

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
DI9, DC9 with DEC2
Industrial engine
opm96-9adec en 1 588 889
2003-10:1

COMMISSIONING REPORT - WARRANTY

When the commissioning report has been filled in and sent to Scania, you have a 1-year warranty from the date of commissioning.

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 and DI9 Industrial Engines with DEC2.

The engines are of direct-injection, liquid-cooled, four-stroke, 6-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.

Scania CV AB
 Industrial and Marine Engines
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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!

Use a container to avoid spillage when bleeding and changing 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:

- *Serviceing 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 serviceing 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.

! Running

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 inhibitor, inhibiting oils, degreasing agents, etc. are hazardous to health. Always follow the safety precautions on the relevant packaging.

Some chemicals, such as inhibiting 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 manufactured 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.

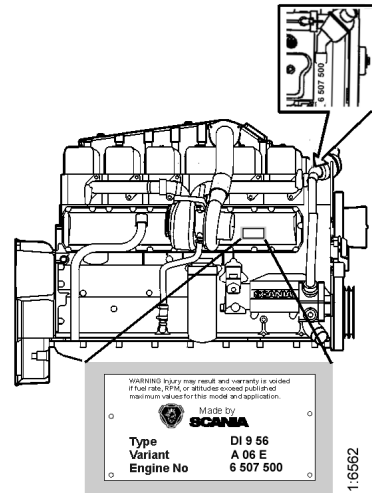
Never start the engine without the air filter fitted. There is a risk of objects being sucked into the impeller or of injury if you come into contact with it.

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 indicated on a type plate affixed to the right-hand side cover behind the oil cleaner. The engine number is also stamped in the top of the engine block in front of the first cylinder head. Refer to the illustration.

Engines which hold certification in respect of smoke and emissions are fitted with a plate which indicates the documents in accordance with which they are certified. This plate is located on rocker cover number two viewed from the front.



1:6562

DI 9 56 A 06 E

Type

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

Displacement in whole dm³

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.

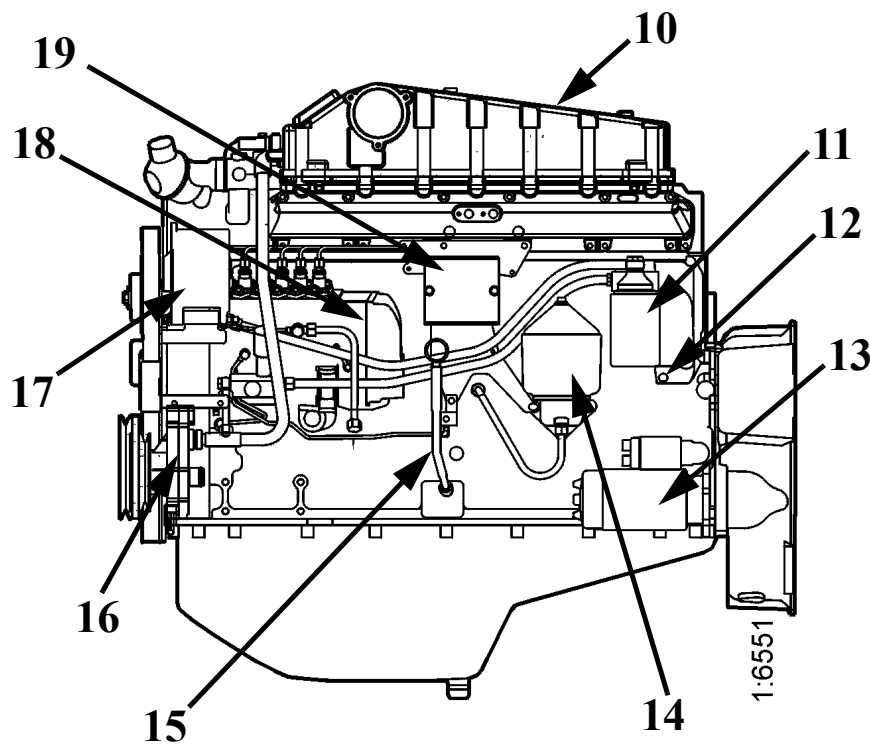
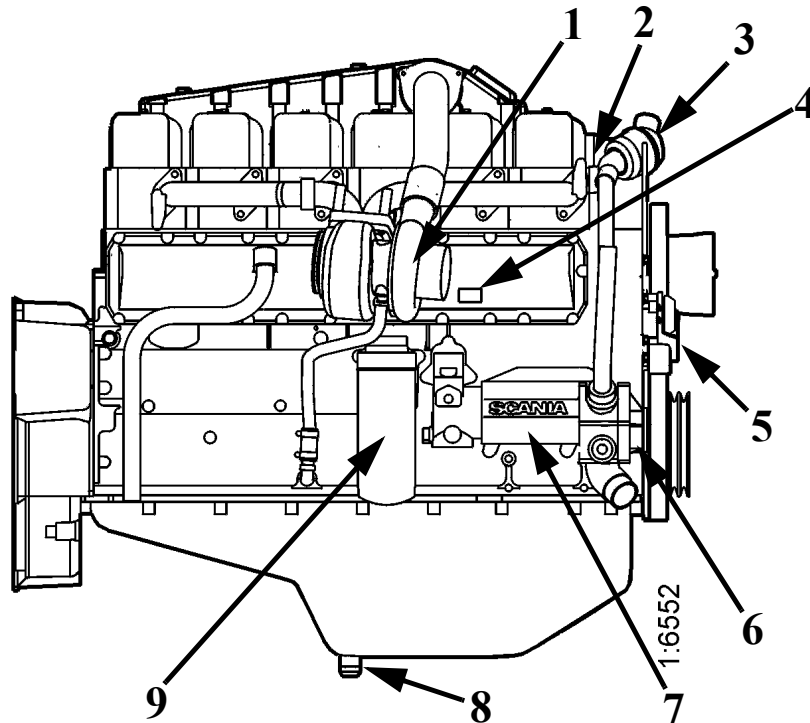
Application

- A For general industrial use

Variant 01-99

Type of regulator

- E Electronically controlled governor (DEC2).



The illustrations show a normal version of a DI9 56 engine.
Your engine may have different equipment from that illustrated.

- | | | |
|---|-------------------------|-----------------------------|
| 1. Turbocharger | 6. Coolant pump | 14. Oil cleaner |
| 2. Engine number,
stamped into the engine
block | 7. Oil cooler | 15. Oil dipstick |
| 3. Thermostat housing with
outlet | 8. Draining, engine oil | 16. Extra coolant pump |
| 4. Type plate | 9. Oil filter | 17. Alternator |
| 5. Automatic belt tensioner | 10. Charge air cooler | 18. Injection pump with EDC |
| | 11. Fuel filter | 19. Connector panel DEC2 |
| | 12. Draining, coolant | |
| | 13. Starter motor | |

DEC2 CONTROL SYSTEM

This engine has an injection pump with an electromagnetic actuator which adjusts the control rack to give the correct amount of fuel.

The system which controls the pump is called DEC2 (Digital Engine Control, generation 2).

The control unit (DEC2) continuously receives signals from sensors for engine speed, charge air temperature and pressure, coolant temperature, oil pressure, throttle pedal position and control rod travel in the injection pump. Using this input data and a control program, the correct amount of fuel for the current operating conditions can be calculated.

The system's sensors may be used only for DEC2, ***not for other instruments or other monitoring purposes.***

The control unit contains monitoring functions to protect the engine in the event of a fault which would otherwise damage it. Faults and the more important monitoring functions are indicated on the control unit in the form of light emitting diodes. See illustration on page 15 for a description.

In the event of a fault *Power* - or *Shutdown* on the control unit comes on as well as the main indicator lamp on the main supply box and instrument panel.

If a fault has been indicated on the main indicator lamp, the operator can determine the cause of the fault with the help of the LEDs on the control unit and the troubleshooting schedule on page 18, and carry out the required investigation and remedy.

Depending on the nature of the fault, the control system can take various steps to protect the engine, reduce its power, allow it to run at a constant low speed or, if a functional fault is detected, the engine will be switched off automatically (*Shutdown*).

In order to read fault indications on the LEDs, there is a lamp test/fault code switch in the main supply box installed near the control unit.

A PC based program is also available to make it easier for service personnel to detect and rectify faults which may arise and to adjust certain parameters in the driving program.

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

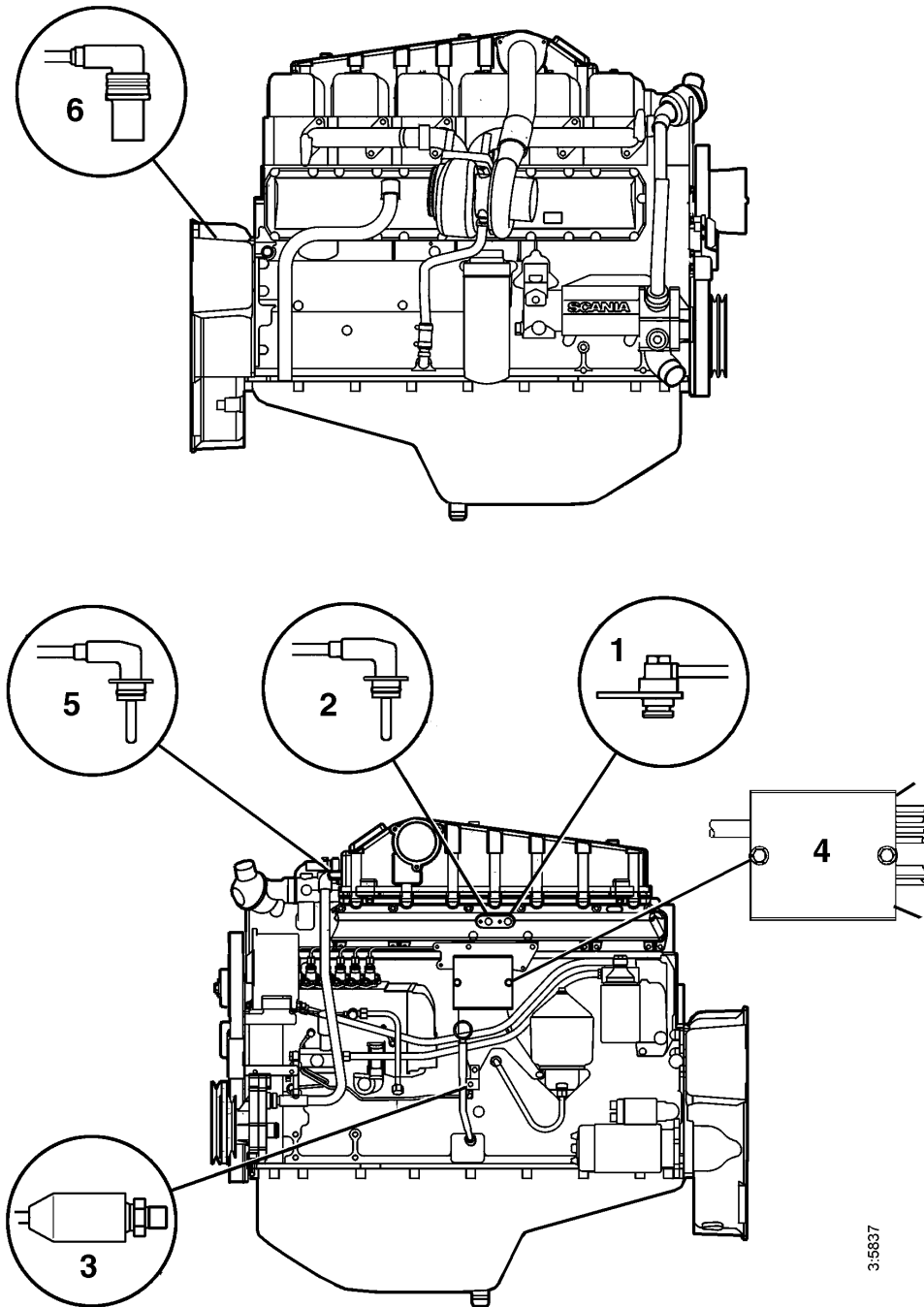
The locations of the sensors and monitors which send signals to the control unit will be evident from the figures on pages 13 and 14.

There is a description of the functions of the LEDs during normal operation on page 15.

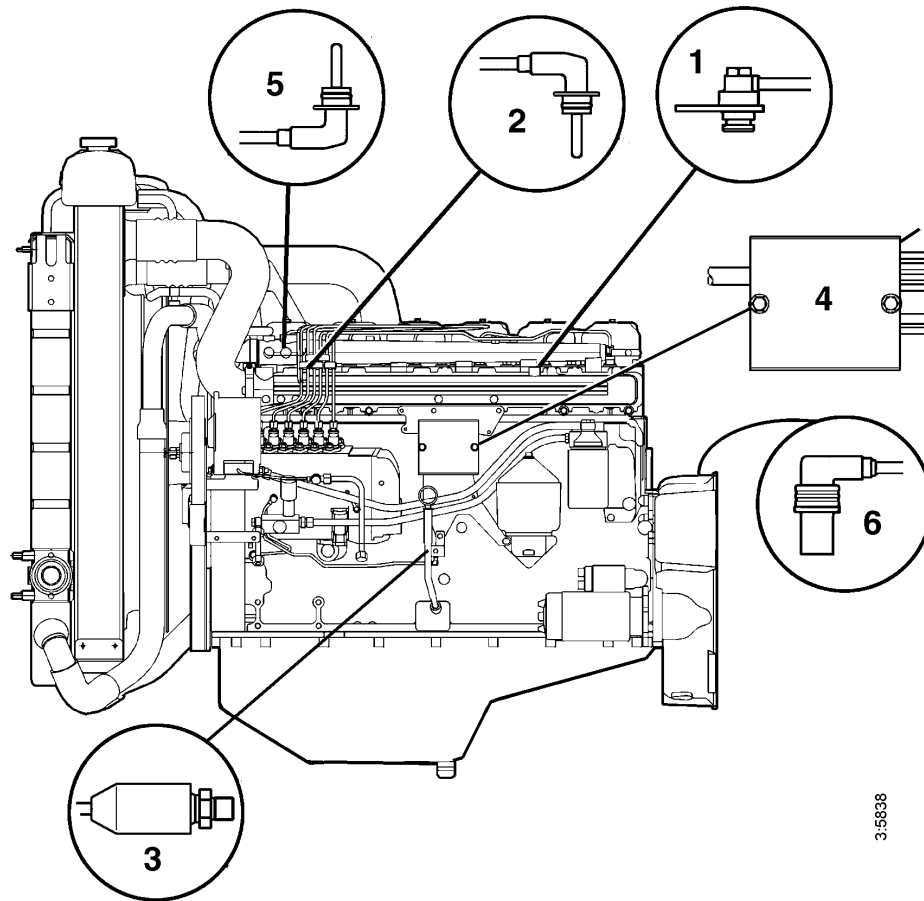
There are descriptions of LED indications when a fault has occurred and the action taken in the case of *Power-* and *Shutdown* on page 16.

Troubleshooting and fault code reading are described on pages 17 and 18.

Location of sensors for DEC2 on DI9



1. Connection of lead to charge air pressure sensor
2. Charge air temperature sensor
3. Oil pressure monitor
4. Connector panel
5. Coolant temperature sensor
6. Rotation speed sensors

Location of sensors for DEC2 on DC9

3-58838

1. *Connection of lead to charge air pressure sensor*
2. *Charge air temperature sensor*
3. *Oil pressure monitor*
4. *Connector panel*
5. *Coolant temperature sensor*
6. *Rotation speed sensors*

LED functions during normal operation

Note: The lamp test/fault code switch should not be depressed. All LEDs come on briefly when the control unit is powered up.

CONTROL STATUS

- ★ The LED flashes continuously when the control unit is supplied with current, regardless of whether the engine is running or not.

SHUTDOWN

- The LED is out.

STARTING

- ★ The LED lights up as soon as the engine starts to rotate during an attempt to start it, follows the programmed starting sequence until it has been completed and then goes out.

RUNNING

- ★ The LED comes on when the engine has started and the "Starting"-LED goes out. It remains on until the engine is stopped.

TORQUE LIMIT

- ★ The LED comes on when the control unit senses that the engine has received the maximum permissible quantity of injected fuel according to its power curve. This means 100% power output at the current rpm. If the load increases, engine rpm will decrease.

BOOST LIMIT

- ★ The LED comes on when the control unit's smoke limiter limits the maximum fuel quantity. Operation of the smoke limiter is dependent on the charge air pressure.

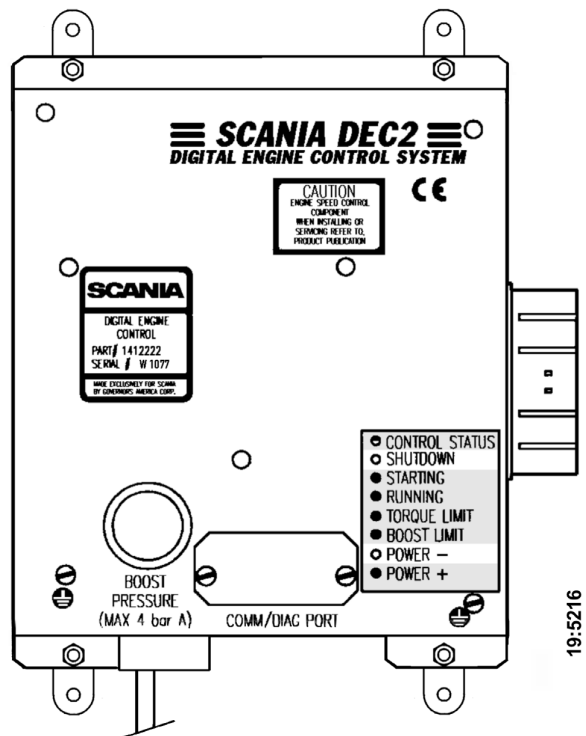
POWER-

- The LED remains out during normal operation as long as no fault is detected by the control unit. See next page for the procedure to be adopted in the event of a fault.

POWER+

- ★ If the control unit is programmed so that the engine can be operated with more than one power/torque curve (map), the following applies.

The LED comes on when the engine is operated at more than 100% power output (MAP 2). It goes out when the engine returns to the 100% power output curve (MAP 1) or when the power requirement drops to below 100%.



Action when a fault arises

LED indications in the event of a fault

Note: It is indicated on the main indicator lamp in the main supply box and on the instrument panel. The lamp test/fault code switch should not be depressed.

CONTROL STATUS

- ✱ The LED continues to flash even if a fault has occurred as long as the control unit is powered up.

POWER-

- ✱ If the LED comes on, the control unit has detected a fault condition which could result in engine damage if allowed to continue.

The control unit automatically reduces the power to a special level if this function has been selected.

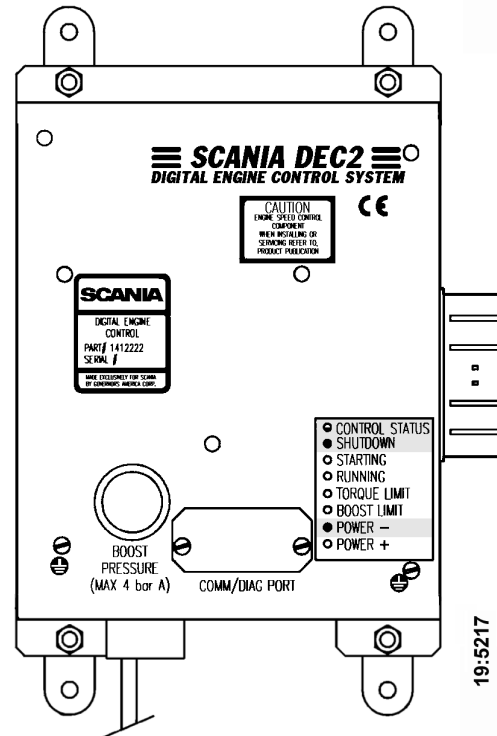
Action: If possible reduce engine speed to idle and conduct troubleshooting according to instructions on page 17 and the chart on page 18.

SHUTDOWN

- ✱ The LED comes on and *the engine is switched off automatically* in the event of a fault so serious that the engine could be damaged if it is still in operation.

Action: Conduct troubleshooting according to instructions on page 17 and the chart on page 18.

If the engine has not stopped, reduce engine speed to idle and carry out troubleshooting.



Resetting functions with DIP switches in control unit

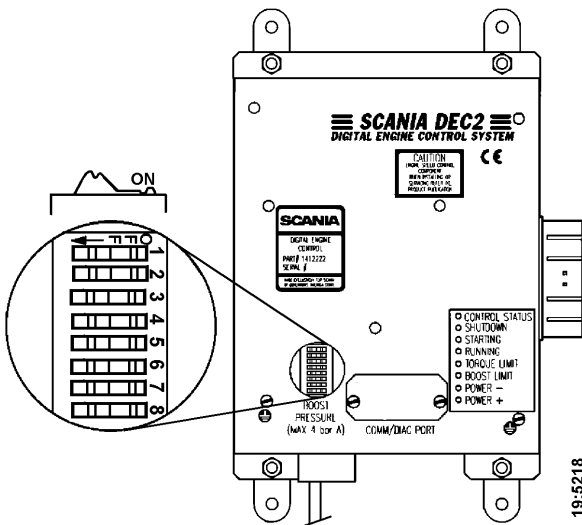
There are 8 DIP switches in the control unit under the round black rubber cover.

These switches should be in the **ON** position for normal operation in accordance with the driving program. For single speed engines, it may also be normal for DIP switches 6, 7 and 8 to be in the **OFF** position.

Shutdown at threshold values for low oil pressure and high coolant temperature can be selected by setting DIP switch **4** to **OFF**.

With DIP switch **4** in position **ON**, **Power-** indication is obtained for these threshold values. Engine power output reduction (*LOP*) can then be selected to prevent damage to the engine. Changes to the program may be made by authorised personnel only.

Note: The engine should only be used in an emergency when the *Power-* indication comes on.



Reading fault codes

Note: If the engine has stopped or lost power but the main indicator lamp is out and neither **POWER- nor **SHUTDOWN** are on, the fault is outside the control unit's detection area. Probable causes: fuel starvation, temporary overload, mechanical fault.**

- Activate the lamp test/fault code switch. In Scania's electrical equipment the main indicator lamp is located in this switch in the main supply box.
- All LEDs will then come on for 2 seconds to indicate that they are intact and in working order. This also applies to the main indicator lamp in the main supply box and on the instrument panel. Make a note of any LED that is defective.
- All LEDs will then go out for approximately 4 seconds.
- Following this, a fault code will be indicated on one of the LEDs for 2 seconds. Note which LED it is.
- The control unit will then automatically return to operating mode.
- After having made a note of the fault code, reset the lamp test/fault code switch and reset the control unit by turning off its power supply momentarily.
- The most probable cause of the fault can then be found in the troubleshooting schedule on the next page.
- When the fault or faults have been rectified the engine can be restarted.
- If the control system still gives an indication on the main indicator lamp, other faults may be registered. The fault codes must then read again as above since the system can only show one fault code at a time.
- The fault or faults will be logged in a special memory in the control unit where the operating time concerned is recorded. Stored faults can be accessed and erased by authorised service personnel.

**READING FAULT CODES
LED INDICATION WHEN THE LAMP TEST/FAULT CODE SWITCH IS ACTIVATED**

		Probable cause								Action	
CONTROL STATUS	SHUTDOWN	STARTING	RUNNING	TORQUE LIMIT	BOOST LIMIT	POWER -	POWER +				
*								DEC2 has detected an internal fault in the control unit.		Send in the control unit for repair as soon as possible.	
	*							The engine temperature has reached the threshold level or the temperature sensor is inoperative.		Check the cooling system. Check the temperature sensor and cable routing.	
		*						The engine has reached the overrevving limit or the engine speed sensor is inoperative.		Check the wiring and connector. Renew the engine speed sensor.	
			*					Control rack position sensor inoperative.		Check connectors and cables to governor.	
				*				The intake air temperature has reached the threshold level or the charge air temperature sensor is inoperative.		Check the intake system. Check the temperature sensor and cable routing.	
					*			DEC2 detects no charge air pressure. The charge air pressure sensor is inoperative.		Check the charge air pressure cable. Send in the control unit if the connection is damaged.	
						*		Engine speed potentiometer or the idling safety switch is inoperative.		Check the cable routing, connectors and cables.	
							*	The oil pressure has dropped to the threshold level or the oil pressure monitor is inoperative.		Check oil level, connector and cable. Renew the oil pressure monitor.	

*** = LED is on**

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 27.

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 29).
6. Checking the coolant level (see page 33).

The coolant should contain anti-corrosive 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.

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:

7-12% 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.

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 anti-corrosive is 7-12% by volume and this must never drop below 7% 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 anti-corrosive! 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.



WARNING

Ethylene glycol and corrosion inhibitor are toxic if ingested. Avoid contact with the skin.

! 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).
15. Checking the electrolyte level in batteries (see page 42).
16. Checking the state of charge in batteries (see page 42).
18. Checking the coolant level monitor (see page 43).
19. Checking the temperature monitor (see page 44).
20. Checking the oil pressure monitor (see page 45).
21. Checking transmission tension (see page 46).



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 27.

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 40).

Out of consideration for our common environment, your new Scania engine has been designed to use a smaller amount of fuel when starting. Using unnecessarily large amounts of fuel when starting the engine always results in the discharge of unburnt fuel.

- Open the fuel cock, if fitted.
- Declutch the engine (not engines with fixed clutch, e.g. generator sets).
- Engines with battery master switch: Switch on the power by means of the battery master switch.
- DEC2: If the main indicator lamp comes on or flashes when the power is turned on, this indicates the presence of a fault in the control system or engine which must be found and rectified before the engine is started. See page 16.
- Start the engine by means of the starter button or starter key.

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. Avoid running it longer than necessary at idling speed.



WARNING

Start the engine only 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 to help you start the engine.
An explosion may occur in the intake manifold with a risk of personal injury.

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.

If the engine has flame start:

- Operating flame start *without timer relay*: Press the control button, which also acts as a pre-glow button (maximum 20 seconds). The glow plug continues to glow as long as this button is depressed after the engine has started. Maximum time is 5 minutes.
- Operating flame start *with timer relay*: Press the pre-glow button (maximum 20 seconds). Release it when the engine starts. The timer relay keeps the glow plug glowing for 5 minutes. If a shorter glow time is required, press the release button. The key must be set to the 0 position if the start attempt fails.

Note: If the engine is equipped with an INTERLOCK switch, this switch should be depressed and held down until the oil pressure has reached a sufficiently high level.

- Generator sets should be operated under load immediately after starting to avoid the risk of white smoke. This applies in particular to engines that have been installed without aids for heating or applying a basic load.
- Warm up the engine with a moderate load. A light load on a cold engine gives better combustion and faster heating than warming up with no load.

! 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 when stopping and starting.
500 - 700 rpm	yellow area:	slow idle.
700 - 2200 rpm	green area:	normal operating speed. The engine's operating speed range is controlled by the DEC2 control system.
2200 - 2600 rpm	yellow/green striped:	unsuitable operating speed. May occur when switching off and during downhill engine braking
2600 - 3000 rpm	red area:	prohibited engine speed



WARNING! When driving the vehicle on a steep downhill slope, or in other installations where the engine can be driven by the vehicle movement, DEC2 will set zero fuel supply to protect against overrevving and will switch off the engine. It must *not* be disengaged in this position since this can cause important functions such as the steering and brake system to fail when the engine stops rotating.

Coolant temperature

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

DEC2: If the temperature is high, 98°C or higher, it is possible to instruct the control system to reduce the engine power (*Power -*) in order to lower the temperature. See the DEC section on page 17.

If the temperature continues to rise, the engine will be stopped automatically (*Shutdown*) at 103°C. See the DEC section on page 17.

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.

! Important

Cooling systems with Scania radiators and plastic expansion tanks must not have excess pressure in the system, i.e. pressure caps must not be used on expansion tanks.

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 of 3 - 6 bar

Min. oil pressure:

warm engine running at a speed of 800 rpm 0.7 bar

At speeds below 800 rpm the gauge may show low oil pressure although no fault is present.

Oil pressure below 0.7 bar at speeds above 800 rpm will cause engine damage. The engine must be stopped immediately.

DEC2: The engine is stopped automatically if this function is selected. See the DEC section on page 17.

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

Charging indicator lamp

If the lamp comes on during operation:

- Check/adjust the alternator drive belts as described under the maintenance point. See page 46.
- 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. Stop the engine with the stop button. Keep the stop button depressed until the engine is completely stationary.
3. DEC2: Before switching off, check that the control system's main indicator lamp is not on or flashing. See page 16 for troubleshooting.
4. Engines with battery master switch: Switch on the power by means of the battery master switch. (Does not apply to emergency generator sets).
5. Set the control switch to "0". (Does not apply to emergency generator sets).

! 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.

Clutch

- See the manufacturer's instructions for handling and operating the clutch.

WARNING! If the clutch output shaft is rotating (e.g. in multiple engine installations where other engines are running), the clutch can, under its own power, be drawn to the engaged position.

THIS CAN CAUSE INJURY and engine damage. For this reason, always secure the clutch in the disengaged position if there is a risk of the output shaft starting to rotate.

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 be drained if it does not contain sufficient glycol, see page 33.
- At temperatures below 0°C: Prepare for the next start by connecting the engine heater.



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

Topping up with coolant should be carried out when the engine is stopped after the first start.

MAINTENANCE

The maintenance programme covers 24 points, divided into the following main groups:

- Lubricating oil system page 28
- Cooling system page 32
- Air cleaner page 38
- Fuel system page 40
- Electrical system, monitors, batteries, etc. . . page 42
- Miscellaneous page 46

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 OPERATING HOURS

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.
15. Checking electrolyte level in batteries.
16. Checking state of charge in batteries.
17. Cleaning batteries.
22. Look for leakage, rectify as necessary



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

**For engines with few operating hours that do not receive periodic maintenance according to the maintenance schedule on page 27, maintenance should be carried out in accordance with the schedule:
"Annually"
"Every 5th year"**

MAINTENANCE SCHEDULE

	<i>First time at</i>		<i>Interval</i>					<i>At least</i>		
	<i>Daily</i>	<i>First start</i>	<i>400 h</i>	<i>200 h</i>	<i>400 h</i>	<i>1200 h</i>	<i>2400 h</i>	<i>4800 h</i>	<i>Annually</i>	<i>Every 5th year</i>
LUBRICATING OIL SYSTEM, page 28										
1. Checking oil level	●	●								
2. Oil change					●1				●	
3. Cleaning oil cleaner					●1				●	
4. Renewing the oil filter					●1				●	
COOLING SYSTEM, page 32										
5. Checking coolant level	●									
6. Checking coolant		●					●4		●	
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					●3					●
11. Changing safety cartridge							●			●
FUEL SYSTEM, page 40										
12. Checking fuel level	●	●								
13. Changing main filter						●1				●
14. Checking injectors							●		●	
ELECTRICAL SYSTEM, page 42										
15. Checking electrolyte level in batteries		●		●2					●	
16. Checking state of charge in batteries		●		●2					●	
17. Cleaning batteries				●2					●	
18. Checking level monitor		●				●			●	
19. Checking temperature monitor		●				●			●	
20. Checking oil pressure monitor		●				●			●	
MISCELLANEOUS, page 46										
21. Checking drive belt		●				●			●	
22. Look for leakage, rectify as necessary	●									
23. Checking/adjusting valve clearances			●				●			
24. Changing (or cleaning) valve for closed crankcase ventilation							●			

1. More often if required
2. For engines with few operating hours, see page 26.
3. Earlier if low pressure indicator shows red.
4. 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 specified oil change intervals are applicable provided that *the fuel sulphur content does not exceed 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.
- When ambient temperatures are extremely low: Consult your nearest Scania representative to avoid starting difficulties.

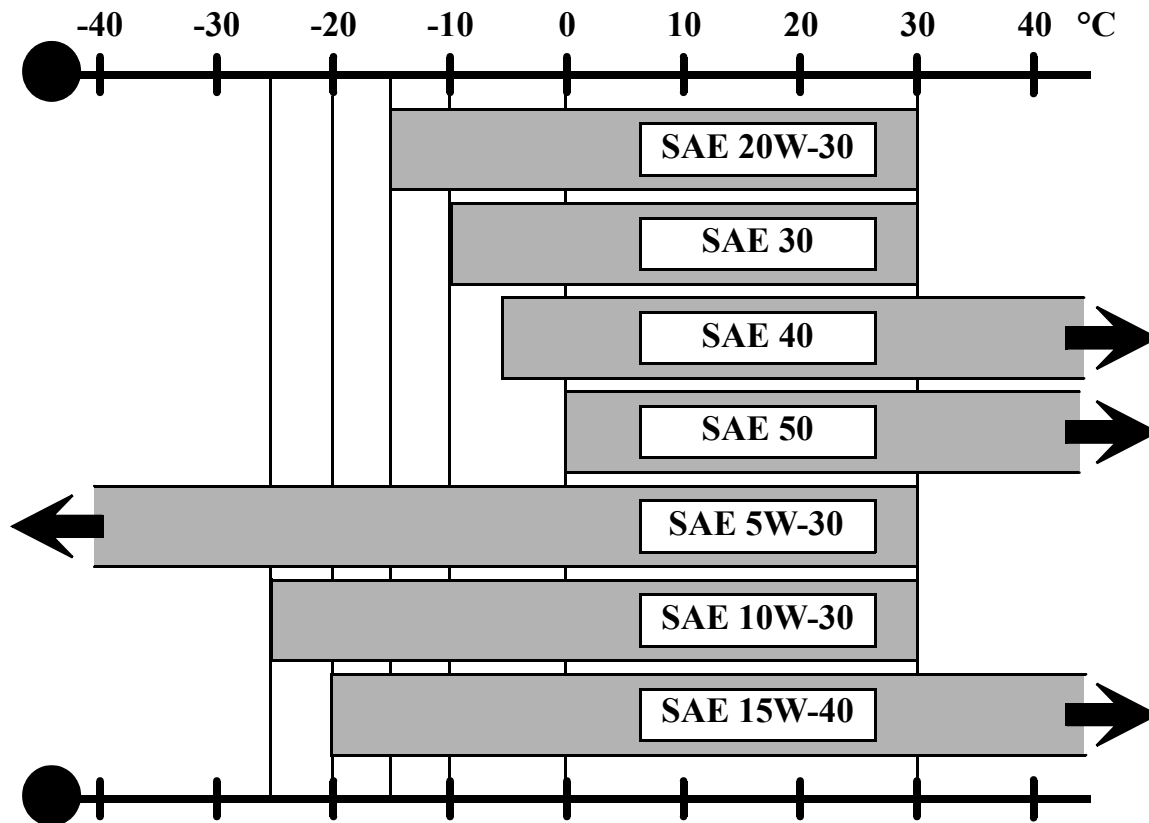
! Important
Additives must not be used.
The oil should be suitable for all temperature variations until the next oil change.

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

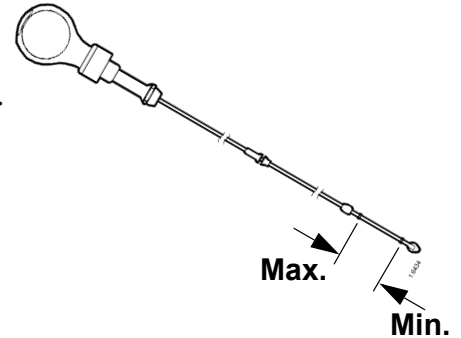
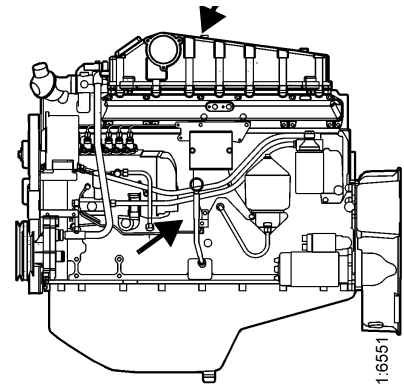
Note: Before checking oil level: Allow the engine to remain stationary for at least 1 minute.

- The correct level is between the marks on the dipstick. Top up when the level is at the lower mark.
- Correct type, see "Oil grade" on page 28.

Checking oil level during operation

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

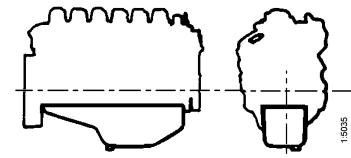
- Remove the oil filler cap to release the pressure in the crankcase.
- Check the level on the dipstick. Correct oil level: **10 mm below the Min. or Max. mark.**



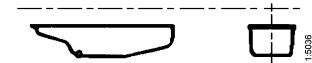
2. Every 400 hours: OIL CHANGE

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. 27 dm³
Min. 20 dm³




Max. 20 dm³
Min. 16 dm³

1 dm³ = 1 litre



WARNING

The oil may be hot.
Wear protective gloves and goggles



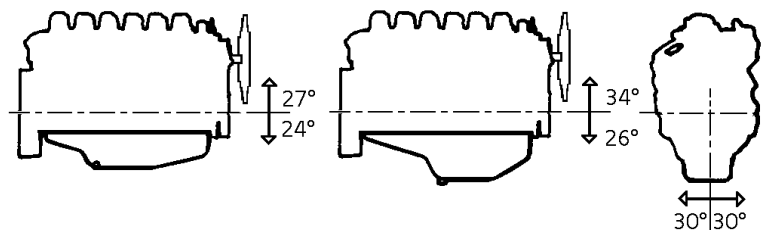
Mind the environment!

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 (at same time as an oil change)

- Unscrew the nut and remove the cover.



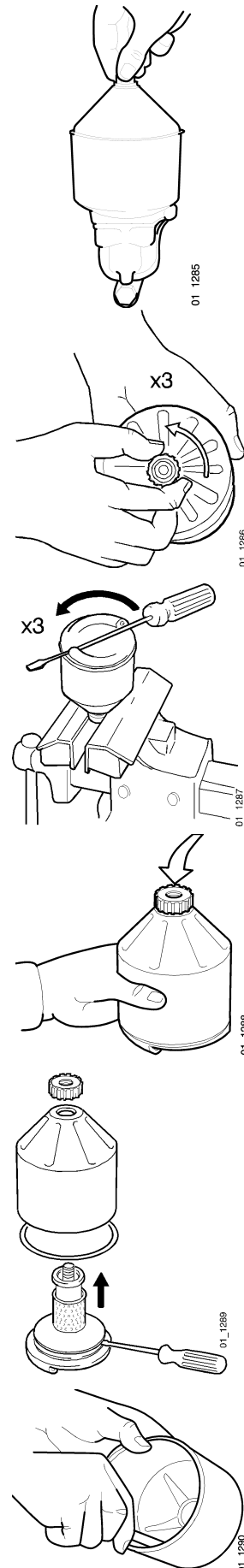
- Lift out the rotor and loosen the nut on the rotor bowl three turns.

- If the nut is jammed:
Clamp the nut, **absolutely not the rotor**, in a vice and turn the rotor three turns by hand or with a screwdriver.

- Tap the nut lightly with your hand or a plastic hammer, to detach the rotor bowl from the bottom plate.

- Unscrew the nut and remove the rotor bowl.
- Prize carefully to detach the strainer from the bottom plate.

- 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 20 mm: clean more often.**



- Wash all parts in diesel oil.
- Fit the O-ring in the rotor bowl. **Make sure it is not damaged.** Change if necessary.

- Assemble the rotor.

- Tighten the rotor nut firmly **by hand**

- Refit the rotor.
- Make sure that it spins easily.

- Check that the O-ring in the bowl is undamaged. A hardened or damaged O-ring must be changed.
- Screw the bowl down hard **by hand**

If the nut is tightened with a tool, the rotor shaft, nut or bowl may be damaged.

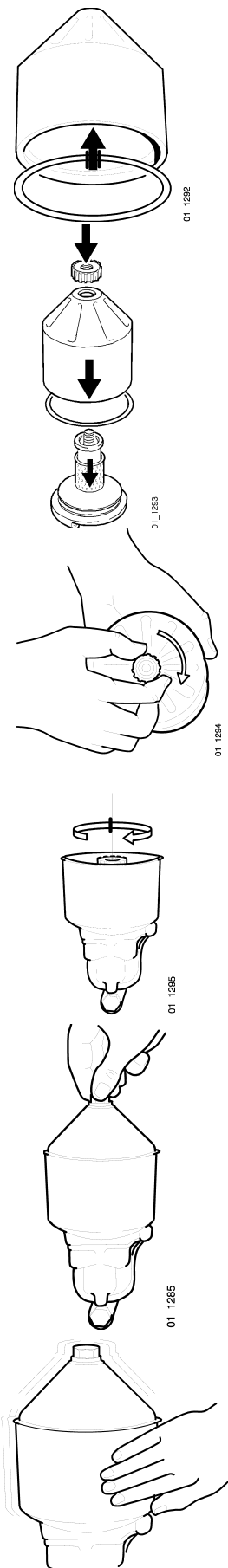
Functional inspection

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 it does not: dismantle it and inspect the component parts.

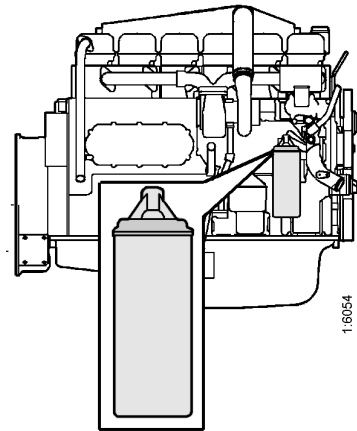


4. Every 400 hours: CHANGING THE OIL FILTER

(at same time as an 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.

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: The coolant should be level with the bottom of the filler neck.
 - Hot engine: The coolant should be about 25 mm above the lower edge of the filler hole.
- 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

Open the cap carefully. Water and steam may spray out.



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 anti-corrosive content.

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

a) Checking the appearance of the coolant

- Fill a container with a little coolant and check that it is clean and clear.
- If the coolant is contaminated or cloudy, consider changing it.
- Water added to the coolant should be clean and free from dirt of any kind.
- 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.*

<p>Coolant composition:</p> <p><u>If there is a danger of freezing:</u></p> <p style="text-align: center;">minimum 30% glycol by volume maximum 60% glycol by volume</p> <p><u>If there is no danger of freezing:</u></p> <p style="text-align: center;">7-12% by volume <i>Scania Corrosion Inhibitor</i></p>

 **WARNING**

**Ethylene glycol is corrosion inhibitor.
Avoid skin contact with glycol.**

! Important

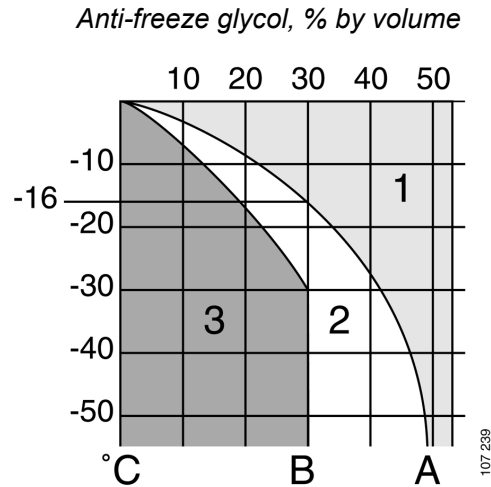
**The coolant should be ready mixed when it is poured into the cooling system.
Never top up with only water or only glycol.**

! 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)

A

% glycol by volume	15	20	25	30	35	40	45	50	60	Cooling system capacity, 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 at different glycol mixes

c)

Checking protection against corrosion

There must always be sufficient corrosive 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 anti-corrosive is 7-12% 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 anti-corrosive!**
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

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

! Important

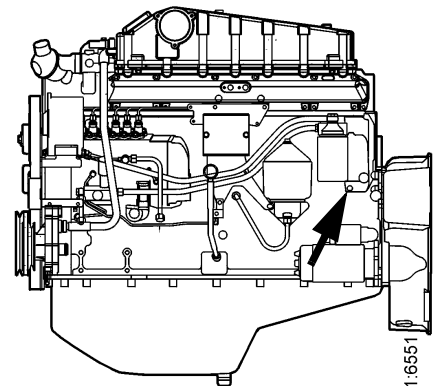
Mixing with glycol or the use of too much corrosion inhibitor can lead to build up of sludge and reduced cooling capacity.


! 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 spillage 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

- Check that the radiator is 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.

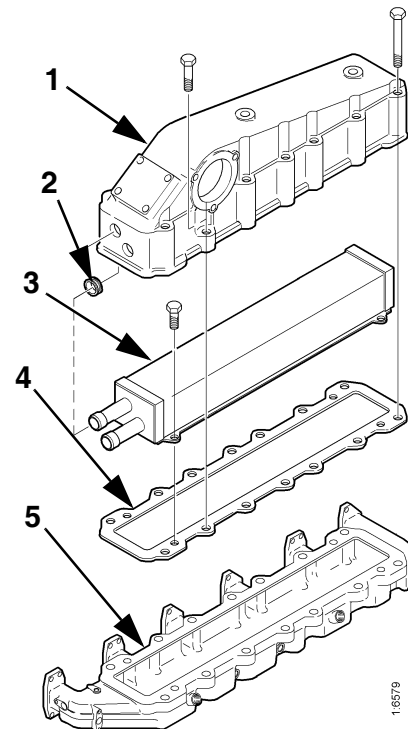
! Important

The cooling system must never be cleaned with caustic soda. There is a risk of damage to aluminium parts.

Charge air cooler (DI engine)

1. Drain the coolant from the engine, see "Changing the coolant".
2. Detach the intake manifold from the turbo.
3. Detach the charge air cooler inlet and outlet connections for the coolant.
4. Remove the upper intake manifold.
Take care not to damage the element's water connections.
5. Remove the bolts holding the element and remove the element.
6. Clean the outside of the element. Use a paraffin-based engine cleaner.
7. Fit a new gasket to the lower part of the intake manifold.
8. Screw the element into the lower part. Tighten the bolts to 26 Nm.
9. Fit new V-ring seals to the inlet and outlet connections of the element and fit the upper part of the intake manifold. Tighten the bolts to 50 Nm.
10. Refit the inlet and outlet connections with new O-rings.
11. Refit the delivery pipe clamps.
12. Connect the intake manifold from the turbo.
13. Fill up with coolant according to the specification on page 33.

1. Intake manifold, upper part
2. V-ring seal
3. Element
4. Gasket
5. Intake manifold, lower part



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:
Read the warning label on the container.**

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.



Mind the environment!

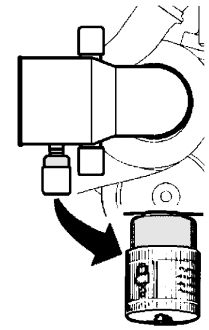
**Use a collecting vessel in order to avoid spillages when changing the coolant.
Dispose of used coolant through an authorised waste disposal contractor.**

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.

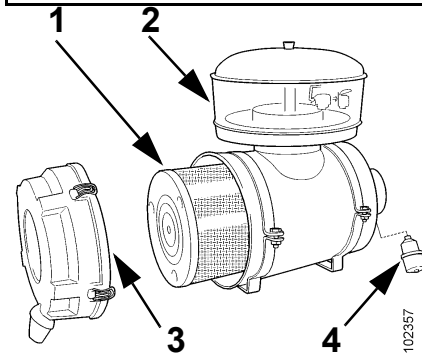


9. Every 200 hours:

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.

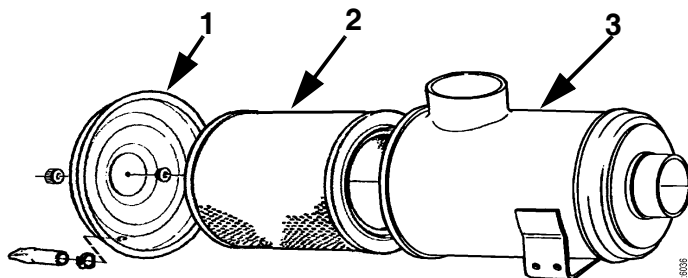
3. Mark the filter when it has been cleaned.

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.

! 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.

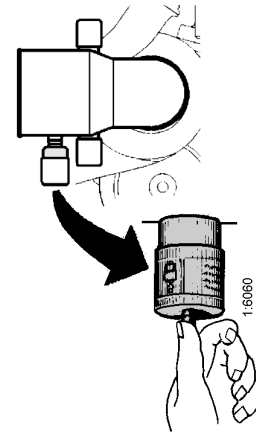
1. Cover
2. Filter element
3. Filter housing

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

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



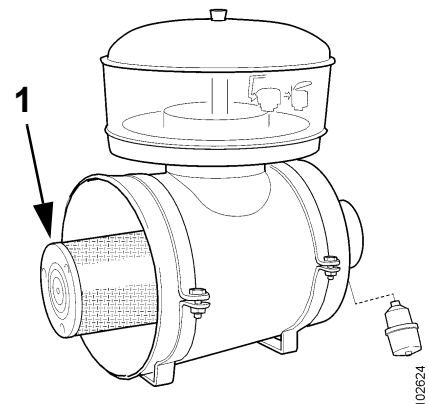
11. Every 2400 hours:

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

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.

! Important

Observe the utmost cleanliness when working on the fuel system.

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

13. Every 1200 hours: CHANGING THE FUEL FILTER

Fuel tanks

- Drain any water from the fuel tanks.

Filter

The filter consists of a filter unit.

- Wash the outside of the filter and unscrew it. Discard the filter according to environmental requirements.
- Fit the new filter and tighten it *by hand*.

Never use tools for this. The filters can be damaged, obstructing circulation.

- Bleed the fuel system as described below.
- Start the engine and check for leaks.

Bleeding the fuel system

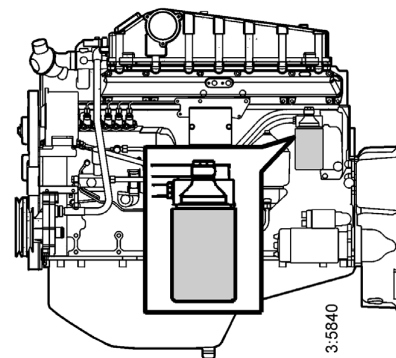
- Open the bleed screw **1** on the main filter.
- Pump with the hand pump **2** until the fuel flowing out by the bleed screw is free from air.
- Close the bleed screw. Pump a few more strokes with the hand pump.

If there are starting difficulties after bleeding

- Unscrew the injection pump overflow valve **3** half a turn and make another attempt at starting.

If the engine will still not start

- Pump with the hand pump until the fuel coming through the overflow valve is free from bubbles.
- Tighten the overflow valve when the engine has started.

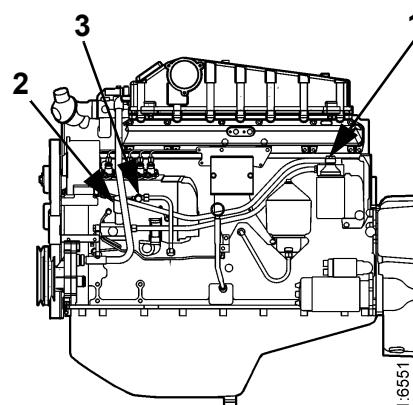


! Important

Only use Scania genuine fuel filter.

Recycle symbol **Mind the environment!**

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



14. Every 2400 hours:

CHECKING THE INJECTORS

Injectors should be inspected by trained personnel with access to the necessary equipment. Inspection should be carried out at least once a year or every 2400 hours.

Removal

1. Clean round the injectors and connections, including clamps and brackets.
2. Detach the delivery pipe bundle and leak-off fuel lines.
3. Unscrew the injector.
4. Fit protective plugs on the injector and delivery pipe.
5. Lift up the sealing washer from the bottom of the injector seat if it does not come out together with the injector.
6. Fit a core plug in the injector seat in the cylinder head.
7. Clean the injectors and check/adjust a nozzle tester.

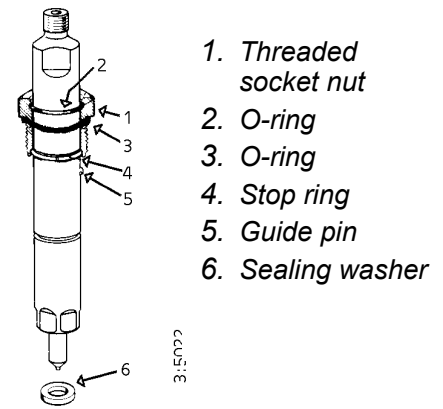
Correct opening pressure, see Technical data, page 54.

Fitting

1. Check that there is no old sealing washer in place and fit a new sealing washer in the bottom of the injector seat.
2. Fit a new O-ring in the threaded socket nut and a new sealing ring under the socket nut.
3. Fit the injector.
4. Tighten the socket nut to 70 Nm (7.0 kpm).
5. Fit the delivery pipe and tighten the cap nuts to 20 Nm (2.0 kpm). Fit clamps and brackets.

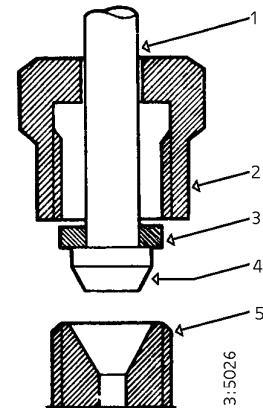
Take care to fit the delivery pipe without tension and make sure that the cone on it is correctly positioned in the connection.

6. Fit the leak-off fuel line. Tighten the bolts to 11 Nm (1.1 kpm).



! Important
The delivery pipes must not be bent.
All clamps must be refitted.

! WARNING
Also wear protective goggles when testing injectors.
A jet from the injector can penetrate tissue and cause serious injury.



1. Delivery pipe
2. Cap nut
3. Washer
4. Cone
5. Connection on injector or injection pump

ELECTRICAL SYSTEM

15. 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.

16. Every 200 hours:

CHECKING THE STATE OF CHARGE IN BATTERIES

Note: Every 200 hours applies to generator sets and the like. Other installations every 1200 hours.

- 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.

17. Every 200 hours:

CLEANING BATTERIES

Note: Every 200 hours applies to generator sets and the like. Other installations every 1200 hours.

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.

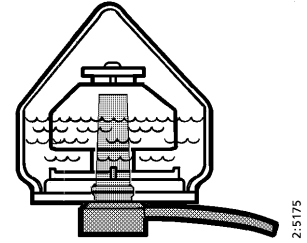
If the terminals are shorted, sparking will occur.

18. Every 1200 hours:

CHECKING THE COOLANT MONITOR

(optional equipment)

1. Start the engine.
2. Lower the coolant level in the expansion tank.
3. *Automatic stop in case of fault:* Engine stops, indicator lamp is on, and buzzer sounds if there is no fault in the level monitor.
4. *No automatic stop in case of fault:* Indicator lamp is on, buzzer 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 spillage when draining the coolant.
Dispose of used coolant through an authorised waste disposal contractor.

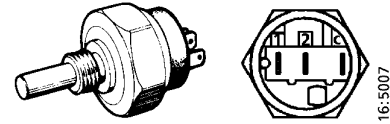
19. Every 1200 hours:

CHECKING THE TEMPERATURE MONITOR

1. Drain the coolant, allowing the temperature monitor to be removed.
2. Remove the temperature monitor cable(s).
3. Unscrew the monitor.
4. Refit the cable(s) on the monitor.
5. Submerge the monitor sensor body in water. Heat the water slowly (about 1° per minute) using an immersion heater, for example.
6. Set the control switch to "ON". Use a thermometer to check that the warning lamp comes on or that an alarm is initiated at the correct temperature.

The correct temperature is stamped on the hexagonal part of the monitor.

The monitor tolerance is $\pm 3^\circ$.



- C = Common connection
 1 = Connection C -1 closes at the stamped temperature
 2 = Connection C -2 switches off at the stamped temperature
 2-pin temperature monitor

CHECKING THE TEMPERATURE SENSOR

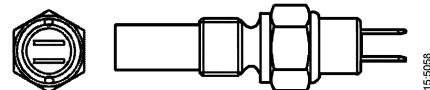
1. Drain the coolant, allowing the temperature sensor to be removed.
2. Remove the temperature sensor cable(s).
3. Unscrew the sensor.
4. Connect an ohmmeter to the temperature sensor.
5. Submerge the sensor body in water. Heat the water slowly (about 1° per minute) using an immersion heater, for example.
6. Check the resistance at the temperatures given below.
7. The sensor should give the following readings:

At temp. °C	Resistance Ω	Tolerance °C
60	134 ± 13,5	±4
90	51,2 ± 4,3	±3
100	38,5 ± 3	±3



Mind the environment!

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



2-pin temperature sensor

20. Every 1200 hours:

CHECKING THE OIL PRESSURE SENSOR/MONITOR

Sensor function

Measure the output voltage from the sensor (pin 3) at different oil pressures.

The sensor should give the following readings:

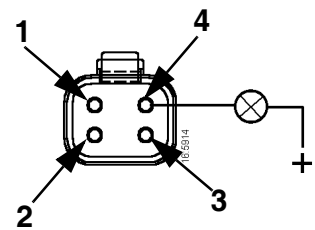
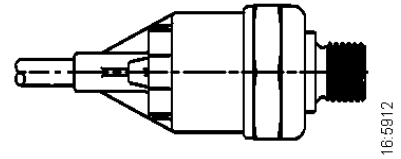
0.85-1.15 bar	=	2.45 volts
1.80-2.20 bar	=	3.70 volts
2.75-3.25 bar	=	4.50 volts
3.79-4.20 bar	=	5.20 volts
4.55-5.45 bar	=	5.70 volts
5.40-6.6 bar	=	6.10 volts

The tolerance values apply at +30°C - 110°C. The tolerance range increases at lower temperatures, e.g. 0°C = x 1.4.

Monitor function

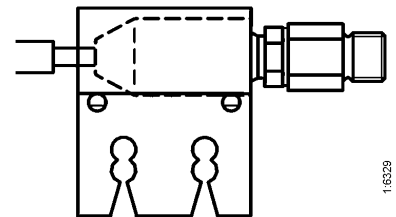
Connect a test lamp to oil pressure monitor pin 4 (- earth) and check that the monitor closes at the correct pressure when the engine is started and stopped. The monitor should close at 0.7 ± 0.15 bar when the engine is stopped.

Important *The sensor/monitor must be supplied with voltage when measuring. Max. load 4 W from test lamp.*



CHECKING THE OIL PRESSURE MONITOR FOR DEC 2

Connect an ohmmeter or test lamp to the oil pressure monitor and check that the monitor opens/closes at the correct pressure when the engine is started and stopped. The monitor should open at 1.1 ± 0.15 bar when the engine is started and close at 0.7 ± 0.15 bar when the engine is stopped.



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.

MISCELLANEOUS

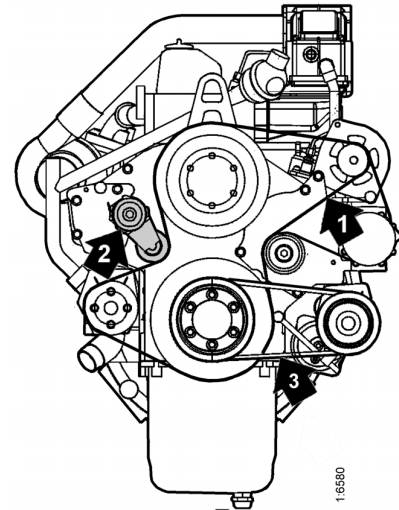
21. Every 1200 hours:

CHECKING THE DRIVE BELT

If the drive belt (1), which is a poly-V belt, is worn or damaged it must be changed.

Also check that the automatic belt tensioner (2) is in proper working order and keeps the drive belt correctly tensioned.

The extra coolant pump is driven with a V-belt (3) via a pulley on the crankshaft. This V-belt should be tensioned with the aid of the pump attachment until it can be pressed down a maximum of 10 mm with a pressure of 35-50 N.



1-63590

22. Daily:

CHECKING FOR LEAKAGE, NECESSARY ACTION

- Start the engine.
- Check for oil, coolant, fuel, air and exhaust leakages.
- Tighten or change leaking connections. Check the overflow holes (1) in the block 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 oil is running out, the liner shelf is leaking.

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.

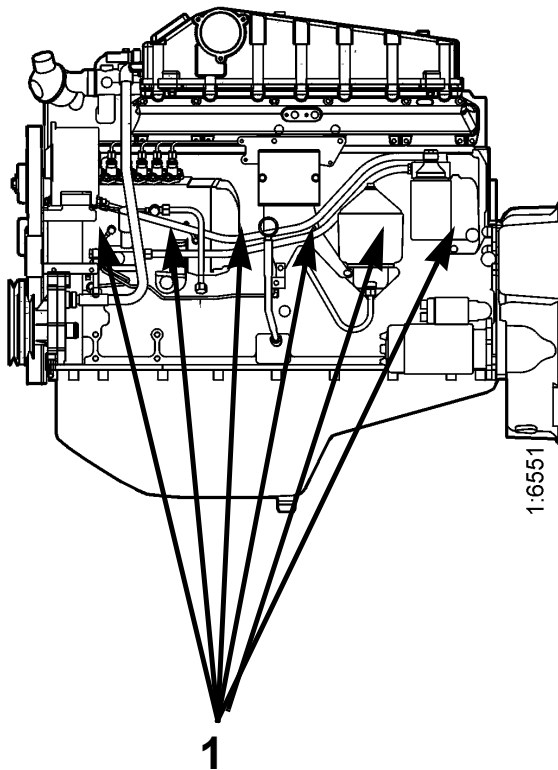


Mind the environment!

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

! Important

If serious leakage occurs, contact your nearest Scania workshop.



23. Every 2400 hours: CHECKING/ADJUSTING VALVE CLEARANCES

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: 0.80 mm.

Alternative 1

- Set No. 1 cylinder to TDC by turning the engine in its direction of rotation until all four valves are closed.
- Adjust the following valves. Correct valve clearances are also given on the instruction plate on one of the rocker covers:

Cylinder	1	Intake and outlet
	2	Intake
	3	Outlet
	4	Intake
	5	Outlet

- Set No. 6 cylinder to TDC by turning the engine one revolution in its direction of rotation and adjust the following valves:

Cylinder	2	Outlet
	3	Intake
	4	Outlet
	5	Intake
	6	Intake and outlet



WARNING

Immobilise the starting device when working on the engine.

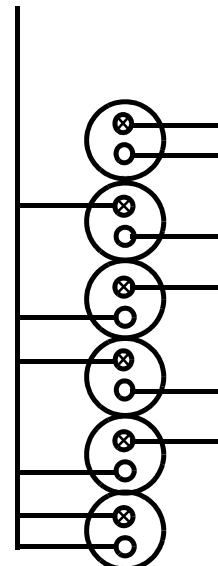
If the engine starts out of control, there is a **SERIOUS RISK OF INJURY.**



FLYWHEEL

Cylinder numbering

TDC TDC
no. 6 cylinder no. 1 cylinder



FLYWHEEL

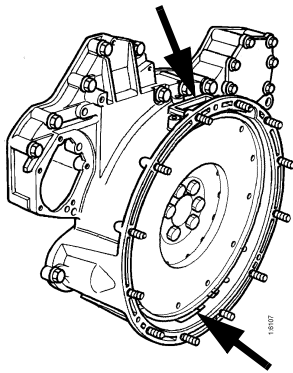
Intake valve

○ Exhaust valve



Alternative 2

- Set No. 1 cylinder to TDC by turning the engine in its direction of rotation until all four valves are closed.
- Adjust all valves for No. 1 cylinder. Correct valve clearances are indicated on the instruction plate on one of the rocker covers.
- Repeat this procedure with the other cylinders in the order 5 - 3 - 6 - 2 - 4 (firing order) by turning the engine 1/3 revolution in its direction of rotation between each adjustment.



*Covers for reading
on the flywheel housing*

Note:

Readings can be taken from the flywheel through covers in the flywheel housing either from above or underneath depending on access when fitting.

It says *up* or *down* on the flywheel

Both covers are fitted with a cover at delivery.

24. Every 2400 hours:

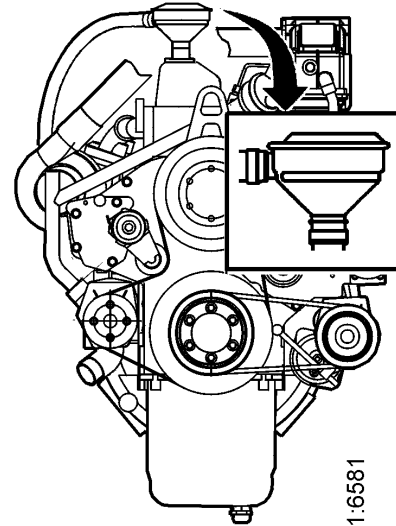
CHANGING (or CLEANING) THE CLOSED CRANKCASE VENTILATION VALVE

Alternative 1:

Change the valve at the specified interval.

Alternative 2:

- Remove the valve after the specified interval.
- Clean the valve by placing it in a bath of diesel fuel oil overnight. Then rinse it several times in diesel and allow it to drip dry.
- Refit the valve.
- The valve may be reused (cleaned), but *not more than twice* after the first 2400 hours of use. Take care to mark the valve after cleaning it.



LONG-TERM 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 the engine for long-term 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 to be stored with a full cooling system, use coolant containing 50% glycol by volume. Glycol *without* nitrite-based inhibitor should be used. For example **BASF G48** or **BASF D542**.



WARNING

Ethylene glycol is toxic if ingested.

Avoid contact with the skin.

Preservative fuel

- Use diesel fuel oil mixed with Lubrizol 560A or equivalent.
- Mix 1 cm³ (ml) Lubrizol 560A in 10 dm³ (l) of fuel.



HANDLING LUBRIZOL 560A

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 oil can be supplied by most petroleum companies.

E.g. Dinitrol 40 or the 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.
- Change the fuel filter and turbo 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 (not single-speed engines) for 20-25 minutes.
- Stop the engine, remove the hoses and connect the regular fuel lines.
- Oil the valve mechanism generously with preservative oil.
- Remove the injectors and spray preservative oil into each cylinder, **max 30 cm³ (ml)**.
Turn the engine over a few times using the starter motor. Spray a **small** amount of oil additionally into each cylinder.
After this the engine must not be cranked. Refit the injectors.
- 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 a full cooling 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, first with penetrating preservative oil such as Dinitrol 25B and then with Dinitrol 112 or the equivalent.

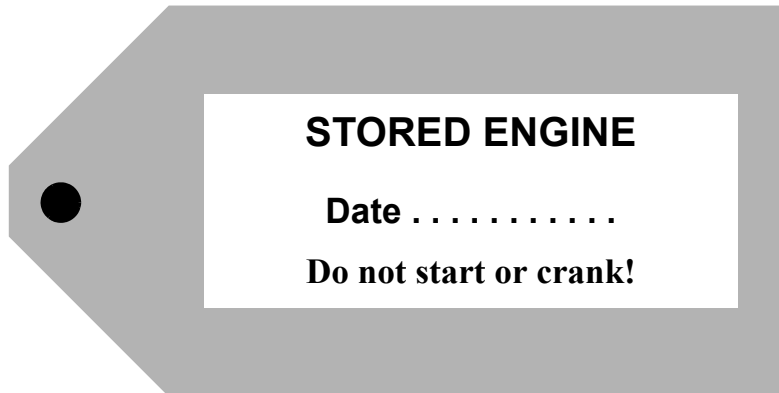


Mind the environment!

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

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

- Attach a label to the engine showing the date of preservation and clearly stating that it 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 if the engine has not been prepared for storage as above.

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 19.
- Check the oil level in the engine or fill up with fresh motor oil.
- Turn the engine over a few times with the injectors removed, at the same time copiously oiling the valve mechanism with pushrods and tappets.

Important! *The engine must be turned over with the injectors removed so that surplus preservative oil will be pressed out of the cylinders.*

- Fit the injectors.
- Empty the fuel system's main filter of preservative oil.
- Bleed the fuel system, see page 40.
- Wash off any externally applied preservative oil, using white spirit.



TECHNICAL DATA

GENERAL	DC9	DI9
Number of cylinders	6 in line	
Cylinder diameter mm	115	
Stroke mm	144	
Capacity dm ³ (litres)	9,0	
No. of main bearings	7	
Firing order	1 - 5 - 3 - 6 - 2 - 4	
Compression ratio	17:1	
Engine direction of rotation viewed from rear	Anti-clockwise	
Fan direction of rotation viewed from front	Clockwise	
Cooling	Liquid	
Valve clearances, cold engine intake valve mm exhaust valve mm	0,45 0,80	
Weight, without coolant or oil *With charge air cooler, radiator, expansion tank and pipes kg	890*	840
Power	see engine card, "Engine record card"	
LUBRICATION SYSTEM		
Max. oil pressure (hot engine at engine speeds above 800 rpm bar (kp/cm ²))	6	
Normal oil pressure (hot engine at operating speeds) bar (kp/cm ²)	3 - 6	
Min. oil pressure (hot engine 800 rpm) bar (kp/cm ²)	0,7	
Oil capacity, see page 29		
Crankcase pressure with closed crankcase ventilation mm VP	-55 - +20	

FUEL SYSTEM		DC9	DI9
Pump setting BTDC		See plate on rocker cover	
Injector, opening pressure	bar (kp/cm ²)	300	
Low idle speed	rpm	700	
Maximum full load speed		See engine card	
Fuel		Diesel fuel oil ¹	
Tightening torques:			
Threaded socket nut for injectors	Nm	70	
Cap nut for delivery pipe	Nm	20	
Oil leakage connection	Nm	11	
¹ see page 56			
COOLING SYSTEM			
Number of thermostats		1	
Thermostat, opening temperature	°C	79	
Coolant temperature:			
system at atmospheric pressure	°C	70 - 93	
system at overpressure	°C	70 - approx. 100	
Volume, incl 0.75 m ² radiator and expansion tank	dm ³ (litres)	50	53
ELECTRICAL SYSTEM			
System voltage	V	24	
Alternator, current	A	65 or 90	
Starter motor output	kW (hp)	4,0 (5,4)	
Monitors, alarm values:			
oil pressure monitor	bar (kp/cm ²)	0,7 ± 0,15	
temperature monitor	°C	Stamped on hexagonal part of monitor	

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 pump. 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.

The diesel fuel must meet European standard EN 590.

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 lose 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. The injection pump may be damaged. 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 injection pump and at worst it may also cause damage to the engine.

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