



Sisudiesel

320, 420, 620, 634

Operator's Manual

8366 40359

Sisudiesel

320, 420, 620, 634

engines

Operator's Manual

01 02

Sisu Diesel Inc.

FIN-37240 Linnavuori, Finland
Telephone: +358 3 341 7111
E-mail: info.sisudiesel@sisudiesel.com
www.sisudiesel.com

Diesel Engines, After Sales
Telefax: +358 3 341 7333

**Sisu Diesel Inc. takes no responsibility for any damages caused
because of incorrect information in this manual**

CONTENTS

TO THE USER	3
– engine type designations	3
– location of the engine serial no.	4
– marking of the injection pump	4
– safety instructions	5
– lifting the engine	6
CONSTRUCTION	7
– technical data	7
– general	12
– air intake system	12
– fuel system	13
– lubrication system	16
– cooling system	18
– electrical system	19
OPERATION AND DRIVING	20
– daily pre–start check	20
– starting	20
– cold start	20
– attention during operation	22
– stopping	22
– coupling additional equipment to the engine	23
SERVICE	24
– periodical maintenance	24
– service chart	24
– basic service after the first 50...100 hours of operation	25
– services to be made daily or at 10 hours intervals	25
– services to be made weekly or at 50 hours intervals	27
– services to be made at 300 hours intervals	29
– services to be made at 600 hours intervals	31
– services to be made at 1200 hours intervals	33
– services to be made at 2400 hours intervals	34
– services to be made at 4800 hours intervals	35
– services to be made every two years	36
ADDITIONAL SERVICE AND ADJUSTING INSTRUCTION	37
– bleed fuel system (Bosch)	37
– check and adjust injection timing (Bosch)	38
– adjust idling speed (Bosch)	40
– bleed fuel system (Stanadyne)	40
– check and adjust injection timing (Stanadyne)	41
– adjust low idling speed (Stanadyne)	42
– fit cylinder head	43
– inspection of the zinc plug	44
– check of the rubber element vibration damper	44
– before the cold season	45
– tightening torques	45
– lubricating oil quality requirements	46
– coolant quality requirements	46
– fuel quality requirements	47
– biodiesel	48
– trouble shooting	49
– storing the engine	51
– after–storage attention	51

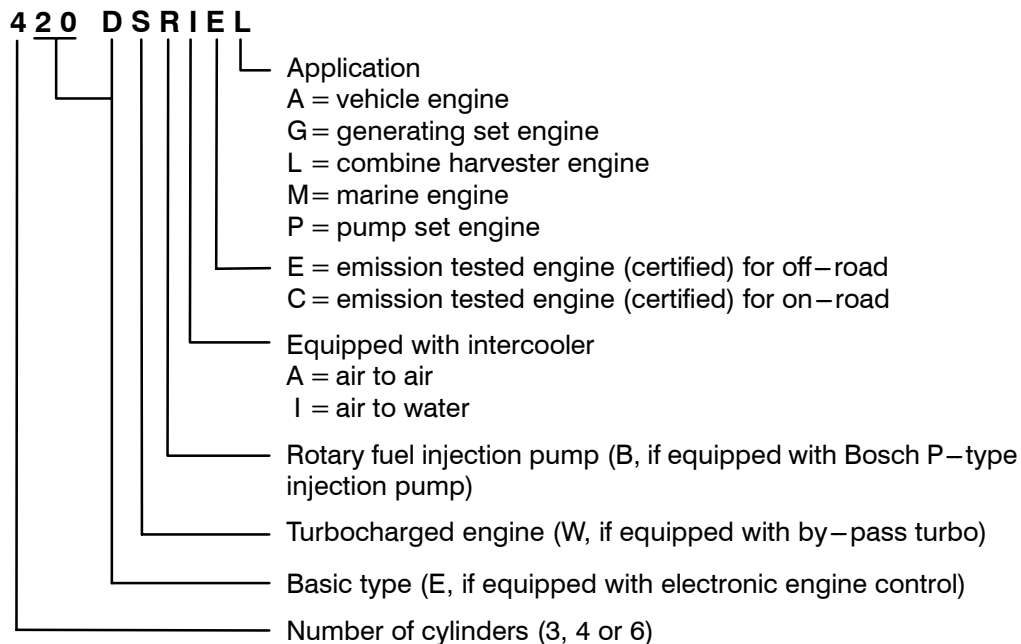
TO THE USER

The purpose of this manual is to familiarise you with the use and maintenance of your Sisudiesel engine and give you the basic technical data and settings relating to its construction. Before using the engine carefully read the operating, service and safety instructions to ensure your engine runs in the most economic way.

When contacting the Service Organisation, please state the engine type and the serial number.

We reserve the right to change the adjustment settings, equipment and also the service and repair instructions of the engines without further notice. Unless otherwise stated, the instructions and settings apply to all variants of 320, 420, 620 and 634 engines.

ENGINE TYPE DESIGNATIONS



LOCATION OF THE ENGINE SERIAL NO.

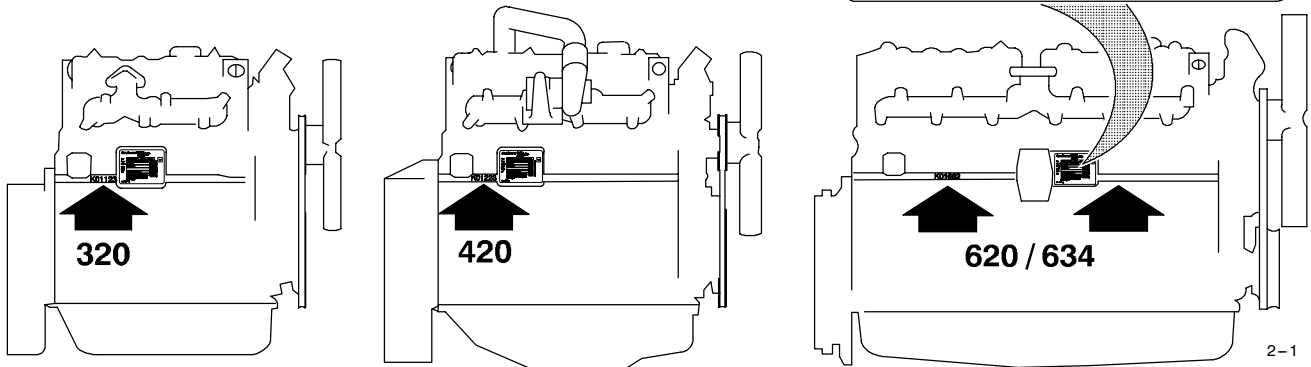
The engine serial number is always stamped on the cylinder block as the picture shows.

If the engine has a type plate, the serial number is also on it.

SisuDiesel Manufacturer		SISU Diesel Inc. FIN-37240 Uusikaari FINLAND	
Type	SISUDIESEL 620 ₄₁₁ DSRE		
Power	110 HP 2200 rpm		
Serial nr	K01662		
Family	D20TRB		
Cust. Part no.			
EPA	YSIDL06.6C2A		
Displacement	6,6 l	Fuel	2-D fuel oil
This engine conforms to 1999 U.S. EPA regulations large nonroad compression ignition engines			
Assembled by:			

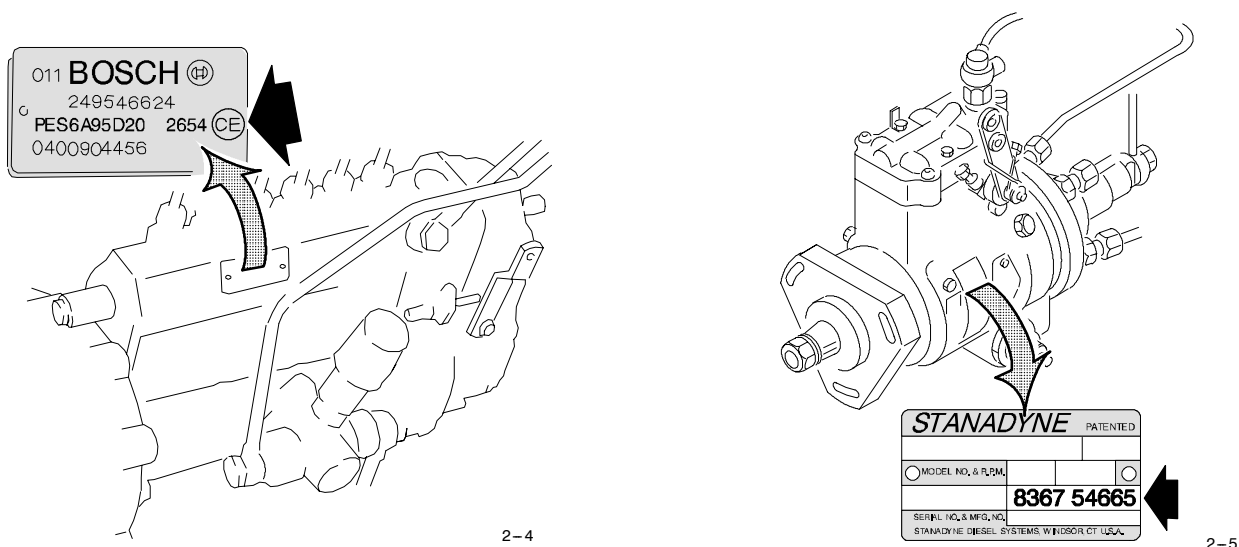
1,87

617*97/68BA*0002*00



NOTE! Because of various engine mountings the engine serial no. may also be located on the left side of the engine.

MARKING OF THE INJECTION PUMP



The type plate of the injection pump indicates the symbol letter of the application or the order number. In some types of rotary pumps there can be both order no. and symbol letter. This letter / order no. must be stated when ordering an injection pump or asking for adjusting settings.



SAFETY INSTRUCTIONS

In the use and service of the engine there is always the possibility of injury. Before starting the service read and understand the following safety instructions and remarks!

-  When you are operating the engine or working near it, use hearing protectors to avoid noise injuries.
-  If you start the engine indoors, be sure you have proper ventilation.
-  Never use aerosol type of starting aid while operating the Thermostart device (risk for explosion).
-  Start the engine only by using the starting switch in the cabin.
-  Stop the engine always before service– or repair work.
-  Open fire, smoking and sparks should not be allowed near the fuel system and batteries. (Specially when loading batteries, explosive.)
-  Open the radiator cap with care when the engine is hot as the cooling system is pressurised. The cooling liquid and lubrication oil of a hot engine causes injuries when touching the skin.
-  Avoid touching the exhaust manifold, turbocharger and the other hot parts of the engine.
-  Always disconnect the minus (–) wire of the battery when doing service or repair of the electric system.
-  When checking fuel injectors do not let the jet of high pressure fuel contact your skin. The fuel penetrates the skin causing severe injuries. Contact your doctor immediately!
-  Keep the engine surfaces clean in order to avoid the risk of fire.
-  At temperatures on excess of 300 °C, e.g. if the engine is burnt by a fire, the viton seals of the engine (e.g. the undermost o–ring of the oil pressure regulating valve) produce very highly corrosive hydrofluoric acid. Do not touch with bare hands, viton seals subjected to abnormally high temperatures. Always use neoprene rubber or heavy duty gloves and safety glasses when decontaminating. Wash the seals and the contaminated area with a 10 % calcium hydroxide or other alkali solution. Put all removed material in sealed plastic bags and deliver them to the point stated by the Authorities concerned.
NOTE! Never destroy viton–seals by burning!
-  The fuel, lubricating oil and coolant cause irritation in skin contact for long time.



Do not let oil and other liquids drop into the soil when servicing the engine. Take them to a suitable disposal point.



Avoid unnecessary idling of the engine.



All the gaskets of the engine are of non–asbestos material.



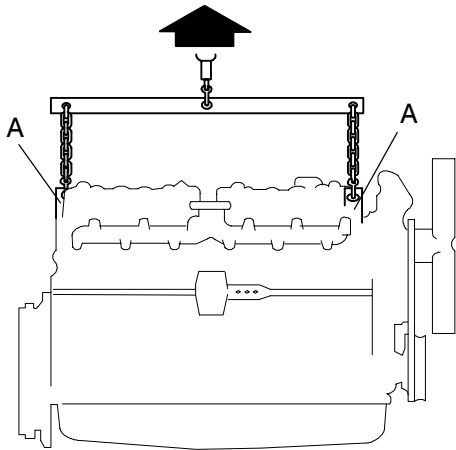
Be careful when washing the engine with a high pressure washing machine. Do not use high pressure to wash e.g. the electric and fuel equipment or the radiator because they can easily be damaged.

LIFTING THE ENGINE

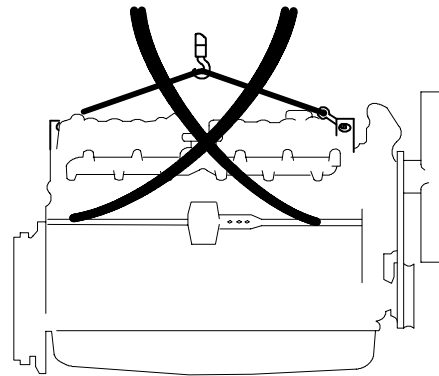
Safe lifting of the engine is done with a lifting device where the lifting force effects the lifting ears vertically.



WARNING



2-6



2-7

A = Engine lifting ears

Engine weight kg (without flywheel and electrical equipment).

320 D = **275**
320 DS = **280**

420 D = **335**
420 DS/DW = **340**
420 DWI = **345**

620 D = **500**
620 DS = **510**
634 DS = **515**

CONSTRUCTION

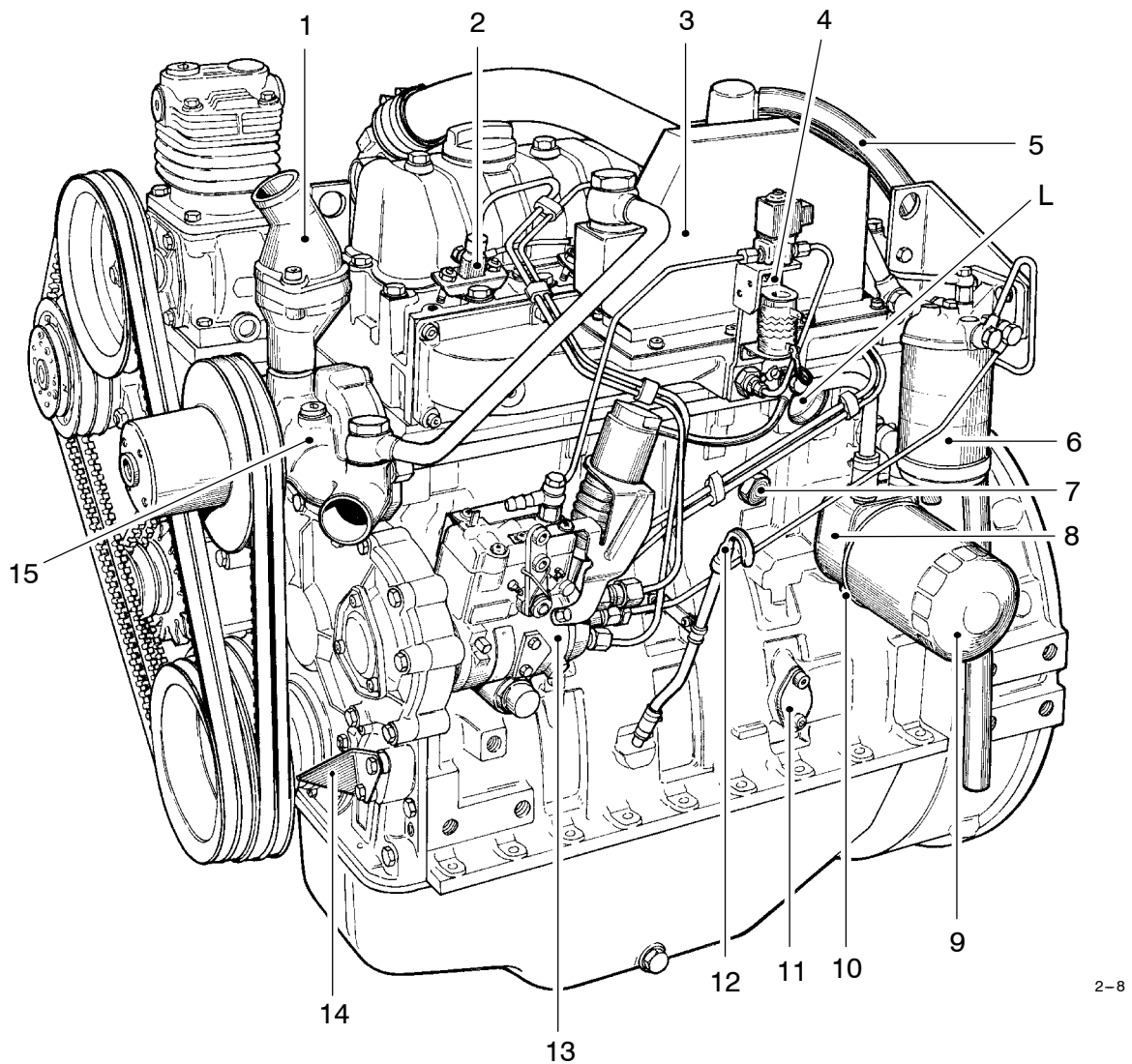
TECHNICAL DATA

PRINCIPAL DIMENSIONS AND DATA	320	420	620	634
Number of cylinders	3	4	6	6
Displacement (ltr)	3,3	4,4	6,6	7,4
Cylinder bore (mm)	108	108	108	108
Stroke (mm)	120	120	120	134
Combustion	Direct injection			
Compression ratio	16,5/18,5 : 1			
Injection timing (B.T.D.C.)	Marked on the crankshaft pulley			
Valve clearance, intake and exhaust (mm)	0,35			
Direction of rotation from the engine front	Clockwise			

FUEL SYSTEM	320	420	620	634
Injection pump	Bosch, in-line type/Stanadyne, rotary type			
Fuel	Gas oil, see page 47			
Feed pressure, in-line pump				
– overflow valve opening pressure	0,6–1,0 bar			
– static	2,7 bar			
Feed pressure, rotary type pump				
– static	0,48 bar			
– min. pressure	0,20 bar/max. rpm			
Injection order	1–2–3	1–2–4–3	1–5–3–6–2–4	
Injector	Five-hole nozzle			
Opening pressure of the nozzle	See 20/34-series Workshop Manual			
Adjusting pressure of the nozzle	See 20/34-series Workshop Manual			
Fuel filter	Bosch/CAV			

LUBRICATION SYSTEM	320	420	620	634
Oil pressure in hot engine at running speed	2,5–4,0 bar			
Oil pressure at idle speed, min.	1,0 bar			
Oil capacity (ltr) without filter and oilcooler ¹	7	12	24	24

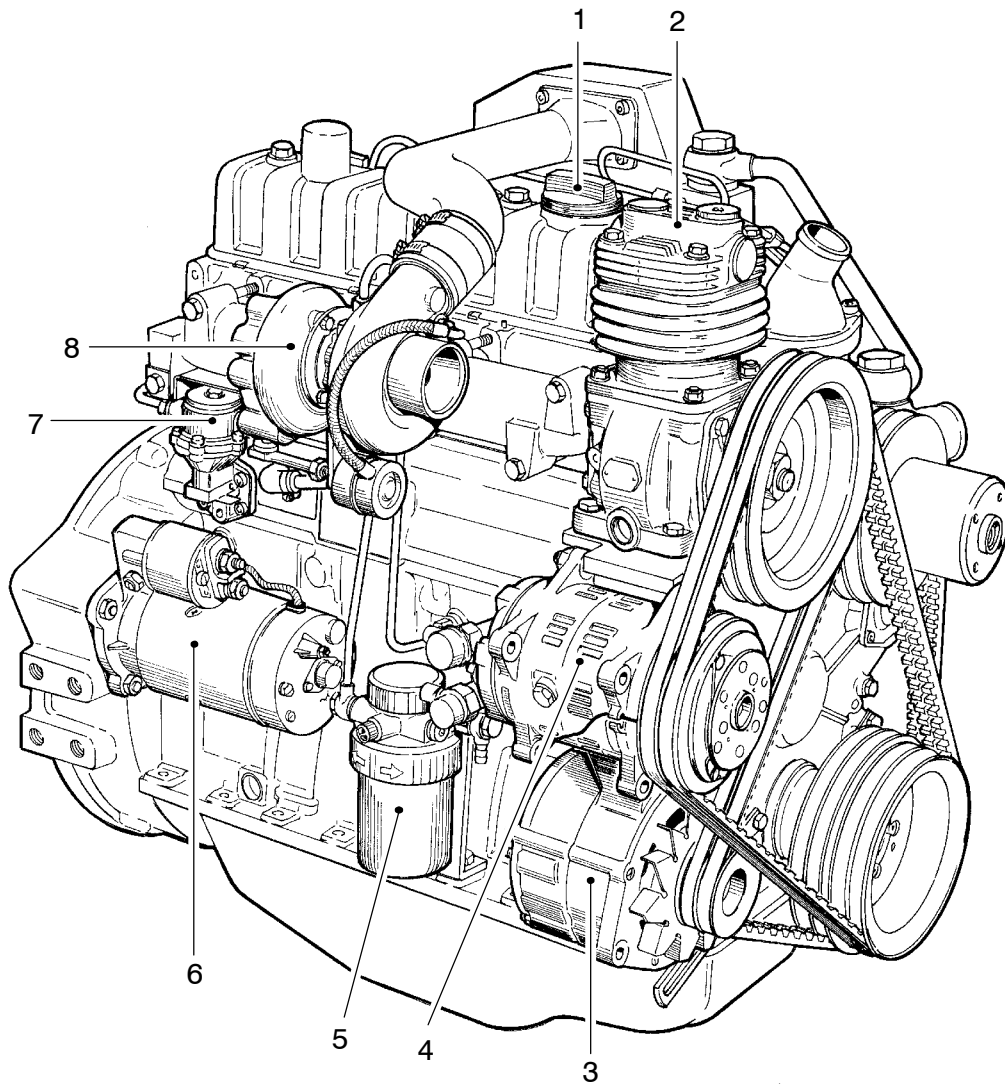
¹) Different oil sumps of many engine variants have not the same oil capacity. Capacities shown above are for standard oil sumps.



**420 DWRIE – engine viewed
from the left**

- | | |
|-----------------------|-------------------------------------|
| 1. Thermostat | 9. Oil filter |
| 2. Injector | 10. Coolant drain plug (oil cooler) |
| 3. Intercooler | 11. Oil pressure regulating valve |
| 4. Thermostart device | 12. Oil dipstick |
| 5. Breather pipe | 13. Injection pump |
| 6. Fuel filter | 14. Timing indicator |
| 7. Coolant drain plug | 15. Coolant pump |
| 8. Oil cooler | |

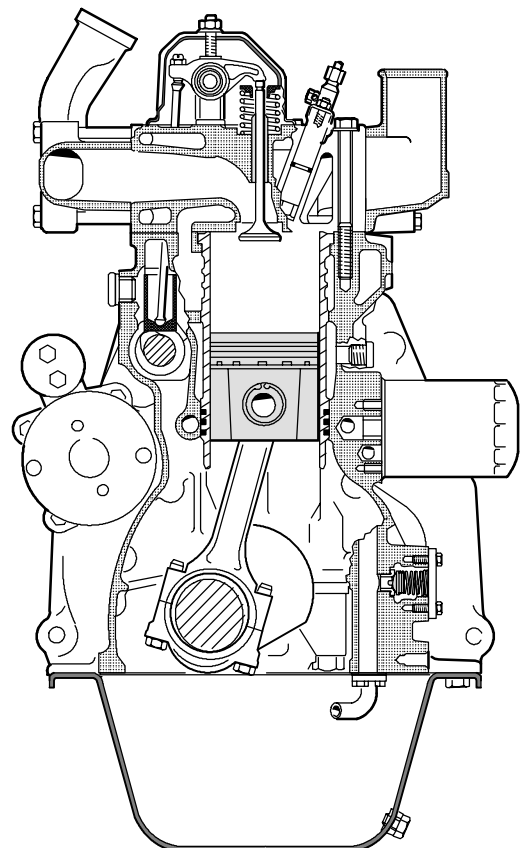
L = mounting point for preheating device



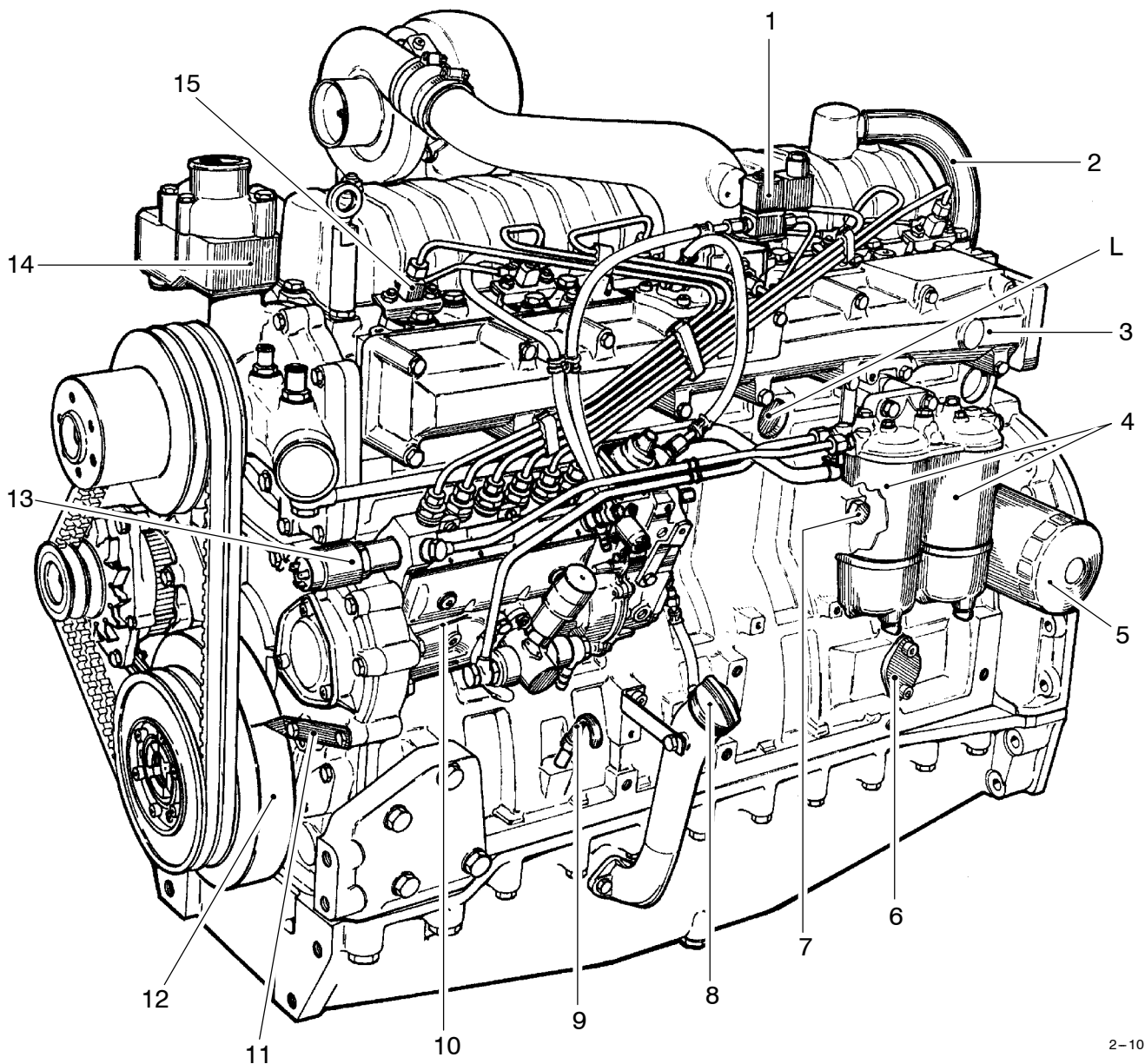
2-9

**420 DWRIE – engine viewed
from the right**

1. Oil filler plug
2. Compressor
3. Alternator
4. Air conditioner compressor
5. Prefilter
6. Starter
7. Fuel feed pump
8. Turbocharger



Cross section

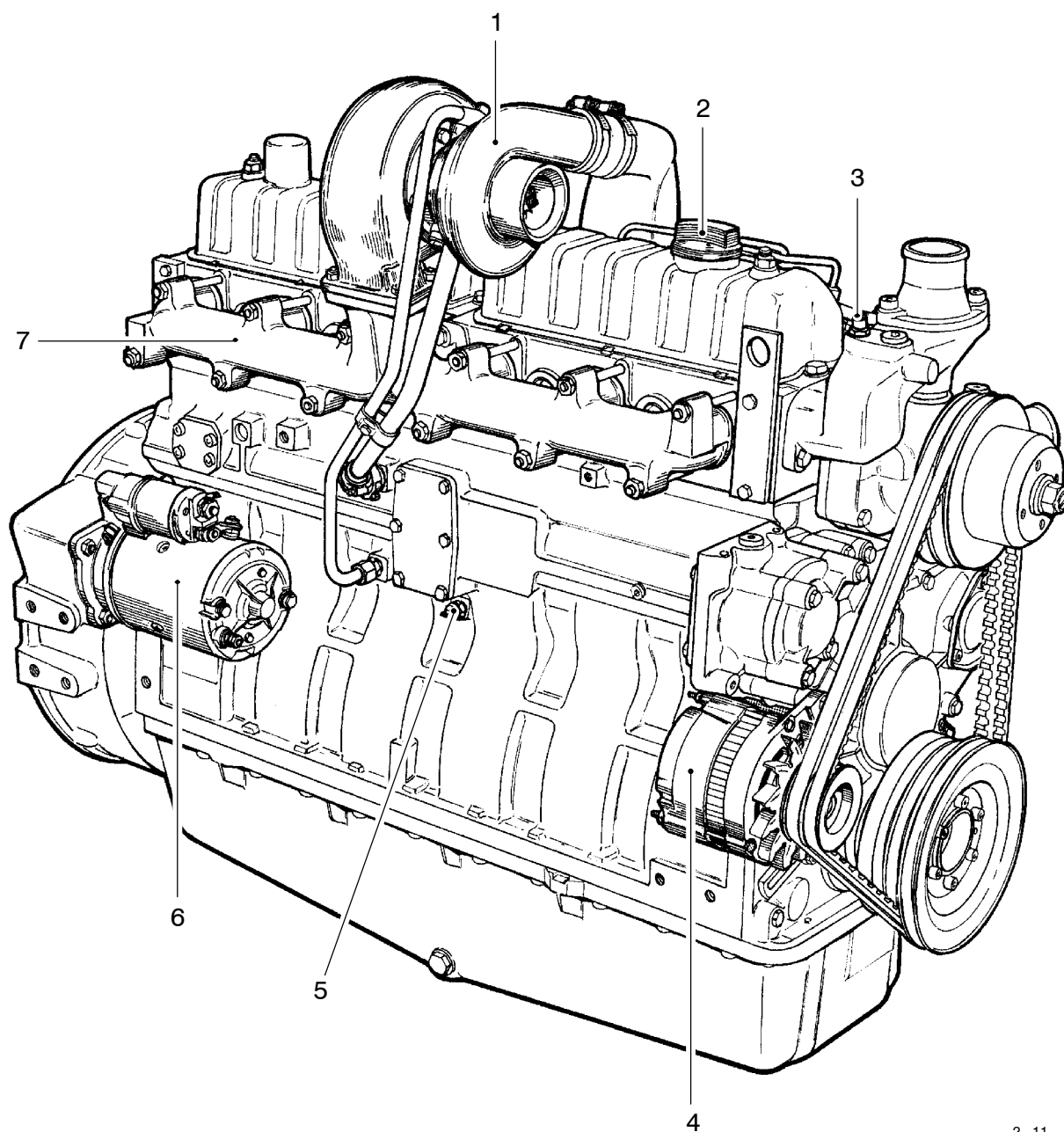


2-10

**620/634 DS – engine viewed
from the left**

- | | |
|----------------------------------|----------------------|
| 1. Thermostart device | 9. Oil dipstick |
| 2. Breather pipe | 10. Injection pump |
| 3. Intake manifold | 11. Timing indicator |
| 4. Fuel filters | 12. Vibration damper |
| 5. Oil filter | 13. Stop solenoid |
| 6. Oil pressure regulating valve | 14. Thermostat |
| 7. Coolant drain plug | 15. Injector |
| 8. Oil filler plug | |

L = mounting point for preheating device



2-11

**620/634 DS –engine viewed
from the right**

1. Turbocharger
2. Oil filler plug
3. Sensor for coolant temperature
4. Alternator
5. Oil pressure sensor
6. Starter
7. Exhaust manifold

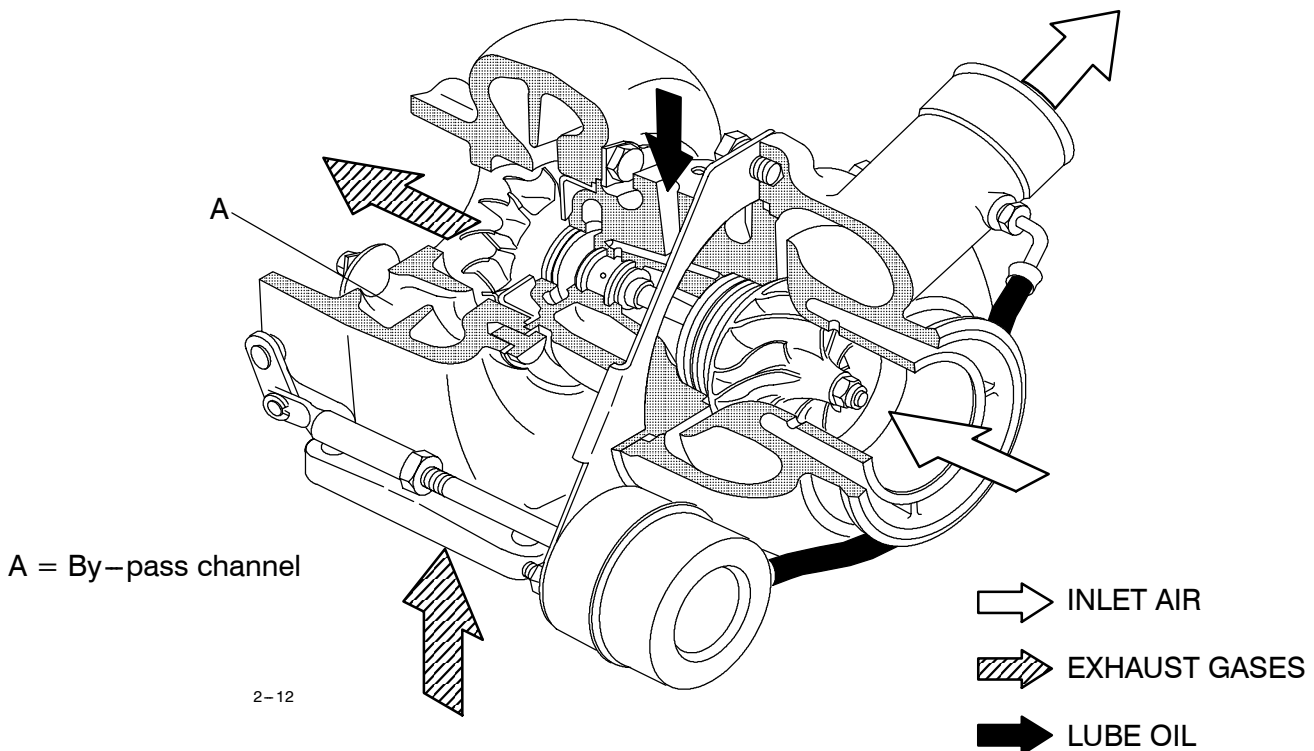
GENERAL

Sisudiesel engine – series consists of water – cooled in – line diesel engines with three, four and six cylinders. The engines are equipped with wet, changeable cylinder liners and consideration was made in the basic design of the engines for turbocharging. To make the spare – part service easier and more flexible, the majority of parts are common to all engines in the range.

AIR INTAKE SYSTEM

The air intake system includes the pre – filter (or cyclone, if installed), air filter, turbocharger (DS/DW – engines), intercooler (cooling of inlet air, DSI/DWI – engines), inlet manifold and air pipes. A mechanical or electric sensor can be fitted to indicate the service point of the air filter. If the engine is operating in very dusty conditions (for example spreading lime) it must be equipped with a special pre – filter and oil bath air filter.

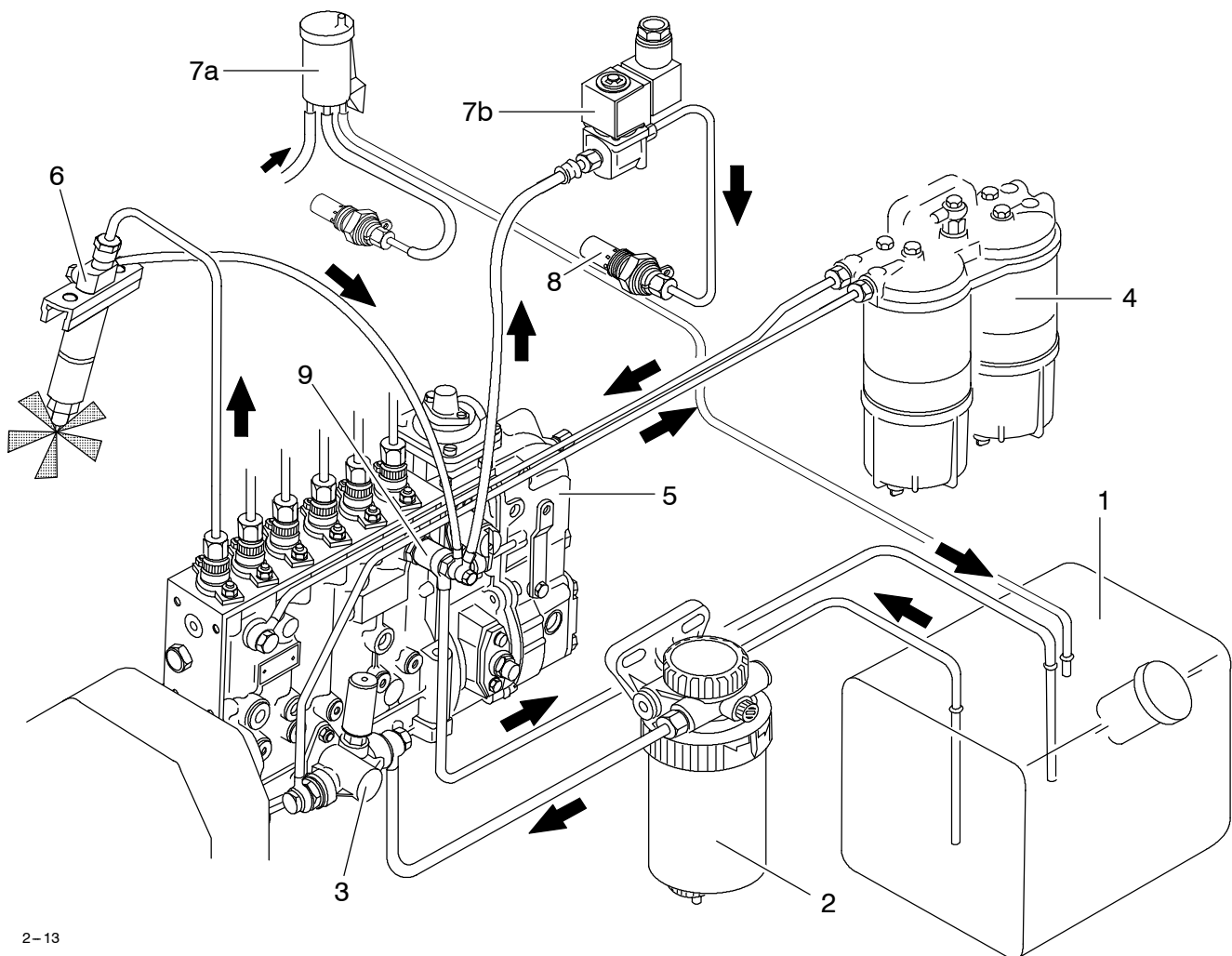
Turbocharger (DS/DW – engines)



The turbocharger is a turbo – compressor driven by exhaust gas. The compact design of the turbocharger is fast to react even during low revolutions. The turbocharger is lubricated and cooled by the lubrication system of the engine. DW/DWI – engine is equipped with a by – pass turbocharger where excessive air pressure is adjusted by a so – called by – pass channel (A).

Cooling of inlet air (DSI/DWI – engines)

The compressed air is cooled on the air to water basis. The air coming from the turbocharger has a temperature abt. 150° C which is cooled by the cooling water of the engine down to abt. 95° C. The cooling cell is installed on the intake manifold and connected to the engine cooling system. The cooling of the compressed air stabilises the combustion, irrespective of the temperature, and minimises the thermal and mechanical load of the engine thus lowering nitric oxides (NO_x).

FUEL SYSTEM

2-13

Fuel system (Bosch –P injection pump)

- | | |
|-------------------|--------------------------------|
| 1. Fuel tank | 6. Injector |
| 2. Prefilter | 7a. Thermostart fuel reservoir |
| 3. Feed pump | 7b. Solenoid valve |
| 4. Fuel filter | 8. Glow plug |
| 5. Injection pump | 9. Overflow valve |

The Sisudiesel engines are equipped with Bosch –A/P in –line injection pump or with Stanadyne rotary injection pump.

The fuel flows from the tank via a prefilter to the feed pump and through the filter to the injection pump. The injection pump forces the fuel into the injector that feeds fuel into the combustion space in a fine spray.

The fuel system is often equipped with the Thermostart device to be used in cold conditions. The glow plug receives fuel from a separate reservoir of the Thermostart device or from the overflow valve of the injection pump regulated by the magnetic valve.

The fuel is gas oil that must be clean and free from water (see page 47, quality requirements of the fuel).

NOTE! Use of anti-freeze solution is not useful and not at all recommended!

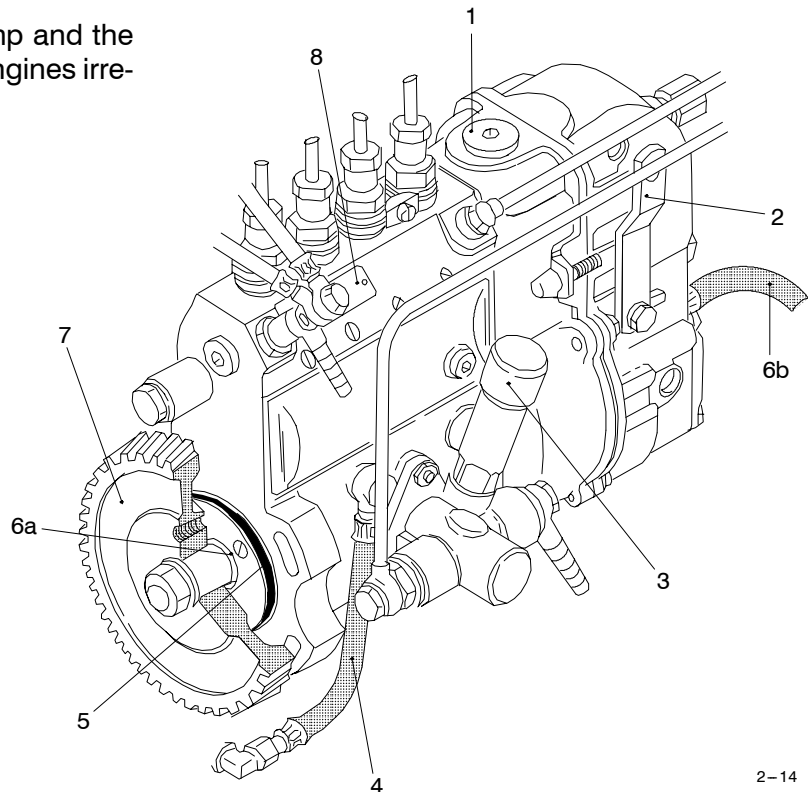
Water is removed from the system by draining the water trap periodically and by cleaning the fuel tank before frost season (see also actions before winter, page 45).

Bosch – A injection pump

The injection pump is an in-line pump and the basic construction is the same in all engines irrespective of the cylinder number.

Injection pump

1. Oil filler plug
2. Speed lever
3. Hand pump
4. Lube oil into the injection pump
5. O-ring seal
- 6a. Return of lube oil to engine
- 6b. Alternative oil return to engine (e.g. aggregate application)
7. Drive gear
8. Identification plate

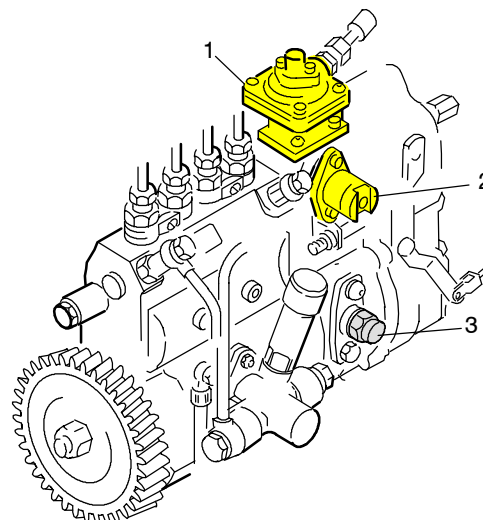


2-14

The fuel injection pump is flange mounted and sealed by one o-ring (5) in the timing gear housing. The injection pump is driven from the crankshaft through an idler gear. The injection pump is connected to the engine force-feed lubrication system through an external pipe (4). Lubricating oil returns to the engine via the hole (6a) at the front end of the injection pump. In some versions, specially locally installed engines, the return of the oil is lead through a hose (6b) from the regulator cover to the crankcase.

Injection pump with the boost control

1. Boost control
2. Cold start solenoid
3. Indicator plug for adjusting injection timing



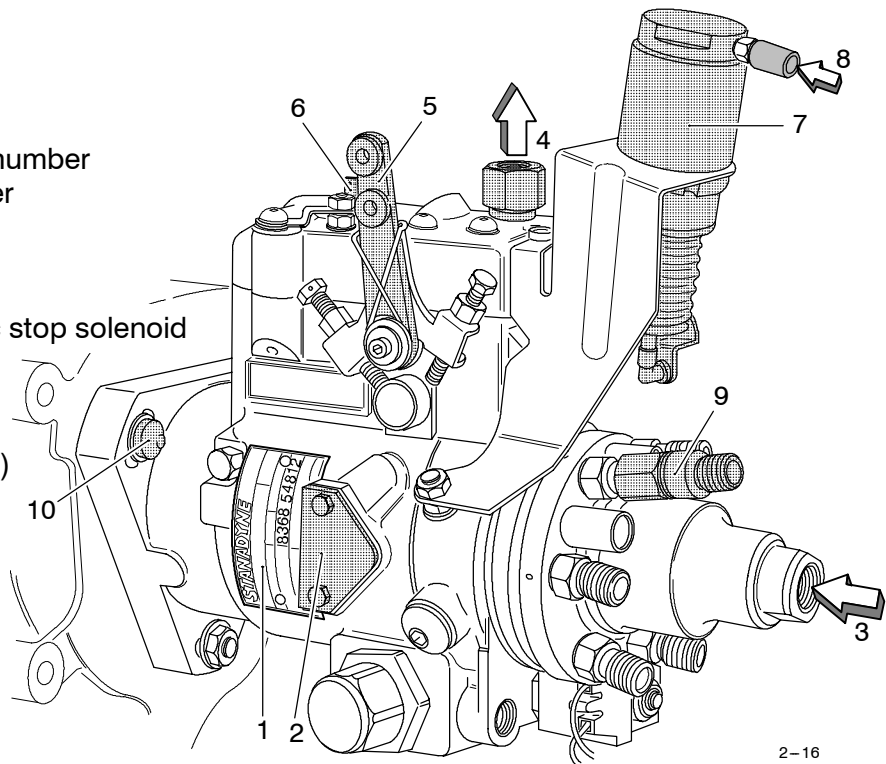
2-15

Stanadyne rotary injection pump

In 20/34-series R-engines have Stanadyne rotary injection pump. The pump is driven by the idler gear and installed on the timing gear housing. The pump is equipped with an electric stop solenoid (ignition switch stop) and with an automatic bleeding system. Stanadyne pump internal lubrication happens with aid of fuel. A separate fuel feed pump is of a membrane type and it is driven by the engine camshaft.

Stanadyne rotary injection pump

1. Type plate with pump order number
2. Timing marks under the cover
3. Fuel inlet
4. Return fuel/overflow valve
5. Revolution lever
6. Connector for wire to electric stop solenoid
7. Aneroid control
8. Boost pressure
9. Timing sensor (E-engine)
10. Interrupted screw (E-engine)



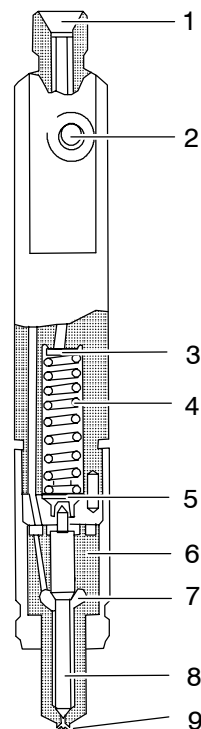
2-16

Injector

The injector has a five-hole nozzle. In the body of the injector there is an in-built slotted nozzle that is service free. The excess fuel lubricating the injector needle returns into the fuel tank through the overflow pipe.

Injector

1. Fuel inlet
2. Leak-off pipe connection
3. Adjusting shim
4. Pressure spring
5. Pressure pin
6. Nozzle body
7. Pressure chamber
8. Injector needle
9. Nozzle hole



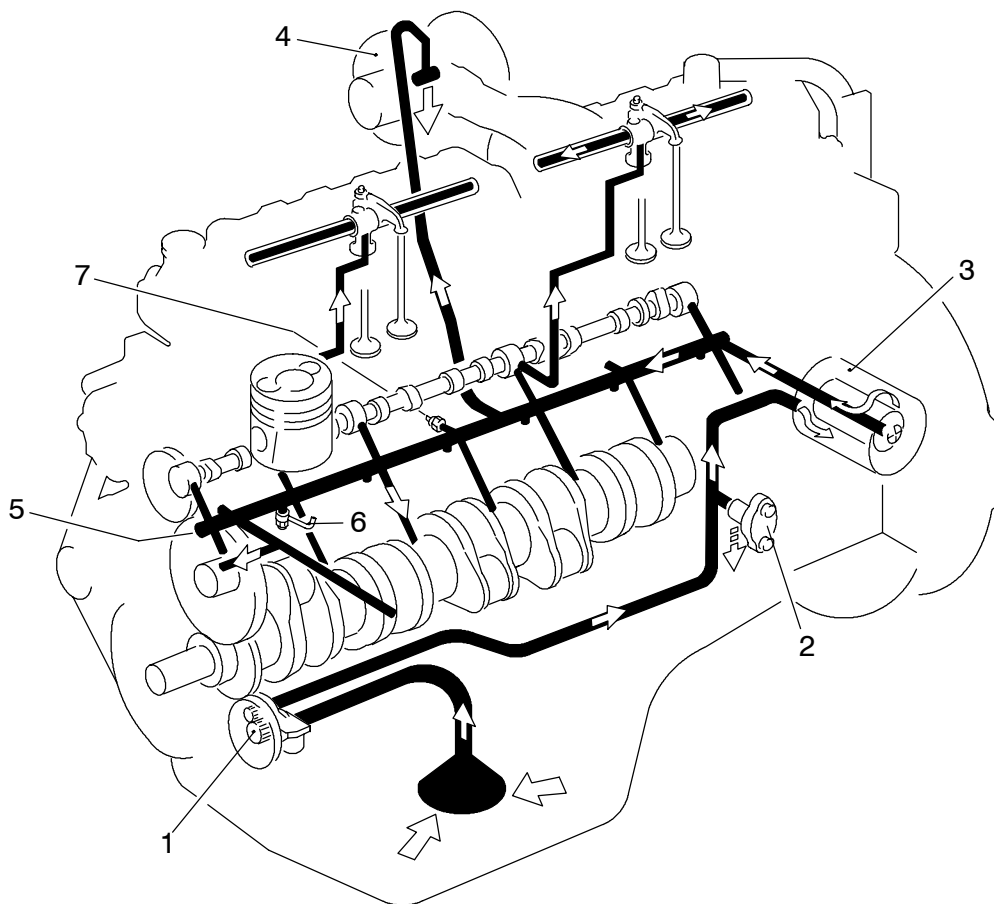
2-17

LUBRICATION SYSTEM

The engine has a pressure lubrication system with the gear oil pump fitted to the lowest level of the engine. The oil pump is driven by the gear at the front end of the crankshaft.

Nearly all the lubrication points and auxiliary equipment are connected to the pressurised lubrication system by oil galleries or pipes. The lubrication of the gears in the gear housing, the upper end of the connecting rods and the pistons is mainly effected by splash lubrication.

The undersides of the pistons of the 620/634 DS engines with high output are always cooled by the oil spray when the oil pressure is more than 3 bar.

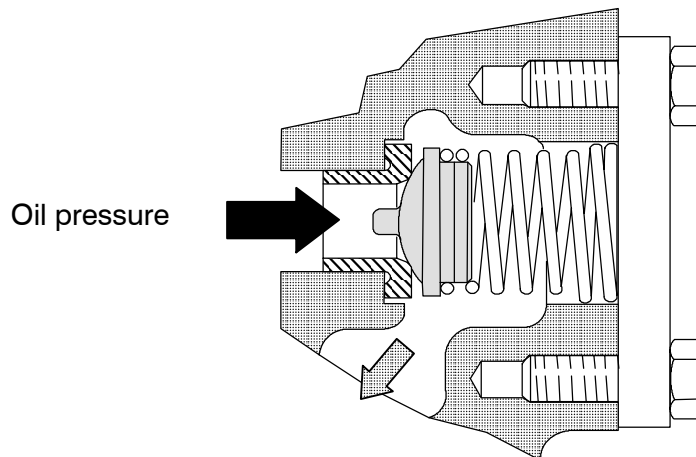


2-18

Lubrication system

- | | |
|----------------------------------|--------------------------|
| 1. Oil pump | 5. Main oil bore |
| 2. Oil pressure regulating valve | 6. Piston cooling nozzle |
| 3. Oil filter | 7. Oil pressure sensor |
| 4. Turbocharger | |

It is very important that you use the lubrication oil that corresponds to ambient temperatures and loads place on the engine (see lubricating oil chart, page 46). Always change the oil and oil filter according to the service chart.

Oil pressure regulating valve

2-19

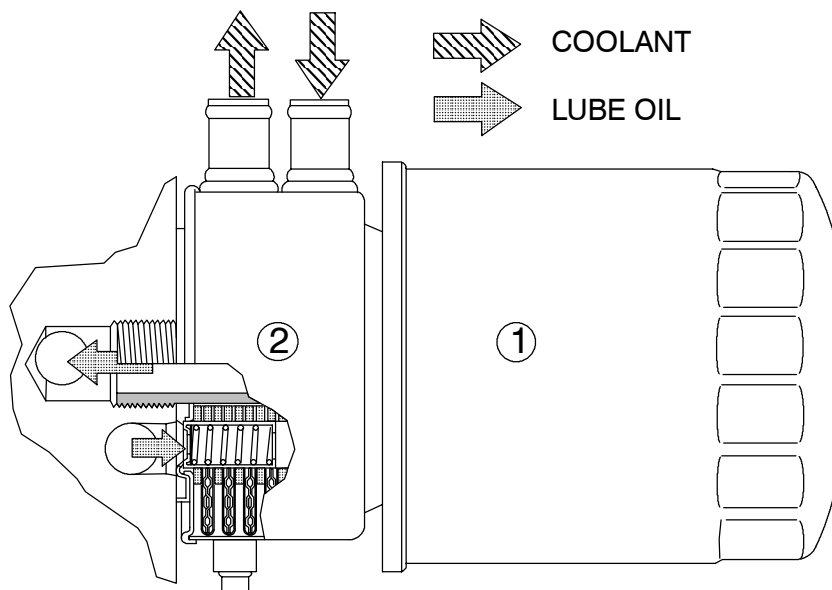
The oil pressure regulating valve is located under the oil filter on the left side of the engine. The regulating valve keeps the oil pressure constant independent of the engine speed.

At working speed the oil pressure is 2,5 to 4 bar depending on the temperature and the quality of lubricating oil. At idling the pressure is 1,0 bar minimum.

Oil filter and oil cooler

The oil filter is of main flow type. It has a replaceable cartridge mounted on the left side of the engine. At the bottom of the oil filter cartridge there is a by-pass valve for cold start or possible clogging of the filter. The filter is also equipped with a baffle that prevents the filter from emptying when the engine is not use.

Some engine types are equipped with a lube oil cooler located between the cylinder block and the oil filter. All the oil that circulates through the filter also goes through the cooler and is cooled by the engine coolant circulating in the oil cooler.

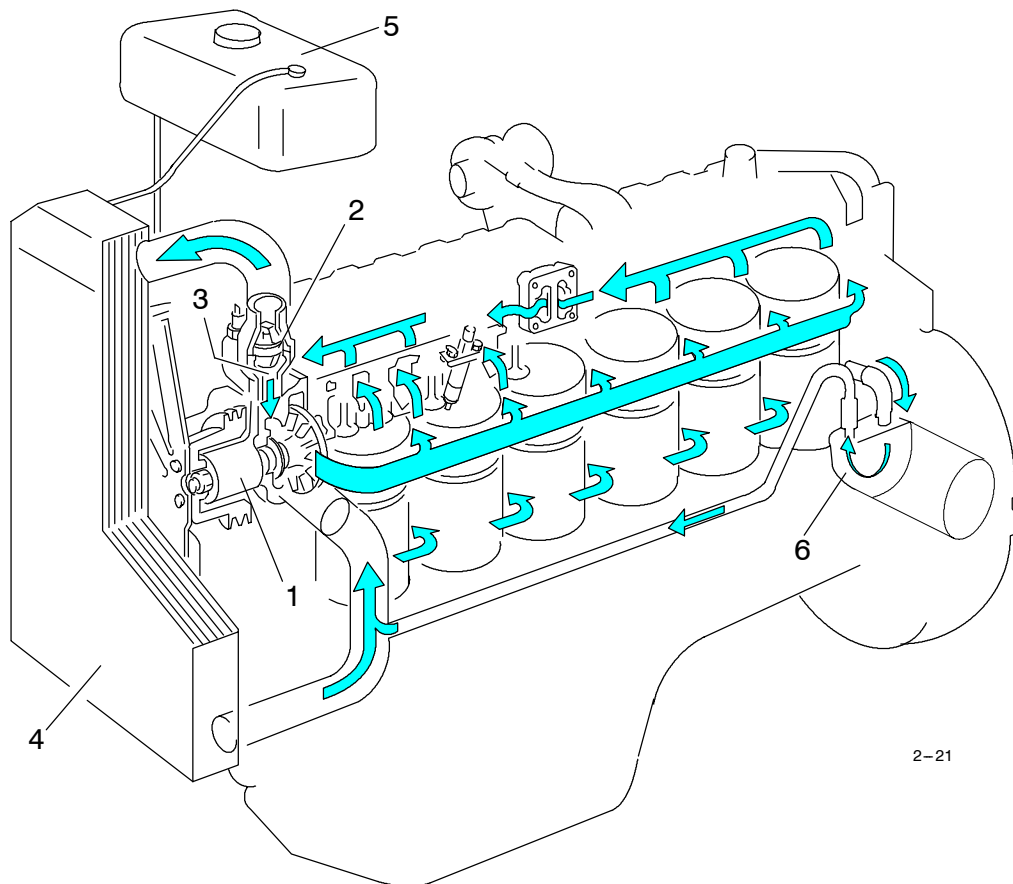


- 1. Oil filter
- 2. Oil cooler

2-20

COOLING SYSTEM

The coolant pump is attached to the front face of the cylinder block and the thermostat housing is mounted above it. The system has the internal liquid circulation via the by-pass pipe. The circulation is regulated by the 2-way thermostat. This arrangement ensures a steady warming-up of the engine under all conditions.



Cooling system

- | | |
|-----------------|-------------------|
| 1. Coolant pump | 4. Radiator |
| 2. Thermostat | 5. Expansion tank |
| 3. By-pass pipe | 6. Oil cooler |

NOTE! Never use only water as a coolant but a mixture of **40–60 %** of water and antifreeze (see page 46, quality requirements of the coolant).

Installing the engine heater

Install the pre-heater of the coolant according to the instructions of the manufacturer.

Most engines of Sisudiesel 20/34-series have the coolant heater as standard equipment. The points where to install the heater are to be seen in the pictures that are in the beginning of the chapter "Construction".

The thread of the connection points of the external heater is **M18x1,5**.

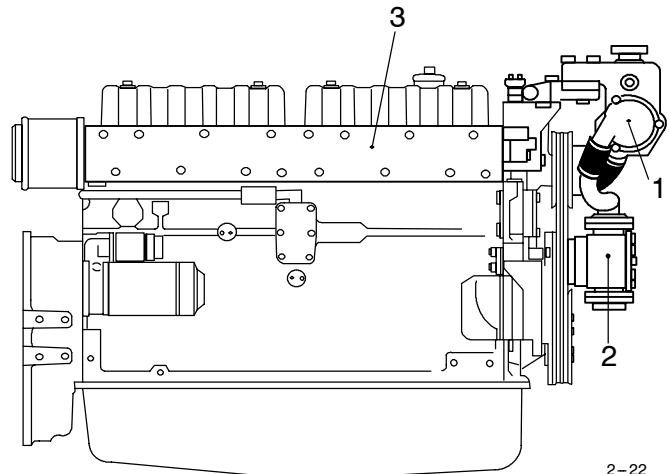
Raw water system in marine engines

In the front of the engine there is a heat exchanger that acts as a cooling water tank. The raw water (sea water) flows through the tubes of the heat exchanger and cools the fresh water (engine coolant) which flows outside the tubes.

The raw water pump with rubber impeller is mounted on the gear housing and is gear driven. The pump sucks the water even at starting speed.

The exhaust manifold is cooled by the fresh water. Thus the temperatures of the exhaust manifold and the exhaust gases are lowered. This minimises the risk of accidents and fire.

NOTE! If the engine run without raw water, the rubber impeller must be taken out of the raw water pump.



2-22

1. Heat exchanger
2. Raw water pump
3. Water cooled exhaust manifold

ELECTRICAL SYSTEM

The voltage of the electrical system is either 12 V or 24 V.

The engine may have a 1 – pole or 2 – pole system depending on the engine type.

NOTE!

- Faulty connections (especially those of the battery or the alternator) will cause alternator damage.
- Never open the charging circuit while the engine is running.
- Disconnect the alternator and battery wires before undertaking any electrical welding.
- Disconnect the battery wires before charging the battery.

Starting with an auxiliary battery

The following should be noted when using an auxiliary battery to start the engine:

- Check that the auxiliary battery has the same voltage as the standard battery.
- Open the battery plugs to avoid risk of explosion.
- Connect the positive pole (+) of the auxiliary battery to the positive pole of the starter or to the positive pole of the discharged battery.
- Connect the negative pole (–) of the auxiliary battery for example to the fastening screw of the starter or to the engine body.
- When the engine starts, first remove the negative cable between the auxiliary battery and the engine body. Then remove the positive cable.

Never connect the cable to the negative pole of the discharged battery. Risk of explosion!

**WARNING**

OPERATION AND DRIVING

(Before using the engine, carefully read the SAFETY INSTRUCTIONS, page 5.)

DAILY PRE-START CHECK

Before starting the engine, check the following points:

- Check the fuel quantity
- Check the lubrication oil level
- Check the coolant level
- Check that the lubrication oil system and coolant system of the engine are not leaking
- Clean the cyclone of the air filter

STARTING

- Check that the stop lever is in drive position.
- Turn the speed lever to half speed position.
- Switch the current on.
- Start the engine and adjust the speed with the speed lever to prevent the engine from racing.
- Watch the oil pressure. To ensure sufficient lubrication, the pressure gauge has to be within normal range in 3...4 seconds after starting. **NOTE!** This is particularly important for the lubrication of the turbocharger (DS/DW-engines).
- Always accelerate the engine at an even rate, never by racing.

NOTE! If the engine has not been used for over a month, crank the engine with the starter until oil pressure rises or dismount the pressure oil pipe of the turbocharger (DS/DW-engines) and pour clean lubrication oil (abt. **0,2 ltr**) into the bearing housing of the turbocharger.

COLD START

(See also actions before winter, page 45)

- Check that the stop lever is in drive position.
- Release the engine of all extra load (move the gear to neutral position, depress the clutch pedal, do not turn the steering wheel etc.).
- Move the speed control lever to half speed position.
- Switch the current on.
- Switch on the glow current for 20 to 25 seconds.
- Crank the engine till all cylinders are firing. Continue glowing for 30 seconds after the engine is firing on all cylinders.
- If the engine fails to start in 10 seconds, stop cranking and continue glowing for abt. 15 seconds. Then start according to the foregoing instruction.
- Watch the oil pressure. Do not race the cold engine because the lubrication is not sufficient while the oil is cold.

NOTE! (The engines without the electrical stop device, Bosch injection pump)

After operating leave stop lever in drive position. Thus ensuring excess fuel feed. (The injection pump has the excess fuel device always switched on when starting and the injection pump gives an extra amount of fuel. At the same time the injection is retarded, which also helps the cold starting).

Always use, if possible, the coolant heater when the temperature is below 0°C.

Use of aerosol type starting aid

If, under very difficult starting conditions, it is necessary to use an aerosol type of starting aid, remove the air filter cartridges before starting to spray the aerosol to prevent the cartridges from catching fire. Spray the aerosol into the intake manifold only when the engine rotates. When the aerosol is properly used (i.e. in small quantities), it is an efficient starting aid. Excessive use may lead to engine damage and the warranty does not cover such damage!

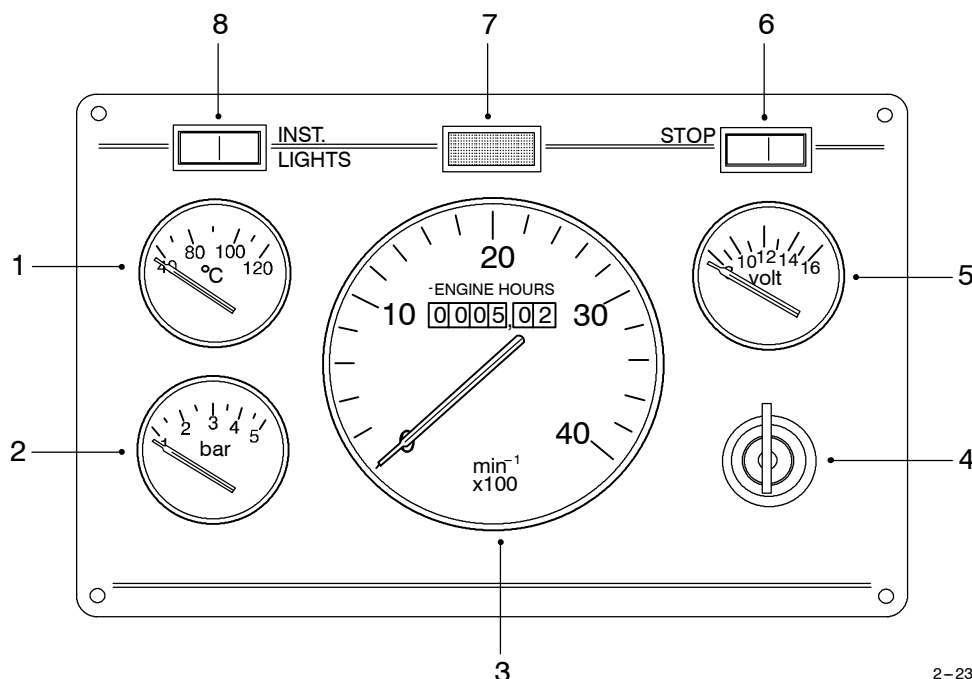
To avoid the risk of fire never use starting aerosol and the Thermostart device simultaneously. Disconnect the cable from the glow plug and isolate the cable connector.



WARNING

Warming up the engine

Since the engine wear is greatest when the engine is running cold, warm up the engine quickly with a light load for a couple of minutes after starting. However, you must not load the engine heavily and the rotation speed must not exceed 2000 rpm when the engine temperature is below 50°C.



2-23

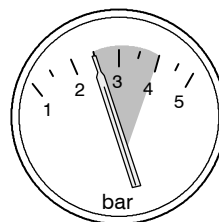
- 1. Coolant temperature gauge
- 2. Oil pressure gauge
- 3. Tachometer/hour counter
- 4. Ignition key

- 5. Voltage gauge
- 6. Stop button
- 7. Charging indicator
- 8. Switch for instruments light

ATTENTION DURING OPERATION

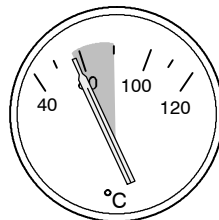
- Check the engine oil pressure
 - running speed **2,5...4 bar**
 - idling speed min. **1 bar**

2,5–4 bar



- Check the coolant temperature
 - normal running temp. **75...90°C**

75–90°C



2–24

- Watch the ammeter reading/warning light

NOTE! – If the engine is overheated, cool it slowly down by idling for a few minutes. Never pour cold coolant into a hot engine! Never remove the 2–way thermostat to reduce the temperature. In that case a greater quantity of the coolant is circulating via the by–pass pipe and the temperature is getting higher than before.

It is dangerous to open the cap of the pressurised hot radiator.

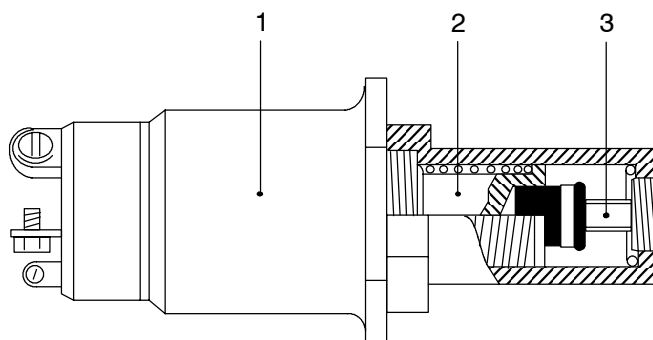
**WARNING**

NOTE! Avoid long periods of idling because then the temperature of combustion is reduced. This causes incomplete combustion and carbon formation which may seize the nozzles and clog the valves and piston rings.

STOPPING

- Move the speed lever into idling position.
- Never stop the engine immediately after heavy driving. Let it idle for a few minutes to equalize the temperatures. This applies especially to a turbocharged engine.
- Turn the stop lever into stopping position or push the stop button.
- Switch the current off. Do not switch the current off while the engine is running.
- In winter move the stop lever into drive position immediately after the engine is stopped (to ensure the function of the automatic cold start device of the engines without the electrical stop device).

The engine stops suddenly while running
(engines equipped with electrical stop device)



2-25

Electrical stop device

1. Solenoid
2. Plunger
3. Regulating rod of the injection pump

If the engine stops when you are running it, the reason for this may be the damage of the solenoid. Take solenoid away from the injection pump and also remove the plunger inside the solenoid. Adjust the solenoid to its place. If the engine starts now, the solenoid is defective. You may carry on running the engine but it must be stopped by the stop lever behind the injection pump. Install the new solenoid as soon as possible.

NOTE! Check the fuse of the solenoid first.

Other eventual running troubles, see chart in page 49.

COUPLING ADDITIONAL EQUIPMENT TO THE ENGINE

Various devices can be coupled to the engine. Be sure that they do not apply constant axial load to the crankshaft or other drive axles.

NOTE! After assembling the clutch or the gear check the axial play of the crankshaft which should be **0,10...0,35 mm**.

SERVICE

PERIODICAL MAINTENANCE

One of the most essential preconditions for secure operation of your engine is proper maintenance at regular intervals. Maintenance costs are low compared to costs caused by negligence.

Maintenance work

Always stop the engine before service.



WARNING

Clean the engine and its surroundings before you start service work.

SERVICE CHART

MAINTENANCE WORK	SERVICE INTERVAL/RUNNING HOURS					
	10	50	300	600	1200	2400
1. Check engine oil level	x					
2. Check coolant level	x					
3. Check for oil, fuel or coolant leakages	x					
4. Clean air filter cyclone	x					
5. Drain water trap		x				
6. Clean/change air filter		x				
7. Clean cooling system (from outside)		x				
8. Change engine oil and oil filter			x			
9. Check fan belt tightness ¹			x			
10. Check battery fluid level			x			
11. Change fuel filter cartridge				x ²		
12. Change prefilter (Stanadyne)				x ²		
13. Drain water out of fuel tank				x ²		
14. Grease coolant pump				x ²		
15. Adjust valves					x	
16. Check and clean injectors						x
17. Turbocharger and intercooler inspection in an authorised workshop	AT 4800 h INTERVALS					
18. Change coolant	EVERY TWO YEARS					

¹) grease spring loaded belt tensioner

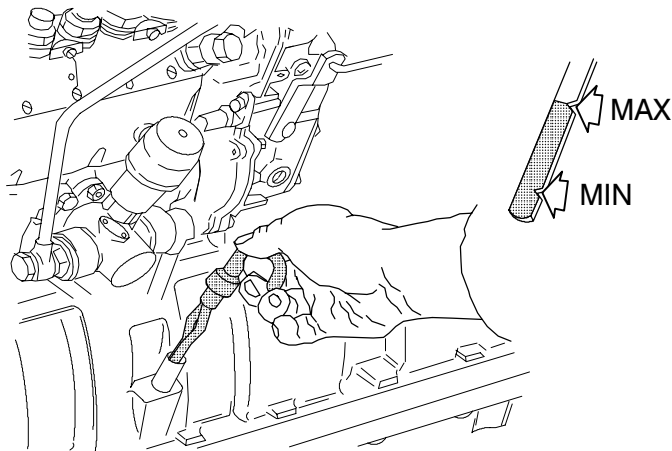
²) or once a year (in the autumn)

BASIC SERVICE AFTER THE FIRST 50...100 HOURS OF OPERATION

1. Check battery fluid level.
2. Check for fuel, lubrication oil and coolant leaks.
3. Check tightness of screw and nuts.
4. Test run.
5. Check oil pressure/charging.
6. Check idling speed.
7. Check max. running speed.
8. Check turbocharger operation.
9. Check thermometer operation.
10. Check stop device operation.
11. Change engine oil and oil filter.
12. Adjust valve clearances.
13. Clean air filter.
14. Drain water trap.
15. Change fuel prefilter

SERVICES TO BE MADE DAILY OR AT 10 HOURS INTERVALS

1. Check engine oil level



2-26

Stop the engine and wait for a few minutes before checking. The oil level should be between the max. and min. lines on the dipstick. When adding oil, top up to the max. line.

2. Check coolant level

Open the radiator cap carefully. If the coolant is hot, there is an overpressure in the system.

**WARNING**

The coolant level should be slightly above the radiator core.

The coolant level should be between the MAX and MIN lines if the system is provided with an expansion tank.

Check the freezing point of the coolant before the cold season.

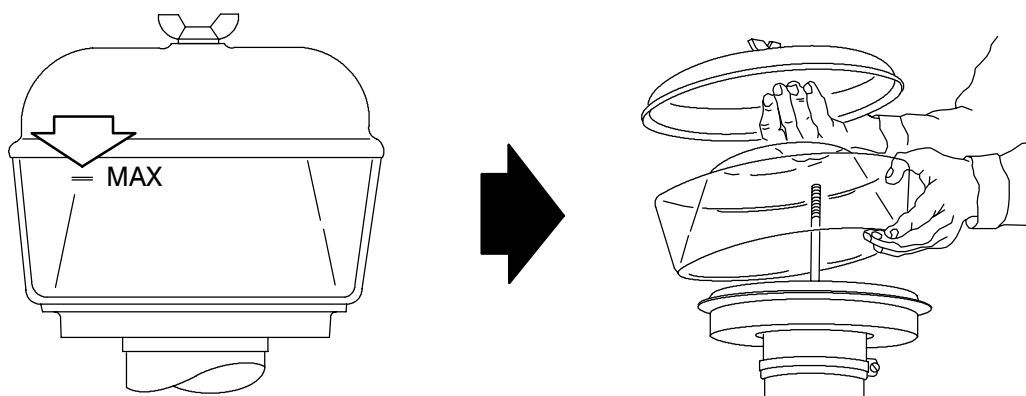
NOTE! Never use only water as coolant. The hot engine can be damaged if you pour cold coolant into it.

3. Check for leakages (fuel, oil, coolant)

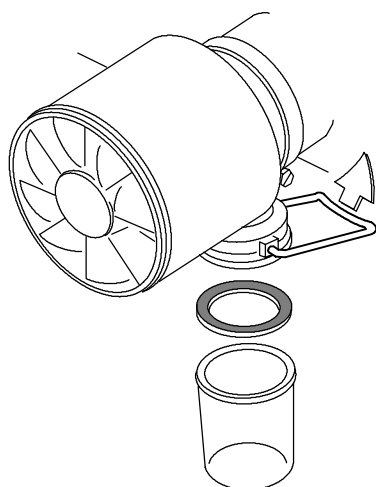
Find any leakage points and eliminate them as soon as possible. The coolant pump is provided with a draining hole on the underside. This hole must not be blocked. If coolant drips out of the hole, the coolant pump must immediately be repaired. There may be a slight leakage on a new pump before it has been run in.

4. Clean air filter cyclone

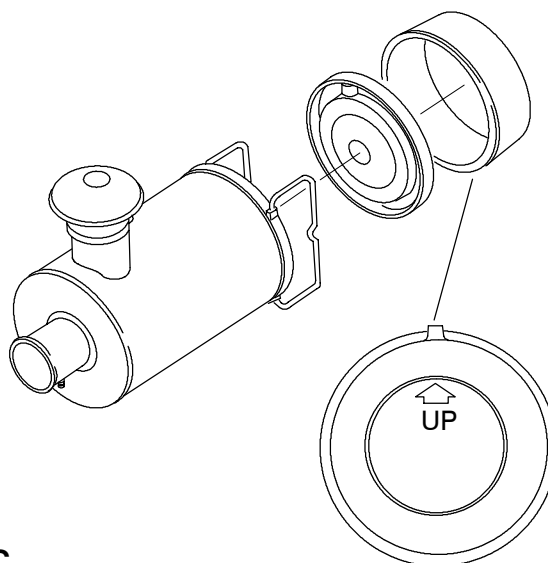
Always stop the engine before cleaning. Undo the locking clamp or the nut on the cyclone, empty and clean the glass bowl. Refit the glass bowl.



A



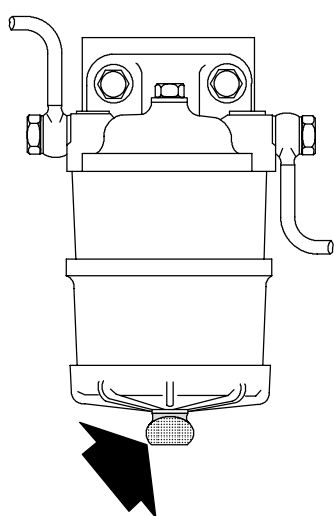
B



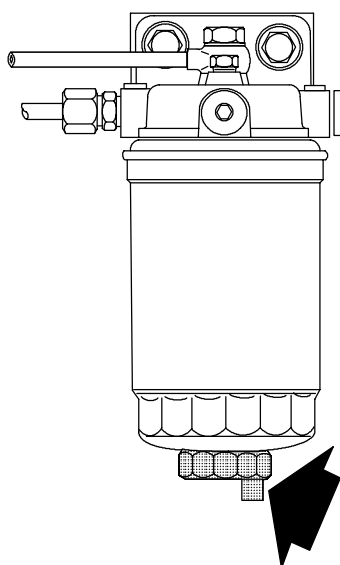
C

SERVICES TO BE MADE WEEKLY OR AT 50 HOURS INTERVALS

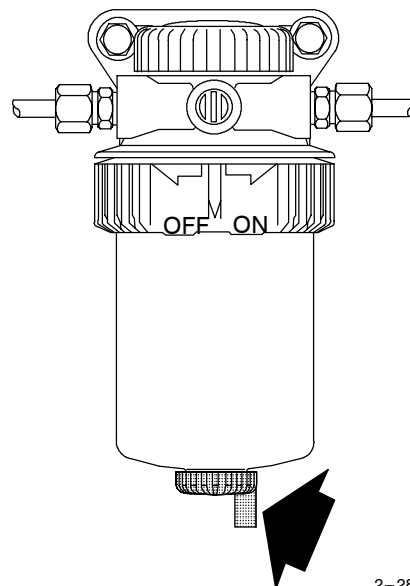
5. Check the water trap



Water trap (CAV)



Fuel filter/Water trap (Bosch)



Prefilter/Water trap (Stanadyne)

2-28

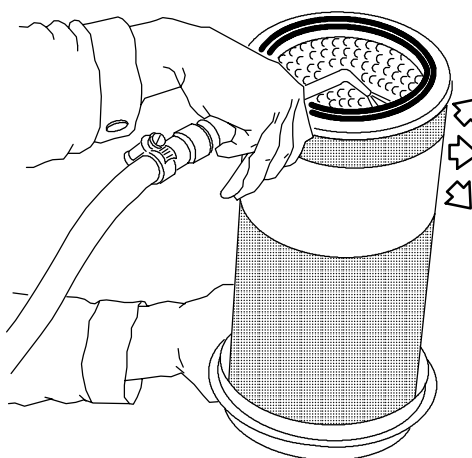
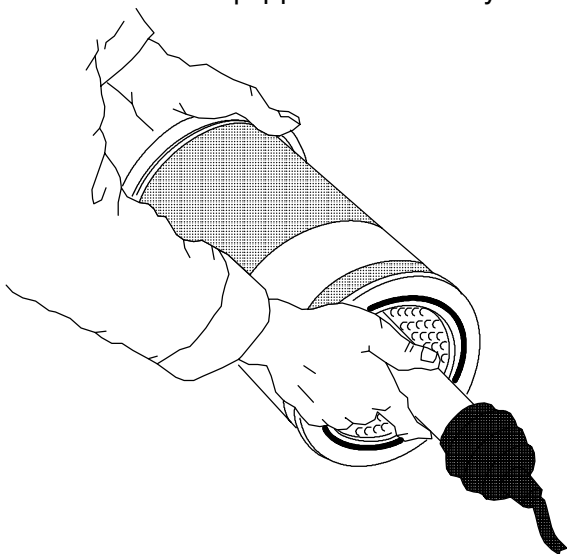
Open the drain plug and drain any water which may be collected in the water trap/prefilter. Wipe off any fuel which may have run down.

6. Clean/change the air filter

Always stop the engine before cleaning/changing.

Unscrew the nut at the end of the air cleaner or undo the locking clamps and take out the filter element.

If the air filter is equipped with a safety filter element do not take it out but change it at 1200 h intervals.



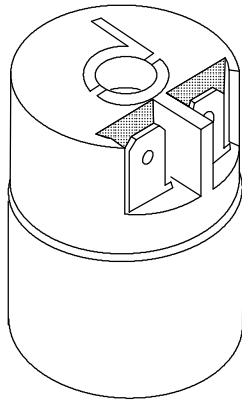
2-29

Clean the filter element with compressed air with a max. pressure of **5 bar** which should be directed obliquely from the middle of the filter and outwards.

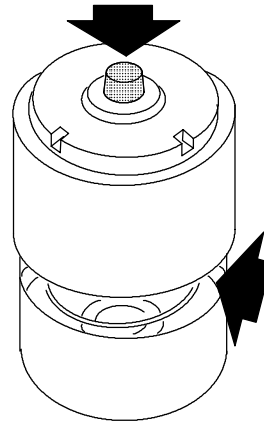
Hold the filter against the light, or lower an electric light down through the filter and check that there are no holes or cracks. If faulty, the filter element must be changed.

When you fit the filter element, check that it is properly located, the seals are in good condition and the sealing surfaces are clean. Do not tighten the nut at the end of the air cleaner too hard.

Engine warranty is valid only when original Sisudiesel air filter elements are used.



ELECTRICAL



MECHANICAL

2-30

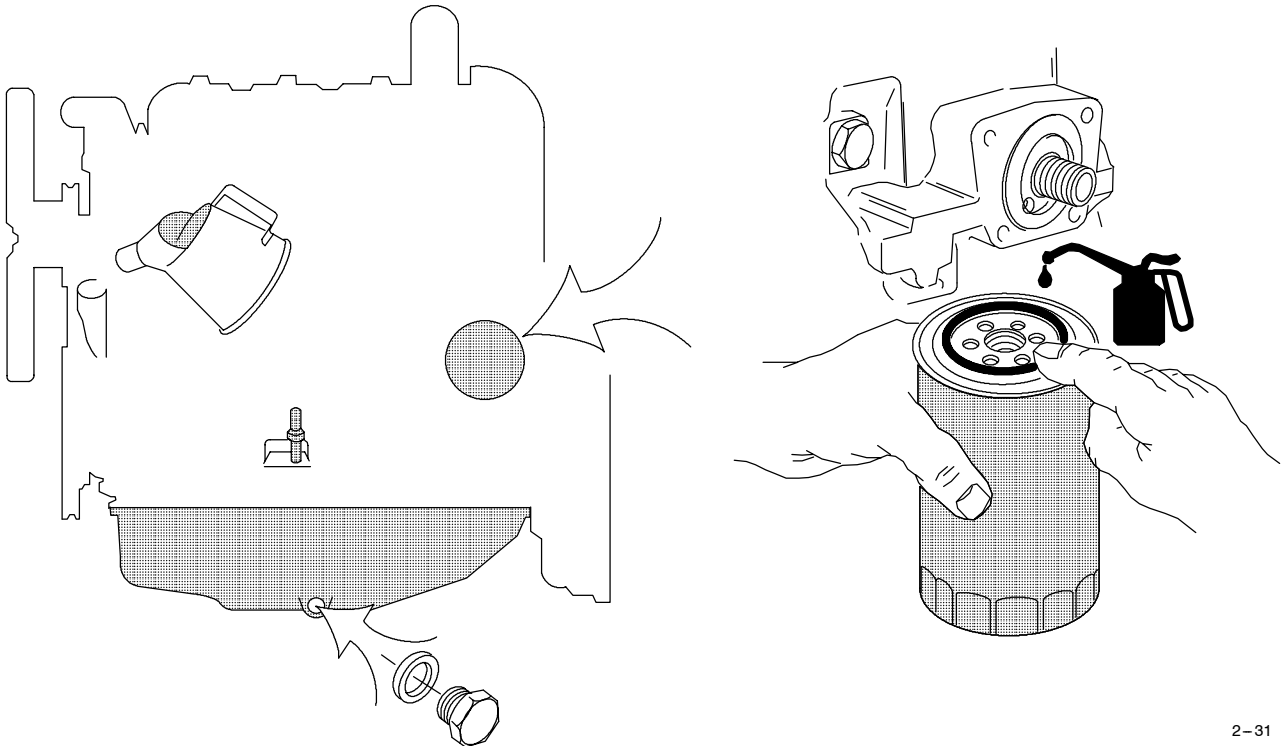
The air intake pipe may be fitted with a mechanical or electrical service indicator to indicate when filter cleaning is due. With the electrical service indicator a lamp in the instrument panel will show when service is needed. When the mechanical service indicator turns red the filter element must be cleaned or replaced. You can reset the indicator by pushing the button at the end of the vacuum indicator.

7. Clean the cooling system

Check and clean the outside of the radiator from time to time. Use compressed air or water spray to remove dirt and impurities. Avoid too high a pressure.

SERVICES TO BE MADE AT 300 HOURS INTERVALS

8. Change engine oil and oil filter



2-31

Run the engine until warm. Stop the engine. Remove the draining plug and drain the oil into a suitable container. When the oil sump is empty, refit the plug. **Take the old oil to a suitable disposal point.**

The engine may be equipped with an oil draining pump (e.g. marine engines), so use the pump to get the oil sump empty.

Fill new oil to the prescribed level (upper mark line on dipstick) through the filler hole.

Note the capacity of the oil filter, abt. **0,7 ltr.**

Regarding oil grade, see Lubrication Oil Chart, page 46.

Change oil filter

Before removing the oil filter clean the surroundings of it. Use the loop tool to unscrew the old filter. Lubricate slightly the rubber gasket of the new filter and clean the sealing faces. Tighten the new filter by hand. Wipe off any oil which has run onto the chassis. Start the engine. Do not race. Ensure that no oil is leaking from the filter. **Take the old filter to a suitable disposal point.**

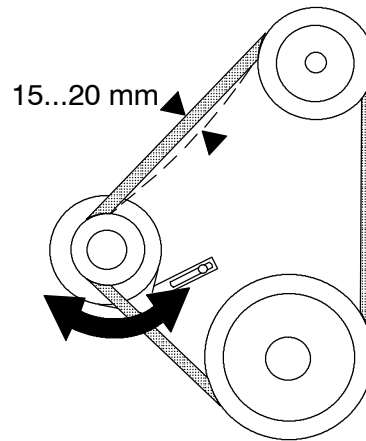
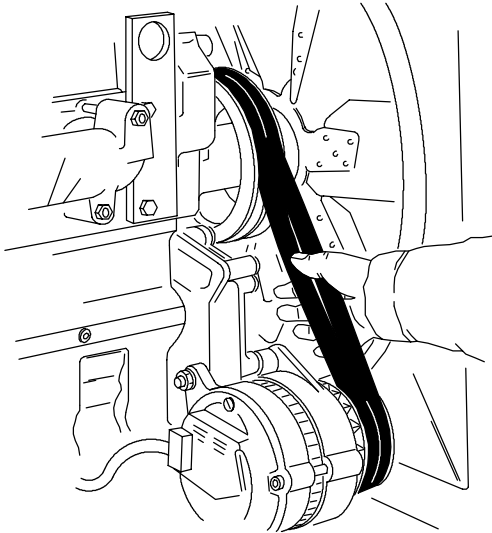
Engine warranty is valid only when original Sisudiesel oil filters are used.

The breather pipe

Always check that the breather pipe is clean and unclogged at the same time as changing the oil.

9. Check fan belt tension

The belt is correctly tensioned, if it deflects abt. **15...20 mm** between the belt pulleys with reasonably hard thumb pressure. A slack, worn or oily belt must be replaced. Always keep a spare fan belt available.



2-32

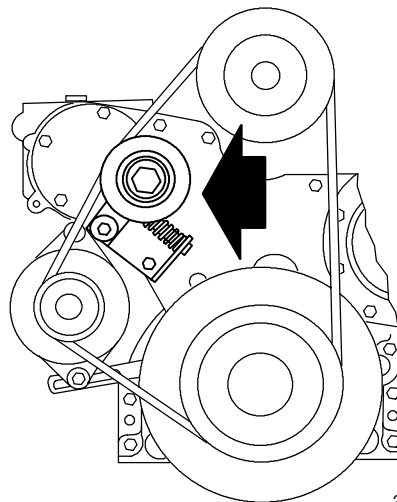
Tensioning

Slacken the attaching screws and move the alternator outwards until the belt is sufficiently tight. Tighten the screws.

If the engine is equipped with a spring loaded belt tensioner, press the spring (e.g. with a suitable screw + nut) so that the tensioner does not press the belts. Perform the tensioning as before shown. Release the spring loaded tensioner.

If the engine is equipped with an air compressor, the compressor fan is tensioned by a separate tightening pulley.

Lubricate the grease nipple.



2-33

10. Check battery fluid level

The fluid should stand abt. **5...10 mm** above the cell plates in the battery.

Top up with distilled water if required. During the cold season it is important that the engine is allowed to run for a while after topping up with distilled water. This is to avoid the freezing of the water before it has had time to mix with the battery acid.

Keep the battery clean and dry on the outside. Ensure proper mounting of the battery.

Clean and protect the pole studs and the cable terminals with battery grease.

Never use a naked flame near the battery to check the fluid level.



WARNING

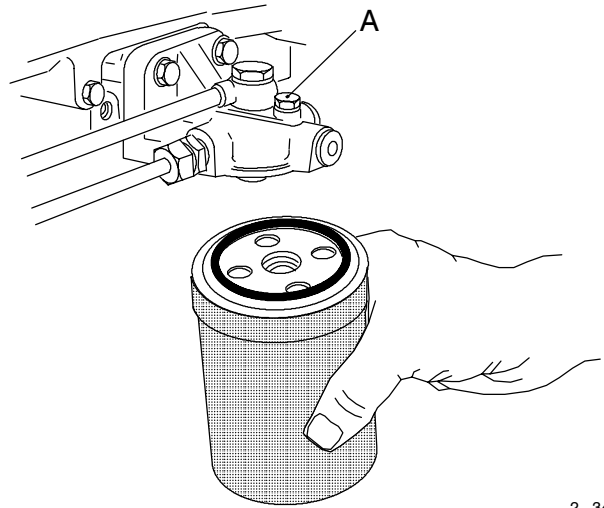
SERVICES TO BE MADE AT 600 HOURS INTERVALS

(or once a year, in the autumn)

11. Change fuel filter Bosch

- Clean the filter and the surrounding area and remove the old filter.
- Lubricate the gasket on the new filter and fit the filter. Turn 3/4 of a turn after the gasket has come into contact with the sealing face.
- Pump fuel with the hand pump until the filter is full.
- Bleed the fuel system, see page 37/40.

A = Bleed screw

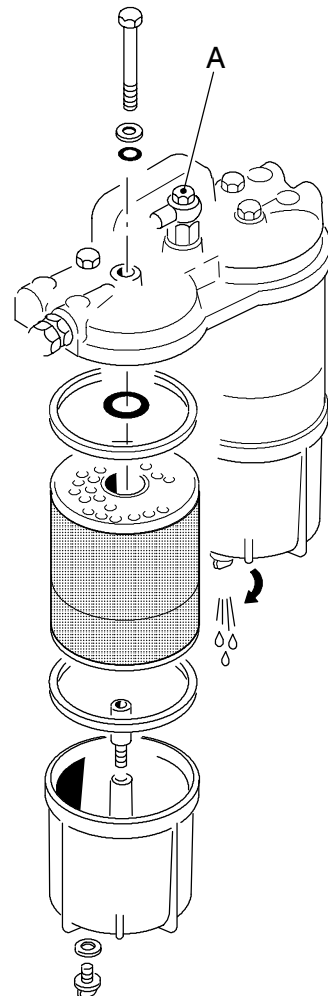


2-34

11. Change fuel filter CAV

- Clean the filter and the surrounding area.
- Empty the fuel filter by opening the plug in the bottom shield. Let the fuel drop into container, not onto the soil.
- Unscrew the screw on the top of the fuel filter. At the same time support the filter bottom.
- Clean the glass bowl and the bottom shield.
- Fit the new seals and reassemble the filter.
- Pump fuel with the hand pump until the filter is full.
- Bleed the fuel system, see page 37/40.

A = Bleed screw



2-35

Take the old filter to a suitable disposal point.

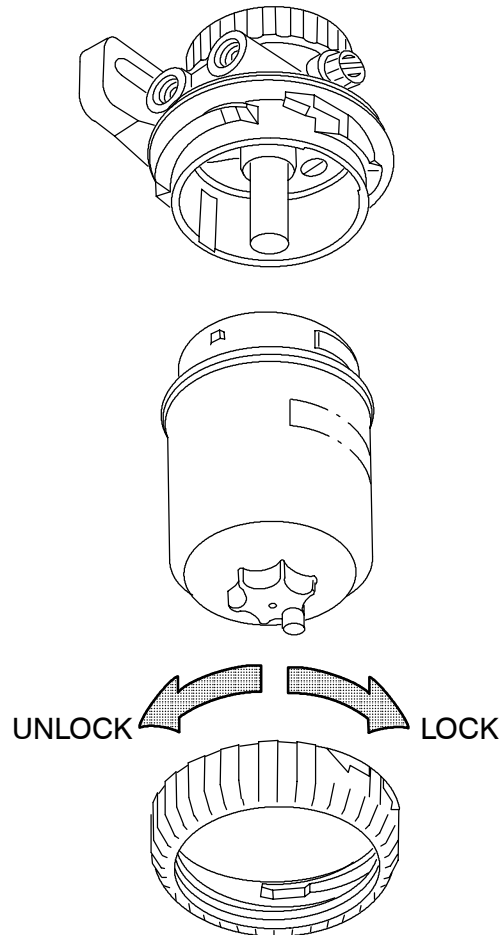
NOTE! Use of spirits as antifreeze is not useful or recommended at all. It makes the fuel solidify and weakens the lubricating qualities of the fuel and increases the possibility of corrosion.

Engine warranty is valid only when original Sisudiesel fuel filter elements are used.

12. Change prefilter Stanadyne

- Clean the prefilter and surrounding area.
- Open the quick change ring and take out the filter element.
- Fit the new element. **NOTE!** The element will only go on one way.
- Turn the quick change ring to ON position until audible “click” will be heard.
- Pump fuel with the hand pump until the prefilter is full.
- Bleed the fuel system, see page 37/40.

Take the old filter element to a suitable disposal point.



2-36

13. Drain fuel tank

The fuel tank should be cleaned before the winter. Thus you avoid troubles caused by the water in the fuel system. The best way to prevent condensation is to always keep the fuel tank as full as possible.

- Empty the fuel tank and rinse it with pure fuel.
- Fill the fuel tank with fuel for winter conditions.

14. Grease coolant pump

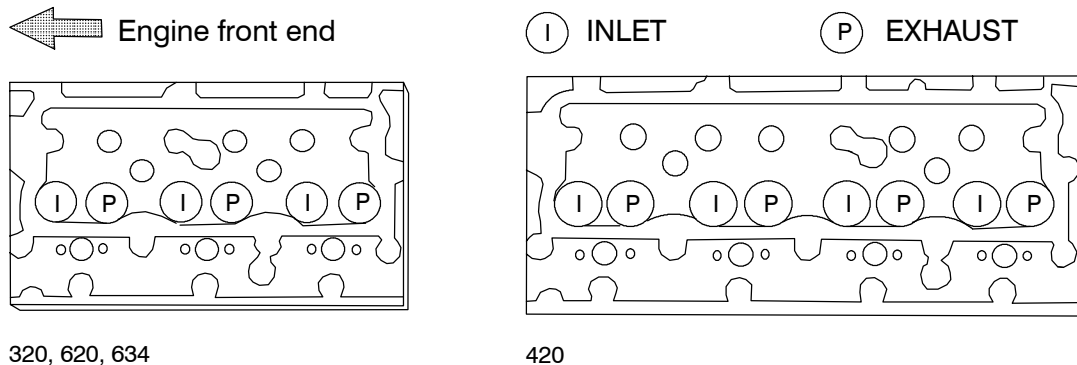
(The pumps fitted with a grease nipple)

Always use heat resistant ball bearing grease (NLG 2) as lubricant. Do not grease the bearings too much as excessive grease is forced out from the bearing space and may damage the seals. To press twice with a grease gun is enough.

SERVICES TO BE MADE AT 1200 HOURS INTERVALS

15. Adjust valve clearances

The nominal clearance of both inlet and exhaust valves is **0,35 mm**. The valve clearances can be checked regardless of whether the engine is cold or hot. The valve clearances of a certain cylinder can be adjusted when the piston is at its compression stroke top dead centre.



2-37

320 – engines

Check the valve clearances in the injection order of the engine. Injection order is 1–2–3.

- Check valves in the 1st cylinder, when the exhaust valve of no. 3 cylinder is completely open (valve no. 6).
- Check valves in the 2nd cylinder, when the exhaust valve of no. 1 cylinder is completely open (valve no. 2).
- Check valves in the 3rd cylinder, when the exhaust valve of no. 2 cylinder is completely open (valve no. 4).

420 – engines

- Rotate the crankshaft in the running direction until the valves in the 4th cylinder are rocking (exhaust closes, inlet opens). Check the valve clearance of the 1st cylinder.
- Rotate the crankshaft by 1/2 of a turn in the running direction so that valves in the 3rd cylinder are rocking. Check valves in the 2nd cylinder.
- Continue according to the order of injection:

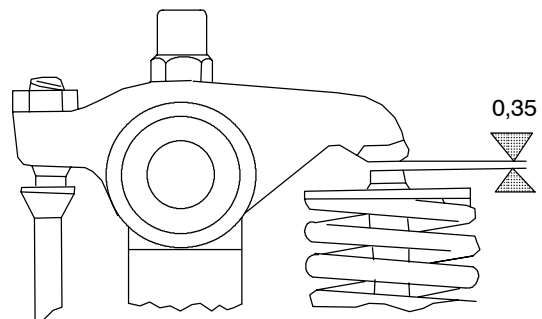
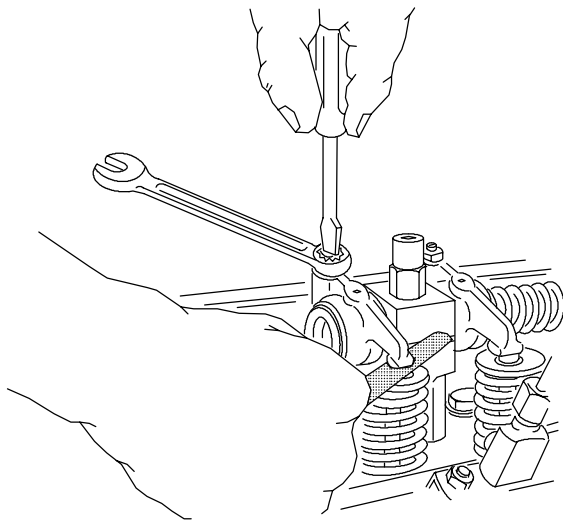
Injection order	1 2 4 3
Valves rock in cyl. no	4 3 1 2

620/634 – engines

- Rotate the crankshaft in the running direction until the valves in the 6th cylinder are rocking (exhaust closes, inlet opens). Check the valve clearance of the 1st cylinder.
- Rotate the crankshaft by 1/3 of a turn in the running direction so that valves in the 2nd cylinder are rocking. Check valves in the 5th cylinder.
- Continue according to the order of injection:

Injection order	1 5 3 6 2 4
Valves rock in cyl. no	6 2 4 1 5 3

Adjusting



2-39

- Slacken the locknut on the adjusting screw on the rocker arm.
- Check the clearance with a feeler gauge and adjust to the correct clearance by turning the adjusting screw.
- Tighten the locknut and again check that the clearance is correct.

SERVICES TO BE MADE AT 2400 HOURS INTERVALS

16. Check and clean injectors

In order to ensure trouble-free engine operation the injectors must be kept in first class condition. Imperfect operation of an injector causes for example, lower engine output, greater consumption of fuel, engine knocking and smoke in naturally aspirated engines.

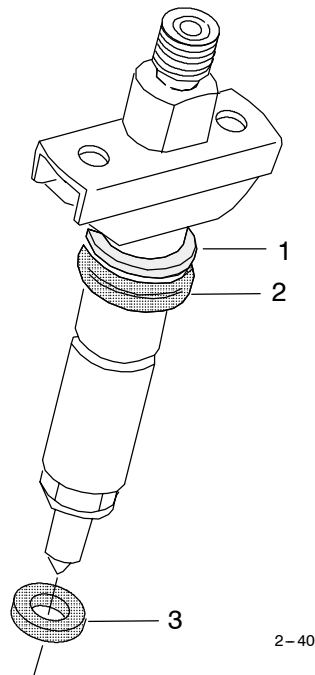
Remove injectors

- Clean the injectors, their pipes and surroundings.
- Detach the injection pipes and the leak-off pipes.
- Detach the nuts from injectors and remove the injectors. If you can not remove the injector by hand, use the extractor no. 9051 71300. Cover all the connection points of the injector.
- Also remove the injector sealing ring from the cylinder head, if not remove with the injector.

Special measuring tools are needed for the injector check. Preferably let Sisudiesel Service Organization check, adjust and clean the injectors.

Fitting injectors

- Ensure that the injector seat on the cylinder head is clean. Install the washer and the rubber ring around the injector. Replace the old sealing ring on the lower end with a new one.
- Install the injector to the cylinder head. Then tighten the nuts screwing them by turns, a little at a time checking that the torques of both nuts are equal all the time. Continue tightening until the final tightening torque, **15 Nm** is reached.
- Attached the injector pipes and the leak – off pipes.



Fitting the injector

1. Washer
2. Protective rubber
3. Seal washer

SERVICES TO BE MADE AT 4800 HOURS INTERVALS

17. Check turbocharger play and check that the intercooler cell is clean (DS/DSI/DW/DWI – engines)

The turbocharger and the intercooler cell service must be entrusted to an expert technician at Sisudiesel Service.

It is essential to carry out regular engine services to keep the turbocharger in good condition. Special attention must be paid to the cleanliness of the air filter cartridge and to the engine oil and oil filter change at recommended intervals. Check regularly that the turbocharger is properly fitted to the exhaust manifold as well as the tightness of the inlet and exhaust manifold jointings. Correct adjustment of the injection equipment is essential for the operation of the turbocharger.

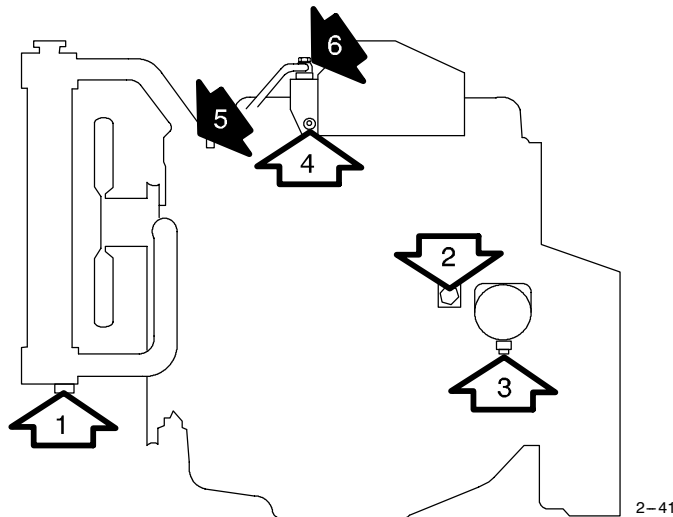
When a new turbocharger is installed, pour abt. **0,2 ltr** of pure engine oil into the bearing housing before attaching the pressure oil pipe. Ensure that no impurities are entering the turbocharger with the oil.

SERVICES TO BE MADE EVERY TWO YEARS

18. Change coolant

Change the coolant every two years. This ensures that the anti-corrosive is always active. See page 46 for the quality requirements of the coolant.

At the same time check the tightness and condition of rubber hoses of the cooling system. Renew broken or damaged hoses before filling the system.



1. Drain plug on radiator
2. Drain plug on cylinder block
3. Drain plug on oil cooler
4. Drain plug on charge air cooler
5. Bleed plug
6. Joint

Drain coolant system

- Remove the filler cap
- Remove the draining plugs on the radiator and on the left side of the cylinder block.
- If the engine is equipped with an oil cooler and an intercooler (DSI/DWI), also remove the draining plugs on them.
- Make sure all coolant is drained out and no impurities are blocking the draining hole.
- The engine assembly may also have other draining plugs (e.g. on the engine heater piping). Also remove these plugs when you change the coolant.

Draining cooling system of marine engine

If you stop the engine in the cold season for so long a time that there is a risk of freezing, always completely drain the raw water system. Ensure also that there is enough antifreeze in the fresh water system.

- Drain the fresh water system until the heat exchanger is empty.
- Open the covers of the heat exchanger and blow the cell tubes empty.
- Open the plate cover of the raw water pump.
- Also drain the raw water out of the oil cooler/oil cooler cell tubes of the marine gearbox.

Fill cooling system

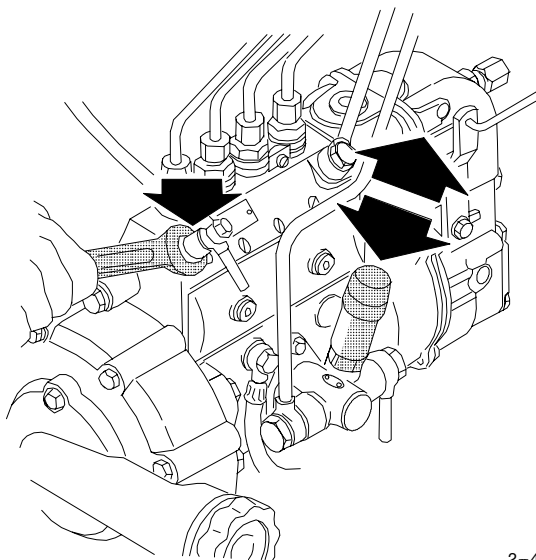
Fill the cooling system with a mixture of antifreeze and coolant until the coolant level comes above the radiator core. Bleed the cooling system by removing the plug/the thermometer feeler on the thermostat body. Pour coolant until the coolant level reaches the plug. Screw the plug and fill rest of the system. In DSI/DWI-engines open also the upper joint for the intercooler coolant pipe.

NOTE! Never use only water as coolant.

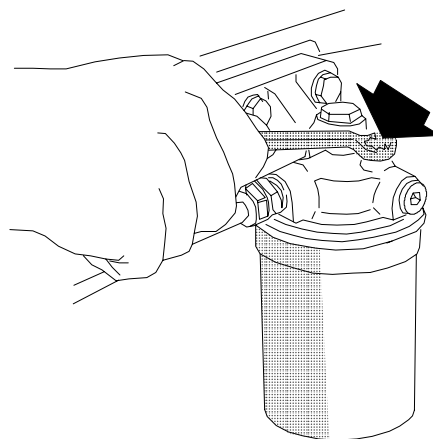
ADDITIONAL SERVICE AND ADJUSTING INSTRUCTION

(to be carried out when required)

BLEED FUEL SYSTEM (Bosch in-line injection pump)



2-42



2-43

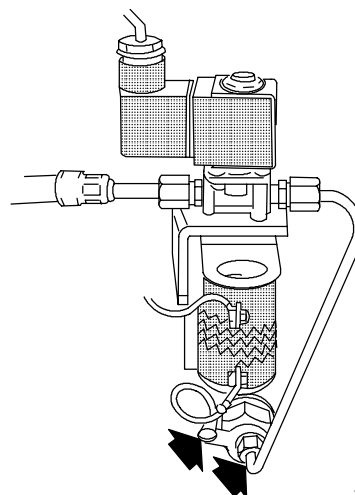
- Pump fuel with the handpump on the feedpump.
- Unscrew the bleed screw on the top of the fuel filter. Pump with the hand pump until the fuel running out of the bleed screw is free of air bubbles. Close the bleed screw.
- If the engine fails to start, open the injector pump overflow valve and continue pumping until the fuel running out is free of air bubbles. Close the overflow valve.
- Clean the engine of leaked fuel.

Bleed the Thermostart system

Always bleed the fuel pipe of the glow plug, if the pipe or the fuel container is empty e.g. after service. Damage to the glow plug can occur due to the lack of fuel when starting the engine.

System with magnetic valve

- Disconnect the glow plug wire and open the pipe adapter.
- Switch the current on the magnetic valve and turn the crankshaft until fuel is running out of the pipe jointing.
- Tighten the pipe adapter and connect the wire.



2-44

System with fuel container

- If the container has become empty, fill it with a drip can through the breather hole on the cover.
- Open the glow plug pipe adapter and let fuel drop through the pipe. Tighten the adapter.

CHECK AND ADJUST INJECTION TIMING (Bosch in-line injection pump)

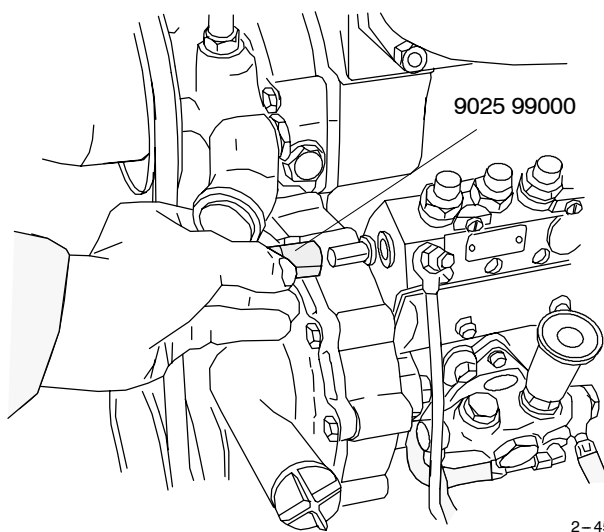
Injection of the 1st cylinder starts when the mark of the crank shaft pulley shows towards the timing indicator which is either on the right or left side of the pulley depending on the engine type. The tractor engines may have the timing mark located on the flywheel.

NOTE! If you remove the hub of the pulley, mark its location. Afterwards when assembling the pulley you must ensure that the marks on the hub and on the crankshaft coincide with each other.

Check

The injection pump is equipped with an automatic excess feed. Therefore move the control rod to the running position before checking the injection timing. Without this action injection timing errors will result!

- Clean the injection pump and its surroundings thoroughly.
- Turn the crankshaft to a position where the 1st cylinder reaches its compression stroke top dead centre. Then turn the crankshaft backwards until the mark on the pulley passes the timing indicator.

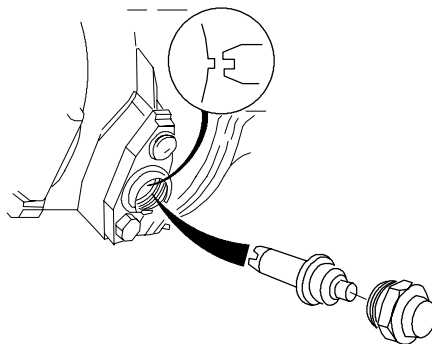


2-45

- Remove the control rod cover/the stop magnet from the injection pump. Move the control rod to drive position with tool 9025 99000.
- Remove the 1st cylinder injection pipe.
- Blow the conical part of the pressure valve holder free of fuel. Turn the crankshaft slowly until the fuel surface in the pressure valve holder stirs but does not yet rise.
- If the injection time marking on the pulley is in line with the tip of the timing indicator, the injection timing is correct. Otherwise adjust the timing.
- After checking and eventual adjustment replace the injection pipe and the control rod cover. Let the engine run for a few minutes and re-check. Thus you can be sure that there is no air in the fuel system as this might affect the timing.

NOTE! In some types of injection pumps the injection starting point in the 1st cylinder has been positioned with aid of an indicator pin in the pump governor housing. Do the inspection of injection timing as follows:

- Turn the crankshaft to a position where the 1st cylinder piston reaches its compression stroke top dead centre. Then turn the crankshaft backwards until the mark on the pulley passes the timing indicator. After that rotate the crankshaft slowly to running direction until the mark on the pulley is at the point of the timing indicator.



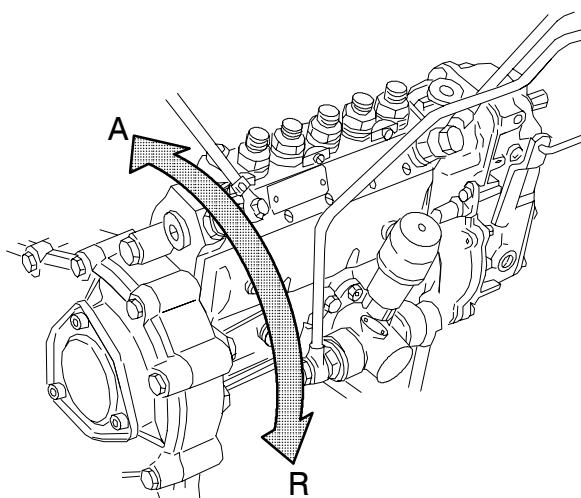
2-46

- Unscrew the plug on the side of the injection pump. Take out the indicator pin.
- Turn the indicator pin and push it into the hole so that the groove at the end of the pin points towards the pump.
- If the pin groove fits on the boss on the governor weight assembly, the injection timing is correct. Otherwise, turn the pump to a position where the boss and the pin groove align.

NOTE! Do not rotate the crankshaft when the groove end of the pin is inside the pump, since the pin end damages easily and plastic pieces remain in the governor housing.

- When the adjustment is correct, turn the indicator pin so that the groove points outwards (running position) and push the pin into the hole. Refit the plug.

Injection timing adjustment

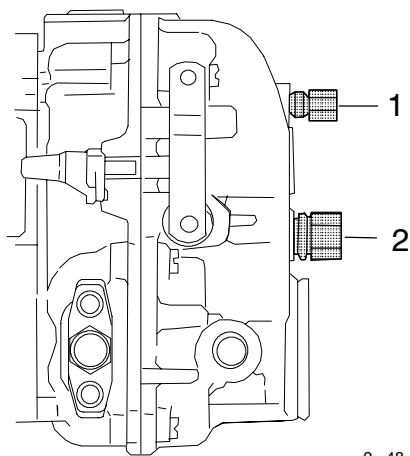


2-47

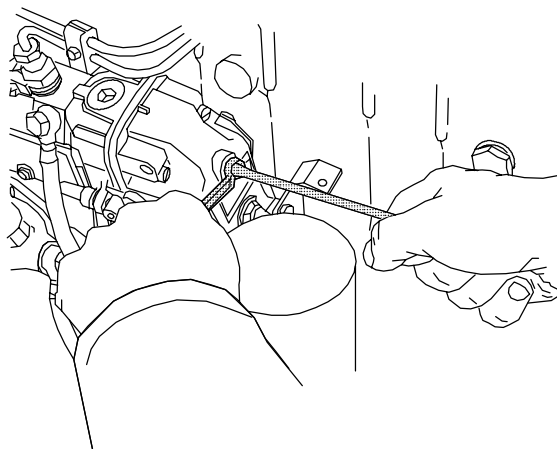
- Loosen the retaining nuts of the injection pump and the connection nuts of the injection pipes.
- If the injection timing is retarded, turn the injection pump anti-clockwise, direction "A" (viewed from the front end of the pump). If the timing is advanced, turn the pump clockwise, direction "R".
- Check the injection timing and turn the pump again, if necessary.
- When the injection timing is correct tighten the retaining nuts of the pump and the connecting nuts of the injection pipes.

ADJUST IDLING SPEED (Bosch in-line injection pump)

If the engine idling speed differs from the rating, adjust as follows:



2-48

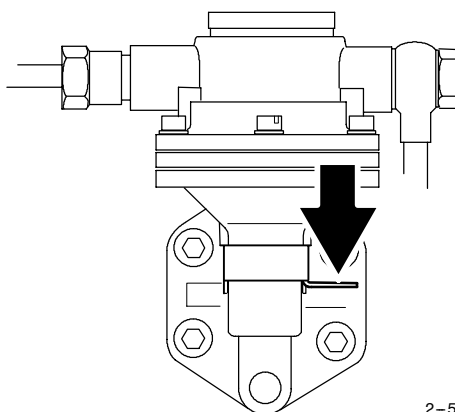


2-49

- Open the protection cap (1) of the idling speed adjusting screw and the protection cap (2) of the adjusting screw of the additional spring for idling.
- Ensure that the throttle lever is in idling position and the engine is at running temperature.
- Start the engine and open the adjusting screw (2) of the additional spring so that it does not affect the idling speed.
- Adjust the idling speed by the adjusting screw (1) at abt **20–30 rpm** below the rating.
- Race the engine a few times and ensure that the idling speed remains as set.
- Tighten the adjusting screw (2) of the additional spring until the idling speed rises to the rated value. Lock the adjusting screw in this position.
- Fix the protection caps of the adjusting screws.

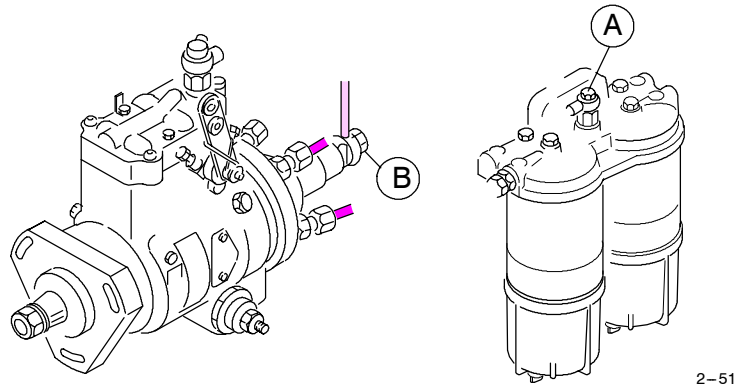
BLEED FUEL SYSTEM (Stanadyne rotary injection pump)

NOTE! This fuel system removes automatically small amounts of air bubbles from the filter and the pump when the engine is running. However, bleed the system always, when the system has been opened or fuel has been exhausted during driving or a new spare pump has been fitted (to avoid long starting time).



2-50

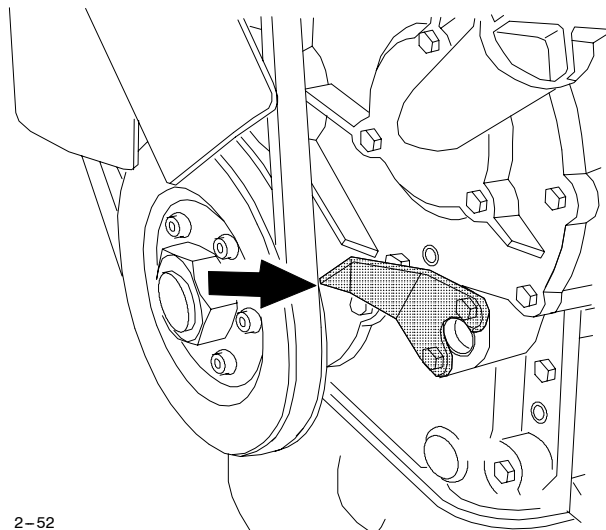
- Pump by hand the fuel feed pump lever. If the pumping seems to be ineffective, turn the engine a little so that the camshaft cam is not at the feed pump lifter.



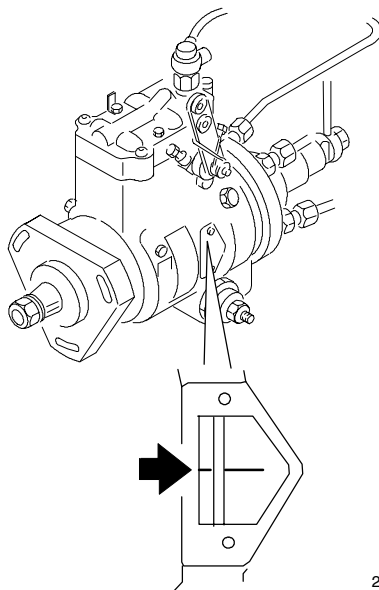
- Loosen the bleeding screw (A) on the filter. Pump with the hand pump until no air bubbles flows out of the bleeding screw hole. Tighten the bleeding screw.
- Pump further with the hand pump and loosen the fuel inlet connection (B) on the pump, until the fuel coming out is free from air bubbles. Tighten the connection.
- Start the engine and assure, that no leaks exist.

NOTE! When the bleeding is done in this way, fuel flows immediately into the internal transfer pump when the starter motor is rotating and the distributor pump housing is filled quickly with fuel. In the pump housing there is a stop solenoid, which must not be switched on for longer periods when the pump housing is empty of fuel.

CHECK AND ADJUST INJECTION TIMING (Stanadyne rotary injection pump)



- Turn the crankshaft to a position where the 1st cylinder piston reaches its compression stroke top dead centre. Then turn the crankshaft backwards until the mark on the pulley passes the timing indicator. After that rotate the crankshaft slowly to running direction until the mark on the pulley is at the point of the timing indicator.

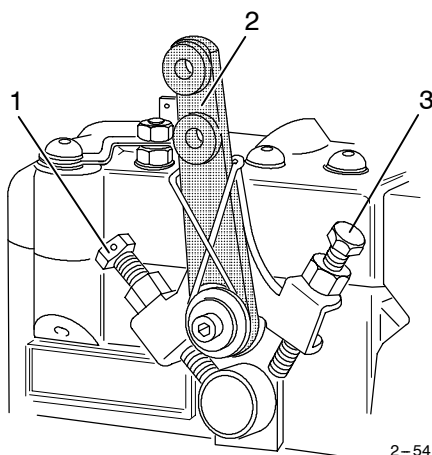


2-53

- Remove the small cover plate on the side of the injection pump. If the pump timing marks are against each other, the timing is correct.
- If the pump timing marks are not against each other, loosen the retaining nuts of the pump and the delivery pipes. Rotate the pump to a position where the timing marks are against each other. Tighten the injection pump into position where the timing marks on the engine and on the injection pump are against each other. Tighten the connecting nuts of the delivery pipes.

NOTE! The E–engine timing check and adjustment is done with special gauges. Contact your Sisudiesel dealer.

ADJUST LOW IDLING SPEED (Stanadyne rotary injection pump)

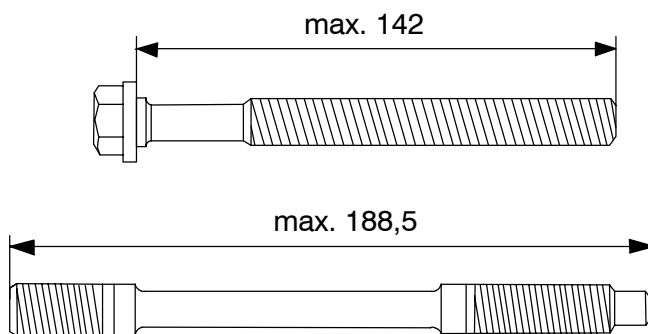


1. Low idling speed
2. Revolution lever
3. Max. revs

2-54

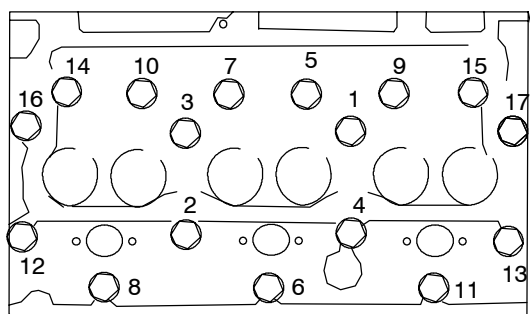
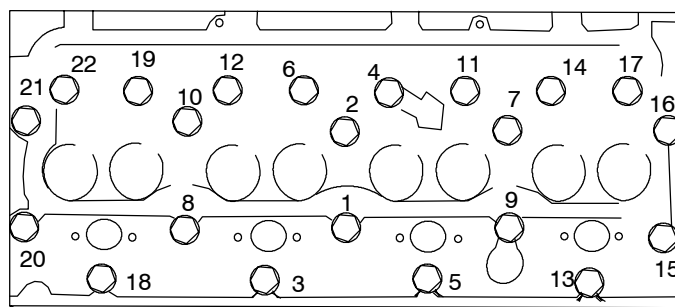
The low idling speed can be adjusted with a limiting screw in front of the revolution lever. The adjusting screw for max. revs has been sealed. This adjustment has been done in the factory, and adjustment of max. revs afterwards is prohibited.

FIT CYLINDER HEAD



2-55

- Measure the screw length which should be within the limits shown in figure. If any screw differs in length from the measures given, replace the screw.
- Fit the cylinder head in its position.


320, 620, 634

420

2-56

- Pictures above show the correct tightening order of the cylinder head bolts. The order has also been marked on the cylinder heads.
- Tighten the cylinder head bolts progressively as follows:
 1. First tightening to **80 Nm**
 2. Tightening of **90°**
 3. Tightening again of **90°**.
- Adjust the valve clearances.
- Run the engine with a light load to the normal running temp. (~ 75°C).
- Tighten the bolts **60°** and adjust the valve clearances.

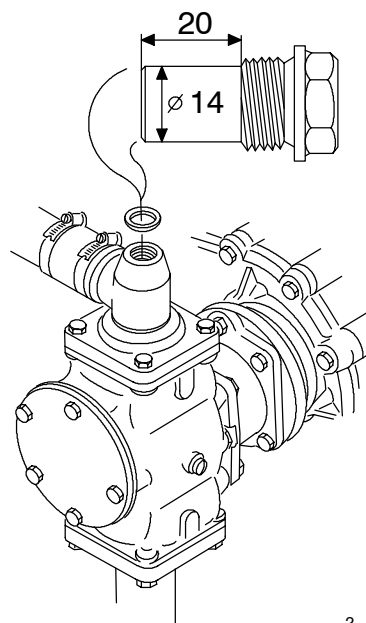
NOTE! After this the cylinder head does not need retightening.

INSPECTION OF THE ZINC PLUG

(620/634 marine engines)

Check the zinc plug at least once every year. If the zinc plug is badly corroded, the inspection must be made more often. The extent of corrosion depends on the chemical contents of the water flowing through the system.

- Empty the raw water system and loosen the zinc plug.
- Clean the zinc plug by scraping.
- Change the plug if it has worn more than to half of a new plug, compare with dimensions shown in picture. Spare part no 8450 85699.



2-57

CHECK OF THE RUBBER ELEMENT VIBRATION DAMPER

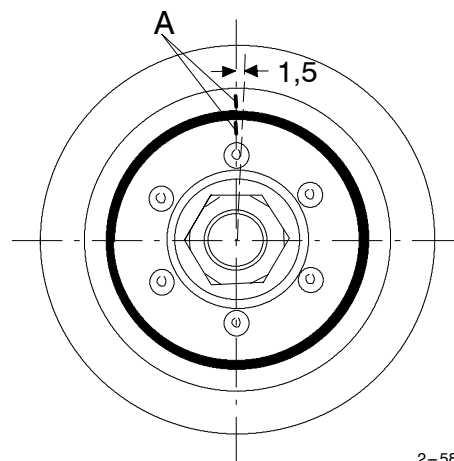
(620/420 – engines)

The inertia member of rubber vibration damper on the crankshaft front end may turn in relation to its hub in the course of hundreds of running hours. There are index lines on the front surface of the vibration damper, where possible turning can be noticed.

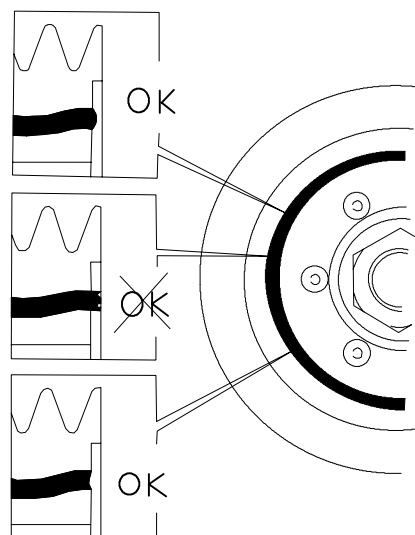
- If lines (A) are more than 1,5 mm out of alignment, change the vibration damper for a new one.

- Check also the condition of rubber element. If pieces of rubber are missing, or if the rubber member is more than 3,5 mm below the surface, or if forward movement of inertia member (outer ring) can be detected, change the vibration damper for a new one.

NOTE! Vibration damper should be replaced every 4000 running hours!



2-58



2-59

BEFORE THE COLD SEASON

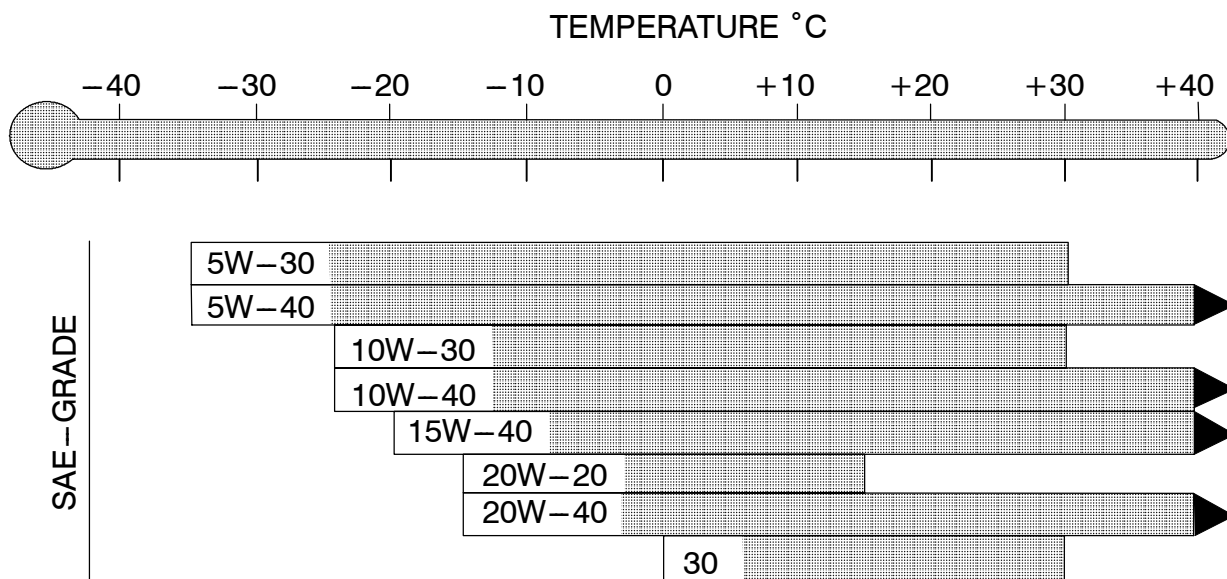
- Drain water out of the fuel tank.
- Drain water out of the water trap.
- Replace the fuel filter and prefilter (Stanadyne).
- Ensure that the fuel in the fuel tank is of winter quality.
- Change the engine oil (winter quality).
- Check the battery condition.
- Move the control rod to the running position after the engine has been stopped (engines without electrical stop device).
- Ensure that the fuel in Thermostart fuel container and in the fuel pipe between the container and the glow plug is of winter quality. If there is fuel of summer quality, it becomes solid and the glow plug is glowing without fuel. The result is that the engine fails to start and the glow spiral is burnt off. The easiest way to change the fuel in the Thermostart container: Remove the fuel pipe at the glow plug end and let the container drip empty. After this replace the fuel pipe and fill the container e.g. with a drip can through the bleed hole on the container. Remove the fuel pipe carefully to ensure that the glow plug gets fuel. Thus also the fuel pipe becomes air free.
- Check externally by hand the glow plug function when the glow plug is fitted and the glowing current is switched on. If the glow plug is working, it is warm on the top.
- Check the function of the engine pre-heater.

TIGHTENING TORQUES

Object	Nm
Cylinder head bolts	80 Nm + 90° + 90°
Cylinder head studs to cylinder block	30
Main bearing bolts	200
Connecting rod bolts	40 Nm + 90°
Crankshaft nut:	
– 320/420	600
– 620/634	1000
Crankshaft pulley bolts	30
Flywheel bolts	140
Flywheel housing bolts:	
– outer ring M12	110
– inner ring M10	60
Idler gear bolts:	
– M10	60
– M14	200
Idler gear retaining screws (with ball bearing):	
– the bigger bolt	180
– the bolts for holding the bearing	22
Balancing weights (420)	60
Piston cooling valve (620/634)	30
Oil pump retaining screws	60
Oil cooler connecting piece	60
Coolant pump pulley nut	120
Exhaust manifold bolts	50
Intake manifold bolts	30
Injection pump pressure valve holder	45
Injection pump gear retaining nut	90
Injection pump gear retaining nut (Bosch–P)	200
Injector attaching nuts (on studs)	15
Injector nozzle sleeve	60
Compressor pulley nut (Knorr)	80

LUBRICATING OIL QUALITY REQUIREMENTS

- Naturally aspirated and turbocharged engines API **CF-4, CG-4, CH-4** ACEA **E2/E3-96, E4-98, E5-99**
- Low emission (E) engines API **CG-4, CH-4** ACEA **E3-96, E4-98, E5-99**



2-60

Lubricating oil is hazardous to health. Avoid prolonged contact with the skin. The oil mist is dangerous to inhale.

**WARNING**

COOLANT QUALITY REQUIREMENTS

The coolant which is used must satisfy the demands of standard ASTM D 3306 or BS 6580:1992.

- The cooling mixture must consist 40...60 % of ethylene/propylene – glycol based antifreeze and water. The best proportion is 50 % of antifreeze liquid and 50 % of water.
- The water used must be mechanically clean and not too acid (e.g. swamp water) or too hard (calciferous well water).
- Check periodically the proportion (the frostproof) of the coolant. Change the coolant every two years.

NOTE! Never use only water as coolant!

Antifreeze is hazardous to health. Avoid contact with the eyes and skin.

**WARNING**

FUEL QUALITY REQUIREMENTS

	Requirement	Test method
Density, +15 °C	0,82...0,86 kg/dm ³	ASTM D 4052, EN ISO 12185
Viscosity, +40 °C	1,2...4,5 mm ² /s	ASTM D 445, ISO 3104
Sulphur content	max. 0,2 % m/m	ASTM D 4294, ISO 8754
Cetane index	min. 45	ASTM D 4737
Water content	max. 200 mg/kg	ASTM D 1744

The fuel should be according to norm EN 590.

Engine output depending on fuel quality

Different fuel qualities like temperature, density and viscosity affect the actual output of the engine. Our output rates use fuel with a density of 0.84 kg/dm³ and specific heat rate of 42,7 MJ/kg at a fuel temperature of +15 °C.

The correction in % caused by the change of fuel qualities is seen in the attached figures.

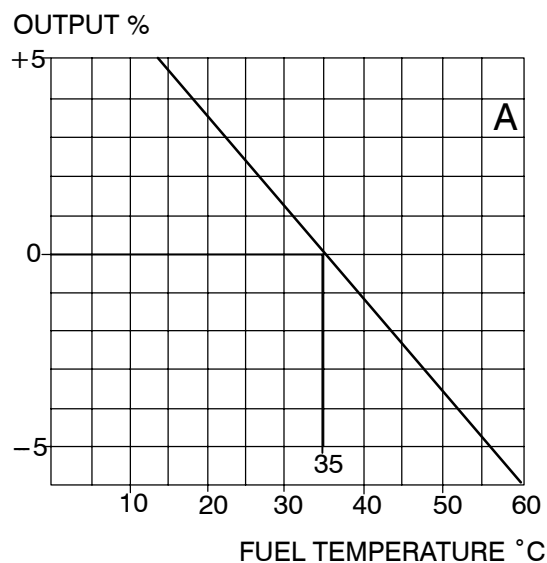


FIG. A. Engine output dependence on fuel temperature. +35 °C is the reference temp (correction 0 %).

The fuel temperature is not only a function of ambient conditions but also varies according to the fuel system of the application (tank size and location, return flow etc.).

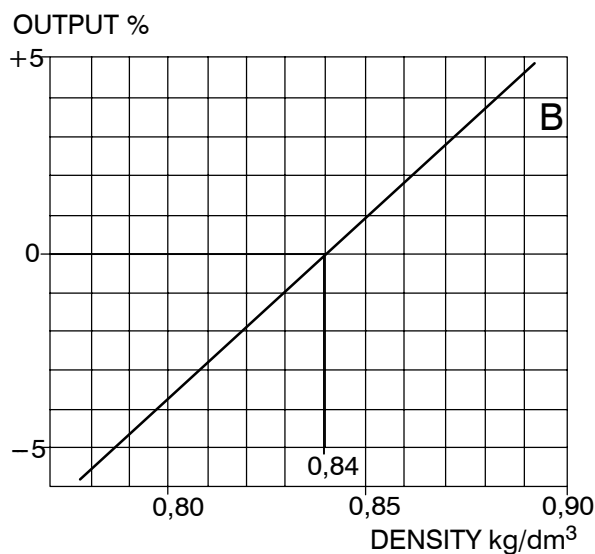


FIG. B. Engine output dependence on fuel density. Normal value is 0,84 kg/dm³ at +15 °C.

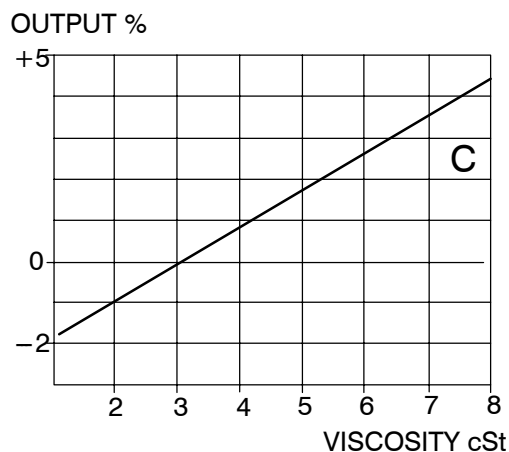


FIG. C. Engine output dependence on fuel viscosity. Normal value is 3 cSt at +20 °C.

Note fig. B and C only if the fuel quality is changed.

In fig. A there are all the quality dependencies caused by the change of the temperature. The fuel density and viscosity can be seen in the produce declaration given by the manufacturer.

The output correction is made as follows: Correction percentages from figures A, B and C are summed up. The given rated power is then corrected with the resulting percentage.

BIODIESEL FUEL

In the Sisudiesel–engines it is accepted to use esterified rape oil as biodiesel fuel—or RME (rape oil esterified with metanol) without technical modifications on the engine. The requirement for the acceptance is that the biodiesel that is used is very pure and that it fills the Austrian “Ö 1190” biodieselnorm demands of pureness. Practically it means that the amount of pure carbon, hydrogen and oxygen content together in the biodiesel is more than 99%.

The warranty forms are the same.

In the service instructions there is one thing changing: checking cleaning of nozzles every 1000 hours.

TROUBLE SHOOTING

Always listen to engine noise and pay attention to how it operates. Eliminating a slight fault often prevents a more serious one.

Troubles and their causes	Troubles and their causes
A. ENGINE CANNOT BE CRANKED 1. Loose or broken wire. 2. Battery discharged. This may be due to a slackened or broken alternator belt. 3. Starter defective. B. ENGINE FAILS TO START 1. Fuel tank empty. Fill the tank and bleed the fuel system. 2. Fuel not fluid enough in cold weather (summer quality). 3. Air in injection pump, pipes or injectors. 4. Leak in fuel inlet or delivery pipe. 5. Clogged fuel filter or pipe. 6. Faulty injectors¹. 7. Feed pump inoperative¹. 8. Retarded injection timing. 9. Low compression¹. a) leaky valves b) piston rings sticking c) cylinder head gasket damaged d) broken valve spring 10. Cold start device defective. 11. Leak-off valve defective. 12. Stop lever not in drive position. 13. Faulty stop solenoid. C. ENGINE STARTS BUT STOPS AFTER A SHORT WHILE 1. Air in injection pump, pipes or injectors. 2. Fuel strainer in fuel tank air pipe clogged. 3. Clogged fuel filter or pipe. 4. Clogged water separator. 5. Feed pump defective¹. 6. Faulty stop solenoid.	D. ENGINE DOES NOT RUN SMOOTHLY 1. Air in injection pump, pipes or injectors. 2. Clogged fuel filter or pipe. 3. Leak in fuel inlet or delivery pipe. 4. Injectors defective¹. 5. Low compression (see B 9 a–d)¹. 6. Feed pump defective¹. 7. Injection pump or governor defective¹. E. ENGINE DOES NOT DEVELOP FULL POWER 1. Air filter clogged. 2. Speed control linkage incorrectly adjusted. Loose linkage. 3. Air in fuel system. 4. Clogged fuel filter, prefilter, water separator or fuel pipe. 5. Injectors defective¹. 6. Leak in fuel inlet or delivery pipe. 7. Incorrect injection timing. 8. Feed pump defective¹. 9. Low compression (see B 9 a–d)¹. 10. Injection pump or governor defective¹. 11. Turbocharger defective¹ (turbocharged engine). 12. Leak-off valve defective. 13. Stop lever not properly in drive position. F. ENGINE KNOCKING 1. Incorrect fuel. 2. Injectors defective¹. 3. Advanced injection timing. 4. Low compression (see B 9 a–d)¹. 5. Excessive bearing clearance¹. ¹) Consult an expert technician

Troubles and their causes	Troubles and their causes
G. SMOKE OR SOOT IN EXHAUST GASES 1. Engine running too cold. 2. Engine has been idling for too long. 3. Air filter clogged. 4. Incorrect fuel. 5. Engine oil level too high. 6. Leak in fuel pipes. 7. Clogged fuel filter, water separator or fuel pipe. 8. Injectors defective¹. 9. Incorrect injection timing. 10. Low compression (see B 9 a–d)¹. 11. Injection pump or governor defective¹. 12. Turbocharger defective¹. H. ENGINE OVERHEATS 1. Slack or broken fan belt. 2. Cooling system not completely filled. System clogged. 3. Thermostat defective or removed (double–acting thermostat). 4. Thermostat upside down. 5. Radiator filler cap not pressure tight. 6. Overloading.	I. ENGINE TENDS TO RACE OR FAILS TO MAINTAIN ITS STANDARD SPEED 1. Governor defective¹. J. OIL PRESSURE TOO LOW 1. Engine has run short of oil. 2. Impurities in control valve. 3. Incorrect SAE grade of oil. 4. Oil too hot. 5. Excessive bearing clearance¹. 6. Idling speed too low. 7. Sensor for oil pressure gauge or indicator lamp defective. 8. Oil pressure gauge shows incorrect reading. 9. Oil filter clogged. 10. Oil diluted by fuel. ¹) Consult an expert technician

STORING THE ENGINE

If the engine is to be stored for the winter period or is left unused for a long time, take the following measures:

1. Clean the engine externally.
2. Clean the fuel tank and water separator.
3. Replace the fuel filter and prefilter (Stanadyne).
4. Replace (or clean) the air filter.
5. Add about **5 ltr** of fuel into the fuel tank and bleed the fuel system.
6. Run the engine until it reaches its normal running temperature.
7. Replace the oil filter.
8. Change the engine oil.
9. Ensure that coolant–antifreeze mixture is strong enough (add antifreeze, if necessary). Drain the raw water (= sea water) cooling system in marine engines as described earlier.
10. Remove the injectors and check their condition.
11. Pour equal quantities of pure engine oil into the cylinders through the injector holes (use about **0,05 ltr** for each cylinder) and crank the engine a few revolutions with the stop lever engaged. The oil will now spread on the cylinder walls.
12. Attach the injectors again. Fit new seal rings.
13. Disconnect the battery and ensure that it gets proper attention (storage).
14. Clean the cable lugs and coat the exposed surfaces with protective oil (with CRC or with grease).
15. Remove the v–belts and apply grease to the pulleys and other engine parts which might rust.
16. Protect the air cleaner and exhaust pipe openings as well as the electrical equipment and the instrument panel with plastic.
17. Fill the fuel tank with gas oil.

AFTER–STORAGE ATTENTION

1. Clean the engine to remove protective grease.
2. Remove the plastic covers.
3. Carefully turn the fan back and forth to release the coolant pump seal (if stuck).
4. Fit the v–belts and adjust their tension.
5. Check the coolant level.
6. Remove the rocker cover and lubricate the valve mechanism with engine oil.
7. Check the engine oil level.
8. Open slightly the draining plug of the fuel tank and drain condensed water if present.
9. Bleed the fuel system.
10. Check all electrical wires and make any necessary repairs. Clean the terminals.
11. Pour about **0,2 ltr** of pure engine oil into the turbocharger bearing housing (turbocharged engines).
12. Connect the battery, fully charged, in place.
13. Start the engine.
14. Watch the oil pressure and alternator warning lights.
15. Check for any coolant, oil or fuel leaks and make repairs as necessary.