

IMPORTANT INFORMATION

When working on the engine, e.g. when adjusting the belts, changing oil or adjusting the clutch it is important that the engine does not start. The engine may be damaged but above all 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

D9 DI9 DC9

Industrial engine

opm96-9a en 1 588 292

2001-05:1

START-UP REPORT - WARRANTY

When the start-up report has been filled in and sent to Scania there is a 1 year warranty starting from the start-up date. Also enter the below information since this will facilitate contacts with e.g. service workshops.

Engine number

.....

Start-up date

.....

User's name and address

.....
.....
.....
.....

Signature

.....

Engine type

.....

Variant

.....

Engine type and variant are indicated on the engine type plate

FOREWORD

This operator's manual describes the operation and maintenance of the Scania D9, DI9 and DC9 industrial engines. The instructions apply to engines in *program 96*, starting with engine number 5 119 902.

The engines are of direct-injection, liquid-cooled, four-stroke, 6-cylinder in-line diesel type. The engines are available with or without charge air cooler, 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 are available with different power output and engine 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 a few points to bear in mind:

- Read the manual before starting to use the engine. You will find new information in this Operator's Manual even if you have previous experience of Scania engines.
- Follow the maintenance instructions. Proper maintenance is essential to keep the engine operating correctly and to increase engine life.
- *Pay special attention to the safety information beginning 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 trained staff with practical experience of Scania engines.

Note: Always use genuine Scania parts in service and repair to keep the engine operating correctly.

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

Scania CV AB
 Industrial and Marine Engines
 S-151 87 Södertälje, Sweden

! Important

**During the warranty period,
 only use genuine Scania parts in
 service and repair for the
 warranty to be valid.**

TABLE OF CONTENTS

| | |
|--|--|
| FOREWORD 2 | AIR CLEANER 30 |
| ENVIRONMENTAL RESPONSIBILITY 4 | CHECKING THE VACUUM INDICATOR ... 30 |
| CERTIFIED ENGINES 5 | CLEANING THE AIR CLEANER COARSE CLEANER 30 |
| SAFETY DETAILS 6 | CLEANING OR CHANGING THE FILTER ELEMENT 30 |
| Safety precautions for operation 7 | RENEWING THE SAFETY CARTRIDGE ... 31 |
| Safety precautions for handling materials 8 | |
| Safety precautions for care and maintenance .. 8 | |
| TYPE DESIGNATIONS 10 | |
| STARTING AND RUNNING 12 | FUEL SYSTEM 32 |
| AT FIRST START 12 | CHECKING THE FUEL LEVEL 32 |
| CHECKS BEFORE RUNNING 13 | RENEWING THE FUEL FILTER 32 |
| STARTING THE ENGINE 13 | CHECKING THE INJECTORS 33 |
| At temperatures below 0 °C: 14 | |
| OPERATION 15 | ELECTRICAL SYSTEM 34 |
| Engine speed 15 | CHECKING THE ELECTROLYTE LEVEL IN BATTERIES 34 |
| 15 | CHECKING THE STATE OF CHARGE IN BATTERIES 34 |
| Coolant temperature 15 | CLEANING THE BATTERIES 34 |
| Oil pressure 16 | CHECKING THE COOLANT LEVEL MONITOR 35 |
| STOPPING THE ENGINE 16 | CHECKING THE TEMPERATURE MONITOR 36 |
| Emergency stop 16 | CHECKING THE TEMPERATURE SENSOR . 36 |
| Clutch 17 | CHECKING THE OIL PRESSURE SEN- SOR/MONITOR 37 |
| CHECKS AFTER RUNNING 17 | CHECKING THE STOP FEATURE 37 |
| MAINTENANCE 18 | MISCELLANEOUS 39 |
| ENGINES WITH FEW HOURS OF OPERATION 18 | CHECKING THE DRIVE BELT 39 |
| MAINTENANCE SCHEDULE 19 | CHECKING FOR LEAKAGE, RECTIFY AS NECESSARY 40 |
| LUBRICATING OIL SYSTEM 20 | CHECKING/ADJUSTING VALVE CLEARANCE 41 |
| OIL GRADE 20 | CHANGING (OR CLEANING) THE CLOSED CRANKCASE VENTILATION VALVE 42 |
| Oil analysis 20 | |
| CHECKING THE OIL LEVEL 21 | LONG-TERM STORAGE 43 |
| OIL CHANGE 21 | Preservative fuel 43 |
| Maximum angles of inclination during operation 21 | Preservative oil 44 |
| CLEANING THE OIL CLEANER 22 | Preparations for storage 44 |
| RENEWING THE TURBO FILTER 24 | Batteries 45 |
| COOLING SYSTEM 24 | Storage 45 |
| CHECKING THE COOLANT LEVEL 24 | Taking out of storage 45 |
| CHECKING THE COOLANT 25 | TECHNICAL DATA 46 |
| Checking the corrosion inhibitor 27 | FUEL 48 |
| Changing the coolant 27 | |
| CLEANING THE COOLING SYSTEM 28 | ALPHABETICAL INDEX 50 |
| Internal cleaning 29 | |

ENVIRONMENTAL RESPONSIBILITY

Scania has always been at the forefront in the development and production of environmentally safe engines.

We have made great progress in reducing harmful exhaust emissions to be able to meet the stringent emission standards that are mandatory for almost all markets.

We have done this without compromising the high quality of Scania industrial and marine engines in terms of performance and cost effective operation.

To maintain these superior properties throughout the life of the engine it is important that the operator/owner follows the instructions of this manual as regards operation, maintenance and choice of fuel and lubricants.

To further contribute to protecting the environment in service, maintenance and repair, ensure that harmful waste (oil, fuel, coolant, filters, batteries etc.) is disposed of and destroyed according to applicable local regulations.

This operator's manual contains highlighted text urging you to protect the environment in different service and maintenance operations.

Refer to example



Mind the environment!

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

CERTIFIED ENGINES

An emission certified engine has been approved according to a specific certification standard. The certified engines delivered by Scania meet the most compelling emission standards in the European (EU) and non-European (USA) markets.

Scania guarantees that all engines of a certified engine type that are delivered, correspond to the engine approved for certification.

The engine is fitted with a certification plate, stating according to which certification rules (standard) the engine has been approved. Refer to page 10.

The following is required for the engine to meet the emission standards after being commissioned:

- *Service and maintenance must be performed according to this Operator's Manual.*
- *Only genuine Scania parts must be used.*
- *Service work on the injection equipment must be performed by an authorized Scania workshop.*
- *The engine must not be modified with equipment not approved by Scania.*
- *Seals and setting data may only be broken/modified after approval by Scania, Södertälje. Changes should only be made by qualified personnel.*
- *Changes affecting the exhaust system and intake system must be approved by Scania.*

Otherwise, follow the instructions in this manual for operation, care and maintenance of the engine. Also observe the safety precautions described in the following four pages.

Important! *If service and maintenance are not performed as stated above, Scania cannot guarantee that the engine corresponds to the certified configuration and will not assume liability for any damage occurring.*

SAFETY DETAILS

General

This Operator's Manual contains safety information that must be observed in order to avoid personal injuries and damage to the product or property. Refer to page 1.

The text boxes to the right on the pages provide information that is important for the proper operation of the engine and to avoid damage to the engine. Failure to follow these instructions may void the warranty.

Refer to example. →

! Important

Only use Scania genuine fuel filter.

Corresponding texts may also appear in the text column, headed **Caution!** or **Important**

The warning text in text boxes to the right on the pages provided with a **warning triangle** and headed **WARNING** is *extremely important* and warns of serious defects to the engine or improper handling that may lead to personal injury.

Refer to 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.**

The safety precautions that must be observed in the operation and maintenance of Scania engines are compiled on the following three pages. The corresponding text is also often stated next to the maintenance step concerned, shown with different degrees of significance as described above.

All items are marked with a **!** to highlight the importance of reading each item in the section.

A general safety rule is that no smoking is allowed:

- Near the engine and the engine bay
- When refuelling and near the filling station
- When work is performed on the fuel system
- Near flammable or explosive materials (fuel, oils, batteries, chemicals etc.)

Safety precautions for operation

! Daily inspection

Always perform visual inspection of the engine and engine bay before the engine is started and when the engine has been stopped after operation.

This will make it easy to detect any leakage of fuel, oil or coolant or any other abnormal condition that may require remedial action.

! Refuelling

When refuelling, there is a risk of fire and explosion. The engine must be stopped and smoking is not allowed.

Do not overfill the tank, since the fuel may expand, and close the fuel filler cap properly.

Only use fuel recommended in the service literature. Fuel of an incorrect grade may cause malfunctions or stoppage by interfering with the operation of the fuel injection pump and the injectors.

This could cause engine damage and possibly personal injury.

! Harmful gases

Only start the engine in a properly ventilated area. The exhaust emissions contain carbon monoxide and nitrogen oxides that are toxic.

When operating the engine in an enclosed area, an effective extraction device for exhaust gases and crankcase gases must be used.

! Starter lock

If the control panel is not fitted with a key switch, the engine bay should be fitted with a lock to prevent unauthorized starting of the engine.

Alternatively, a lockable main switch or battery master switch may be used.

! Starting spray

Never use starting spray or similar as a starting aid. An explosion may occur in the intake pipe, which could cause personal injury.

! Operation

The engine should not be operated in environments with surrounding explosive materials since electrical or mechanical components of the engine may emit sparks.

It is always a safety hazard to be near an engine that is running. Body parts or clothing, or a dropped tool may get stuck in rotating parts, such as the fan, causing bodily injury.

Always cover rotating parts and hot surfaces as much as possible to ensure personal safety.

Safety precautions for handling materials

! Fuel and lubrication oil

All fuels and lubricants as well as many chemicals are flammable. Always follow the instructions stated on the container.

All work on the fuel system must be performed when the engine is cold. Fuel leakage and spillage on hot surfaces may cause fire.

Store drenched rags and other flammable materials in a safe way to avoid spontaneous combustion.

! Batteries

Batteries, particularly when being recharged, emit highly flammable fumes that can explode. Do not smoke or let open flame or sparks come near the batteries or the battery compartment.

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

! Chemicals

Most chemicals, such as glycol, corrosion inhibitors, preservation oils, degreasers etc. are hazardous. Always follow the safety precautions stated on the container.

Some chemicals, e.g. preservative oil, are flammable.

Always store chemicals and other hazardous materials in approved and distinctly marked containers and out of reach of unauthorized persons. Always dispose of superfluous or used chemicals through an authorized waste disposal contractor.

Safety precautions for care and maintenance

! Stop the engine

Always stop the engine before any maintenance and service work unless otherwise stated.

Prevent unauthorized starting by removing the starter key and turning off the power by the main switch or the battery disconnect switch, locking it in the off position. Also attach a warning tag, stating that work on the engine is in progress, at a suitable location.

It is always a safety hazard to work on an engine that is running. Parts of your body or clothing, or a dropped tool may get stuck in rotating parts, causing bodily injury.

! Hot surfaces and fluids

A hot engine always presents a risk of scalding. Always take care not to touch the exhaust manifold, turbocharger, oil pan, hot coolant and oil in pipes and hoses.

! Lifting the engine

Use the engine lifting eyes when lifting the engine. First check that the lifting equipment is in proper condition and has sufficient lift capacity rating.

Auxiliary equipment fitted to the engine may cause the centre of gravity to be displaced. Thus, additional lift devices may be required in order to provide proper balance and a safe lift.

Never work below a suspended engine!

! Batteries

Batteries contain a highly corrosive electrolyte (sulphuric acid). Always take care to protect your eyes, skin and clothing when charging and handling batteries. Wear protective gloves and goggles.

If electrolyte splashes on the skin, wash the affected part of the body with soap and plenty of water. If electrolyte splashes into the eyes, rinse eyes immediately with plenty of water and seek medical attention.

Dispose of used batteries through an authorized waste disposal contractor.

! Electrical system

Before work is performed on the electrical system, turn off the power by the main switch or the battery disconnect switch.

Also disconnect any external power supply to auxiliary equipment on the engine.

! Arc Welding

Before welding near or on the engine, remove the battery and alternator cables. Also remove the control unit connector.

Connect the weld clamp to the component to be welded, close to the weld location. Never connect it to the engine or in such a way that the current can pass through a bearing.

After the welding is completed, connect the cables to the alternator and the control unit before connecting the batteries.

! Lubrication system

Hot oil may cause scalding and skin irritation. Avoid skin contact with hot oil.

Make sure that the pressure in the lubrication system is relieved before work is carried out. Never start or operate the engine with the oil filler cap removed since oil will be ejected forcefully.

Dispose of used oil through an authorized waste disposal contractor.

! Cooling system

Never open the coolant filler cap while the engine is hot. Steam and hot coolant can come out forcefully and cause scalding.

If the cooling system must still be opened or disassembled while the engine is hot, open the filler cap very cautiously and slowly to release the pressure before the cap is removed. Use gloves since the coolant is still very hot.

Dispose of used coolant through an authorized waste disposal contractor.

! Fuel system

Always use gloves when checking for leaks in or performing other work on the fuel system. Always wear eye protection when testing injectors.

Fuel escaping under high pressure can penetrate body tissue and cause serious injury.

Never use non-genuine parts in the fuel system and the electrical system. Genuine parts are designed and manufactured to minimize fire and explosion hazard.

! Before starting

Install any guards that have been removed before the engine is started. Check to ensure that no tools or other objects have been left on the engine.

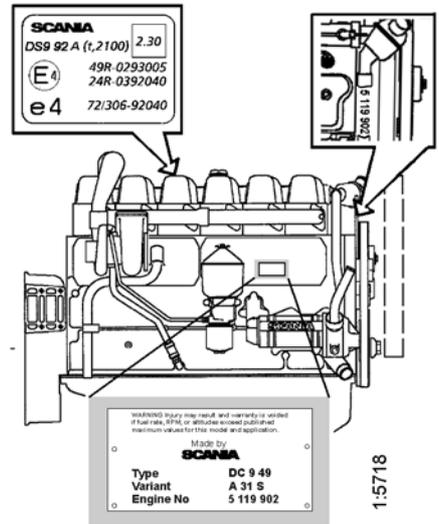
Never start the engine unless the air filter is installed. Otherwise there is a risk of objects entering the compressor wheel or a risk of personal injury from contact with it.

TYPE DESIGNATIONS

The engine designation indicates, as a code, engine type, its size and applications, etc.

The type designation and engine number are indicated on a type plate which is located on the right-hand side cover, behind the oil cleaner. The engine number is also stamped on the top of the engine block, in front of the first cylinder head.

Engines that are certified regarding smoke and emissions are fitted with a certification plate specifying the documents they conform to. This plate is located on the second rocker cover from the front.



DC 9 49 A 31 S

Type

- D Turbocharged diesel engine
- DC Turbocharged diesel engine with air-cooled charge air cooler.
- DI Turbocharged 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.

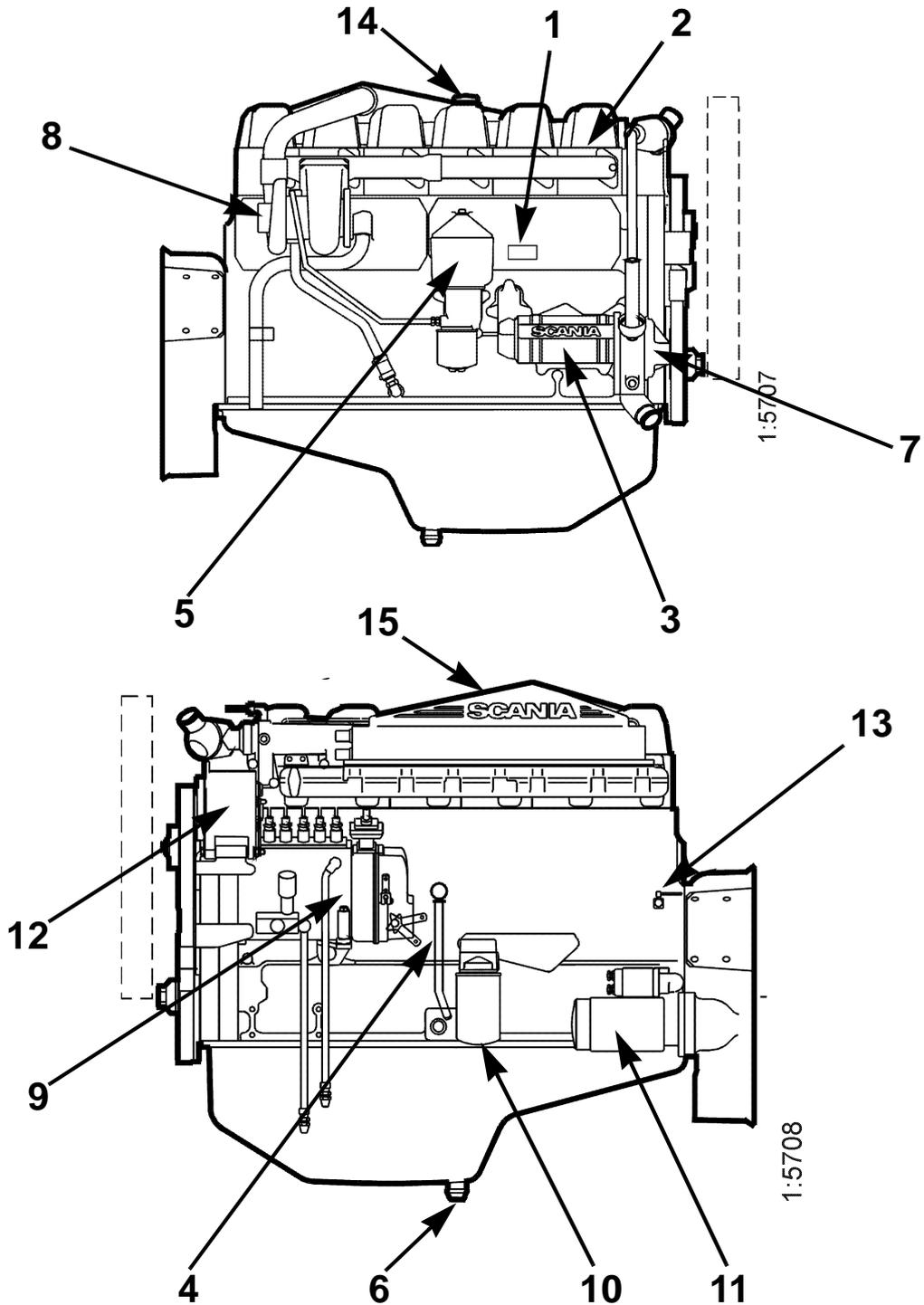
Application

- A For general industrial use

Variant 01-99

Governor type

- D Electronically controlled auxiliary governor
- S RSV, all-speed and single-speed governor



The illustrations show a typical DI9 engine configuration.
Your engine may have different equipment from the one shown.

- | | | |
|--|-------------------------|-----------------------|
| 1. Type plate | 6. Draining, engine oil | 12. Alternator |
| 2. Engine number, stamped in engine block | 7. Water pump | 13. Draining, coolant |
| 3. Oil cooler | 8. Turbocharger | 14. Oil filling |
| 4. Oil dipstick | 9. Injection pump | 15. Charge air cooler |
| 5. Oil cleaner | 10. Fuel filter | |
| | 11. Starter motor | |

STARTING AND RUNNING

AT FIRST START

When the engine is started for the first time, follow the maintenance points listed under "First start" in the maintenance schedule, see page 19.

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 (refer to page 21).
6. Checking the coolant (refer to page 25).

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 glycols 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. A content of 30 % by volume provides protection down to -16 °C. Refer to page 25.
- *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 corrosion inhibitor content is 7-12% by volume and must never be less than 7% by volume. The inhibitor in *Scania Corrosion Inhibitor* is free of nitrite.
- First filling: Fill the cooling system with *water + 10% by volume of Scania Corrosion Inhibitor*. Use drinkable water with a pH value of 6 - 9.
- *Never top up with only water or only anti-corrosive! Fluid losses must always be replaced with premixed coolant: water + 10 % by volume of Scania Corrosion Inhibitor.*

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:
7-12% by volume
Scania Corrosion Inhibitor
(no glycol)



WARNING

Ethylene glycol and corrosion inhibitor, if swallowed can be fatal.

Avoid contact with the skin.

! Important

The recommended glycol must not be mixed with glycol having nitrite-based anti-corrosive.

! Important

The use of too much *Scania Corrosion Inhibitor* as mixed with glycol may cause deposits.

! Important

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

- 12. Checking the fuel level (refer to page 32).
- 15. Checking the electrolyte level in batteries (refer to page 34).
- 16. Checking the state of charge in batteries refer to page 34)
- 18. Checking the coolant level monitor (refer to page 35).
- 19. Checking the temperature monitor (refer to page 36).
- 20. Checking the oil pressure monitor (refer to page 37).
- 21. Checking the stop feature (refer to page 37).
- 22. Checking the tension of drive belts (refer to page 39).



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 19.

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 32.

For environmental reasons, 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.

- Engines with mechanical stop control: Set the stop control to operating position.
- 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 using the battery master switch.
- Set the speed control to raised idling. (Does not apply to gensets)
- Start the engine.

Important *A maximum of 3 start attempts per minute may be made when the stop solenoid is activated at start. The timer module can be damaged resulting in the loss of the stop feature.*

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

Only start the engine in a properly ventilated area. When operating the engine in an enclosed area, an effective extraction device for exhaust gases and crankcase gases must be used.



WARNING

Never use starting spray or similar as a starting aid. An explosion may occur in the intake pipe, which could cause 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 cool 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 (max. 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 (a maximum of 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 turned 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 until the oil pressure has reached a sufficiently high level. If the INTERLOCK switch is released too early, the engine will stop.

- 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 light load. A light load on a cold engine gives better combustion and faster heating than warming up with no load.

! *Important*

Maximum starter engagement time is 30 seconds. Risk of overheating. Allow starter to cool for 2 minutes after a starting attempt before cranking again.

OPERATION

Check instruments and warning lamps at regular intervals.

Engine 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: | low idle. |
| 700-2200 rpm | green area: | normal operating speed. Highest torque and lowest fuel consumption at 1400 - 1600 rpm. Low operating speed gives less engine wear. |
| 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 |

Coolant temperature

Correct coolant temperature during operation:

70 - 93 °C for system at atmospheric pressure.

70 - about 100 °C for system with positive pressure.

High coolant temperature leads to engine damage. Reduce the load on the engine in order to lower the temperature. If the temperature does not drop, stop the engine and look for the fault.

During long periods of operation with very low power take-off, the engine may have difficulty in reaching 70 °C. However, if the load is increased, temperature will rise.

! Important

Overpressure is not allowed in cooling systems with Scania radiators and expansion tanks made of plastic, i.e. the expansion tank must not be fitted with a pressure cap.

Oil pressure

Max. oil pressure:

warm engine running at a speed above 800 rpm 6 bar

Normal oil pressure:

warm engine running at operating speed 3 - 6 bar

Min. oil pressure:

warm engine running at 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.

Charging indicator lamp

If the lamp comes on during operation:

- Check that the alternator drive belt is tensioned. See page 39
- 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 using the stop control. Engines with a stop solenoid are stopped using the stop button. Keep the stop button depressed until the engine has fully stopped.
3. Engines with battery master switch: Switch the power off with the battery master switch. (Does not apply to emergency generator sets).
4. 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.

Emergency stop

The stop solenoid linkage system has a knob marked "STOP". Pull the linkage system to the stop position using this knob if it is not possible to stop the engine using the stop solenoid.

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 MAY CAUSE PERSONAL 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 a sufficient amount of glycol, refer to page 25
- Vid temperatur under 0 °C: Förbered nästa start genom att koppla in ev. motorvärmare.



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

Top up engine coolant when the engine has been stopped after being started for the first time.

MAINTENANCE

The maintenance programme covers 25 points, divided into the following main groups:

| | |
|---|--------|
| Lubricating oil system | sid 20 |
| Cooling system | sid 24 |
| Air cleaner | sid 30 |
| Fuel system | sid 32 |
| Electrical system, monitors, batteries etc. | sid 34 |
| Miscellaneous | sid 39 |

The maintenance points are divided into intervals as follows:

Daily maintenance

Maintenance before 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



WARNING

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

ENGINES WITH FEW HOURS OF OPERATION

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 the oil level.
5. Checking the coolant level.
8. Checking the vacuum indicator.
12. Checking the fuel level.
15. Checking the electrolyte level in batteries.
16. Checking the state of charge in batteries.
17. Cleaning the batteries.
23. Checking for leakage, rectify as necessary

! Important

For engines with few operating hours that are not subject to periodic maintenance according to the maintenance schedule on page 19, maintenance should be carried out in accordance with the schedule:

"Every year"

"Every 5 years"

MAINTENANCE SCHEDULE

| | Daily | First time at | | Interval | | | | At least | |
|---|-------|---------------|-------|----------|-------|--------|--------|----------|----------|
| | | First start | 400 h | 200 h | 400 h | 1200 h | 2400 h | 4800 h | Annually |
| LUBRICATING OIL SYSTEM, page 20 | | | | | | | | | |
| 1. Checking the oil level | ● | ● | | | | | | | |
| 2. Oil change | | | | | ●1 | | | ● | |
| 3. Cleaning the oil cleaner | | | | | ●1 | | | ● | |
| 4. Renewing the oil filter | | | | | ●1 | | | ● | |
| COOLING SYSTEM, page 24 | | | | | | | | | |
| 5. Checking the coolant level | ● | | | | | | | | |
| 6. Checking the coolant | | ● | | | | ●4 | | ● | |
| 7. Cleaning the cooling system | | | | | | | ●1 | | ● |
| AIR CLEANER, page 30 | | | | | | | | | |
| 8. Checking the vacuum sensor | ● | | | | | | | | |
| 9. Cleaning the coarse cleaner | | | | ●1 | | | | | ● |
| 10. Cleaning or renewing filter element | | | | | ●3 | | | | ● |
| 11. Renewing the safety cartridge | | | | | | ● | | | ● |
| FUEL SYSTEM, page 32 | | | | | | | | | |
| 12. Checking the fuel level | ● | ● | | | | | | | |
| 13. Renewing the main filter | | | | | ●1 | | | | ● |
| 14. Checking the injectors | | | | | | ● | | ● | |
| ELECTRICAL SYSTEM, page 34 | | | | | | | | | |
| 15. Checking the electrolyte level in batteries | | ● | | ●2 | | | | ● | |
| 16. Checking the state of charge in batteries | | ● | | ●2 | | | | ● | |
| 17. Cleaning the batteries | | | | ●2 | | | | ● | |
| 18. Checking the level monitor | | ● | | | ● | | | ● | |
| 19. Checking the temperature monitor | | ● | | | ● | | | ● | |
| 20. Checking the oil pressure monitor | | ● | | | ● | | | ● | |
| 21. Checking the stop function | | ● | | | ● | | | ● | |
| MISCELLANEOUS, page 39 | | | | | | | | | |
| 22. Checking the drive belt | | ● | | | ● | | | ● | |
| 23. Checking for leakage, rectify as necessary | ● | | | | | | | | |
| 24. Checking/adjusting valve clearance | | | ● | | | ● | | | |
| 25. Renewing (or cleaning) the valve for closed crankcase ventilation | | | | | | ● | | | |

1. More often if required
2. For engines with few operating hours, see page 18.
3. Earlier if vacuum 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 apply provided that *the fuel sulphur content does not exceed 0.3% by weight*. If the sulphur content exceeds 0.3 % but is maximum 1.0%, the oil change intervals must be halved (200 h).
- Viscosities as illustrated below.
- For operation at extremely low ambient temperature: Consult your nearest Scania representative on how to avoid starting difficulties.

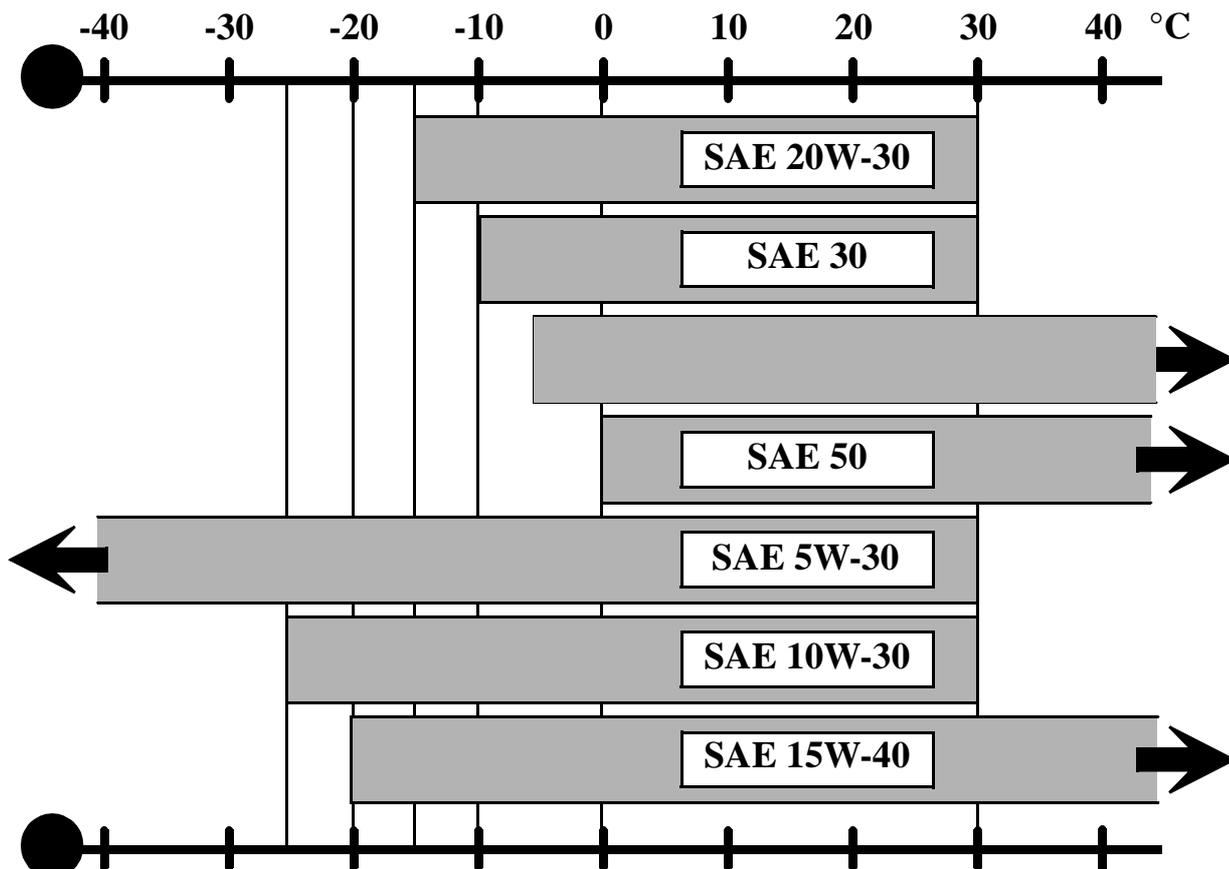
! Important
Additives must not be used.
The oil should be suitable for all temperature variations until the next oil change.

Oil analysis

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

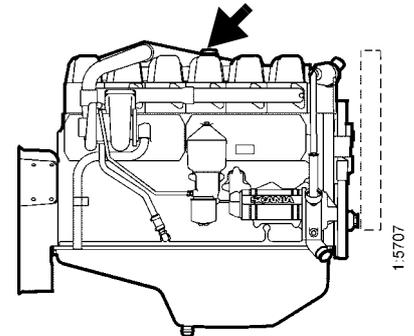
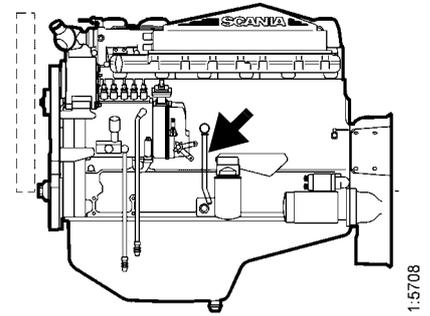


1. Daily: CHECKING THE OIL LEVEL

Note Before checking oil level: Allow the engine to remain stopped 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 20.

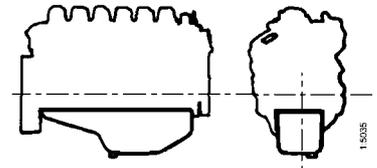
Note! Checking of oil level during operation can not be performed on engines with standard oil sump, see picture.



2. Every 400 hours: OIL CHANGE

Note Under extremely severe operating conditions, especially in dusty environment or if the deposits in the centrifugal cleaner are thicker than 20 mm: change oil more frequently.

- 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 liter



WARNING

The oil may be hot.
Wear protective gloves and goggles



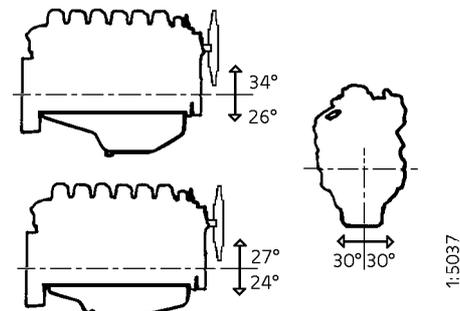
Mind the environment!

Always use a suitable container to avoid spillage when changing oil.
Dispose of used oil through an authorized 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 angles 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.



WARNING

Open the cap carefully. The oil may be hot.

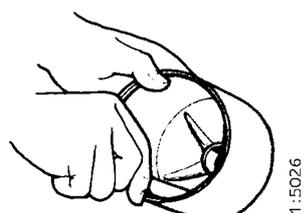
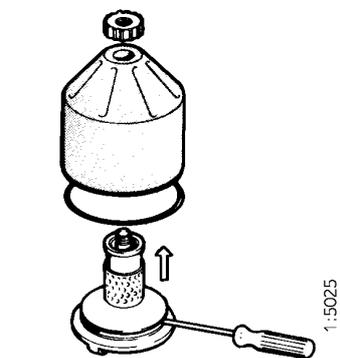
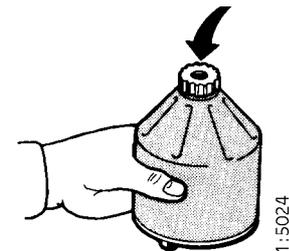
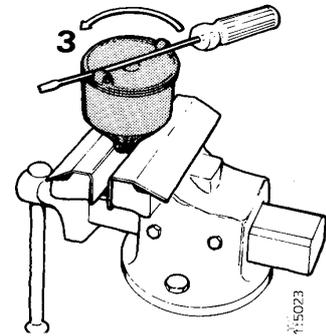
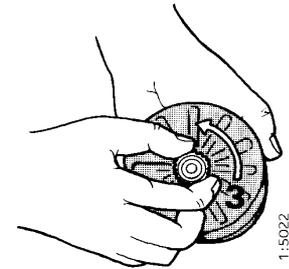
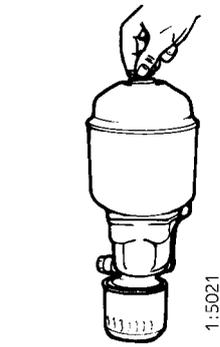
- Lift out the rotor and loosen the nut on the rotor bowl three turns.

- If the nut is jammed:
Clamp the nut, *not the rotor*, in a vise and turn the rotor three revolutions by hand or using a screwdriver.

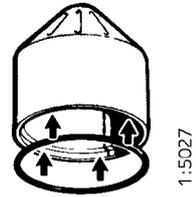
- Tap the nut lightly with your hand or a plastic hammer, to detach the rotor bowl from the bottom plate.

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

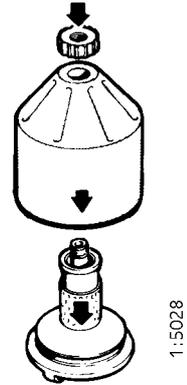
- Scrape off the deposits from the inside of the rotor bowl. If there are no deposits, this indicates that the cleaner is not working properly.
- If the deposits are *thicker than 20 mm: clean more frequently.*



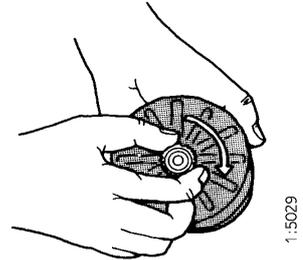
- Rinse all parts in diesel fuel.
- Fit the O-ring in the rotor bowl. **Make sure it is not damaged.**
Renew parts if necessary.



- Assemble the rotor.



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

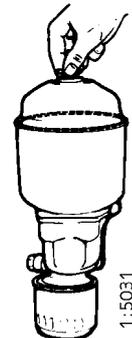


- Refit the rotor.
- Make sure that it spins easily.



- Check that the O-ring in the bowl is undamaged.
Renew the O-ring if hard or damaged.
- Secure the bowl firmly, tightening the nut

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



Operational test

The rotor rotates very fast and should continue to turn 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 inspect.



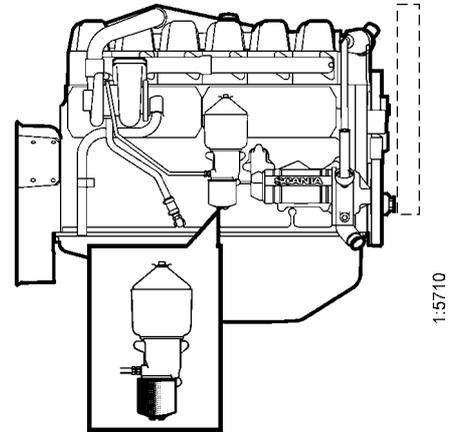
4. Var 400:e timme:

RENEWING THE TURBO 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 a tool for tightening. The filter could be damaged, obstructing circulation.
- Start the engine and check for leaks.

Important *If the deposits in the centrifugal cleaner are thicker than 20 mm the oil filter should be renewed more frequently. This includes cleaning the centrifugal filter and changing oil.*



1:57/10



Mind the environment!

Always collect oil in a suitable container to avoid spillage when renewing the oil filter.
Dispose of used filters through an authorized waste disposal contractor.

COOLING SYSTEM

5. Daily:

CHECKING THE 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 lower edge of the filler neck.
 - Hot engine: The coolant should be approximately 25 mm above the lower edge of the filler neck.
- 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 cause cracks in the cylinder block and the cylinder head.



WARNING

Carefully open the cap.
Hot water and steam may blow 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 only glycol: Check the glycol content.
- c) Coolant with only *Scania Anti-corrosive*: Check the corrosion inhibitor.

The composition of the coolant is described in 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 the coolant
- Water added to the coolant should be clean and free from dirt of any kind.
- Use drinkable water with a pH value 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.
- A content of 30% glycol by volume protects against freezing down to -16°C. If further protection is needed, refer to the table on the next page for calculating the required amount of glycol.

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 Change the coolant when cleaning the cooling system: every 4800 hours or minimum every 5 years.

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

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 Anti-corrosive

 **WARNING**

Ethylene glycol is highly dangerous if ingested and can prove fatal.
Avoid skin contact with glycol.

! Important

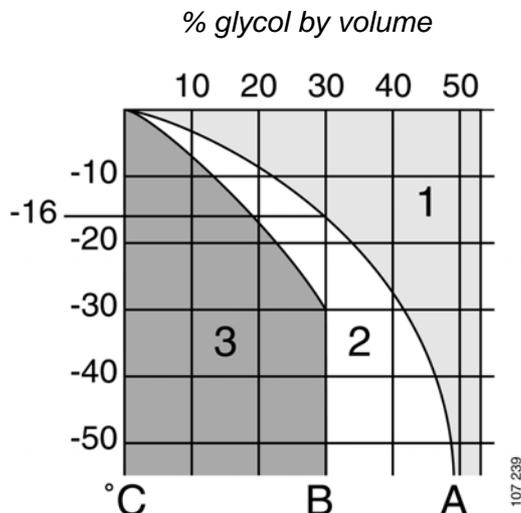
The coolant should be ready mixed when it is poured into the cooling system.
Never top up with only water or only glycol.

! 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.

Properties 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 build up starts (slush)

Curve B: Temperature at which damage due to freezing can occur

1. Safe range
2. Malfunctions may occur (ice slush)
3. Risk of damage by freezing

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 the corrosion inhibitor

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 Anti-corrosive* should be used in the coolant.

The inhibitor in *Scania Anti-corrosive* is free of nitrite.

The correct proportion of anti-corrosive is **7-12% by volume**.

- Topping up with 1.0% *Scania Anti-corrosive* 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 premixed coolant: water + 10% by volume of Scania Anti-corrosive.

Note The coolant should be changed when the cooling system is cleaned: every 4800 hours or minimum every 5 years.



WARNING

Corrosion inhibitor, if swallowed can be fatal. Avoid contact with the skin.



Important

Mixing corrosion inhibitor with glycol or adding too much corrosion inhibitor may cause deposits and reduced cooling capacity.

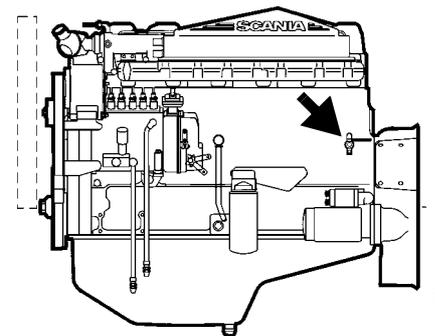


Important

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 cocks.
4. Fill up with coolant through the expansion tank's filler hole.
Mix coolant as described on page 25.



Mind the environment!

Always collect fluid in a suitable container to avoid spillage when changing coolant. Dispose of used coolant through an authorized 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.

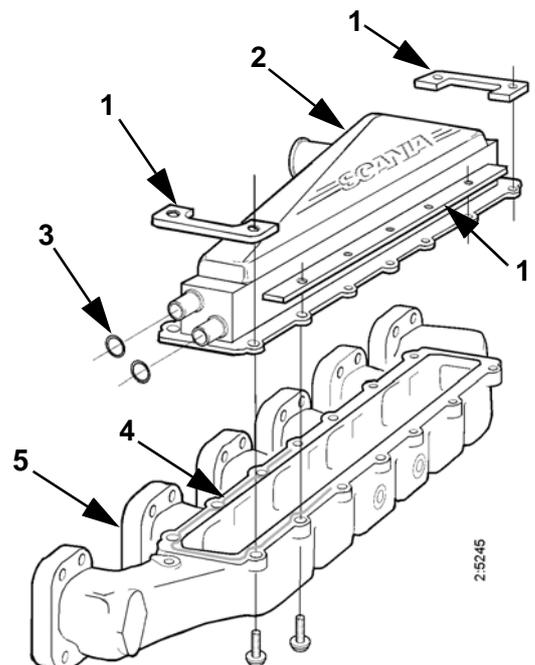
! Important
The cooling system must never be cleaned with caustic soda. There is a risk of damage to aluminium parts.

Charge air cooler (DI engine)

1. Drain the coolant from the engine, refer to "Changing the coolant".
2. Detach the intake manifold from the turbo.
3. Detach the charge air cooler inlet and outlet connections.
4. Unbolt the charge air cooler assembly from the intake manifold. The charge air element is integrated into the housing.
Be careful - do not damage the core water connections.
5. Clean the outside of the element. This is especially important if the engine is equipped with closed crankcase ventilation. Use a paraffin-based engine cleaner.
6. Clean and degrease the sealing surfaces on the core and the air intake pipe with a spirit based cleaner.
7. Apply sealant (silicone 816 064) in a uniform bead, approximately 2-3 mm, on the sealing surface of the air intake pipe.
8. Tighten the charge air cooler by means of the clamp rails. Install the charge air cooler within 15 minutes of applying the sealant. Torque tighten the bolts to 50 Nm.
9. Refit the inlet and outlet connections with new O rings.
10. Connect the intake manifold from the turbo.
11. Fill up with coolant according to the specification on page 25.

Important Allow the sealant to cure for minimum 24 hours before the engine is used.

1. Clamp rail
2. Charge cooler housing with element
3. O-ring
4. Sealant 816 064
5. Intake manifold



Internal cleaning

Removing oil and grease

- If possible, run the engine until it has reached the operating temperature and then drain the cooling system.
- Remove the thermostat.
- Fill the system with clean, hot water mixed with liquid dishwasher detergent intended 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 approximately 20-30 minutes.
- Drain the water from the system.
- Refit the thermostat.
- Fill up with new coolant according to the specification on page 25.



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 thermostat.
- Fill the system with clean, hot water mixed with a commercially available radiator cleaner 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 approximately 20-30 minutes.
- Drain the water from the system.
- Refit the thermostat.
- Fill up with new coolant according to the specification on page 25.



Mind the environment!

**Always collect fluid in a suitable container to avoid spillage when draining coolant.
Dispose of used coolant through an authorized waste disposal contractor.**

AIR CLEANER

8. Daily: CHECKING THE VACUUM INDICATOR

If the indicator's red plunger is fully visible, change or clean the air cleaner filter insert, point 10.



9. Every 200 hours: CLEANING THE AIR CLEANER COARSE CLEANER

1. Detach the eccentric catch and remove the coarse cleaner.
2. Remove the plastic cover from the coarse cleaner and clean the parts.
3. Check that the plastic cover is intact and that it makes a seal against the air cleaner housing during assembly.
4. Assemble the air cleaner.

! Important
The coarse cleaner should be fitted with the marking "TOP" facing up.

10. Every 1200 hours: CLEANING OR CHANGING THE FILTER ELEMENT

Note Earlier if the vacuum indicator shows red

Dismantling

1. Remove and clean the coarse cleaner, see point 9.
2. Undo the nut securing the filter insert and remove it.
3. Change or clean the insert.

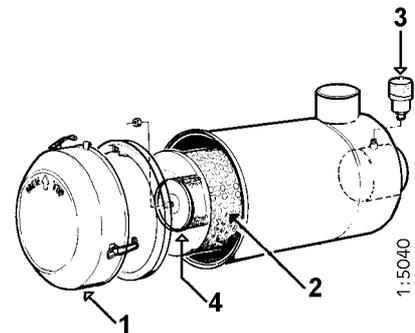
Note Cleaning the element always entails a risk of damaging it. The element should only be cleaned four times a year at most. After cleaning, it has poorer dust capacity than a new element.

4. 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.



1. Pre-filter with cover
2. Filter insert
3. Low pressure indicator
4. Safety cartridge

Air cleaner with pre-filter

! 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.

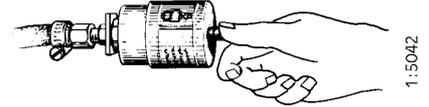
! WARNING
Never start the engine unless the air filter is installed.
Danger of personal injury or engine damage.

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.

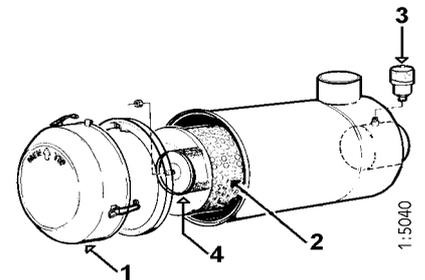


11. Every 2400 hours:

RENEWING THE SAFETY CARTRIDGE

1. Remove and clean the coarse cleaner, see point 9.
2. Undo the nut securing the filter element and remove it.
3. Change or clean the filter element, see point 10.
4. Undo the nut securing the safety cartridge and remove it.
5. Fit a new Scania genuine safety cartridge.
6. Assemble the air cleaner.

! Important
Do not remove the safety cartridge unnecessarily.



1. Pre-filter with cover
2. Filter insert
3. Low pressure indicator
4. Safety cartridge

Air cleaner with pre-filter

! 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, refer to paragraph 13.

! Important

Observe the utmost cleanliness when working on the fuel system.

Malfunions could easily occur and the injection equipment could be damaged.

13. Every 1200 hours:

RENEWING 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.
- Tighten the new filter *by hand*.

Never use a tool for tightening. 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

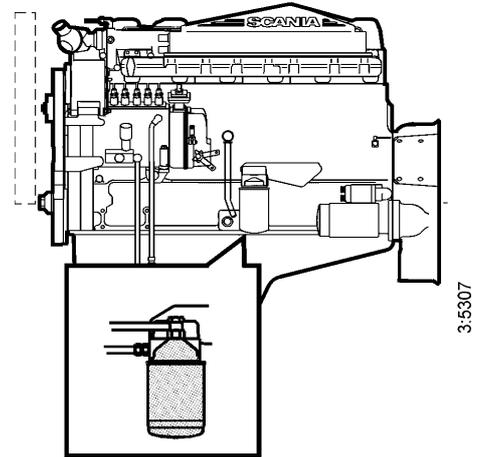
- Open the bleed screw **1** on the main filter.
- Pump the hand pump **2** until air-free fuel flows out at the main bleed screw.
- Close the bleed screw. Pump a few times using the hand pump.

If the engine is difficult to start after bleeding

- Slacken the injection pump overflow valve **3** one half turn and try starting again.

If the engine fails to start after bleeding

- Pump the hand pump until bubble-free fuel flows from the overflow valve.
- Tighten the overflow valve when the engine has started.



3:5307

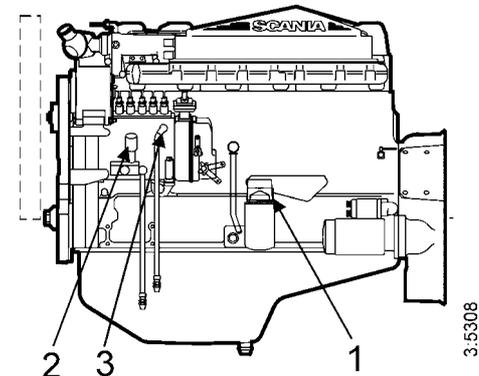
! Important

Only use Scania genuine fuel filter.



Mind the environment!

Always collect fuel in a suitable container to avoid spillage when bleeding system or renewing components.



3:5308

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 around 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 seal 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 in a nozzle tester.

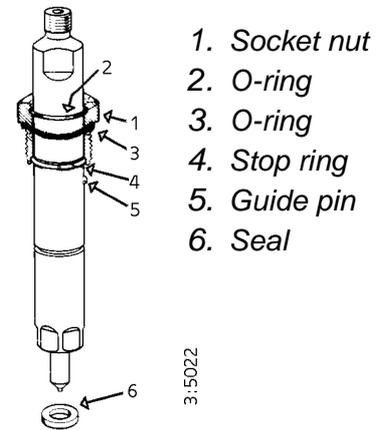
Correct opening pressure, see Technical data, page 46.

Fitting

1. Check that there is no old seal in place and fit a new seal in the bottom of the injector seat.
2. Fit a new O-ring in the socket nut and a new seal 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 union nuts to 20 Nm (2.0 kpm). Fit clamps and brackets.

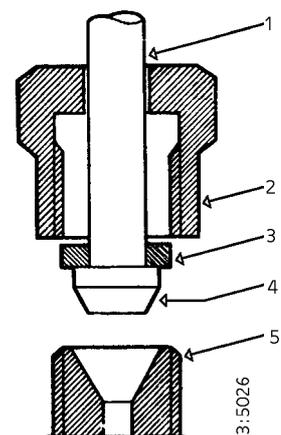
Important *Take care to fit the delivery pipe without tension and make sure that the cone on it is correctly positioned in the connection.*

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
Always wear gloves and eye protection when testing injectors.
Fuel escaping under high pressure can penetrate body tissue and cause serious injury.



1. Delivery pipes
2. Cap nut
3. Washer
4. Cone
5. Connector 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

Do not let open flame or sparks come near the batteries. When batteries are charged, they emit highly flammable fumes that can explode.

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 batteries. This will damage the battery in the long run.



WARNING

Wear gloves and eye protection when charging and handling batteries. Batteries contain a highly corrosive acid.

17. Every 200 hours:

CLEANING THE 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

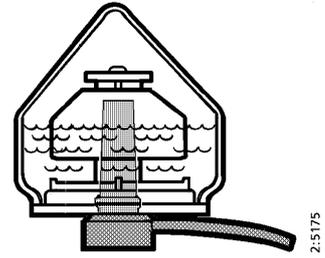
Do not connect the cables to the wrong terminals. This could cause serious damage to the electrical system. If the terminals are shortcircuited, sparks will be generated.

18. 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 case of fault:* The engine stops, the indicator lamp comes on and the buzzer sounds if the level monitor is OK.
4. *Without automatic stop in case of fault:* The indicator lamp comes on and the buzzer sounds if the level monitor is OK.
5. Top up coolant to the correct level, refer to page 24.



2-pole level monitor installed in expansion tank for radiator supplied by Scania



Mind the environment!

Always use a suitable container to avoid spillage when draining coolant.

Dispose of used coolant through an authorized waste disposal contractor.

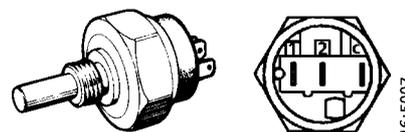
19. Every 1200 hours:

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) to the monitor.
5. Submerge the monitor sensor body in water. Heat the water slowly (approx. 1° minute) using e.g. an immersion heater.
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 stamped temperature

2 = Connection C -2 opens at stamped temperature

2-pole temperature monitor

CHECKING THE TEMPERATURE SENSOR

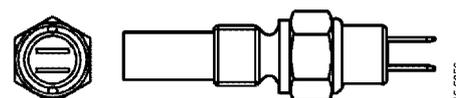
1. Drain the coolant, allowing the temperature sensor to be removed.
2. Remove the temperature sensor cable(s).
3. Unscrew the sensor.
4. Connect an ohmmeter to the temperature sensor.
5. Submerge the sensor body in water. Heat the water slowly (approximately 1° per minute) using e.g. an immersion heater.
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!

Always use a suitable container to avoid spillage when draining coolant. Dispose of used coolant through an authorized waste disposal contractor.



2-pole temperature sensor

20. Every 1200 hours:

CHECKING THE OIL PRESSURE SENSOR/MONITOR

Sensor function

Measure the sensor output voltage (pin 3) at different oil pressures. The sensor output voltage shall be as follows:

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

The tolerances apply at +30°C - 110°C. At lower temperatures the tolerance range is wider, e.g. 0°C = x 1.4.

Monitor function

Connect a test lamp to the oil pressure monitor, pin 4 (- ground), and check that the monitor switches on at the correct pressure when the engine is started and stopped. The monitor shall switch on at $0.7 \pm 0.15 \text{ bar}$ when the engine is stopped.

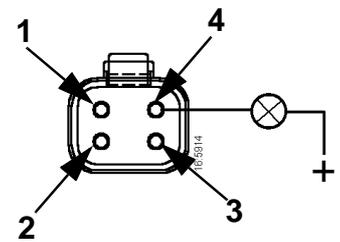
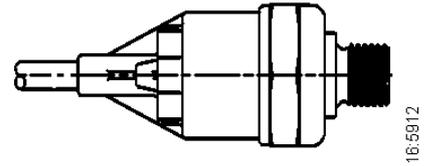
Important *The sensor/monitor must be supplied with voltage during the measurement. Maximum 4 W load from a test lamp.*

Monitor connected for automatic stop in case of a fault:

1. Start the engine.
1. Check on the oil pressure gauge that oil pressure rises.
2. Stop the engine manually (using the emergency stop).
3. Check on the oil pressure gauge at what pressure the stop solenoid operates and the monitor opens. Correct pressure: $0.7 \pm 0.15 \text{ bar}$.

Monitor connected to buzzer:

1. Main power switch in operating position, check that buzzer sounds.
2. With the engine running, check that the buzzer falls silent when the oil pressure is *above* $1.1 \pm 0.15 \text{ bar}$ and the monitor closes.



21. Every 400 hours:

CHECKING THE STOP FEATURE

Check that the stop solenoid is activated and stops the engine when the stop signal is given by the button, temperature monitor, coolant level monitor and oil pressure monitor if these are coupled for automatic stop in the case of fault.

Important *Stop solenoids with a timer module may be activated for start and stop a maximum of 3 times per minute. Otherwise, the timer module may be damaged and the stop feature cease.*

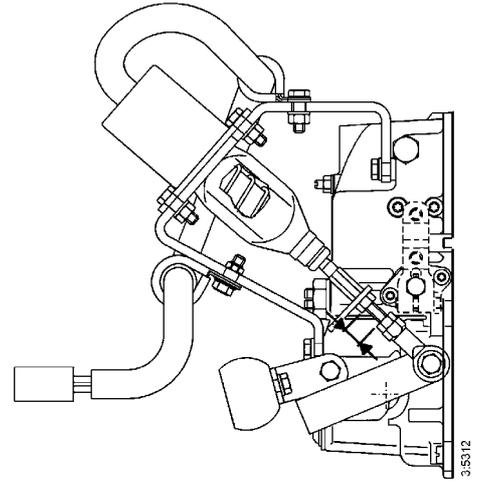
CHECKING STOP SOLENOID STOP POSITION

When changing the stop solenoid, or if the stop feature is not satisfactory, the following should be done (the figures show the stop control with the engine in stop position):

Stop position at “Pull to stop”.

- Check and/or set the length of the link rod so that the distance between the locknuts (nut height 5.2 mm) is 21.0 ± 0.1 mm when the nuts are tightened.
- Fit the stop solenoid in the bracket as in the figure.
- Connect the stop solenoid electrically, **red** to battery + and **black** to battery -, and activate it so that it is fully pulled. **Note: Pole reversal will damage the timer module.**
- Screw the clevis onto the stop lever using the link pin and check, in stop position, that there is a small clearance (0.2-0.3 mm) between the stop lever and the operating point on the governor
- Check the stop feature by starting the engine and then stopping it by activating the stop solenoid.

Important *The stop solenoid must not be activated more than 3 times per minute as the timer module can be damaged.*

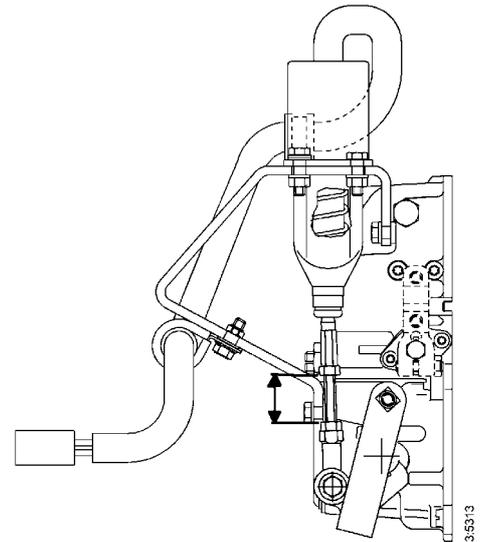


Installation “Pull to stop”

Stop position at “Pulled during operation”.

- Check and/or set the length of the link rod so that the distance between the locknuts (nut height 5.2 mm) is 26.0 ± 0.1 mm when the nuts are tightened.
- Fit the stop solenoid in the bracket as in the figure.
- Connect the stop solenoid electrically, **red** to + and **black** to - and activate it so that it is fully pulled. **Note: The timer module is damaged if the poles are reversed.**
- Turn the stop lever to operating position and screw the clevis onto the stop lever using the link pin and check, in operating position, that there is a small clearance (0.2-0.3 mm) between the stop lever and the operating point on the governor
- Activate the stop solenoid and start the engine. Stop the engine by cutting the power to the stop solenoid.

Important *The stop solenoid must not be activated more than 3 times per minute as the timer module can be damaged.*



Installation “Pulled during operation”

RENEWING THE BATTERY

Removal

1. Disconnect the negative cable (-) from the battery (cable connected to ground).
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 ground).



WARNING

Do not connect the cables to the wrong terminals.

This could cause serious damage to the electrical system.

If the terminals are short-circuited, sparks will be generated.



Mind the environment!

Dispose of used batteries through an authorized waste disposal contractor.

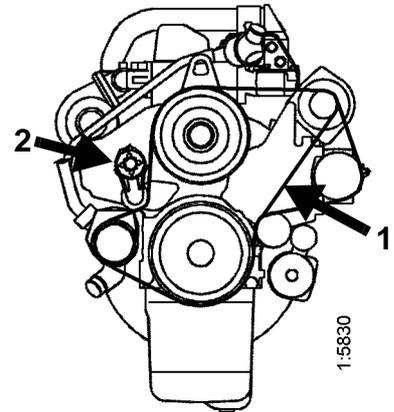
MISCELLANEOUS

22. Every 1200 hours:

CHECKING THE DRIVE BELT

Replace the drive belt (1) (poly V-belt) if worn or damaged.

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



23. Daily:

CHECKING FOR LEAKAGE, RECTIFY AS NECESSARY

- Start the engine.
- Check for oil, coolant, fuel, air and exhaust leakage.
- Tighten or change leaking connections. Check the overflow holes (1) which show whether the O rings between the cylinder liners and crank-case are leaking, refer to illustration.
 - a) If coolant is leaking out, the two upper O-rings are leaking.
 - b) If oil is leaking out, the lower O-ring is leaking.

A small amount of leakage from the overflow holes during the engine running-in period is normal. (Seals and O-rings to be lubricated with soap or oil when fitted).

This leakage normally stops after a time.

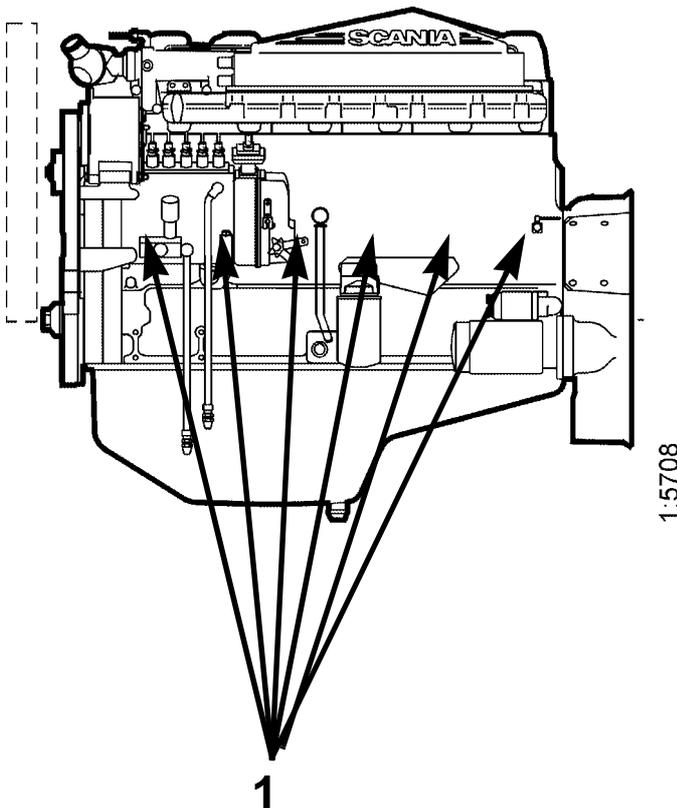


Mind the environment!

Ensure that any leakage does not pollute the environment.

! Important

In case of major leakage, contact the nearest Scania workshop.



24. Every 2400 hours: CHECKING/ADJUSTING VALVE CLEARANCE

Note Checking/adjusting valve clearance 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: 20 Nm.

Intake valve clearance: 0,45 mm.
Outlet valve clearance: 0,80 mm.

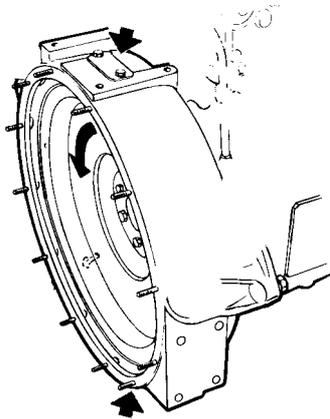
Alternative 1

- Set No. 1 cylinder to TDC by turning the engine in its direction of rotation until both valves are closed.
- Adjust the following valves. Correct valve clearance is indicated on the instruction plate on one of the rocker covers:

| | | |
|----------|---|--------------------|
| Cylinder | 1 | Intake and exhaust |
| | 2 | In |
| | 3 | Ex |
| | 4 | In |
| | 5 | Ex |

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

| | | |
|----------|---|-----------|
| Cylinder | 2 | Ex |
| | 3 | In |
| | 4 | Ex |
| | 5 | In |
| | 6 | In and Ex |



Covers for reading
on flywheel casing

Note

Readings can either be taken from underneath or from above, depending on which flywheel is used.

The cover not being used is covered with a seal and an instruction plate.



WARNING

Immobilise the starting device when working on the engine.

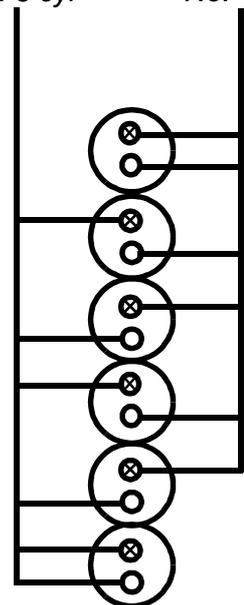
If the engine starts out of control, there is a **SERIOUS RISK OF INJURY.**



FLYWHEEL

Cylinder numbering

TDC No. 6 cyl TDC No. 1 cyl



FLYWHEEL

- Intake valve
- ⊗ Exhaust valve

Alternative 2

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

25. Every 2400 hours:

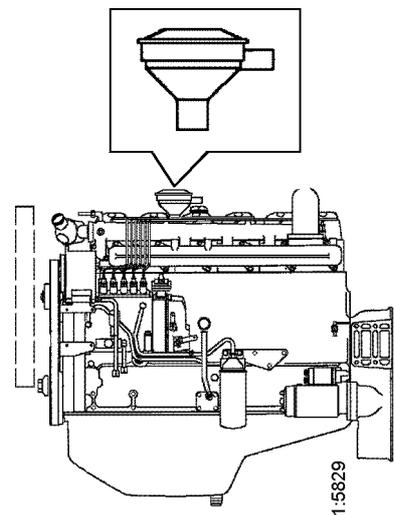
CHANGING (or CLEANING) THE CLOSED CRANKCASE VENTILATION VALVE

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 oil overnight. Then rinse it several times in diesel oil and allow it to drip dry.
- Refit the valve.
- The valve may be reused (cleaned), *maximum twice* after the initial 2400 hours of operation. 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
- To run the engine for a period of time with preservative fuel, preservative oil and preservative 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 must be used. E.g. **BASF G48** or **BASF D542**.



WARNING

Ethylene glycol, if swallowed can be fatal.

Avoid contact with the skin.

Preservative fuel

- Use diesel fuel mixed with Lubrizol 560A or equal.
- Mix 1 cm³ (ml) of Lubrizol 560A with 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.

In case of splashes in the eye: Rinse with moderate water spray (for min. 15 minutes). Seek medical attention.

In case of skin contact: Wash affected areas with soap and water.

If you inhale it: Fresh air, rest and warmth

Flammable: Fire class 2A. Flash point + 27°.

In case of fire: Extinguish using carbonic acid, powder or foam

Storage: In properly sealed container 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 approximately 1000 rpm (not single-speed engines) for 20-25 minutes.
- Stop the engine, remove the hoses and connect the normal fuel lines.
- Oil the valve mechanism generously with preservative oil.
- Remove the injectors and spray preservative oil into each cylinder, **maximum 30 cm³ (ml)**.
Turn the engine over a few revolutions using the starter motor. Spray an additional **small** amount of oil 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 renew the filter element.
- Cover air intakes and exhaust pipes.
- Alternator and starter motor:
- Spray with water-repellent anti-corrosive oil, CRC 226, LPS1 or equal.
- Spray the outside of bright metal engine parts, first with penetrating preservative oil such as Dinitrol 25B and then with Dinitrol 112 or equal.

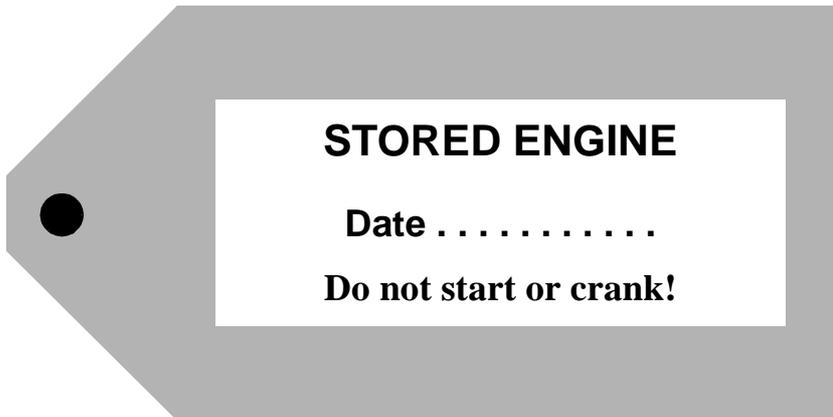


Mind the environment!

Always use suitable containers to avoid spillage when draining oil and coolant.

Dispose of used oil and coolant through an authorized 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 a charging station. (Does not apply to batteries, which the manufacturer specifies to be maintenance free). 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 cooling system with coolant, refer to page 12.
- 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 cranked 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.
- Wash off any externally applied preservative oil, using white spirit.

 **WARNING**

Wear gloves and eye protection when charging and handling batteries.

Batteries contain a highly corrosive acid.

TECHNICAL DATA

| GENERAL | | D9 | DI9 | DC9 |
|---|---------------------------|--------------------------|------------|------------|
| Number of cylinders | | 6 in line | | |
| Cylinder bore | mm | 115 | | |
| Stroke | mm | 144 | | |
| Displacement | dm ³ (litres) | 9,0 | | |
| Number of main bearings | | 7 | | |
| Firing sequence | | 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 the front | | Clockwise | | |
| Cooling | | Fluid | | |
| Valve clearance, cold engine | | | | |
| intake valve | mm | 0,45 | | |
| exhaust valve | mm | 0,80 | | |
| Weight, without coolant and oil | | | | |
| *With charge air cooler, radiator, expansion tank and pipes | kg | 825 | 835 | 890* |
| Output | | see "Engine record card" | | |
| LUBRICATION SYSTEM | | | | |
| Max. oil pressure (warm engine at speed above 800 rpm) | bar (kp/cm ²) | 6 | | |
| Normal oil pressure (warm engine at operating speed) | bar (kp/cm ²) | 3 - 6 | | |
| Min. oil pressure (warm engine 800 rpm) | bar (kp/cm ²) | 0,7 | | |
| Oil capacity, see page 21 | | | | |
| Crankcase pressure with closed crankcase ventilation | mm VP | -55 - +20 | | |

| FUEL SYSTEM | | D9 | DI9 | DC9 |
|--|---------------------------|---|------------|------------|
| Pump setting BTDC | | See plate on rocker cover | | |
| Injectors, opening pressure | bar (kp/cm ²) | 300 | | |
| Low idle | rpm | 700 | | |
| Maximum full load speed | | See engine card | | |
| Fuel | | Diesel fuel oil ¹ | | |
| Tightening torques: | | | | |
| Socket nut for injectors | Nm | 70 | | |
| Cap nut for delivery pipe | Nm | 20 | | |
| Oil leakage connection | Nm | 11 | | |
| ¹ see page 48 | | | | |
| COOLING SYSTEM | | | | |
| Number of thermostats | | 1 | | |
| Thermostat, opening temperature | °C | 79 | | |
| Coolant temperature: | | | | |
| system with atmospheric pressure | °C | 70 - 93 | | |
| system with positive pressure | °C | 70 - about 100 | | |
| Capacity including 0.75 m ² radiator and expansion tank | dm ³ (litres) | 50 | 53 | 50 |
| ELECTRICAL SYSTEM | | | | |
| System voltage | V | 24 | | |
| Alternator, current | A | 65 alt. 90 | | |
| Starter motor power | kW (hp) | 4,0 (5,4) | | |
| Monitors, settings: | | | | |
| Oil pressure monitor | bar (kp/cm ²) | < 2-pole: 1.0 ± 0.15 Stamped on monitor hexagon | | |
| Temperature monitor | °C | | | |

FUEL

Diesel fuel

The composition of the diesel fuel is vitally important to the operation and life of the engine and the fuel injection pump. The engine power output and the exhaust emissions are also dependent on the fuel quality. The requirements and the test standards for the most important properties are described in the workshop manual in sections that can be ordered from your Scania dealer or directly from Scania. The address of Scania is printed on the cover.

The diesel fuel shall 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 different grades of so called environmentally favorable fuels (SS15 54 35). Grade 1 is sulphur-free and grade 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 is not intended for the expected temperature and no diesel fuel with the correct temperature properties is available, we recommend that an electric fuel heater be 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, maximum 0.5-2% alcohol (isopropanol) may be added.

Drain fuel tanks and drain or renew fuel filters at regular intervals.



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. Petrol may cause wear to the fuel injection pump and it may also cause damage to the engine.

ALPHABETICAL INDEX

| | | | |
|---|----|---|----|
| Air cleaner | 30 | Leakage | 40 |
| Air cleaner, prefilter | 30 | Lubricating oil pressure sensor/monitor | 37 |
| Air cleaner, safety cartridge | 31 | Lubricating oil system | 20 |
| Air cleaner, vacuum indicator | 30 | Lubrication oil pressure | 16 |
| Air filter, element | 30 | | |
| | | Maintenance | 18 |
| Batteries | 34 | Maintenance schedule | 19 |
| Battery, renewing | 39 | | |
| Bleeding, fuel system | 32 | Oil analysis | 20 |
| | | Oil capacity | 21 |
| Certified engines | 5 | Oil change | 21 |
| Checks after running | 17 | Oil cleaner | 22 |
| Checks before running | 13 | Oil grade | 20 |
| Clutch | 17 | Oil level | 21 |
| Coolant | 25 | Operation | 15 |
| Coolant level | 24 | | |
| Coolant level monitor | 35 | Prefilter, air cleaner | 30 |
| Coolant temperature | 15 | Preparations for storage | 43 |
| Coolant temperature monitor | 36 | | |
| Coolant temperature sensor | 36 | Safety cartridge, air cleaner | 31 |
| Coolant, changing | 27 | Safety details | 6 |
| Cooling system | 24 | Safety precautions for care and maintenance | 8 |
| Cooling system, cleaning | 28 | Safety precautions for handling materials | 8 |
| Corrosion inhibitor | 27 | Safety precautions for operation | 7 |
| | | Starting the engine | 13 |
| Drive belt | 39 | Stop solenoid | 38 |
| | | Stopping the engine | 16 |
| Electrical system | 34 | Storage | 45 |
| Emergency stop | 16 | | |
| Engine speed | 15 | Taking out of storage | 45 |
| Environmental responsibility | 4 | Temperature monitor | 36 |
| | | Turbo filter | 24 |
| Filter, air cleaner | 30 | Type designations | 10 |
| Filter, fuel | 32 | | |
| Foreword | 2 | Valve clearance | 41 |
| Fuel filter, renewing | 32 | | |
| Fuel level | 32 | Warranty | 1 |
| Fuel specifications | 48 | | |
| Fuel system | 32 | | |
| Fuel system, bleeding | 32 | | |
| | | | |
| Glycol | 25 | | |
| | | | |
| Injector | 33 | | |