engine until warm for about 20-30 minutes. Do not forget the cab heating system (if fitted).
- Drain the cooling system.
- Fill the system again using clean, hot water and run the engine for about 20-30 minutes.
- Drain the water from the system.
- Refit the thermostats.
- Top up the system with new coolant according to the specification on page 33**.**

WARNING

Handling cleaning agents for the cooling system:

Carefully read the warning label on the container.

Mind the environment!

Use a container to avoid spills when changing the coolant.

Dispose of used coolant through an authorised waste disposal contractor.

Removing deposits

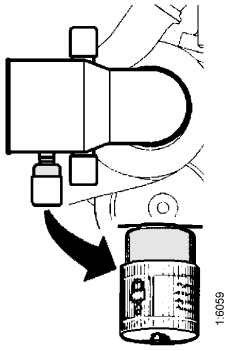
- If possible, run the engine until it has reached operating temperature and then drain the cooling system.
- Remove the thermostats.
- Fill the system with clean, hot water mixed with one of the commercially available radiator cleaners based on sulphamic acid and containing dispersing agents. Follow the manufacturer's instructions for mixing proportions and cleaning times.
- Run the engine for the specified time and then drain the cooling system.
- Refill the system with hot water and run the engine for about 20-30 minutes.
- Drain the water from the system.
- Refit the thermostats.
- Top up the system with new coolant according to the specification on page 33.

AIR CLEANER

8. Daily:

READING THE VACUUM INDICATOR

If the red indicator telltale is entirely visible, change or clean the air cleaner filter element, point 10. This is particularly important if the engine is run at high loads and high speed.



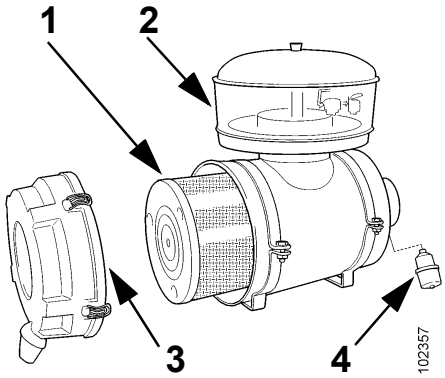
9. Every 200 hours:

CLEANING THE AIR CLEANER COARSE CLEANER

1. Remove the cover from coarse cleaner 2.
2. Remove the conical coarse separator. Empty out the particles of dirt and clean it.
3. Fit the coarse cleaner as shown in the figure and screw the cover in place.

! *Important*

The coarse cleaner must always be fitted in an upright position.



1. Filter element
2. Coarse cleaner
3. Cover
4. Vacuum indicator
Air cleaner with coarse cleaner

10. Every 1200 hours:

CLEANING OR CHANGING THE FILTER ELEMENT

Note: Earlier if the vacuum indicator shows red

Dismantling

1. Remove the side cover from the air cleaner.
2. Change or clean the element.

Note: Cleaning the element always entails a risk of damaging it. The element can only be cleaned a maximum of four times. After cleaning, it has poorer dust capacity than a new element.

3. Mark the filter when it has been cleaned.

Cleaning the element

- Carefully blow the filter element clean using dry compressed air from the inside.

Note: This filter element must not be washed with water.

Checking

- Insert a torch into the element and check from the outside that there are no holes or cracks in the filter paper.
- Change the filter element if it has the slightest damage. Danger of engine damage.

Assembly

! *Important*

Only use Scania genuine air filter.

Change the filter element if it is damaged.

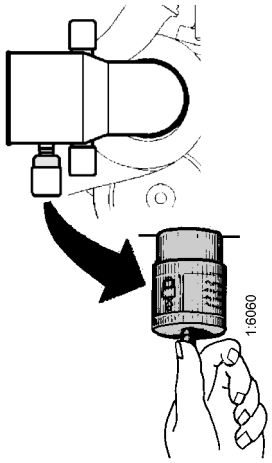
Danger of engine damage if the filter element is damaged.

⚠ *WARNING*

Never start the engine without the air filter.

There is a risk of injury or serious engine damage.

1. Assemble the air cleaner in reverse order.
2. Reset the red plunger in the vacuum indicator by depressing the button.



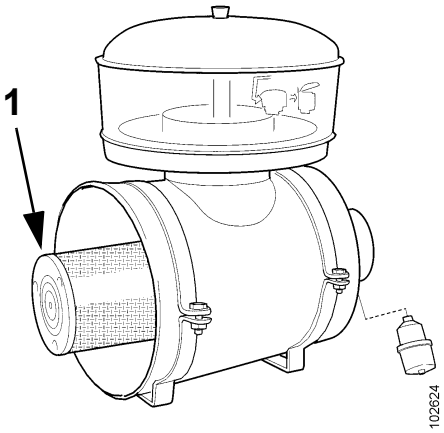
11. Every 2400 hours:
CHANGING THE SAFETY CARTRIDGE

Note: Not all filters are equipped with a safety cartridge. When changing the safety cartridge, take great care to ensure that no dirt or other impurities can get into the engine.

1. Remove the side cover from the air cleaner.
2. Remove the filter element.
3. Remove the safety cartridge.
4. Fit a new genuine Scania safety cartridge.
5. Change or clean the filter element, see point 10.
6. Assemble the air cleaner.

! *Important*

Do not remove the safety cartridge unnecessarily.



1. Safety cartridge

Air cleaner with safety cartridge

! *Important*

Never clean the safety cartridge

FUEL SYSTEM

! *Important*

Observe the utmost cleanliness when working on the fuel system.

There is a risk of engine malfunction and damage to the injection equipment.

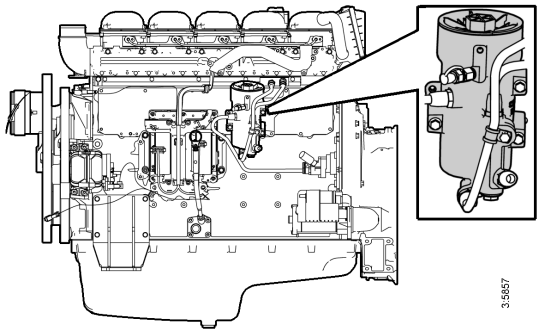
12. Daily:

CHECKING THE FUEL LEVEL

- Top up with fuel if necessary.
- If the tank has been run dry, bleed the fuel system, see point 13.

13. Every 1200 hours:

CHANGING THE FUEL FILTER

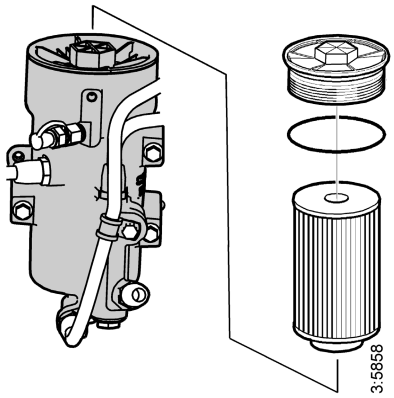


Fuel tanks

- Drain any water from the fuel tanks.

Main filter

- Unscrew the filter lid with a ***closed tool*** with hexagon driver, e.g. socket 587 637, so as not to damage the lid.
- Lift out the filter lid and filter element. At the same time, the filter housing will drain automatically. This applies only if the fuel tank is lower than the engine. The fuel shut off valve must otherwise be first shut off.
- Undo the removed filter element from the lid by carefully bending it to one side. Discard the filter according to environmental requirements.
- Renew the O-ring in the cover. Lubricate the new O-ring with a suitable grease.
- Check that the filter housing is drained of fuel. Contaminated fuel may enter the injectors if the drainage does not work.
- Press a new filter element into the snap fastener in the lid.
- Fit the lid with the filter element in the housing. Tighten the lid to 25 +/-5 Nm. Use a ***closed tool*** with hexagon driver.
- After changing the water separating filter, bleed the fuel system as instructed on the next page.



! *Important*

Only use Scania genuine fuel filters.

Water separating filter

- Drainage must be carried out when filling fuel.
- The filter must be changed at the same replacement interval as the main filter.

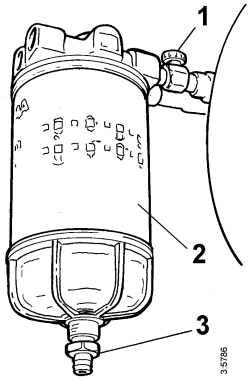
Mind the environment!

Use a container to avoid spillage when bleeding and changing components.

- Close the drain tap *1* before the filter.
- Unscrew the container and drain valve *3*.
- Unscrew and change the filter *2*. Lubricate the seal before tightening the new filter by hand.
- Screw the container and drain valve into position.
- Open the drain tap *1*.

- Bleed the fuel system after changing both filters.

Bleeding the fuel system



1. *Shut-off cock*
2. *Filter*
3. *Drain valve*

A

- Attach a clear plastic hose to the bleeder nipple *1* on the fuel filter housing, to lead fuel into a container.
- Open the bleeder nipple and pump with the hand pump *2* until fuel comes out of the hose. When the fuel system is empty, approximately 100 pump strokes will be needed to draw fuel up to the bleeder nipple.
- Pump until fuel without air bubbles comes out, approximately 20 strokes.
- Close the bleed nipple and remove the hose.

B

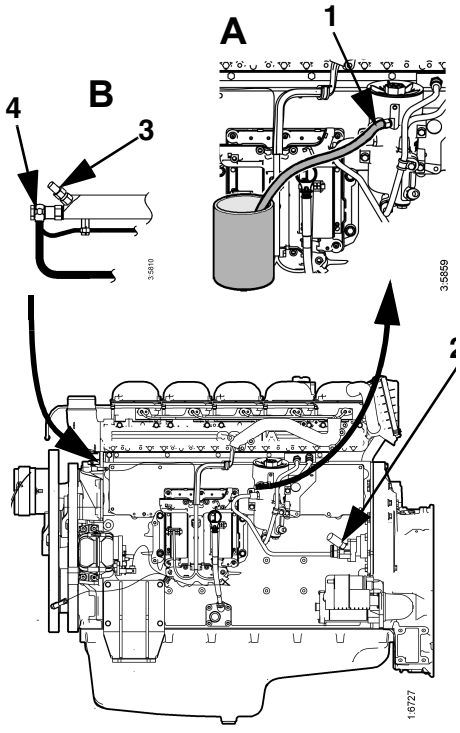
- Transfer the plastic hose to the fuel manifold bleeder nipple *3*.
- Open the fuel manifold bleeder nipple and pump with the hand pump until the fuel is free from air bubbles (approx. 50 strokes).
- Close the bleeder nipple on the fuel manifold and remove the plastic hose.
- Pump approx. 20 hand pump strokes until the overflow valve *4* opens. You will hear a creaking sound when it opens.

If the engine fails to start after bleeding. . . . . .

- Open the bleeder nipple again and pump the hand pump until fuel without air bubbles flows out.
- Tighten the bleeder nipple. Start the engine and check for leaks.

Mind the environment!

Use a container to avoid spillage when bleeding and changing components.



ELECTRICAL SYSTEM

14. Every 200 hours:

CHECKING THE ELECTROLYTE LEVEL IN BATTERIES

1. Unscrew the plugs and check the electrolyte level in all cells.
2. Top up with distilled water until the level is 10-15 mm above the plates.

WARNING

Avoid naked flames or sparks near the batteries.

When the batteries are charged, oxyhydrogen gas is formed which is inflammable and explosive.

15. Every 1200 hours:

CHECKING STATE OF CHARGE IN BATTERIES

- Check the density with an acid tester.

In a fully-charged battery it should be:

1.280 at +20°C

1.294 at 0°

1.308 at -20°C

- If the density is below 1.20, the battery must be charged. A discharged battery freezes at -5°C.

Do not rapid-charge the battery. This will damage the battery in the long run.

WARNING

Wear gloves and protective goggles when charging and handling batteries

The batteries contain a highly corrosive acid.

16. Every 1200 hours:

CLEANING BATTERIES

1. Clean batteries, cables and cable terminals.
2. Check that all cable terminals are firmly tightened.
3. Grease battery terminal posts and cable terminals with vaseline.

WARNING

Do not connect the terminals up incorrectly.

This can cause serious damage to the electrical system.

If the terminals are shorted, sparking will occur.

CHANGING THE BATTERY

Removal

1. Disconnect the negative cable (-) from the battery (cable connected to earth).
2. Disconnect the positive cable (+) from the battery (cable connected to starter motor).

Fitting

1. Connect the positive cable (+) to the battery (cable connected to starter motor).
2. Connect the negative cable (-) to the battery (cable connected to earth).

WARNING

Do not connect the terminals up incorrectly.

This can cause serious damage to the electrical system.

If the terminals are shorted, sparking will occur.

Mind the environment!

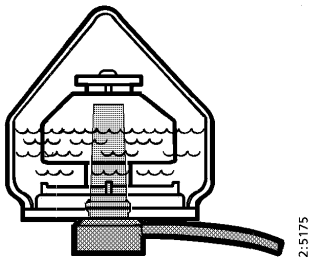
Dispose of used batteries through an authorised waste disposal contractor.

17. Every 1200 hours:

CHECKING THE COOLANT LEVEL MONITOR

(optional equipment)

1. Start the engine.
2. Lower the coolant level in the expansion tank.
3. ***Automatic stop in the event of a fault***: The engine stops, fault code, the indicator lamp comes on and the buzzer (if fitted) sounds if there is no level monitor fault.
4. ***No automatic stop in the event of a fault***: The indicator lamp comes on and the buzzer (if fitted) sounds if there is no fault in the level monitor.
5. Top up coolant to the correct level, see page 32.



2-pin level monitor installed in the expansion tank for radiators supplied by Scania

Mind the environment!

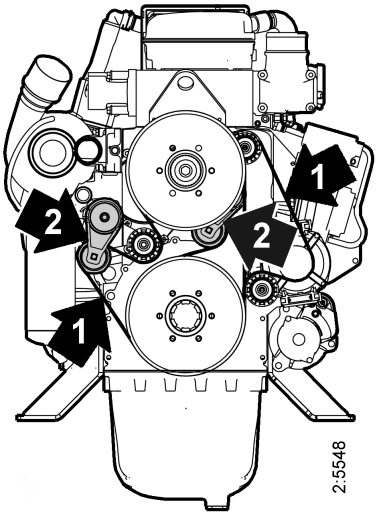
Use a container to avoid spills when draining the coolant.

Dispose of used coolant through an authorised waste disposal contractor.

MISCELLANEOUS

18. Every 1200 hours:

CHECKING THE DRIVE BELT



- If the drive belts (**1**), which are poly-V belts, are worn or damaged they must be changed.
- Also check that the automatic belt tensioners (**2**) are in proper working order and keep the drive belts correctly tensioned.

19. Daily:

CHECK FOR LEAKS, RECTIFY AS NECESSARY

- Start the engine.
- Check for oil, coolant, fuel, air and exhaust leaks.
- Tighten or change leaking connections. Check the overflow holes (1) (below the side covers) which show whether the O-rings between the cylinder liners and crankcase are leaking, see figure.

  a) If coolant is running out, the O-ring is leaking.

  b) If lubricating oil is running out, the liner shelf is leaking.
- Check that the coolant pump drain hole (2) is not clogged, see figure. If there is leakage, change the pump seal or the complete coolant pump.

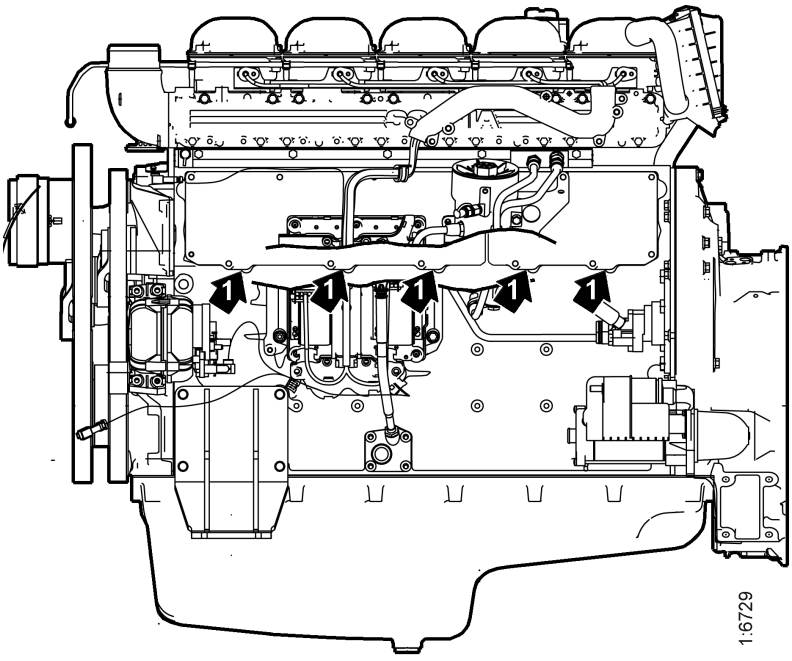
  A small amount of leakage from the overflow holes during the engine running-in period is normal. (Seals and O-rings are lubricated with soap or oil when fitted).
- This leakage normally stops after a time.

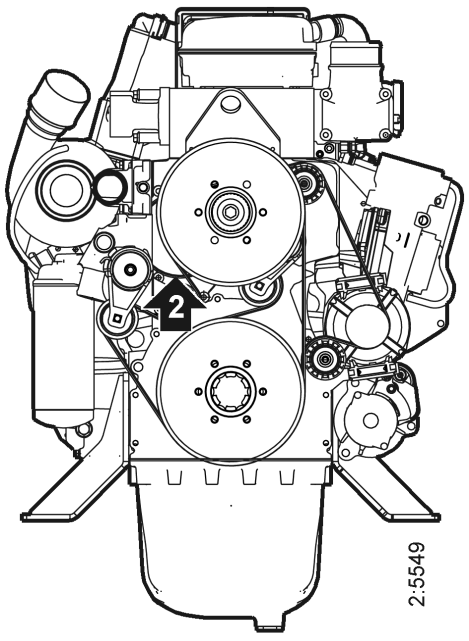
Mind the environment!

Take care to ensure that any leaks do not cause pollution.

! Important

If serious leakage occurs, contact your nearest Scania workshop.





20. Every 2400 hours:

CHECKING/ADJUSTING VALVE CLEARANCES

WARNING

Immobilise the starting device when working on the engine.

If the engine starts out of control, there is a SERIOUS RISK OF INJURY.

Note: Checking/adjusting valve clearances should also be done after the first 400 hours of operation.

Valve clearances should be adjusted when the engine is cold, at least 30 minutes after running.

The rocker cover gaskets should be changed as necessary.
Tightening torque: 26 Nm.

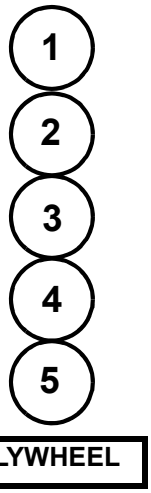
Intake valve clearance: 0.45 mm.
Exhaust valve clearance: 0.70 mm.

Tightening torque for locknut: 35 Nm

Order of adjustment

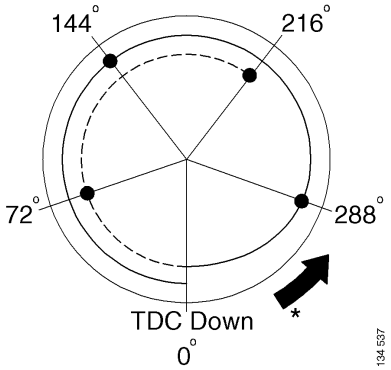
To make sure you adjust on the correct revolution, proceed as follows:

- Rotate the flywheel using tool 99 309 so that the 72° mark on the flywheel can be seen in the **lower** window of the flywheel housing and there is valve overlap on cylinder 5. Refer to table.
- Then turn the flywheel **clockwise** so that it passes *TDC Down* (0°) by about 20° and then turn it **anticlockwise** until *TDC Down* (0°) is visible in the **bottom** window on the flywheel housing. The reason for turning past *TDC down* (0°) and then back is to counteract any backlash.
- You are now on the first revolution and can adjust the valves as shown in the table on the next page.
- Measure the valve clearance using a feeler gauge. Correct valve clearances are also given on the instruction plate on one of the rocker covers.
- Continue to turn the flywheel **anticlockwise** so that the marking on the flywheel is visible in the **lower** window on the flywheel housing and adjust the valves as shown in the table on the next page.
- Check/adjustment of the rockers for the PDE injectors should be done together with the valve clearance check/adjustment. See step 21



Cylinder numbering

Important! ***The flywheel marking is only correct if the reading is taken through the lower opening.***



Flywheel seen from the rear of the engine.

** Direction of rotation when adjusting.*

The continuous line show which sequence the angles should be measured on revolution 1 and the dashed line show the sequence for revolution 2

Mark on flywheel (reading taken through the lower opening)	Revolution	Valve overlap on cylinder	Adjust the valves on cylinder
TDC Down (0°)	1	-	1
	2	1	-
144°	1	-	2
504°	2	2	-
288°	1	-	4
648°	2	4	-
72°	1	5	-
432°	2	-	5
216°	1	3	-
576°	2	-	3

If reading cannot be taken from underneath:

- Turn the flywheel with tool 99 309 to valve overlap on cylinder ***1*** (which corresponds to TDC down (0°) in the lower opening). Then turn the flywheel anti-clockwise 144° at a time and observe the valve overlap. Adjust the valves according to the table below.

Valve overlap on cylinder		Adjust the valves on cylinder	Adjust unit injector rocker arm on cylinder
TDC-down (0°)	1	5	5
(144°)	2	3	3
(288°)	4	1	1
(432°)	5	2	2
(576°)	3	4	4

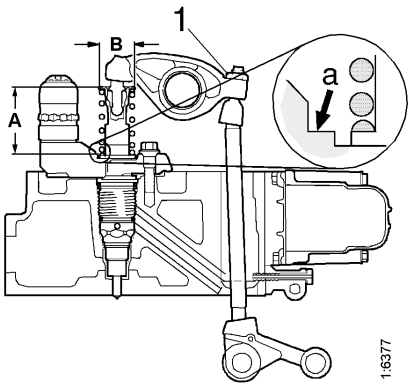
21. Every 2400 hours:

CHECKING/ADJUSTING THE PDE INJECTOR ROCKERS

Note: **Checking/adjusting the rockers for the PDE injectors should also be done together with the valve clearance check/adjustment after the first 400 hours of operation.**

Important! ***The unit injectors are adjusted using setting tool 99 414 or a digital sliding caliper.***

This adjustment is important as incorrect positioning of the unit injector can lead to poor performance and possible damage.



Measurement A= PDE32: 69,9±0,1 mm

Measurement B= PDE32: 38,8 mm

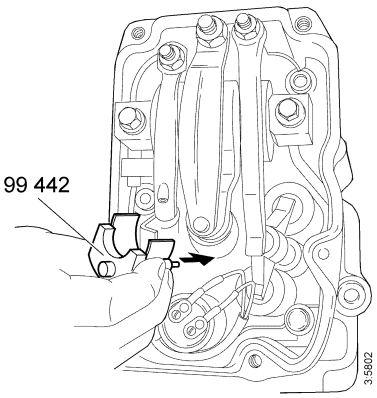
Order of adjustment

- Follow the work description on page 49 and the table below at check/adjustment of the unit injectors.
- The table below is only valid if the reading is taken in the lower opening.

Mark on flywheel (reading taken through the lower opening)	Revolution	Valve overlap on cylinder	Adjust unit injector rocker arm on cylinder
TDC Down (0°)	1	-	2
	2	1	-
144°	1	-	4
504°	2	2	-
288°	1	-	5
648°	2	4	-
72°	1	5	-
432°	2	-	3
216°	1	3	-
576°	2	-	1

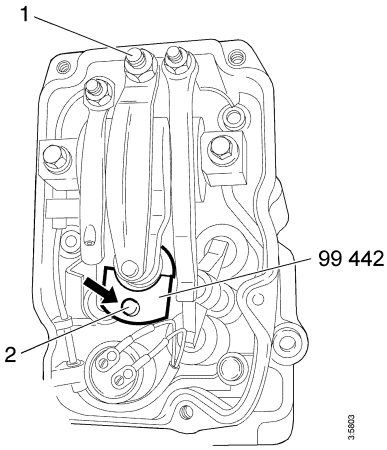
PDE32:

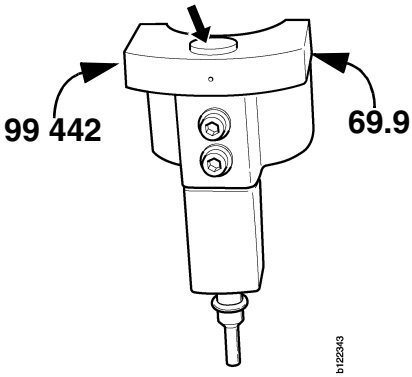
1. See page 46 for a description of how the engine should be turned to access *TDC down* (0°) to be able start checking and adjusting the injectors.
2. You are now on the first revolution and can check/adjust the injectors as specified in the table on the previous page.
3. Firstly, measure the distance *A* between plane ***a*** and the top edge of the valve spring washer on the PDE injector using a digital sliding caliper. See figure.
4. Measurement *A* should be 69.9 mm for PDE31 (measurement B = 38.8 mm).
5. The dimension is adjusted by undoing the lock nut and screwing the rocker arm adjusting screw *1* to the correct measurement.



WARNING! Take care when carrying out the adjustment if the dimension is well outside the adjustment dimension. The spring is pre-tensioned and can cause personal injury if it is released.

6. Position setting tool 99 442 with the metal plate around the injector spring.
7. Finely adjust dimension *A* by simultaneously using a finger to sense that the small piston *2* is level with the flat upper surface of the tool. It is possible to sense differences of less than a tenth of a millimetre.
8. If the setting tool is not available, a digital sliding caliper can also be used for fine adjustment. The rocker position is adjusted by means of the adjusting screw to 69.9 +/-0.1 mm as stated above.
9. Tighten the adjusting screw lock nut to 39 Nm and remove the tool.
10. Continue to turn the flywheel **anticlockwise** so that the marking on the flywheel is visible in the lower window on the flywheel housing and adjust the valves as shown in the table on the previous page.

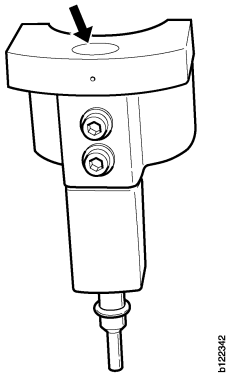




Piston above or below the flat surface. Adjustment necessary

If the reading cannot be taken from underneath:

- Turn the flywheel with tool 99 309 to valve overlap on cylinder ***1*** (which corresponds to TDC down (0°) in the lower opening). Then turn the flywheel anti-clockwise 144° at a time and observe the valve overlap. Adjust the unit injectors according to the table in page 47 and the work decsription above.



Piston level with the flat surface. The adjustment is correct

PREPARING THE ENGINE FOR STORAGE

If the engine is not to be used for a lengthy period of time, special measures should be taken to protect the cooling system, fuel system and combustion chamber from corrosion and the exterior from rusting.

The engine can normally stand idle for up to six months. If it remains unused for longer than this the following measures, which provide protection for about four years, should be adopted. An alternative to preparing the engine for long-term storage is to start the engine and warm it up every 6 months.

Preparing for storage means:

- Thoroughly cleaning the engine
- Running the engine for a certain time using special preservative fuel, oil and coolant.
- Otherwise preparing the engine for storage (filter changes, lubrication, etc.).

Preservative coolant

If the engine is stored with coolant in the system, the coolant should contain 50% glycol by volume. Glycol ***without*** nitrite-based inhibitor should be used. For example **BASF G48 or BASF D542**.

WARNING

Ethylene glycol is highly dangerous if imbibed and can prove fatal.

Avoid contact with the skin.

Preservative fuel

- Use diesel fuel oil mixed with Lubrizol 560H or equivalent.
- Mix 1 cm^3 (ml) Lubrizol 560H in 10 dm^3 (l) of fuel.

HANDLING LUBRIZOL 560H

Hazardous!

Contains aromatic hydrocarbons

Use spot extractors where there is a danger of vapour build-up.
Wear protective gloves and goggles when handling Lubrizol. Do not use contaminated clothing.

If it gets in your eyes:	Rinse with a gentle stream of water (at least 15 minutes). Seek medical attention.
If it gets on your skin:	Wash the affected area with soap and water
If inhaled:	Fresh air, rest and warmth
Inflammable:	Fire class 2A. Flashpoint + 27°.
In case of fire:	Extinguish with carbon dioxide, powder or foam.
Storage:	In well-sealed receptacle in a dry, cool place. **Keep out of reach of children.**

Preservative oil

Suitable preservative oils are supplied by most oil suppliers.

E.g. Dinitrol 40 or equivalent.

Preparations for storage

- Drain and flush the cooling system. Top up with preservative coolant.
- Warm up the engine on regular fuel. Stop the engine and drain the oil.
- Renew the fuel filter.
- Fill the engine with preservative oil up to the minimum level on the dipstick.
- Mix preservative fuel in a can. Detach the fuel pipe at the feed pump suction line and connect a hose from the can.
- Detach the fuel pipe at the overflow valve and connect a return hose to the can.
- Start the engine and run it at about 1000 rpm for 20 - 25 minutes.
- Stop the engine, remove the hoses and connect the regular fuel lines.
- Remove the rocker covers and lubricate the valve mechanisms and PDE mechanisms with preservative oil. Refit the rocker covers.

Note: The PDE injectors should not be removed.

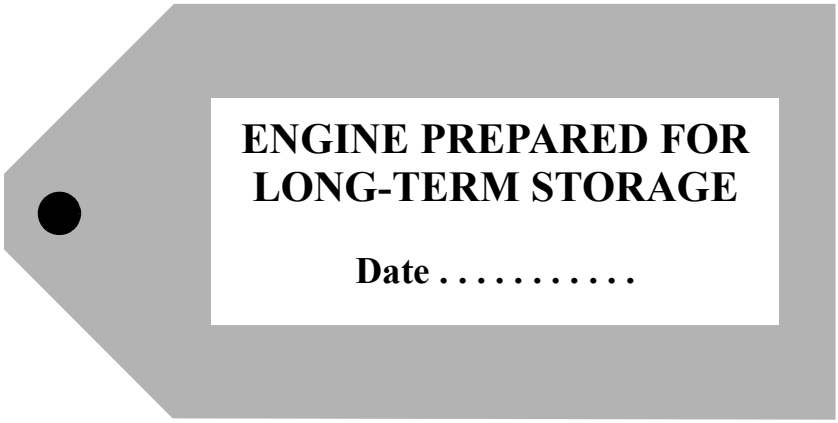
- Drain the preservative oil from the engine. Fresh engine oil can be filled directly or when the engine is taken out of storage.
- Drain the coolant if the engine is not to be stored with coolant in the system. Plug and tape over all coolant connections (if the cooling system is not completely assembled).
- Air cleaner: Clean or change the filter element.
- Cover air intakes and exhaust pipes.
- Alternator and starter motor:
  - Spray with water-repellent anti-corrosive oil, CRC 226, LPS1 or the equivalent.
- Spray the outside of bright engine parts with penetrating preservative oil, for example Dinitrol 25B, and then with Dinitrol 112 or equivalent.

Mind the environment!

Use a container to avoid spills when draining the oil and coolant.

Dispose of used oil and coolant through an authorised waste disposal contractor.

- ***Attach a label to the engine, clearly stating the storage preparation date and that the engine must not be started or cranked.***



Batteries

Remove the batteries for trickle charging at the battery charging station. (Does not apply to batteries which according to the manufacturer do not require any maintenance). The same is applicable for short-term storage, even if the engine has not been prepared for storage as above.

WARNING

Wear gloves and protective goggles when charging and handling batteries

The batteries contain a highly corrosive acid.

Storage

After the preparations, the engine should be stored in a dry and warm place (room temperature).

Taking out of storage

(Procedure when the engine is to be put into operation)

- Remove plugs and tape from coolant connections, air intakes and exhaust pipes.
- Fill the system with coolant, see page 18.
- Check the oil level in the engine or fill up with fresh motor oil.
- Lubricate the valve mechanisms and their pushrods and valve tappets as well as the PDE injector mechanisms.
- Drain the preservative fuel from the fuel manifold and fuel filter.
- Connect and bleed the fuel system, see page 41.
- Wash off any externally applied preservative oil, using white spirit.

TECHNICAL DATA

GENERAL		DC9 EMS
Number of cylinders		5 in line
Cylinder diameter	mm	127
Stroke	mm	140
Displacement	dm^3 (litres)	8.87
No. of main bearings		6
Firing order		1 - 2 - 4 - 5 - 3
Compression ratio		18:1
Engine direction of rotation viewed from rear		Anticlockwise
Fan direction of rotation viewed from front		Clockwise
Cooling		Liquid
Valve clearances, cold engine intake valve exhaust valve	 mm mm	 0.45 0.70
Weight, without coolant or oil *With charge air cooler, radiator, expansion tank and pipes	kg	887
LUBRICATION SYSTEM		
Max. oil pressure hot engine at engine speeds above 1000 r/min	bar (kp/cm^2)	6
Normal oil pressure: hot engine at operating speed	bar (kp/cm^2)	3 - 6
Min. oil pressure: hot engine under 1000 rpm hot engine above 1000 rpm	bar (kp/cm^2)	 0.7 2.3
Oil volume, see page 27		
Crankcase pressure with closed crankcase ventilation	mm VP	-55 - +20

FUEL SYSTEM		DC9 EMS
Low idle speed	rpm	700 (adjustable 500-800)
Maximum full load speed		See engine card
Fuel		Diesel fuel oil[1]
[1] see page 55		
COOLING SYSTEM		
Number of thermostats		1 (dual thermostat)
Thermostat, opening temperature	°C	83
Coolant temperature: system at atmospheric pressure system at overpressure	 °C °C	 83 - 95 83 - approx. 100
Volume, including radiator, engine and expansion tank with 1.0 m^2 radiator	dm^3 (litres)	57
ELECTRICAL SYSTEM		
System voltage	V	24
Alternator, current	A	80 or 100
Starter motor output	kW (hp)	5.5 (7.5)
Monitors, threshold values: oil pressure monitor temperature monitor	 bar (kp/cm^2) °C	 1,0 ±0,15 Programmed in S6

FUEL

Diesel fuel oil

The composition of the diesel fuel oil has a great influence on the functioning and the service life of the engine and the injection system. The engine output and exhaust emissions are also dependent on the fuel quality. The requirements and testing standards for the most important properties are described in the service manual in sections which can be ordered from Scania dealers or directly from Scania. The address of Scania is printed on the cover.

Diesel fuel must comply with the following standard: EN 590 (European standard).

The table below shows the requirements for some of the most important properties:

Property	Requirement
Viscosity at 40°C	2.0 - 4.5 mm^2/s (cSt)
Density at 15°C	0.82 - 0.86 kg/dm^3
Sulphur (concentration by mass)	max. 0.3%
Ignitability (CET rating)	min. 49
Flashpoint	56°C

Environmentally favourable fuels (low sulphur fuels)

There are three classes of so called environmentally favourable fuels (SS15 54 35).
Class 1 is sulphur-free and class 2 is low in sulphur. Compared with class 3 (normal fuel), these fuels are less dense and this reduces engine power output. Only class 1 fuel should be used with a catalytic converter.

Short term use of fuel with a higher sulphur content than 0.05% by weight will not cause permanent damage to the catalytic converter.

The catalytic converter may, however, require fuel with low sulphur content for some time after this to regain its normal efficiency.

Temperature dependence of diesel fuel

At temperatures lower than those specified for the diesel fuel, paraffin wax may precipitate from the fuel and block filters and pipes. The engine can then loose power or stop.

The diesel fuel is adapted for use in the specific climate of each country. If a vehicle or an engine is to be operated in a temperature zone with lower temperature than normal, **first identify the temperature properties of the fuel concerned**.

The properties of the fuel when cold can be improved by adopting one of the following measures ***before the temperature drops***:

- If the fuel concerned cannot cope with the expected temperatures, and diesel fuel is not available with the correct temperature properties, we recommend that an electric fuel heater is installed **as a preventative measure.**
- The low temperature properties of diesel fuel may be improved by adding kerosene **as a preventative measure**. A maximum of 20% may be added. When refuelling, the kerosene should be added first, so that it mixes thoroughly with the diesel fuel.

Note: It is prohibited to use kerosene in engine fuel in some countries.

- To prevent water in the fuel from freezing and forming ice, a maximum of 0.5-2% alcohol (isopropanol) may be added.

Drain fuel tanks and drain or change fuel filters regularly.

WARNING

It is not permitted to mix kerosene with diesel fuel that is already adapted for the climate concerned. This can damage the PDE injectors. All use of paraffin other than kerosene is forbidden, as it causes engine damage.

Important

It is not permissible to mix petrol with diesel fuel. In the long term, petrol may cause wear to the PDE injectors and it may also cause damage to the engine.

ALPHABETICAL INDEX