

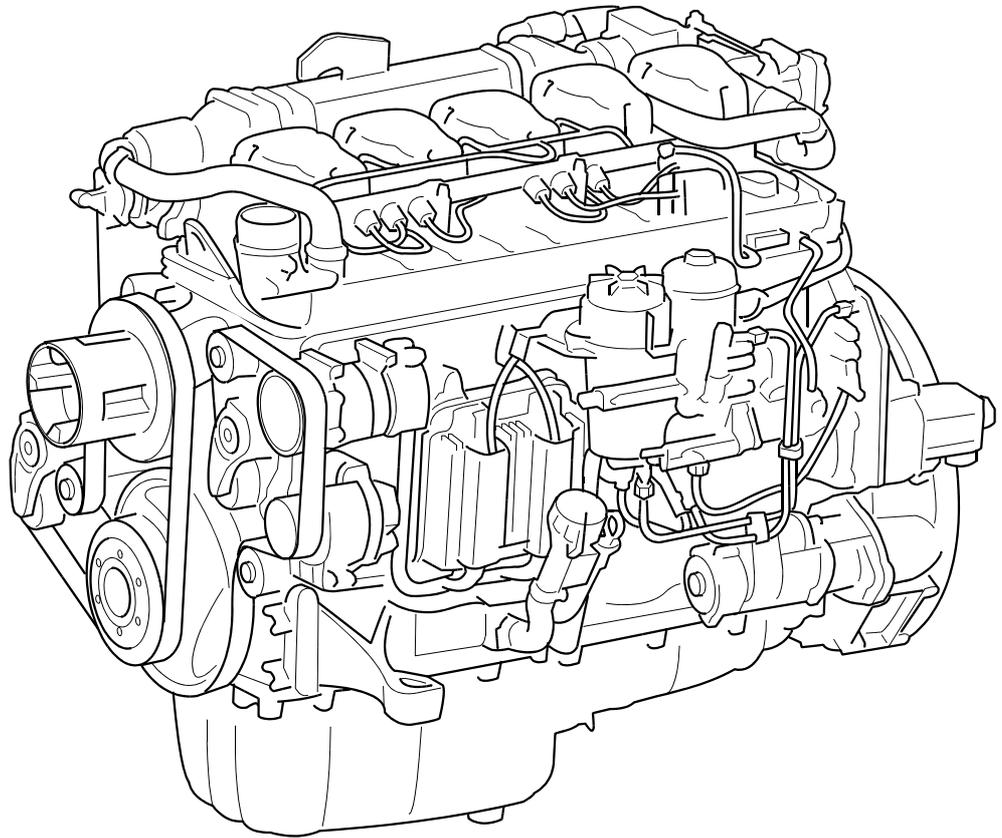
SCANIA

00:23-02

Issue 5.0 en-GB

Inspection instructions DC09 industrial engine with XPI

E2011



336504

E2011	1
Inspection	3
Engines with few hours of operation	5
Cleaning the engine	5
Inspection intervals	6
Lubrication system	7
Oil grade	7
Oil analysis	8
Checking the oil level	8
Changing the oil	9
Labels for top-up engine oil grade	10
Parts	10
Cleaning the centrifugal oil cleaner	11
Operational testing	16
Renewing the oil filter	17
Cooling system	18
Coolant	18
Checking the coolant level	21
Checking antifreeze and corrosion inhibitor	22
Antifreeze and corrosion inhibitor	23
Changing coolant	24
Cleaning the cooling system	26
Air cleaner	29
Reading the vacuum indicator	29
Renewing the filter element	29
Renewing the safety cartridge	30
Fuel system	31
General information on the XPI fuel system	31
Checking the fuel level	31
Renewing the fuel filter	32
Bleeding the fuel system	36
Miscellaneous	37
Checking the drive belt	37
Checking for leaks	39
Checking and adjusting the valve clearance	39
Renewing the reductant filter	41
Cleaning the reductant tank filler filter	43
Cleaning the reductant tank ventilation filter	43

Inspection

The inspection programme covers a number of points that are divided into the following sections:

- Lubrication system
- Cooling system
- Air cleaner
- Fuel system
- Miscellaneous



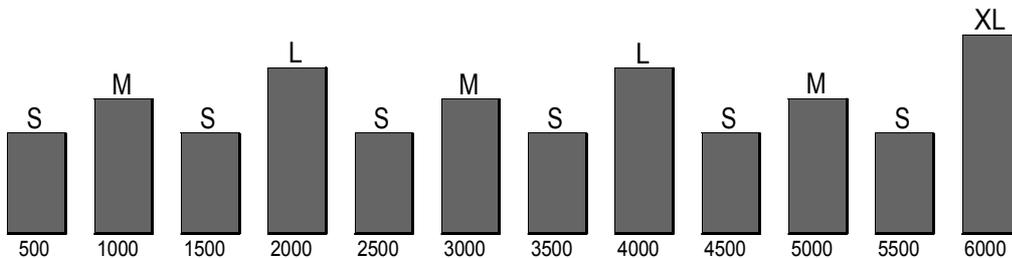
WARNING!

Block the starting device when working on the engine. If the engine starts unexpectedly, there is a serious risk of injury.

The inspection programme includes the following inspections:

- S inspection: Minimum basic inspection.
- M inspection: More extensive inspection.
- L inspection: Includes nearly all inspection points.
- XL inspection: Includes all inspection points.

During a period, the sequence is S-M-S-L-S-M-S-L-S-M-S-XL.



313 153



IMPORTANT!

On delivery a Scania engine is optimised for its application. However, regular inspection is necessary to:

- prevent unplanned stops
- extend the service life of the engine
- maximise the long-term emission performance of the engine

- give the best possible operating economy.
-

Engines with few hours of operation



IMPORTANT!

On engines with few hours of operation, inspection must be carried out annually or every 5 years.

Stand-by generator sets and the like that are not used regularly should be test run and checked in accordance with the manufacturer's instructions.

The following inspection points must be carried out once the engine has been warmed up to operating temperature.

1. Checking the oil level.
2. Checking the coolant level.
3. Checking the vacuum indicator.
4. Checking the fuel level.
5. Checking for engine leaks.

Cleaning the engine

The engine must be cleaned before starting work.

Clean the engine with hot water. Also use a degreasing agent, if necessary.

Avoid spraying water on the engine control unit, see illustration.



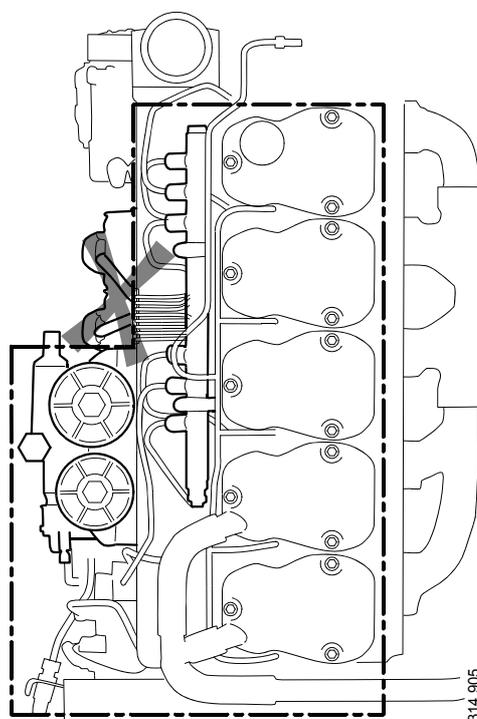
WARNING!

Beware of hot water! Use suitable protective equipment.



Environment

The washing water must be disposed of in compliance with the relevant national and international regulations.



Clean within the marked area.

Inspection intervals

	Daily	First time at		Interval (hours)				Minimum									
		first start	500	500	1,000	2,000	6,000	annually	every 5 years								
				S	M	L	XL										
Lubrication system	X	X															
Checking the oil level																	
Changing the oil.					X ¹	X ¹	X ¹	X ¹	X								
Cleaning the centrifugal oil cleaner					X ¹	X ¹	X ¹	X ¹	X								
Renewing the oil filter				X ¹	X ¹	X ¹	X ¹	X									
Cooling system	X	X															
Checking the coolant level																	
Checking coolant antifreeze or corrosion protection				X				X	X	X							
Cleaning the cooling system and changing coolant									X ¹		X						
Air cleaner	X																
Reading the vacuum indicator																	
Renewing the filter element													X ¹	X		X	
Renewing the safety cartridge													X	X		X	
Fuel system	X	X															
Checking the fuel level																	
Renewing the fuel filter													X ¹	X	X		X
Miscellaneous	X	X															
Checking the drive belt													X	X	X	X	
Checking for leaks															X	X	
Checking and adjusting the valve clearance												X			X	X	
Renewing the reductant filter					X	X	X										
Cleaning the reductant tank filler filter				X ¹	X ¹	X ¹	X ¹										
Cleaning the reductant tank ventilation filter					X ¹	X ¹	X ¹										

1 More often if required.

Lubrication system

Oil grade

Scania LDF stands for the Scania Long Drain Field test standard. Scania LDF oils have been carefully selected after extensive testing. The approval is only granted to the highest quality engine oils available on the market.

Recommended oil
Scania Oil LDF
Scania Oil LDF-2
Scania Oil LDF-3
Scania Oil E7

The engine oil must fulfil the following quality requirements:

- ACEA E5/API CI-4
- ACEA E7/API CI-4+
- For engines not run on low-sulphur fuel, the TBN (Total Base Number) should be at least 12 (ASTM 2896).
- Oils with a low ash content (ACEA E9/API CJ4) are not recommended.

Check with your oil supplier that the oil meets these requirements.

If the engine is used in areas of the world where lubricating oil with ACEA or API classification is not available, the oil grade must be measured in actual operation. In this case contact the nearest Scania workshop.

For operation at extremely low outdoor temperatures: Consult your nearest Scania representative on how to avoid starting difficulties.

Viscosity class	Outdoor temperature	
SAE 20W-30	-15°C (5°F)	- +30°C (86°F)
SAE 30	-10°C (14°F)	- +30°C (86°F)
SAE 40	-5°C (23°F)	- > +45°C (113°F)
SAE 50	0°C (32°F)	- > +45°C (113°F)
SAE 5W-30	< -40°C (-40°F)	- +30°C (86°F)
SAE 10W-30	-25°C (-13°F)	- +30°C (86°F)
SAE 15W-40	-20°C (-4°F)	- > +45°C (113°F)

Oil analysis

To be able to extend the oil change intervals using an oil analysis, Scania LDF-2 and LDF-3 oils must be used.

Oil companies can offer analysis of the engine oil.

The following conditions must remain fulfilled when the oil is changed.

- Viscosity at 100°C (212°F): max. $\pm 20\%$ of original value of the fresh oil.
- TBN (in accordance with ASTM D4739): > 3.5
- TBN (in accordance with ASTM D4739): > TAN (in accordance with ASTM D664)
- Soot (DIN 51452): < 3%

Such analysis measures the oil's TBN (Total Base Number), TAN (Total Acid Number), fuel dilution, water content, viscosity and the quantity of 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 new change intervals.

Checking the oil level

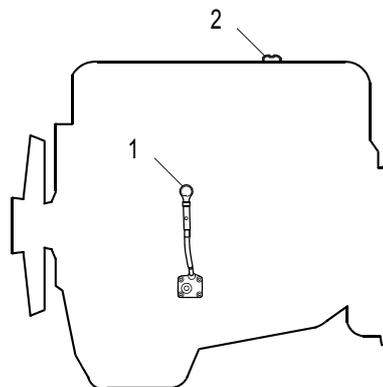
Checking the oil level with the engine switched off

Note:

Leave the engine off for at least 1 minute before checking the oil level.

1. Remove the oil dipstick (1) and check the oil level. The correct level is between the minimum and maximum marks on the oil dipstick.
2. Top up with more oil (2) when the oil level is at or below the lower mark.

Information on the correct oil type is found under the heading Oil grade.



312506

Changing the oil

Note:

Renew the oil filter and clean the centrifugal oil cleaner when changing oil.



WARNING!

Hot oil can cause burns and skin irritation. Wear protective gloves and goggles when changing hot oil.

Make sure that there is no pressure in the lubrication system before starting work on it.

The oil filler cap must always be in place when starting and running the engine to prevent oil being ejected.



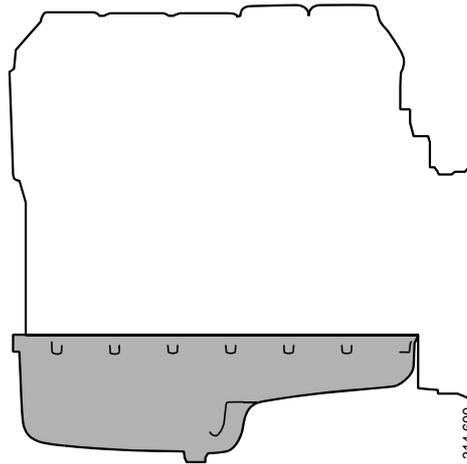
Environment

Use a container to avoid spillage. Used oil must be disposed of as specified in national and international law.

Note:

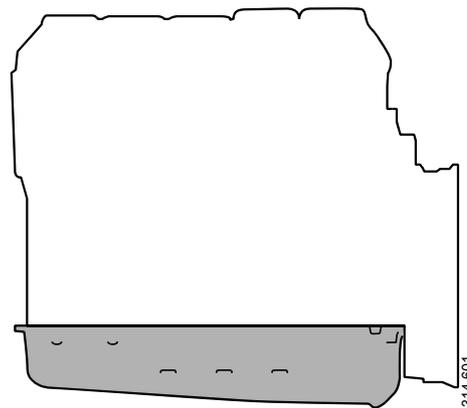
Change oil more often if the engine is subjected to particularly demanding operation, such as a dusty environment, or if deposits in the centrifugal oil cleaner are thicker than 28 mm (1.1 in).

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



Max. 36 litres (9.5 US gallons)

Min. 31 litres (8.2 US gallons)

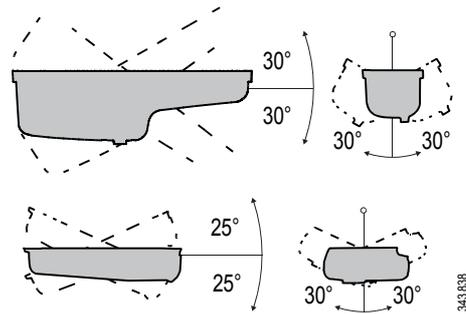


Max. 34 litres (9 US gallons)

Min. 29 litres (7.7 US gallons)

Maximum angles of inclination during operation

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



Labels for top-up engine oil grade

When changing oil it is important to use the correct engine oil grade.

The oil filler cap must be clearly marked with a label showing the top-up oil grade.

If the label is missing or if the engine oil grade is changed, a new label must be fitted.



The illustration shows the label for oil grade Scania LDF-2.

Parts

Oil grade	Colour	Part No.
Scania LDF-2	Blue	2 132 424
Scania LDF-3	Red	2 132 426
Scania LDF	Grey	2 269 345
ACEA E7	White	2 132 425

Cleaning the centrifugal oil cleaner

When cleaning the centrifugal oil cleaner there will be some dirt deposits in the rotor cover. If this is the case, this indicates that the rotor is working. If it is not working, the cause must be established immediately.

If the dirt deposit exceeds 28 mm at the recommended intervals, the rotor cover should be cleaned more often.



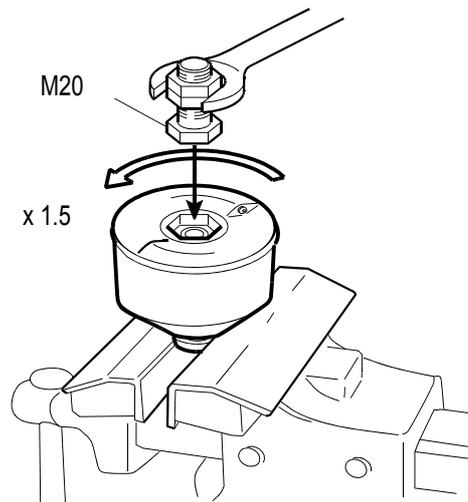
WARNING!

The oil may be hot. Carefully remove the cover from the centrifugal oil cleaner.

1. Clean the cover. Unscrew the nut securing the outer cover.
2. Let the oil run out from the rotor.
3. Lift out the rotor. Wipe off the outside. Undo the rotor nut and unscrew it about 1.5 turns to protect the bearing.

Note:

Take care not to damage the rotor shaft.

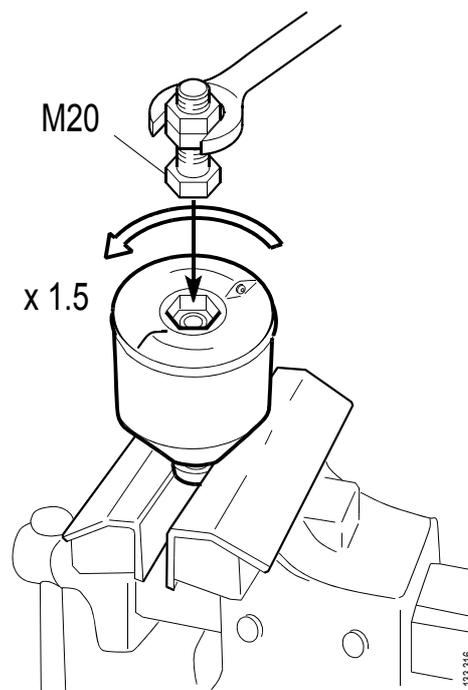


4. If the rotor nut is difficult to get loose, turn the rotor upside down and fasten the rotor nut in a vice. Turn the rotor counterclockwise 1.5 turns by hand or use an M20 nut, see illustration.

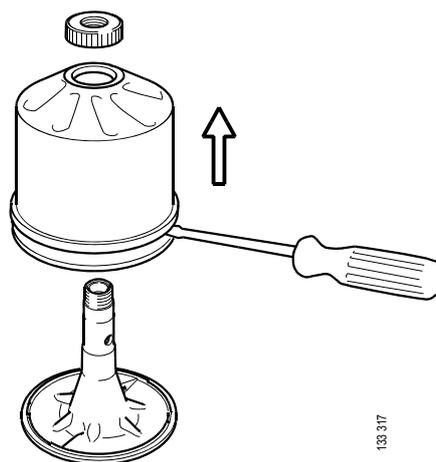


IMPORTANT!

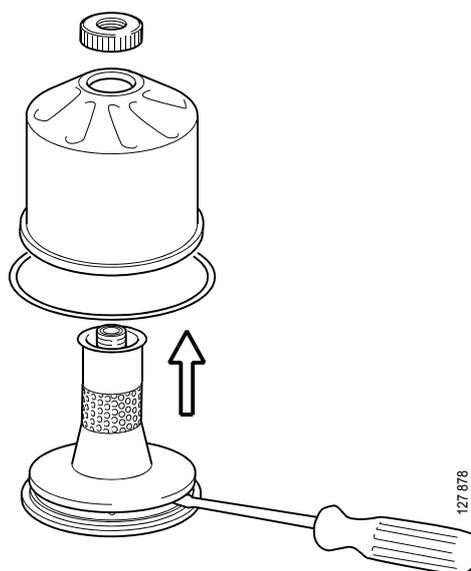
The rotor must not be put in a vice. Never strike the rotor cover. This may cause damage resulting in imbalance.



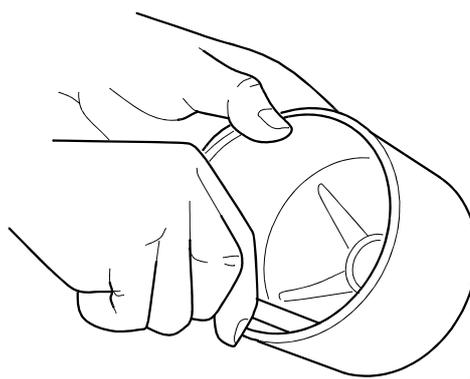
5. Remove the rotor cover by holding the rotor in both hands and tapping the rotor nut against the table. Never strike the rotor directly as this may damage its bearings.



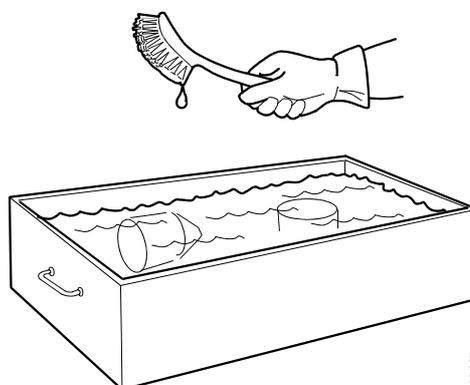
6. Remove the strainer from the rotor cover. If the strainer is stuck, insert a screwdriver between the rotor cover and strainer and carefully prise them apart.



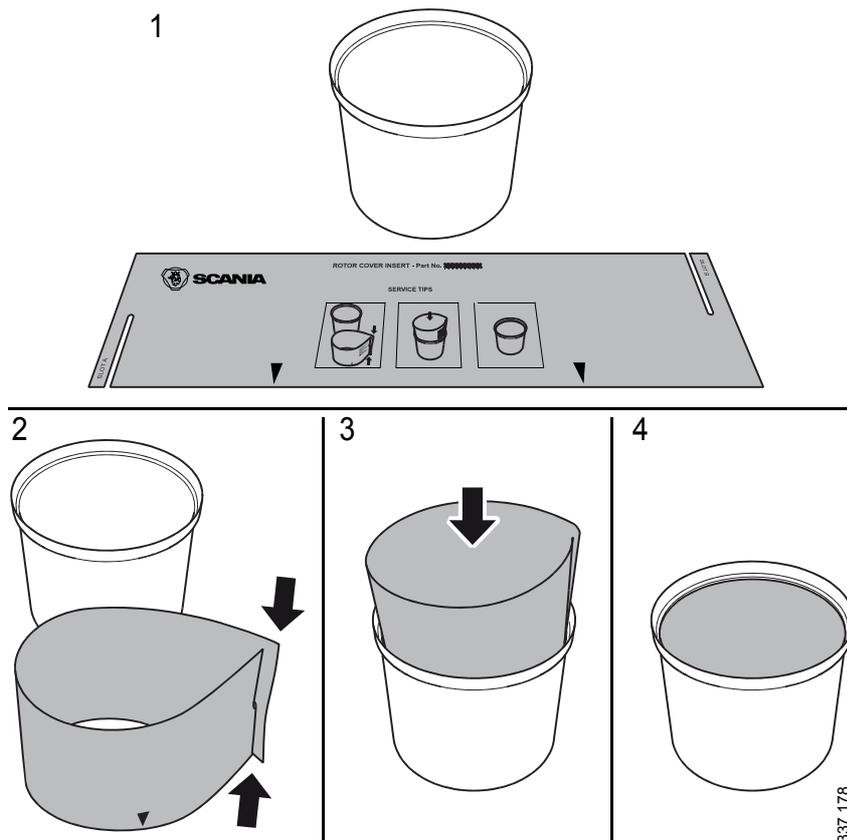
7. Remove the paper insert and scrape away any remaining dirt deposits inside the rotor cover. If the deposits are thicker than 28 mm, the centrifugal oil cleaner must be cleaned more often.



8. Wash the parts.
9. Check the 2 nozzles on the rotor. Ensure that they are not blocked or damaged. Renew any damaged nozzles.
10. Check that the bearings are undamaged.



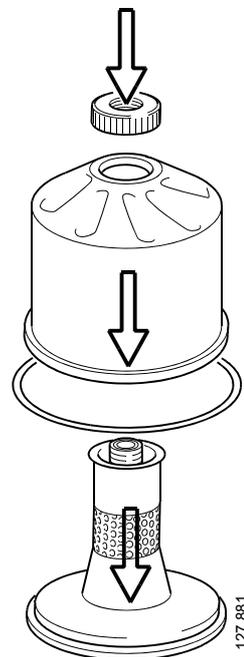
11. Fit a new paper insert on the inside of the rotor cover. Fit the strainer onto the rotor.



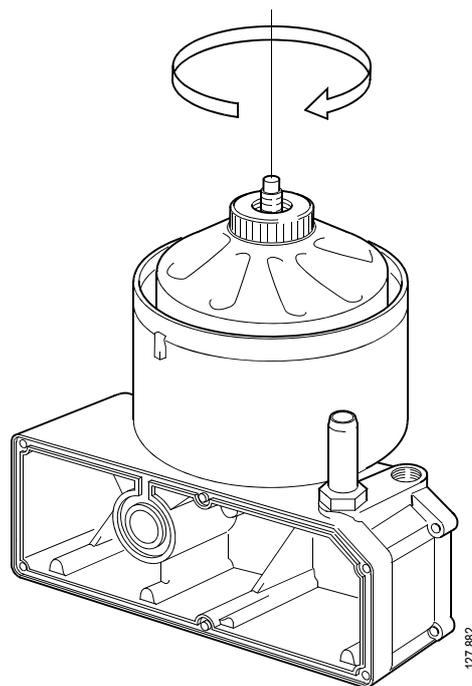
12. Fit the strainer onto the rotor.
13. Fit a new O-ring by sliding it over the strainer.
14. Refit the rotor cover. Make sure that the O-ring sits correctly on the inside.
15. Screw the rotor nut back on by hand.
16. Check that the shaft is not loose. Secure with thread-locking fluid 561 200 if it is loose. First clean thoroughly using a suitable solvent. Tighten the rotor shaft using socket wrench 99 520. Tightening torque 27 Nm.

Note:

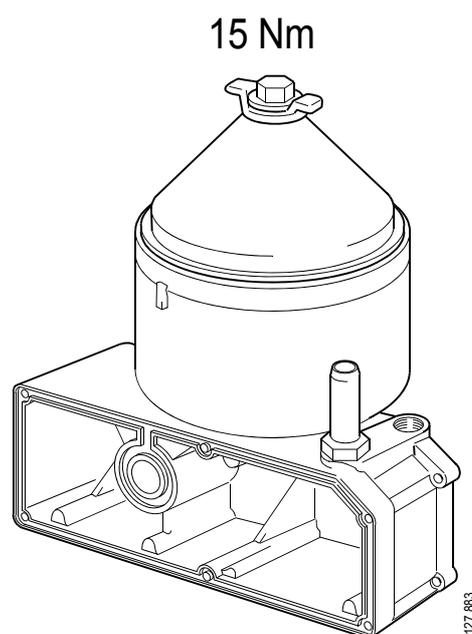
Take care not to damage the rotor shaft.



17. Refit the rotor and rotate it by hand to make sure it rotates easily.



18. Renew the O-ring on the cover of the oil cleaner housing and fit the cover. Tighten the lock nut to 15 Nm.

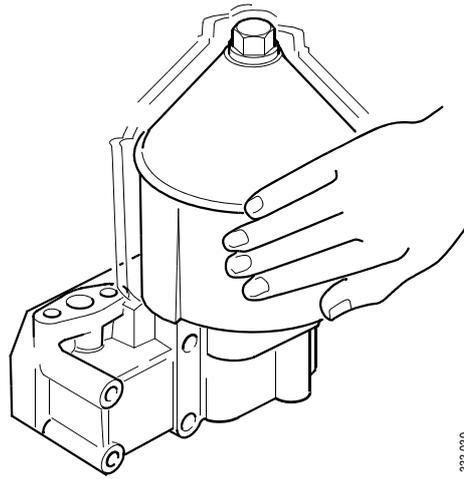


Operational testing

A functional inspection need only be carried out if it is suspected that the centrifugal oil cleaner is not working properly. For example, if there is an abnormally small amount of deposit in the centrifugal oil cleaner in relation to the distance driven.

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

1. Run the engine until it is warm.
2. Stop the engine and listen for the rotor. Use your hand to feel if the filter housing is vibrating.
3. If the filter housing is not vibrating, dismantle and check the centrifugal oil cleaner.



333 029

Renewing the oil filter



IMPORTANT!

Clean the centrifugal oil cleaner when renewing the oil filter.

Otherwise, the oil filter will be blocked and resistance in the filter will increase. If this happens, an overflow valve in the filter retainer opens and lets the oil pass without being filtered.

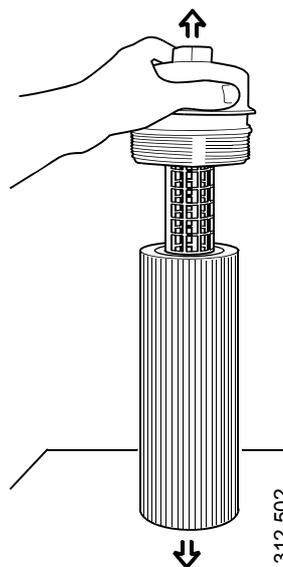
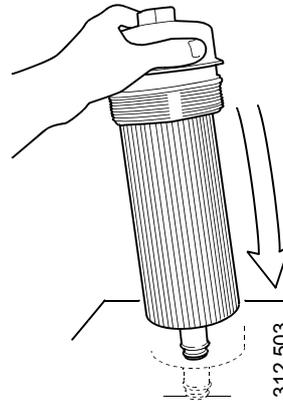
-
1. Unscrew the filter cover with a socket wrench with hexagon driver e.g. 36 mm socket 588 475.



IMPORTANT!

Do not use an adjustable spanner or other open tool as there is risk of damaging the filter cover.

-
2. Lift out the filter housing cover with filter element. The filter housing will drain automatically once the filter has been removed.
 3. Detach the old filter from the cover by holding the cover and carefully tapping the entire filter element against something hard. Remember that there will be oil splashes.
 4. Fit the new filter and tighten the filter cover to 25 Nm (18 lbf ft).



Cooling system

Coolant



WARNING!

Ethylene glycol can be fatal if ingested and can cause skin irritation and eye damage.

The coolant recommended by Scania is a mixture of water with antifreeze and corrosion inhibitor (ethylene glycol). The coolant has several characteristics which are important for the operation of the cooling system:

- Corrosion inhibitor
- Antifreeze
- Increases the boiling point

The coolant should always contain 35-55% by volume of antifreeze and corrosion inhibitor so that the coolant properties ensure that the coolant works correctly.

Note:

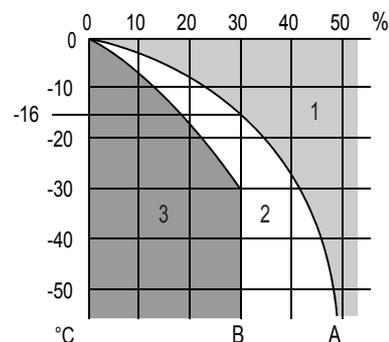
The coolant should be changed when the cooling system is cleaned: every 6,000 hours or at least every 5 years. Refer to Changing coolant.

Coolant resistance to cold

The following example shows coolant properties with 30 percent by volume of antifreeze and corrosion inhibitor:

- Ice slush starts to form at -16°C (3°F).
- At -30°C (-22°F), there is a risk of cooling system malfunction.
- There is no risk of damage by freezing with a minimum antifreeze and corrosion inhibitor content of 35 percent by volume.

The chart depicts coolant properties at different percents of antifreeze and corrosion inhibitor concentration by volume.



312.505

Curve A: Ice formation starts (ice slush)

Curve B: Damage by freezing occurs

Area 1: Safe range

Area 2: Malfunctions may occur (ice slush)

Area 3: There is risk of damage by freezing

Antifreeze and corrosion inhibitor concentration table

35% by volume of antifreeze provides sufficient protection against corrosion.

Example:

1. The total volume of the cooling system is 40 litres in this example.
2. The measured concentration of ethylene glycol is 35% by volume (freezing point -21 °C). According to the table, there are 14 litres of ethylene glycol in the cooling system.
3. The measured concentration of ethylene glycol is 45% by volume (freezing point -30 °C). According to the table, 18 litres of ethylene glycol are required in the cooling system.
4. Since there are already 14 litres in the cooling system, 4 litres of ethylene glycol must be added to the cooling system (18 - 14 = 4 litres).

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

Antifreeze and corrosion inhibitor concentration table

35% by volume of antifreeze provides sufficient protection against corrosion.

Example:

1. The total volume of the cooling system is 10.6 US gallons in this example.
2. The measured concentration of ethylene glycol is 35% by volume (freezing point -6°F). According to the table there are 3.7 US gallons of ethylene glycol in the cooling system.
3. The measured concentration of ethylene glycol is 45% by volume (freezing point -22°F). According to the table, 4.8 US gallons of ethylene glycol are required in the cooling system.
4. Since the cooling system already contains 3.7 US gallons, fill another 1.1 US gallons of ethylene glycol in the cooling system ($4.8 - 3.7 = 1.1$ US gallons).

Volume of ethylene glycol (%)	For calculation			Adequate protection against corrosion					Cooling system volume (US gallons)
	20	25	30	35	40	45	50	60	
Ice slush forms ($^{\circ}\text{F}$)	21	16	10	-6	-11	-22	-36	-58	
Volume of ethylene glycol (US gallons)	1.3	1.6	2.1	2.9	3.2	3.7	4	4.8	7.9
	1.6	2.1	2.6	3.7	4.2	4.8	5.3	6.3	10.6
	2.1	2.6	3.4	4.8	5.3	6.1	6.6	7.9	13.2
	2.4	3.2	4	5.5	6.3	7.1	7.9	9.5	15.9
	2.9	3.7	4.8	6.6	7.4	8.5	9.2	11.1	18.5
	3.2	4.2	5.3	7.4	8.5	9.5	10.6	12.7	21.1
	3.7	4.8	6.1	8.5	9.5	10.8	11.9	14.3	23.8
	4	5.3	6.6	9.2	10.6	11.9	13.2	15.9	26.4
	4.5	5.8	7.4	10.3	11.6	13.2	14.5	17.4	29.1
	4.8	6.3	7.9	11.1	12.7	14.3	15.9	19	31.7
	5.3	6.9	8.7	12.2	13.7	15.6	17.2	20.6	34.3
	5.5	7.4	9.2	12.9	14.8	16.6	18.5	22.2	37
	6.1	7.9	10	14	15.9	18	19.8	23.8	39.6
	6.3	8.5	10.6	14.8	16.9	19	21.1	25.4	42.3
	6.9	9	11.4	15.9	18	20.3	22.5	26.9	44.9
7.1	9.5	11.9	16.6	19	21.4	23.8	28.5	47.6	
7.7	10	12.7	17.7	20.1	22.7	25.1	30.1	50.2	
7.9	10.6	13.2	18.5	21.1	23.8	26.4	31.7	52.8	

Checking the coolant level

The following instructions apply to Scania expansion tanks. For other types of expansion tanks, follow the manufacturer's instructions.



WARNING!

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

If the cap has to be opened do it slowly and carefully to release the pressure before removing the cap. Wear gloves as the coolant is still very hot.

1. Open the expansion tank cap and check the coolant level.
 - The right coolant level on a cold engine is even with the lower edge of the filler neck.
 - The right coolant level on a hot engine is approximately 25 mm (1 in) over the lower edge of the filler neck.
2. Top up with coolant as necessary.



IMPORTANT!

Do not top up large quantities of coolant through the expansion tank. Top up in accordance with the instructions in the section headed Changing coolant instead.



IMPORTANT!

Never fill a large amount of cold coolant in a hot engine. There is great risk of cracks forming in the cylinder block and cylinder heads.



IMPORTANT!

Only pour pre-mixed coolant into the cooling system.

Checking antifreeze and corrosion inhibitor

Note:

Use only pure fresh water that is free from particles, sludge and other impurities.

1. Pour a small amount of coolant into a container and check that the coolant is pure and clear.
2. Change the coolant if it is contaminated or cloudy.
3. Measure the content of antifreeze and corrosion inhibitor with one of the following instruments:

Part No.	Designation
588 805	Refractometer
588 226	Refractometer

The following rules apply to ethylene glycol-based coolant:

- The antifreeze and corrosion inhibitor content must be minimum 35 percent by volume for corrosion protection to be sufficient.
- An antifreeze and corrosion inhibitor content greater than 55 percent by volume impairs the ability to protect against frost.
- If ice forms in the coolant, there are disruptions initially, but there is no immediate risk of damage. The engine should not be subjected to heavy loads when ice starts to form.

Antifreeze and corrosion inhibitor

Only the product Scania coolant, or other products that are tested to provide proper antifreeze and protection against corrosion for Scania, may be used in Scania engines. Products that do not satisfy the requirements for use in a Scania engine can result in faults in and damage to the cooling system. This can lead to the invalidation of Scania's warranty for faults and damage caused by the use of inappropriate coolant.

The antifreeze and corrosion inhibitor used in Scania engines should be of the ethylene glycol type.

Scania concentrate

Designation	Contents	Part No.	Volume	Volume (US gallons)
Coolant	Antifreeze and corrosion inhibitor (concentrate)	1 894 323	5 l	1.3 gallons
Coolant	Antifreeze and corrosion inhibitor (concentrate)	1 894 324	20 l	5.3 gallons
Coolant	Antifreeze and corrosion inhibitor (concentrate)	1 894 325	210 l	55 gallons
Coolant	Antifreeze and corrosion inhibitor (concentrate)	1 894 326	1,000 l	264 gallons

Scania Ready Mix

Designation	Contents	Part No.	Volume	Volume (US gallons)
Coolant	Scania antifreeze and corrosion inhibitor Ready Mix 50/50	1 921 955	5 l	1.3 gallons
Coolant	Scania antifreeze and corrosion inhibitor Ready Mix 50/50	1 921 956	20 l	5.3 gallons
Coolant	Scania antifreeze and corrosion inhibitor Ready Mix 50/50	1 921 957	210 l	55 gallons
Coolant	Scania antifreeze and corrosion inhibitor Ready Mix 50/50	1 896 695	1,000 l	264 gallons

Changing coolant



Environment

Avoid spillage and use a suitable container. Used coolant must be disposed of as specified in national and international law.



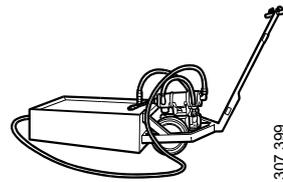
IMPORTANT!

Mix the coolant as specified under the section Coolant.

1. Remove the filler cap on the expansion tank.
2. Drain the coolant at the following two points:
 - Lowest point of the cylinder block.
 - The lowest point of the cooling system.
3. Close the taps.

Filling coolant

1. Connect the hose from unit 588 540 to the engine's drain valve.
2. Ensure that the cooling system bleed pipes are not blocked or damaged. There are bleed pipes from the radiator, engine and expansion tank.
3. Open the expansion tank cap.
4. Pump in coolant using coolant unit 588 540. Fill with coolant to the max. level of the expansion tank.
5. Disconnect the hose.
6. Set the heating control to maximum heating and start the engine. Idling speed must not exceed 600 rpm. Leave the engine idling for 15 minutes.
7. Stop the engine and top up with coolant to the maximum level through the expansion tank.
8. Air pockets may still be left in the cooling system, which will disappear after the engine has been operated for a period of time. It may, therefore, need some topping up to start with.



307 399

Unit 588 540**IMPORTANT!**

When it is necessary to fill a large quantity of coolant, it must be pumped in from underneath. This is to ensure that air does not get into the cooling system, which can cause the coolant pump to overheat.

Cleaning the cooling system

Note:

Clean the cooling system more often than the inspection interval if necessary.



IMPORTANT!

Do not use caustic soda or other alkaline detergent as this could damage the aluminium.

External: Cleaning the radiator and charge air cooler

1. Check that the radiator and the charge air cooler are not clogged on the air side and that the cooling fins are not damaged.
2. Carefully scrape away any deposits from the radiator cooling fins. Use a paraffin-based engine cleaner if necessary.
3. Carefully straighten bent cooling fins using a steel brush or the like.



WARNING!

To ensure proper handling of cooling system detergent, study the warning text on the package.

Internal: Removing oil and grease

1. Run the engine until it has reached operating temperature and then drain the cooling system.
2. Remove the thermostats.
3. Fill the system with clean, hot water mixed with liquid dishwasher detergent intended for household machines. Concentration 1% (0.1/10 l).
4. Warm up the engine for approximately 20-30 minutes. Remember to switch on the cab heating system, if one is installed.
5. Drain the cooling system.
6. Fill the system with clean, hot water and run the engine for about 20-30 minutes.
7. Drain the water from the cooling system.
8. Refit the thermostats.
9. Fill the cooling system with new coolant following the specification under Coolants earlier in the document.



Environment

Avoid spillage and use a suitable container. Used coolant must be disposed of as specified in national and international law.

Internal: Removing deposits

1. Run the engine until it has reached operating temperature and then drain the cooling system.
2. Remove the thermostats.
3. Fill the system with clean, hot water mixed with some commercially available radiator detergent which is based on sulphamic acid and contains dispersing agents. Follow the manufacturer's instructions for the concentration and cleaning period.
4. Run the engine for the specified time. Remember to switch on the cab heating system, if one is installed.
5. Drain the cooling system.
6. Fill the cooling system with clean, hot water and run the engine for about 20-30 minutes.
7. Drain the water from the cooling system.
8. Refit the thermostats.
9. Fill the system with new coolant following the specification under Coolants earlier in the document.



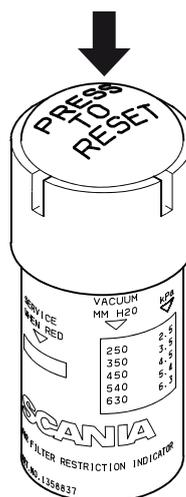
Environment

Avoid spillage and use a suitable container. Used coolant must be disposed of as specified in national and international law.

Air cleaner

Reading the vacuum indicator

If the indicator's red plunger is fully visible, renew or clean the air cleaner filter element following the instructions.



326 671

Renewing the filter element

Note:

Renew the filter element earlier than the inspection interval if the indicator shows red.

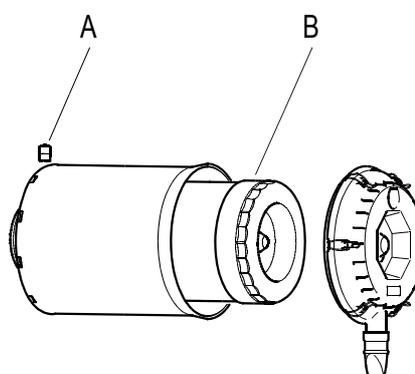
There is always a risk that the filter element will be damaged when it is cleaned.

The filter element must not be cleaned in water or be blown clean with compressed air.



WARNING!

Never start the engine without the air filter as this could cause injury and severe engine damage.



336 100

A Vacuum indicator

B Filter element

1. Remove the cover from the air cleaner.
2. Renew the filter element.
3. Carry out a check by inserting an inspection lamp into the element and checking from the outside that there are no holes or cracks in the filter paper.
4. Assemble the air cleaner.
5. Reset the vacuum indicator by pressing the button.

Renewing the safety cartridge



IMPORTANT!

When renewing the safety cartridge, take great care to ensure that no dirt or other impurities get into the engine. Do not remove the safety cartridge unnecessarily.

1. Remove the cover from the air cleaner.
2. Remove the filter element.
3. Remove the safety cartridge.
4. Fit a new safety cartridge.
5. Renew or clean the filter element.
6. Assemble the air cleaner.

Fuel system

Sulphur content in fuel and its effect on oil change interval

- A sulphur content of 0-500 ppm in the fuel gives an oil change interval of up to 500 hours.

Note:

More than 15 ppm sulphur content must only be used where Stage 3A/Tier 3 or less restrictive emission laws apply.

General information on the XPI fuel system

**WARNING!**

The fuel system is very sensitive to dirt. It is therefore very important that everything is as clean as possible when work is carried out on the fuel system.

- Do not use compressed air to blow components in the fuel system clean.
 - Use lint-free cloths for cleaning.
 - Clean tools before use.
 - Do not use worn chrome-plated tools as flakes of chrome may come off.
 - Plug or tape connections on components which are removed.
-

Checking the fuel level

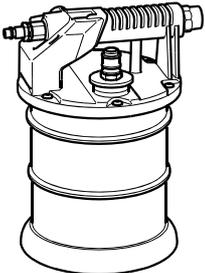
- Check the fuel level and top up with fuel as necessary.

Note:

The fuel system must be bled if the tank has been run dry. Refer to the Bleeding the fuel system section.

Renewing the fuel filter

Removing

Tool No.	Designation	Illustration
588 475	Socket	
588 793	Suction tool	



Environment

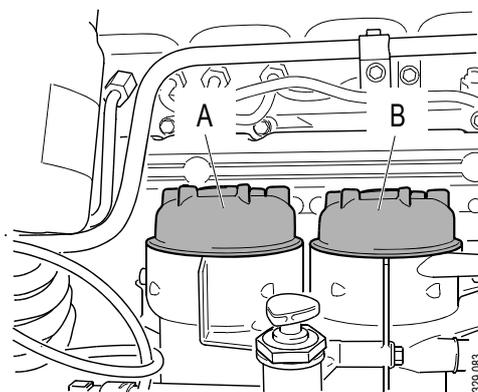
Avoid spillage and use a suitable container. Used fuel must be disposed of as specified in national and international law.

To ensure that the filter housings are drained properly, the filter covers must be removed as follows:



IMPORTANT!

Start with the water separating suction filter (A)! Do not open the pressure filter cover (B) until the filter housing for the water separating filter (A) is completely drained.



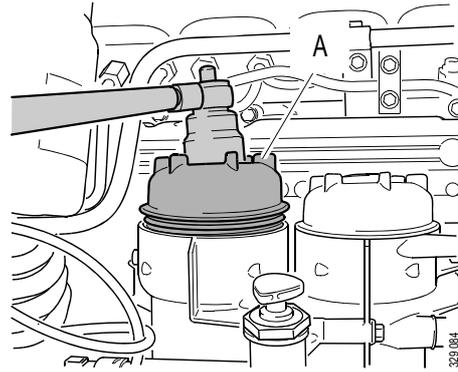
A Water separating suction filter

B Pressure filter

! **IMPORTANT!**

Do not use an adjustable spanner or other open tool to undo the filter covers, as this risks damaging the filter covers.

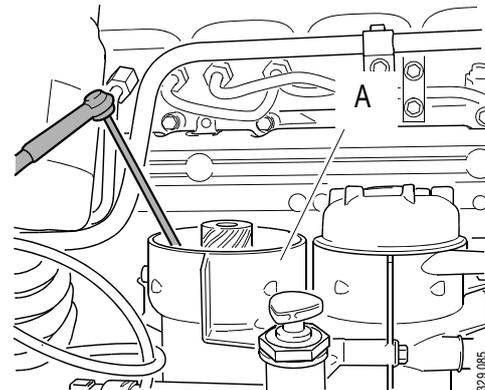
1. Make a mark on the water separating suction filter cover (A). Unscrew the cover 3 to 4 turns using a socket wrench with hexagon driver, e.g. 588 475.



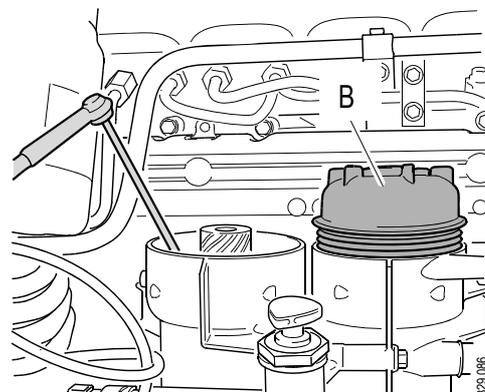
! **IMPORTANT!**

Wait a minimum of 2 minutes to allow as much of the fuel as possible to drain out of the filter housing.

2. Unscrew the filter cover (A) and lift it up slowly with the filter element.
3. Make sure the suction tool is completely drained before starting work. Draw out remaining fuel and any particles using suction tool 588 793 or a similar tool.
4. Keep the suction tool hose in the filter housing for the water separating suction filter (A).



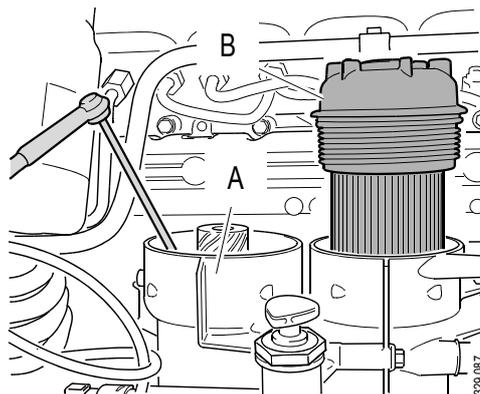
5. Make a mark on the pressure filter cover (B). Unscrew the cover 3 to 4 turns using a socket wrench with hexagon driver, e.g. 588 475. Draw out fuel which may drain into the water separating suction filter housing when the pressure filter is detached.



! **IMPORTANT!**

Wait a minimum of 2 minutes to allow as much of the fuel as possible to drain out of the filter housing.

6. Unscrew the pressure filter cover (B) and lift it up slowly with the filter element.
7. Fuel from the pressure filter housing (B) will flow into the water separating suction filter housing (A). Leave the suction tool in the water separating suction filter housing (A) until it is completely drained of fuel.



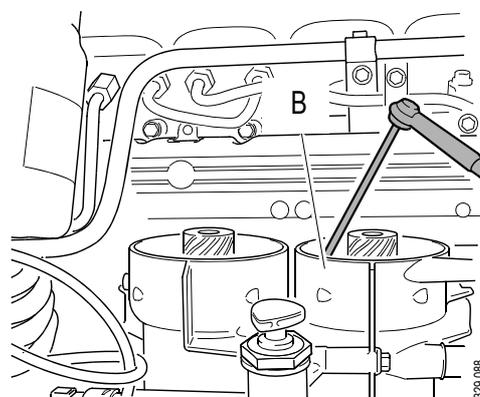
8. Move the suction tool to the pressure filter housing (B). Draw out remaining fuel and particles.



IMPORTANT!

It is important to remove remaining fuel and particles from the filter housings to prevent fuel system contamination.

9. Undo the old filter elements from the covers by carefully bending them to one side.



Fitting

Tool No.
588 475

Designation
Socket

Illustration



-
1. Unpack the new filter elements and the supplied O-rings.



IMPORTANT!

Check that there is no remaining packaging material stuck to the filters.

-
2. Fit the new O-rings to the covers. Lubricate the O-rings with O-ring grease 2 002 537.
 3. Press the filter elements into the snap fasteners on the covers.



IMPORTANT!

Fit the filter element to the filter cover before positioning it in the fuel filter housing. The filter element can otherwise be damaged.

Open the bleed nipple to prevent back pressure in the filter housings when the filter elements are screwed on.

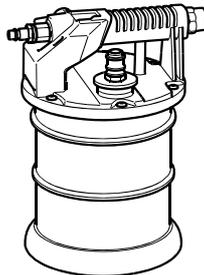
-
4. Check that the filter housing is clean before fitting.
 5. Press down the filter element with the filter cover into the fuel filter housing.
 6. Screw on the filter cover. Use a socket wrench with hexagon driver e.g. 588 475.
 7. Check that there is no gap between the filter cover and the filter housing. If there is a gap, repeat the procedure and make sure that the bleed nipple is open.

Bleeding the fuel system

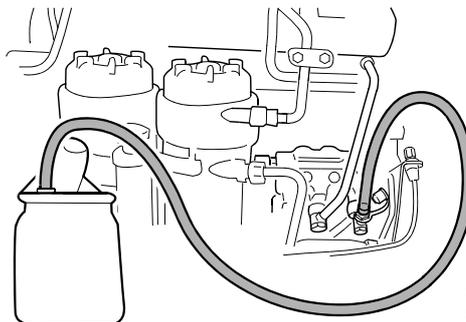
Tool No.
588 793

Designation
Suction tool

Illustration



1. Open the bleed nipple at the high pressure pump and connect a clear plastic hose from suction tool 588 793 or similar tool.
2. Drain the suction tool. Hold the suction tool straight and draw out a full container of fuel. Bleeding is now complete.
3. Start the engine.



328 119

Miscellaneous

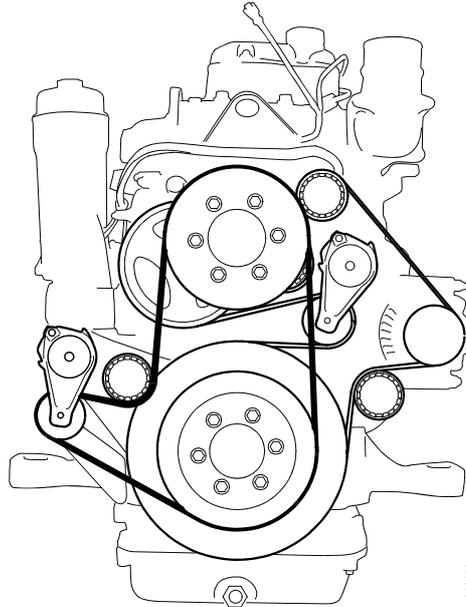
Checking the drive belt



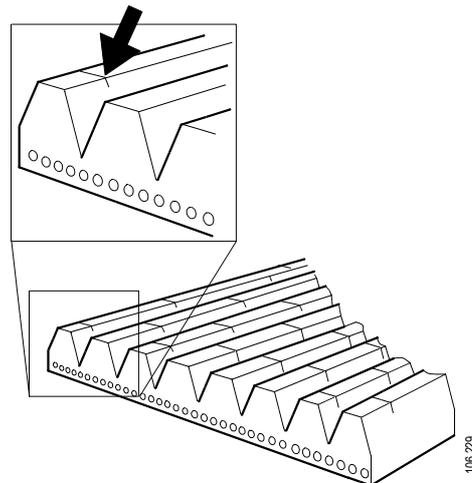
IMPORTANT!

Refit the drive belt with the same direction of rotation as it had before removal.

Check the drive belt thoroughly, particularly at the idler rollers.

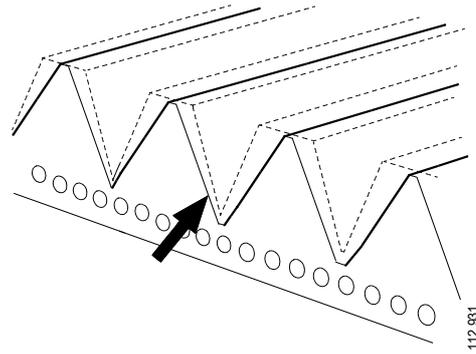


Check the drive belt for cracks.

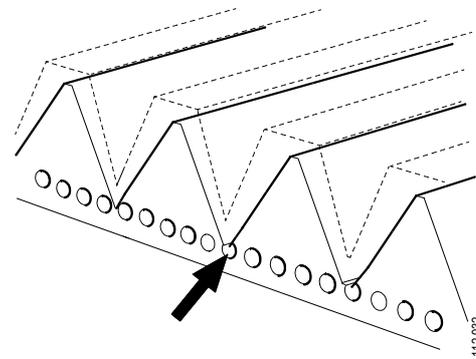


The drive belt must be renewed if it has cracks.

Check drive belt wear.



The drive belt is starting to become worn, but can be refitted.



The belt is worn down to the cord. The drive belt must be renewed.

Checking for leaks

- Start the engine.
- Check for oil, coolant, fuel, air or exhaust leaks.
- Tighten or renew leaking connections. Check the overflow holes which show whether the O-rings between the cylinder liners and crankcase are leaking.
- Check whether the drain hole on the coolant pump is blocked. If there is a leak, renew the seal in the pump or the complete coolant pump.



IMPORTANT!

If serious leakage occurs, contact your nearest workshop.

Checking and adjusting the valve clearance

Note:

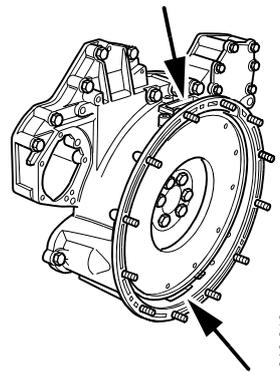
Checking and adjusting valve clearances should also be done after the first 500 hours of operation.

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



WARNING!

Block the starting device when working on the engine. If the engine starts unexpectedly, there is a serious risk of injury.

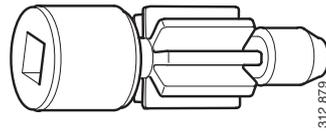


Openings for taking readings on the flywheel housing.

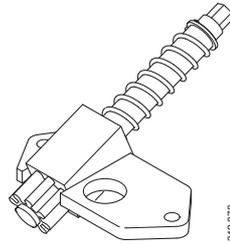
Intake valve clearance	0.45 mm (0.018 in)
Exhaust valve clearance	0.70 mm (0.028 in)

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

"TDC up" or "TDC down" is found on the flywheel. Both openings are fitted with a blanking piece on delivery.



Special tool 99 309 is used when turning from below.

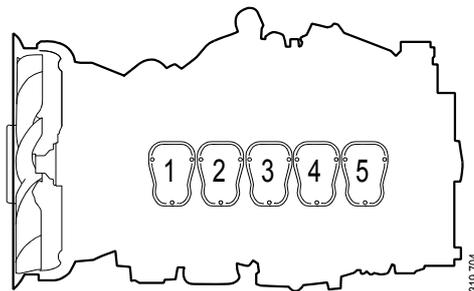


Special tool 99 109 is used when turning from above.

From below	Valve transition	Valve adjustment	From above
TDC down		1	TDC up
72/432	5		252/612
144/504		2	324/684
216/576	3		36/396
288/648		4	108/468
TDC down	1		TDC up
72/432		5	252/612
144/504	2		324/684
216/576		3	36/396
288/648	4		108/468

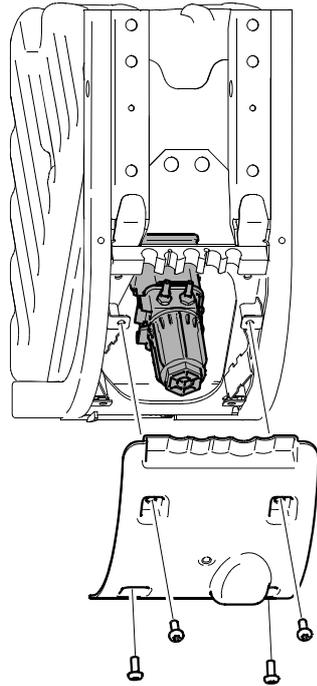
- Turn the flywheel in the engine's direction of rotation so that TDC up or TDC down is visible in the flywheel housing window.
- If there is valve clearance on cylinder 1, start valve adjustment as indicated in the table.
- If there is valve transition on cylinder 1, work should start at row six of the table.

Tightening torque for lock nut 35 Nm (26 lbf ft).



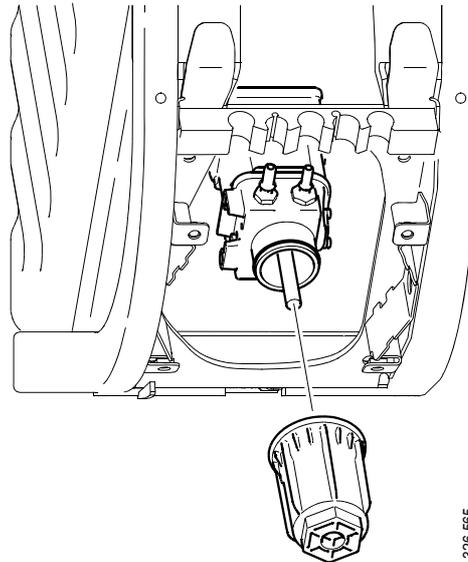
Renewing the reductant filter

1. Remove the cover on the rear of the reductant tank.



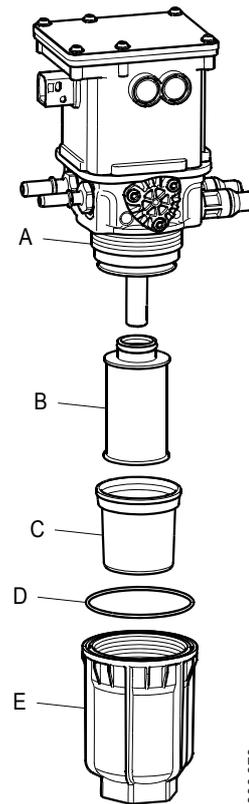
316 163

2. Place a suitable container underneath.
3. Unscrew the filter cover. Use a 46 mm socket.
4. Remove the filter cover and O-ring.



326 565

5. Remove the frost protection device (C) and the filter (B).
6. Wipe the pump clean (A).
7. Fit the new filter (B).
8. Fit the new frost protection device (C).
9. Lubricate the threads with the spray.
10. Fit the new O-ring (D) in the new cover (E).
11. Check that the frost protection device and valve ring are correctly fitted in the new cover.
12. Fit the new cover and tighten to 80 Nm (59 lbf/ft).



336879

A Pump

B Filter

C Frost protection device

D O-ring

E Cover

Cleaning the reductant tank filler filter

Make sure that the filler filter is clean. If it is dirty: Clean the filler filter with clean water and refit it.

Cleaning the reductant tank ventilation filter

Make sure that the ventilation filter is clean. If it is dirty: Clean the ventilation filter with clean water and refit it.