

### 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

#### Marine engine

opm96-9m en 1 588 295

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 and DI9 marine 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.

The engines may have two different cooling systems, a heat exchanger which is cooled by sea water or keel cooling which has cooling coils on the keel in which the engine coolant is cooled.

Common areas of usage include propulsion engines in boats like patrol boats and fishing boats, larger pleasure craft or propulsion engines or aggregate engines on board ships.

The engines have different output and speed settings and can be classified in different classification societies (classed engines must be used in certain marine installations).

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.

## **! Important**

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

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## 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. →

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

### **Important**

**Only use Scania genuine fuel filter.**

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.

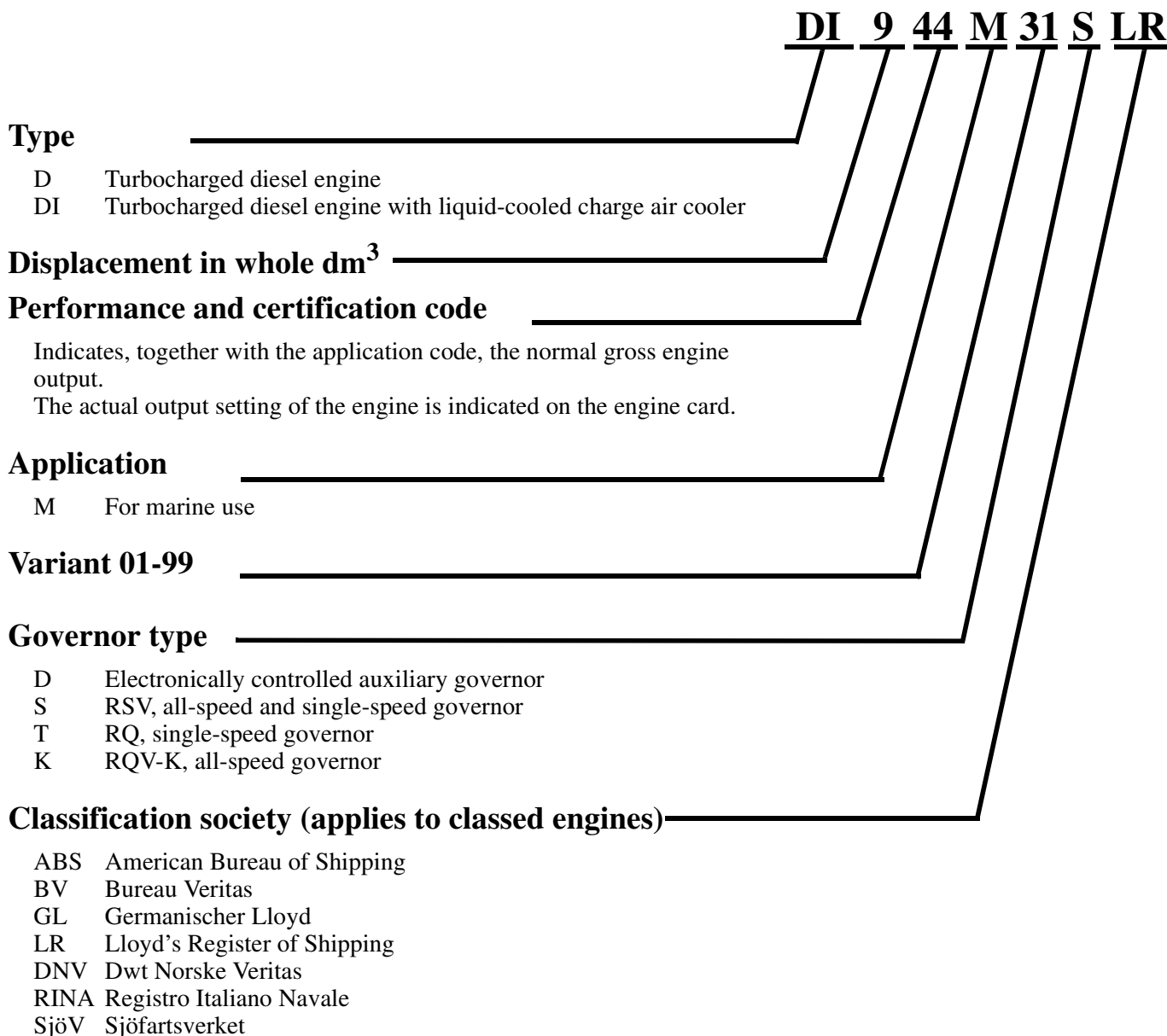
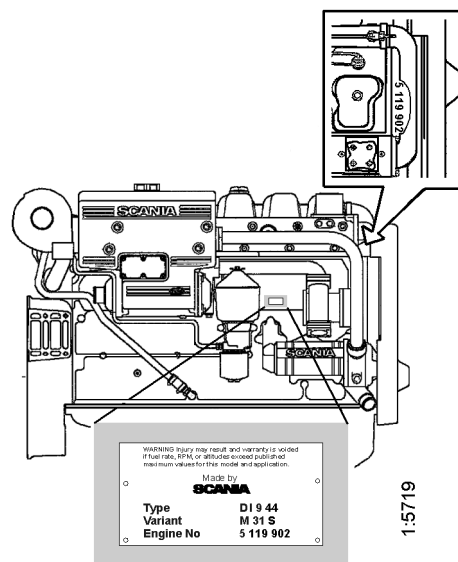
Never start the engine unless the air filter is installed. Otherwise there is a risk of objects entering the compressor wheel or a risk of personal injury from contact with it.

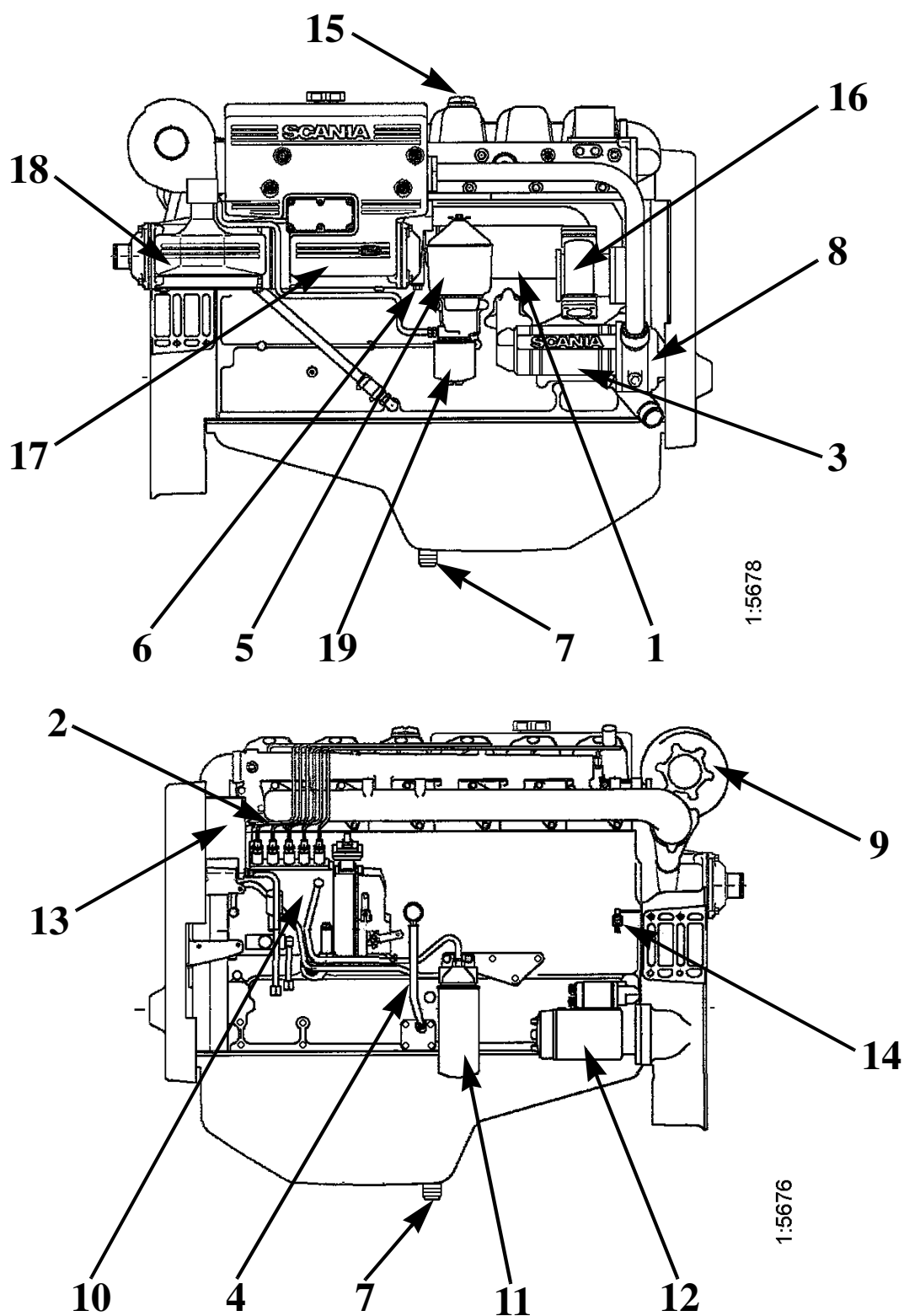
# TYPE DESIGNATIONS

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

The type designation and engine serial number are indicated on a type plate affixed to the right-hand side of the engine. The engine number is also stamped on the top of the engine block beside the first cylinder head.

Engines that are certified regarding smoke and emissions are fitted with a certification plate specifying the documents they conform to. The plate is fitted to rocker cover number two as viewed from the front.





*The drawings illustrate a common type of DI9 engine.  
Your engine may have other equipment not shown here.*

- |  |                         |                       |
|--|-------------------------|-----------------------|
| 1. Type plate                                | 7. Draining, engine oil | 14. Draining, coolant |
| 2. Engine number,<br>stamped in engine block | 8. Coolant pump         | 15. Oil filling       |
| 3. Oil cooler                                | 9. Turbo charger        | 16. Sea water pump    |
| 4. Oil dipstick                              | 10. Injection pump      | 17. Heat exchanger    |
| 5. Oil cleaner                               | 11. Fuel filter         | 18. Charge air cooler |
| 6. Protective anode                          | 12. Starter motor       | 19. Turbo filter      |
|  | 13. Alternator          |                       |

# 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 (see page 21).
8. Checking the coolant (see page 26).

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

### If there is a danger of freezing:

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

**BASF G48 or BASF D542**

- The concentration of glycol should be **30 - 60%** by volume depending on the ambient temperature. A content of 30 % by volume provides protection down to -16 °C. See page 26.
- *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 Anti-corrosive* 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 Anti-corrosive* is free of nitrite.
- First filling: Fill the cooling system with *water + 10% by volume of Scania Anti-corrosive*. 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 Anti-corrosive.*

### 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 Anti-corrosive*  
(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 Anti-corrosive* as mixed with glycol may cause deposits.

### ! Important

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

14. Checking the fuel level (see page 35).
17. Checking the electrolyte level in batteries (see page 37).
18. Checking the state of charge in batteries (see page 37).
20. Checking the coolant level monitor (see page 38) (if fitted).
21. Checking the temperature monitor (see page 39).
22. Checking the oil pressure monitor (see page 40).
23. Checking stop feature (see page 40).
24. Checking transmission belt (see page 42).



## **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 35).

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 fuel valve (if fitted).
- Declutch the engine (does not apply to engines with fixed clutch, e.g. gensets).
- 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 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 (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 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.
- Set the appropriate idle speed before the engine reaches 1,000 rpm (does not apply to gensets).
- 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.**

## RUNNING

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 .
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.

## 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 engine speeds below 800 rpm the gauge may indicate 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.***

**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 in the maintenance step. See page 42.
- 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 and fuel shut-off valve are stopped using the stop button. Hold the stop button depressed until the engine has fully stopped.
3. Engines with battery master switch: Cut the power using the battery master switch. (Does not apply to emergency power back-up units).
4. Set the control switch to 0. (Does not apply to emergency power back-up units).

### **! 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 CAN 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 26.
- Close inlet valve for the sea water system (if fitted).
- *If there is danger of freezing, the sea water system must be emptied.*
- At temperatures below 0 °C: Prepare for the next start by connecting the engine heater (if fitted).



### **WARNING**

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



### **! Important**

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

# MAINTENANCE

The maintenance programme covers 27 points, divided into the following main groups:

Lubrication oil system . . . . .	page 20
Cooling system . . . . .	page 24
Air cleaner . . . . .	page 32
Fuel system . . . . .	page 35
Electrical system, monitors, batteries etc. . .	page 37
Miscellaneous . . . . .	page 42

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

Periodic maintenance after every 1,200 hours of operation (carried out after 1,200, 2,400, 3,600 etc. hours)

Periodic maintenance after every 2,400 hours of operation (carried out after 2,400, 4,800 etc. hours)

Periodic maintenance after every 4,800 hours of operation (carried out after 4,800, 9,600 etc. hours)

Annual Maintenance

Maintenance every 5th year

## ENGINES WITH FEW HOURS OF OPERATION

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

1. Checking oil level.
5. Checking coolant level.
10. Checking low pressure indicator.
14. Checking fuel level.
17. Checking electrolyte level in batteries.
18. Checking state of charge in batteries.
19. Cleaning batteries.
25. 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 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	
		At first start	400 h	200 h	400 h	1200 h	2400 h	4800 h	Annually	Every 5th year
<b>LUBRICATION OIL SYSTEM, page 20</b>										
1. Checking oil level	•	•								
2. Oil change					•1				•	
3. Cleaning the lubrication oil cleaner					•1				•	
4. Changing the turbo filter					•1				•	
<b>COOLING SYSTEM, page 24</b>										
5. Checking coolant level	•									
6. Checking corrosion protection rods 4)					•5				•	
7. Checking seawater pump impeller 4)					•5				•	
8. Checking coolant		•					•6		•6	
9. Cleaning cooling system								•1		•
<b>AIR CLEANER, page 32</b>										
10. Test reading low pressure indicator	•									
11. Cleaning coarse cleaner				•1						•
12. Cleaning or changing filter insert						•3				•
13. Changing safety cartridge							•			•
<b>FUEL SYSTEM, page 35</b>										
14. Checking fuel level	•	•								
15. Changing main filter						•1				•
16. Checking injectors							•		•	
<b>ELECTRICAL SYSTEM, page 37</b>										
17. Checking electrolyte level in batteries		•		•2					•	
18. Checking charge state of batteries		•		•2					•	
19. Cleaning batteries				•2					•	
20. Checking level monitor		•				•			•	
21. Checking temperature monitor		•				•			•	
22. Checking oil pressure monitor		•				•			•	
23. Checking stop function		•			•				•	
<b>MISCELLANEOUS, page 42</b>										
24. Checking transmission belt		•				•			•	
25. Look for leaks. Remedy as necessary	•									
26. Checking/adjusting valve clearance.			•				•			
27. Changing (or cleaning) valve for closed crankcase ventilation							•			

1. More often if required.
2. For engines with few operating hours, see page 18.
3. Earlier if low pressure indicator shows red.
4. Applies only to M engines with sea water pump.
5. Reference value. Varies depending on the composition of the sea water.
6. If inhibitor has not been topped up for five years, the coolant should be changed.

# LUBRICATION 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

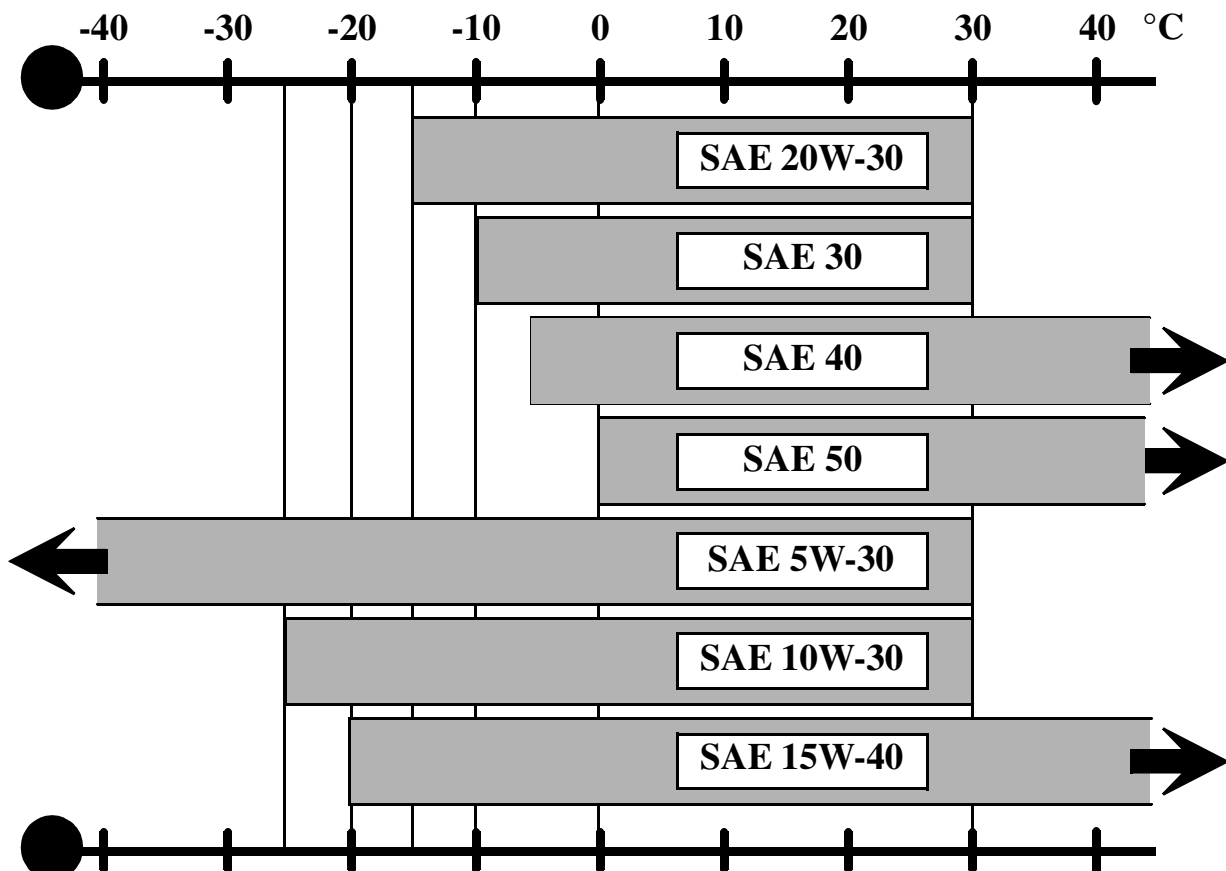
**Additives must not be used.**  
**The oil should be suitable for all temperature variations until the next oil change.**

## 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.

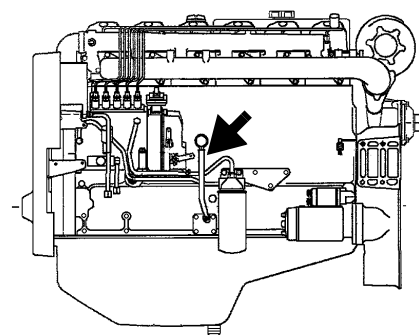


# 1. Daily:

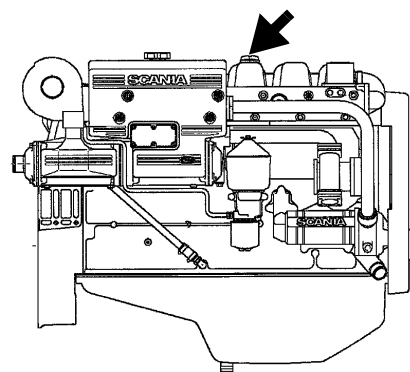
## CHECKING THE OIL LEVEL

**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.

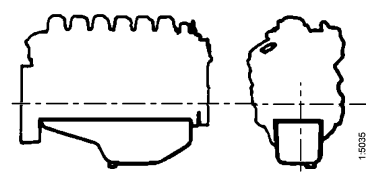


# 2. Every 400 hours:

## 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.

- Pump out the oil with the oil bilge pump when the engine is warm.
- Fill up with new oil.
- Check the level on the dipstick.



Max 25 dm<sup>3</sup>  
Min 20 dm<sup>3</sup>



Max 20 dm<sup>3</sup>  
Min 16 dm<sup>3</sup>

1 dm<sup>3</sup> = 1 litre



### WARNING

The oil may be hot.  
Wear protective gloves and goggles



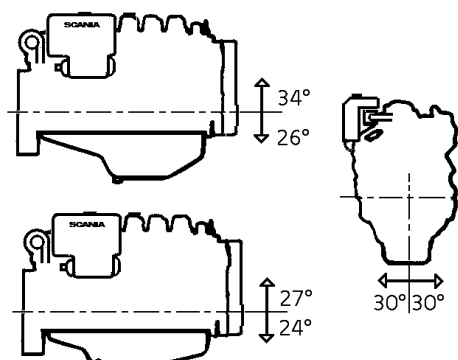
**Mind the environment!**

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.

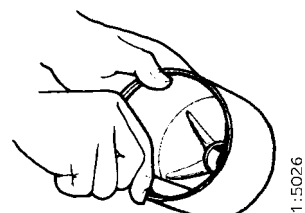
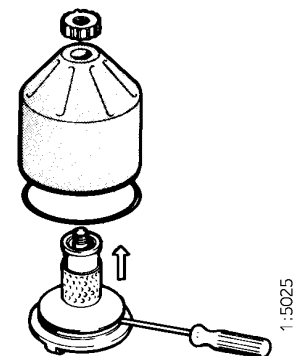
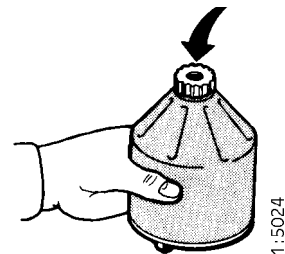
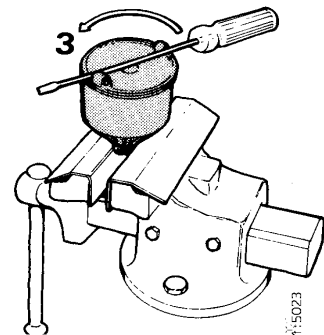
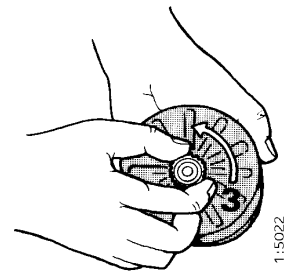
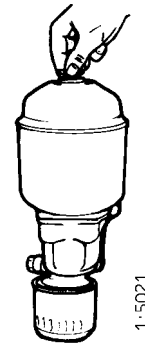
**Note** Specified angle may only occur intermittently.



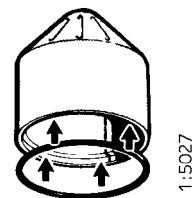
1:5502

### 3. Every 400 hours: CLEANING THE OIL CLEANER (at same time as oil change)

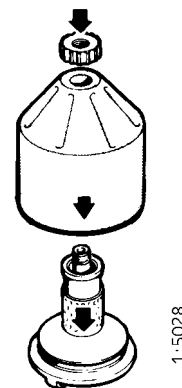
- Unscrew the nut and remove the cover.
- Lift out the rotor and slacken the rotor bowl retaining nut three turns.
- If the nut is jammed:  
Clamp the nut, **never the rotor**, in a vice and turn the rotor three turns by hand or with a screwdriver.
- Tap the nut lightly with your hand or a plastic hammer, to detach the rotor bowl from the bottom plate.
- Unscrew the nut and remove the rotor bowl.
- Prise 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**.



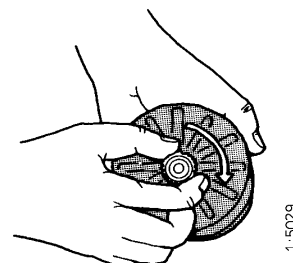
- Clean all parts in diesel fuel.
- Fit the O-ring in the rotor bowl. **Make sure it is not damaged.** Change if necessary.



- Assemble the rotor

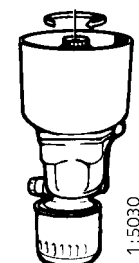


- Tighten the rotor nut firmly **by hand**.

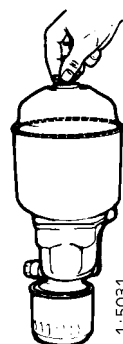


- Refit the rotor.
- Make sure that it spins easily.

- 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 using a tool, the rotor shaft, nut or bowl may be damaged.**



## Functional test

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

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

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

**If not: dismantle it and inspect.**

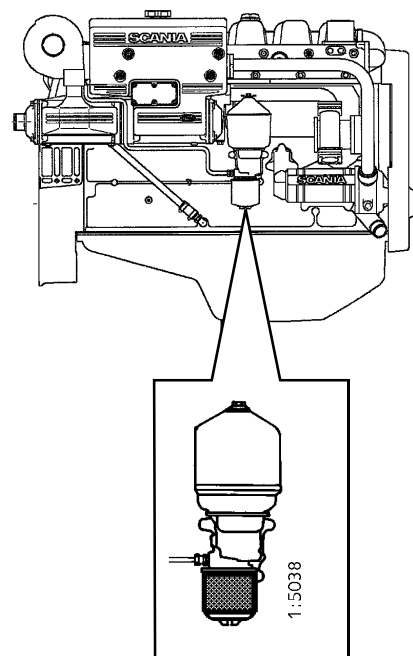


## 4. Every 400 hours: CHANGING THE TURBO FILTER

(at the 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 exceed 20 mm the oil filter must be changed at more frequent intervals, at the same time as the centrifugal filter is cleaned and the oil changed.*



1:5678



**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 COOLANT LEVEL

- Open the expansion tank filler cap and check the coolant level.
- *Correct level: (integrated expansion tank in heat exchanger)*
  - Cold engine: Coolant level should reach the lowest part of the filler pipe.
  - Warm engine: Coolant level should be between 10-20 mm above the lowest part of the filler pipe.
- Other types of expansion tank according to the installer's instructions.
- 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.



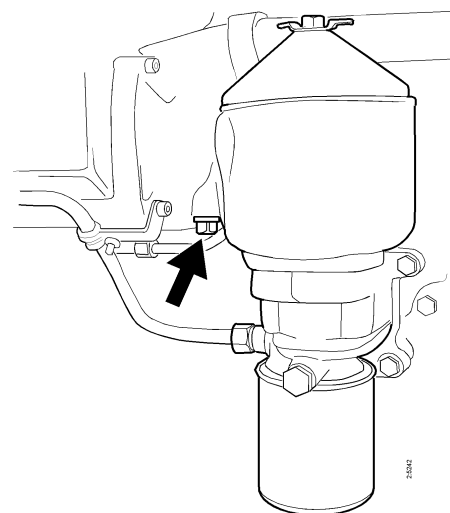
## 6. Every 400 hours:

### CHECKING CORROSION BARS

(Only engines with heat exchanger)

- Empty the sea water circuit and check the corrosion bars (protection anodes). Located as illustrated.
- Scrape off all loose material on the anode.
- Change if less than half the bar is left.  
A new bar is 55 mm long with a diameter of 17 mm.

**Important** *If the corrosion bars are very corroded they need to be checked more often, for example every 200 hours.*



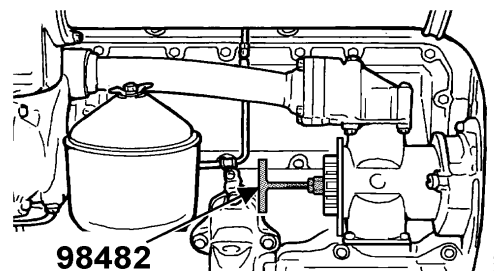
## 7. Every 400 hours:

### CHECKING THE SEAWATER PUMP IMPELLER

(Only engines with heat exchanger)

- Close the bottom valve if the seawater pump is below the water line.
- Empty the sea water circuit.
- Take off the seawater pump cap.
- Check that the impeller vanes are not worn or damaged.

**Important** *If the impeller must be changed frequently, the cleaning of the sea water must be improved.*



### Changing the impeller

- Pull out the impeller with puller 98 482 (Scania Special Tools).
- Fit new impeller and cap. Check that the cap seal is not hard or damaged.

**Note** A spare impeller should be kept on board.

- The impeller can be deformed at longer periods of inactivity. Change before or remove the impeller before longer periods of stoppage. Also see "Preparations of storage".

## 8. 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 *Scania Anti-corrosive*: Check the anti-corrosive content.

The composition of the coolant is also described under  
“Starting and running”

a)

### Checking the appearance of the coolant

- Fill a receptacle 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.
- 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 fracture 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**

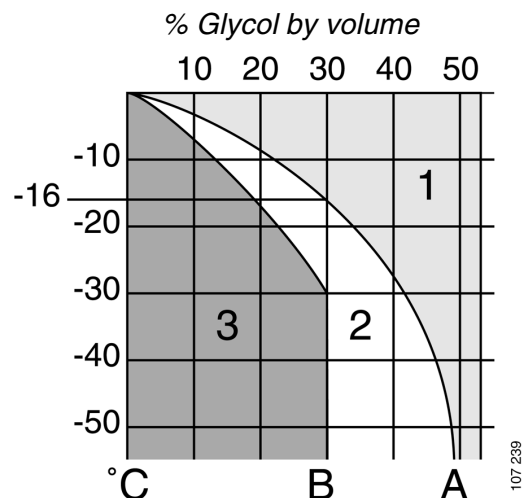
The coolant should be ready  
mixed when it is poured into the  
cooling system.  
Never top up with only water or  
only glycol.

#### **! 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 formation 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 <sup>3</sup>
Ice slush starts to form at °C	-6	-9	-12	-16	-22	-27	-36	-46	-55	
Glycol dm <sup>3</sup> (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 anti-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.

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

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.

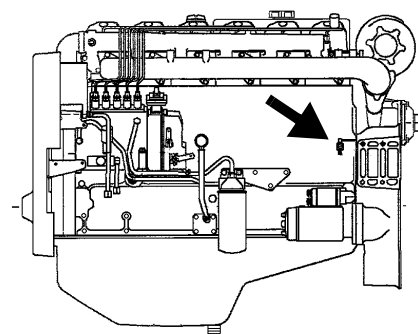


### **Important**

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 as illustrated:
    - the "lowest point" of the engine block, see drawing.
    - the "lowest point" of the cooling system.
  3. Close the valves.
  4. Top up with coolant through the expansion tank filler hole.
- Mix coolant as described on page 26.



1:5676



### **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.

## 9. Every 4800 hours: CLEANING THE COOLING SYSTEM

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

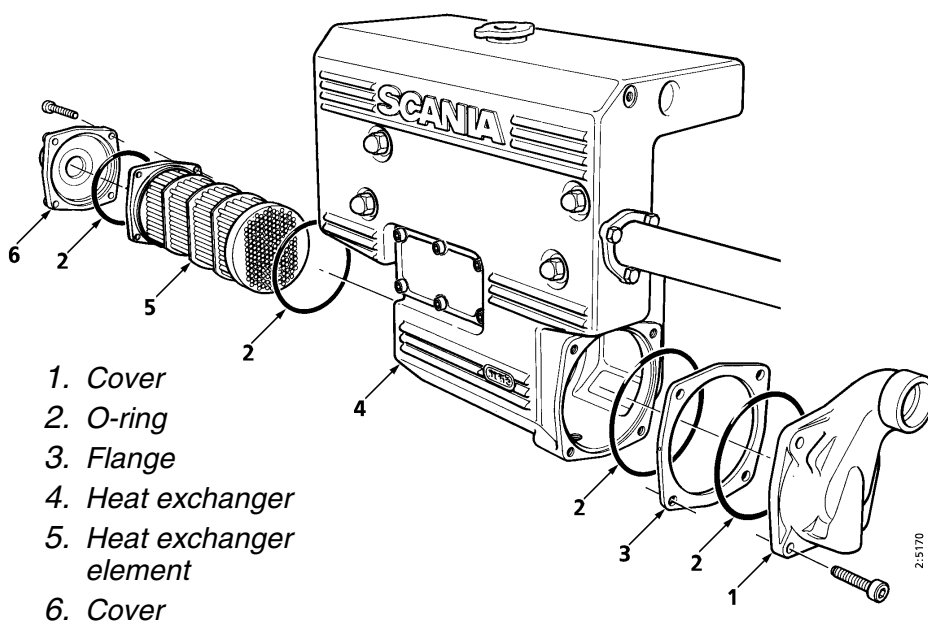
### External cleaning

#### Heat exchanger

1. Drain the coolant from the engine, see "Changing coolant".
2. Drain the seawater circuit.
3. Detach the heat exchanger hose and pipe connections.
4. Dismantle the heat exchanger as illustrated. DI9: Start by removing the charge air cooler.
5. Clean the outside of the element. Use a paraffin-based engine cleaner.
6. Any deposit on the inside of the pipes is removed mechanically using a round rod.
7. Change the O-rings and assemble the heat exchanger.  
DI9: See "Charge air cooler".
8. Refit hose and pipe connections.
9. Fill the system with coolant as described on page 26.

### **! Important**

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

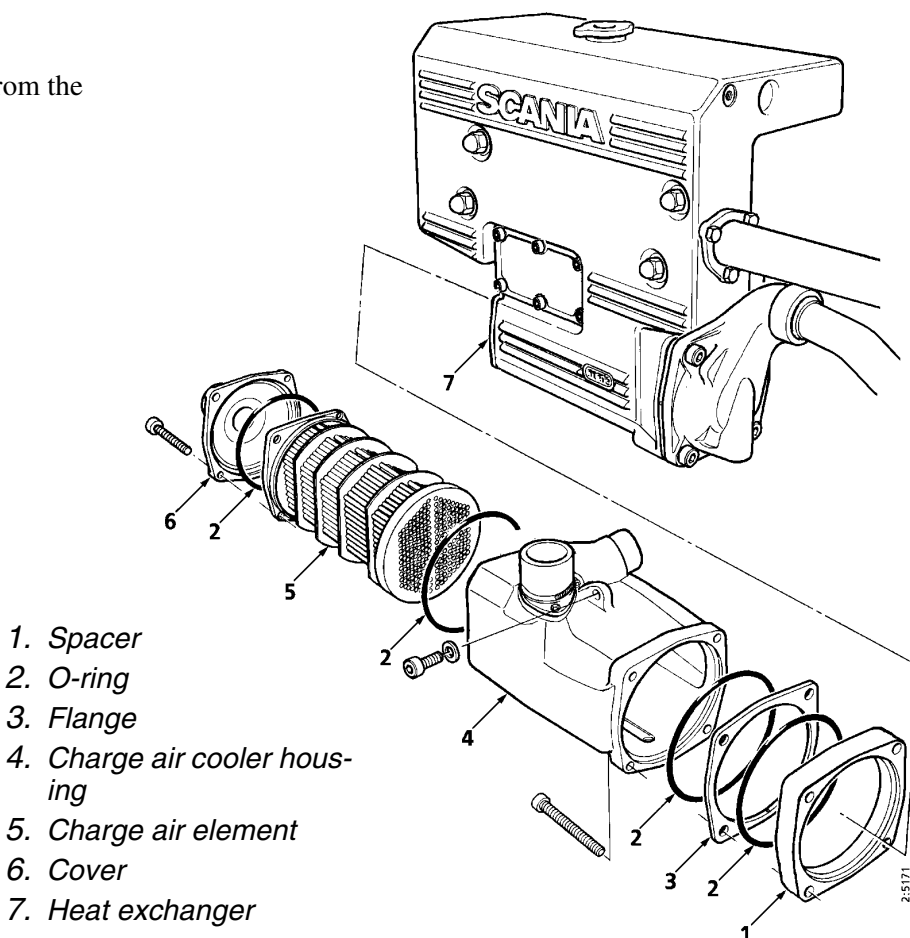


## Charge air cooler (DI engine)

1. Drain the coolant from the engine, see "Changing the coolant".
2. Drain the seawater circuit.
3. Detach the connections to the turbo and the intake manifold.
4. Detach the water connection from the charge air cooler's outlet.
5. Remove the complete charge air cooler and dismantle it as illustrated.
6. Clean the outside of the element. Use a paraffin-based engine cleaner.
7. Any deposit on the inside of the pipes is removed mechanically using a round file.
8. Change the O-rings and assemble the charge air cooler.
9. Refit the charge air cooler to the heat exchanger.
10. Refit the hose connections to the turbo and intake manifold and the connection to the charge air cooler cover.
11. Fill the system with coolant as described on page 26.
12. Connect the intake manifold from the turbo.

### **! Important**

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



## Engines without heat exchanger (keel-cooling)

1. Check cooling elements/cooling pipes on the inside and outside of the keel.
2. If necessary, clean with paraffin-based engine cleaner, or carefully scrape off deposits on external pipes.

**Take care not to damage the cooling element or cooling pipe.**

## Internal cleaning

### Removing oils and greases

- If possible, run the engine until it has reached the 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 it has reached operating temperature 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 coolant according to the specification on page 26.



### **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 the 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 coolant according to the specification on page 26.



### **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

## 10. Daily:

### READING THE LOW PRESSURE INDICATOR

If the indicator's red plunger is fully visible, change or clean the air cleaner filter element, point 12.



## 11. 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

#### ! Viktigt

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

## 12. Every 1200 hours:

### CLEANING OR CHANGING THE FILTER ELEMENT

**Note** Earlier if the vacuum indicator shows red.

#### Disassembly

1. Remove and clean the coarse cleaner, see point 11.
2. Undo the nut securing the filter element and remove it.
3. Change or clean the element.

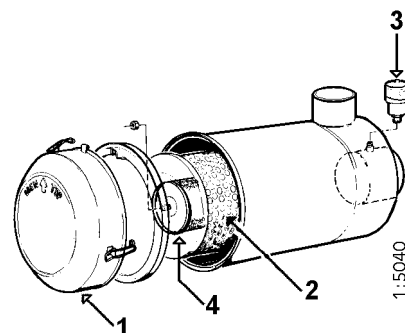
**Note** Cleaning the element always entails a risk of damaging it. The element can be cleaned a maximum of four times. After cleaning, it has poorer dust capacity than a new element.

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

#### ! 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

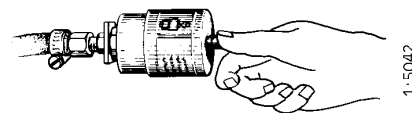
Never start the engine unless the air filter is installed.

Danger of personal injury or engine damage.



## Checking

- Insert a flashlamp into the insert and check from the outside that there are no holes or cracks in the filter paper.
- Change the filter insert if there is any damage at all. Danger of engine damage.



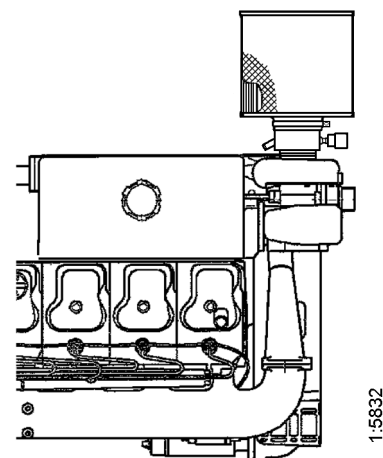
## Assembly

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

## Filter with a non-changeable element (unit cleaner)

### Cleaning

- The filter may be cleaned a maximum of 3 times. Mark the filter after each time it has been cleaned.
  - Use a cleaning solution consisting of water mixed with approx. 1% mild detergent.
1. Pour the cleaning solution into the element outlet at the same time as turning the element so that the cleaning solution pours through the element against the direction of the air flow.
  2. Leave the element in the cleaning solution for 5 minutes and then take it out so that all the cleaning solution drains away.
  3. Rinse the element with ca 30 litres clean water at 30 - 40 °C. Pour the rinsing water into the element in the same way as the cleaning solution.
  4. Take out the element and allow the rinsing water to drain off.
  5. Repeat the procedure until the rinsing water is clean.
  6. Leave the element to dry in a warm place for a few days.

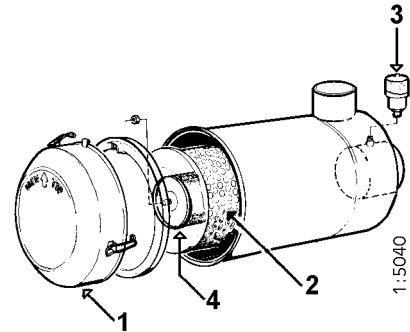


**Note** The element must not be dried with compressed air.

## 13. Every 2400 hours: CHANGING SAFETY CARTRIDGE

1. Remove and clean the coarse cleaner, see point 11.
2. Undo the nut securing the filter insert and remove it.
3. Change or clean the filter insert, see point 12.
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

## 14. Daily:

### CHECKING FUEL LEVEL

- Top up fuel if necessary.
- If the tank is run dry, bleed the fuel system, see point 15.

Be extremely careful with cleanliness when working on the fuel system.

Malfuncions can easily arise and the injection equipment can be damaged.

## 15. Every 1200 hours:

### CHANGING THE FUEL FILTER

#### Fuel tanks

- Drain any water from the fuel tanks.

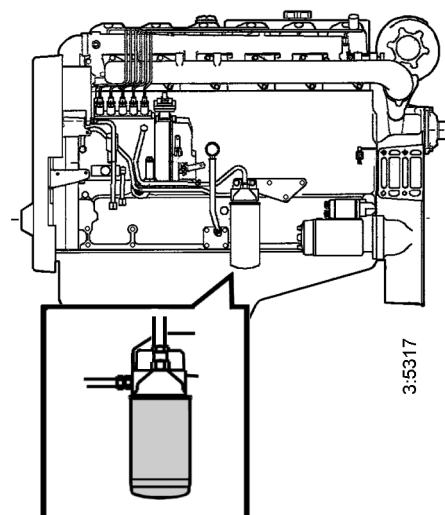
#### Main filter

The filter consists of a filter unit.

- Wash the outside of the filter and unscrew it.
- 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 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. On the 8000 pump, the overflow valve is located on the fuel shut-off valve.

If the engine still won't start . . . . .

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

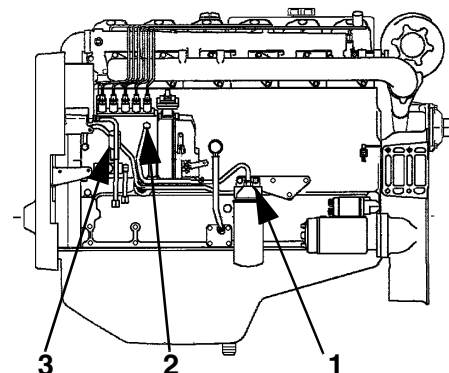
#### ! Important

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.



## 16. 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 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.

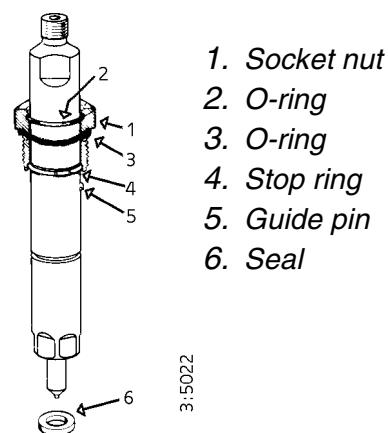
*Correct opening pressure, see Technical data, page 49.*

#### 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 threaded 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

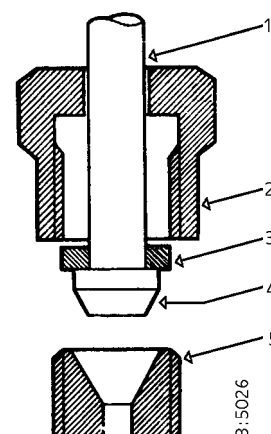
**The delivery pipes must not be bent.  
All clamps must be refitted.**



#### 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

*Delivery pipe connection*

# ELECTRICAL SYSTEM

## 17. Every 200 hours:

### CHECKING THE ELECTROLYTE LEVEL IN BATTERIES

1. Undo 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.

## 18. Every 200 hours:

### CHECKING THE STATE OF CHARGE IN BATTERIES

**Note** Every 200 hours applies to gensets 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 °C
- 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.

## 19. Every 200 hours:

### CLEANING BATTERIES

**Note** Every 200 hours applies to gensets 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.

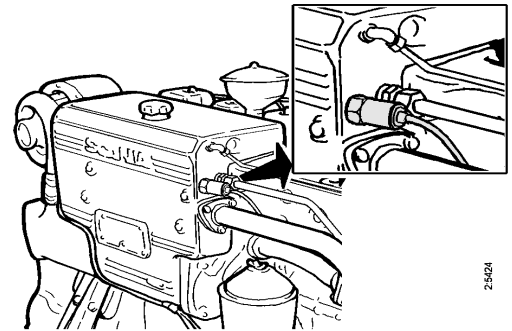
## 20. Every 1200 hours:

# CHECKING THE COOLANT LEVEL MONITOR

(optional equipment)

**Note** Check the coolant level monitor when the engine is cold.

1. Loosen the coolant level monitor cable clamps towards the cable cluster and disconnect the connector.
2. Put a container under the heat exchanger and unscrew the monitor. Immediately insert a threaded plug M18x1.5 in the hole for the monitor. *Avoid contact with the skin when handling coolant.*
3. Connect the monitor connector and put the control switch in the "ON" position.
4. Check that the warning lamp remains on and that the buzzer sounds (if fitted).
5. Lower the monitor into a metal container (steel) with liquid. It is important that the monitor body is in contact with the metal.
6. After approximately 2 seconds the warning lamp should go out.
7. Remove the monitor from the liquid. After approximately 7 seconds the warning lamp will come on and the buzzer sound (if fitted).
8. Disconnect the monitor connector and screw on the monitor again.
9. Clamp the monitor cable as before and connect the connector.
10. Top up the system with coolant according to the specification on page 26.



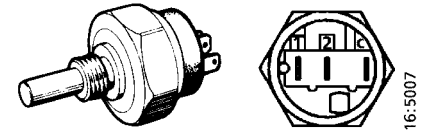
## 21. Every 1200 hours:

### 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 (about 1° per 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 temperature 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*

16:5007



**Mind the environment!**

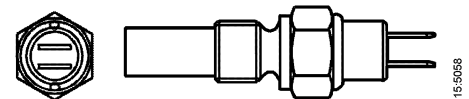
**Always use a suitable container to avoid spillage when draining coolant.**

**Dispose of used coolant through an authorized waste disposal contractor.**

### CHECKING 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 $\Omega$	Tolerance °C
60	$134 \pm 13.5$	$\pm 4$
90	$51.2 \pm 4.3$	$\pm 3$
100	$38.5 \pm 3$	$\pm 3$



*2-pole temperature sensor*

15:5058

## 22. 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 ± 0.15 bar** when the engine is stopped.

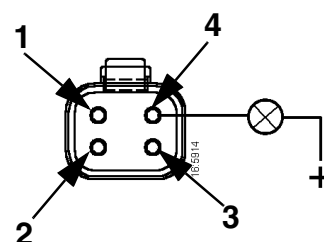
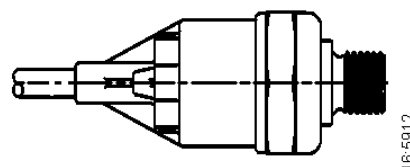
**Important** *The sensor/monitor must be supplied with voltage during the measurement. Maximum 4 W load from a test lamp.*

#### Monitor connected for automatic stop in case of a fault:

1. Start the engine.
2. Check on the oil pressure gauge that oil pressure rises.
3. Stop the engine manually (using the emergency stop).
4. Check on the oil pressure gauge at what pressure the stop solenoid operates and the monitor opens. Correct pressure: **0.7 ± 0.15 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 ± 0.15 bar** and the monitor closes.



## 23. 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.*

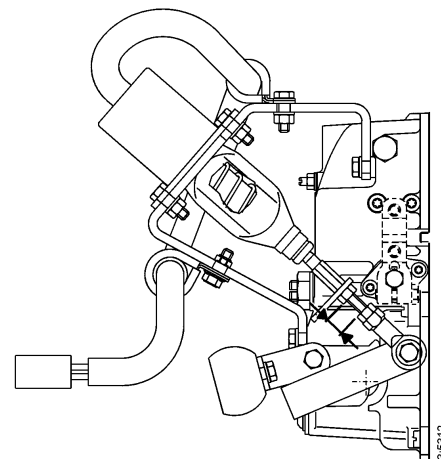


## CHECKING STOP SOLENOID STOP POSITION

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):

### The 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  $21.0 \pm 0.1$  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.

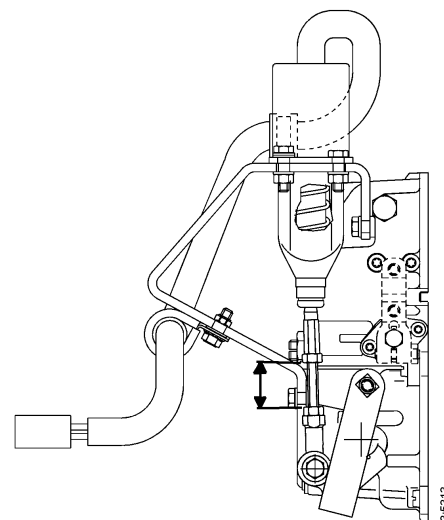


Installation “Pull to stop”

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

### 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  $26.0 \pm 0.1$  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.**
- 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.



Installation “Pulled during operation”

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

## 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.**

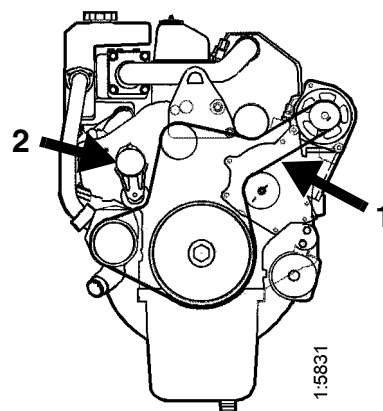
## MISCELLANEOUS

### 24. 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.



## 25. 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 liner and crank-case are leaking, see drawing.
  - 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 are lubricated with soap or oil when fitted).

This leakage normally stops after a time.

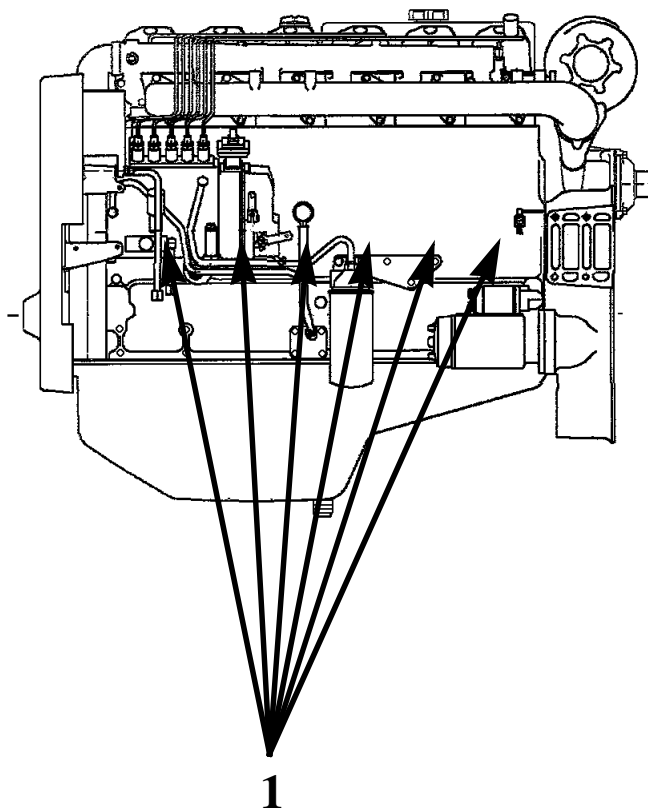


***Mind the environment!***

**Ensure that any leakage does not pollute the environment.**

***! Important***

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



1:5676

## 26. Every 2400 hours:

### CHECK/ ADJUST VALVE CLEARANCE

**Note** Checking/adjusting valve clearances should also be carried out after the first 400 hours of operation.

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

Rocker cover gaskets should be changed as necessary. Tightening torque: 25 Nm.

Intake valve clearance: 0.45 mm

Outlet valve clearance: 0.80 mm.

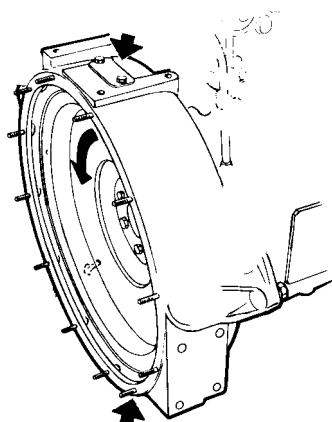
#### Alternative 1

- 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.
- 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.



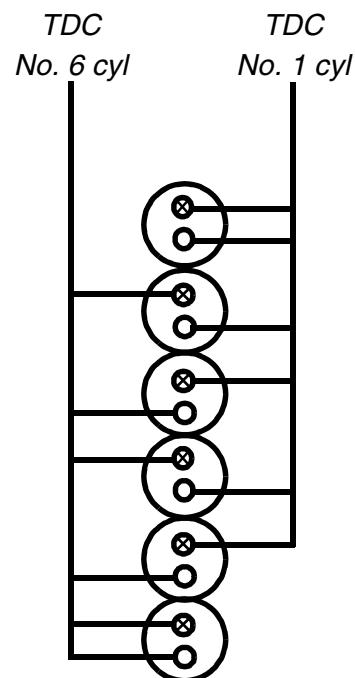
#### WARNING

Immobilise the starting device when working on the engine.

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



FLYWHEEL



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.

## 27. Every 2400 hours:

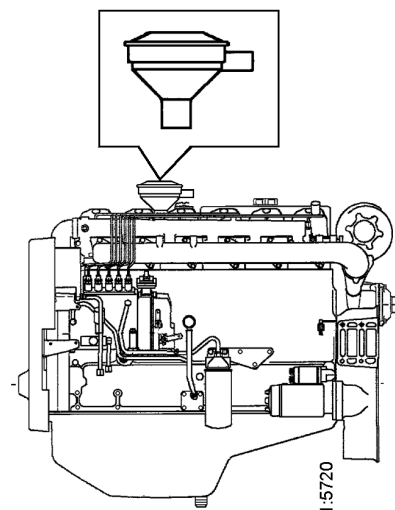
### CHANGING (or CLEANING) THE CLOSED CRANKCASE VENTILATION VALVE

#### 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 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 cm<sup>3</sup> (ml) of Lubrizol 560A with 10 dm<sup>3</sup> (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.

For example: 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, **max 30 cm<sup>3</sup> (ml)**.  
Turn the engine over a few times 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 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 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!***

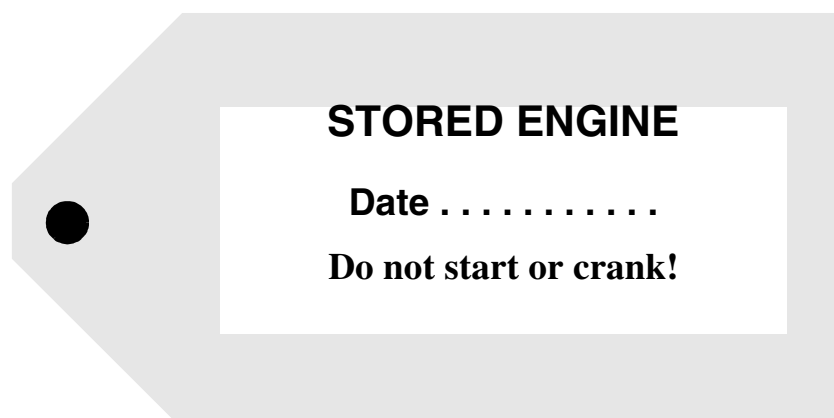
**Always use suitable containers to avoid spillage when draining oil and coolant.**

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

## Winter storage

- In order to minimize the risk of condensation water in the fuel tank during a winter stop it should be filled with fuel.

- 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. (This does not apply to batteries which, according to the manufacturer, are 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 system with coolant, see page 12.
- Check the oil level in the engine or top up with new 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 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.**



### **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.**



# TECHNICAL DATA

GENERAL		D9	DI9
Number of cylinders		6 in line	
Cylinder bore	mm	115	
Stroke	mm	144	
Displacement	dm <sup>3</sup> (litres)	9.0	
Number of main bearings		7	
Firing sequence		1 - 5 - 3 - 6 - 2 - 4	
Compression ratio		17:1	High output engine: 15:1
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)			
engine <u>with</u> heat exchanger	kg	890	905
engine <u>without</u> heat exchanger			
(keel-cooling engine)	kg	855	-
Output		see "Engine record card"	
<b>LUBRICATION SYSTEM</b>			
Max. oil pressure			
(warm engine at speeds above 800 rpm)	bar (kp/cm <sup>2</sup> )	6	
Normal oil pressure			
(warm engine at operating speed)	bar (kp/cm <sup>2</sup> )	3 - 6	
Min. oil pressure			
(warm engine 800 rpm)	bar (kp/cm <sup>2</sup> )	0.7	
Oil capacity, see page 21			
Crankcase pressure with closed crankcase ventilation	mm VP	-55 - +20	

<b>FUEL SYSTEM</b>		<b>D9</b>	<b>DI9</b>
Pump setting BTDC		See plate on rocker cover	
Injectors, opening pressure	bar (kp/cm <sup>2</sup> )	300	
Low idle with RSV governor	rpm	700	
Maximum full load speed		See engine card	
Fuel		Diesel fuel oil <sup>1</sup>	
Tightening torques:			
Socket nut for injectors	Nm	70	
Cap nut for delivery pipe	Nm	20	
Oil leakage connection	Nm	11	
<sup>1</sup> see page 51			
<b>COOLING SYSTEM</b>			
Number of thermostats		2	
Thermostat, opening temperature	°C	79	
Coolant temperature:			
system with atmospheric pressure	°C	70 - 93	
system with positive pressure	°C	70 - about 100	
Capacity with heat exchanger	dm <sup>3</sup> (litres)	40	
without heat exchanger (keel-cooling engine)	dm <sup>3</sup> (litres)	25	
<b>ELECTRICAL SYSTEM</b>			
System voltage	V	24	
Alternator, current	A	65 or 90	
Starter motor power	kW (hp)	4.0 (5.4)	
Monitors, settings:			
Oil pressure monitor	bar (kp/cm <sup>2</sup> )	2-pole: 0.7 ± 0.15	
Temperature monitor	°C	Stamped on monitor hexagon	

# 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 <sup>2</sup> /s (cSt)
Density at 15°C	0.82 - 0.86 kg/dm <sup>3</sup>
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.**

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