

6. Test run, adjustments, checks

1. TEST RUN

The engine is now completely reassembled. Install engine on test bench and carry out test run. The engine does not require a long time running-in program. After a short run according to low specifications the engine is ready for normal operation.

Also the use of special break-in oils or lub. Oil additives are not recommended.

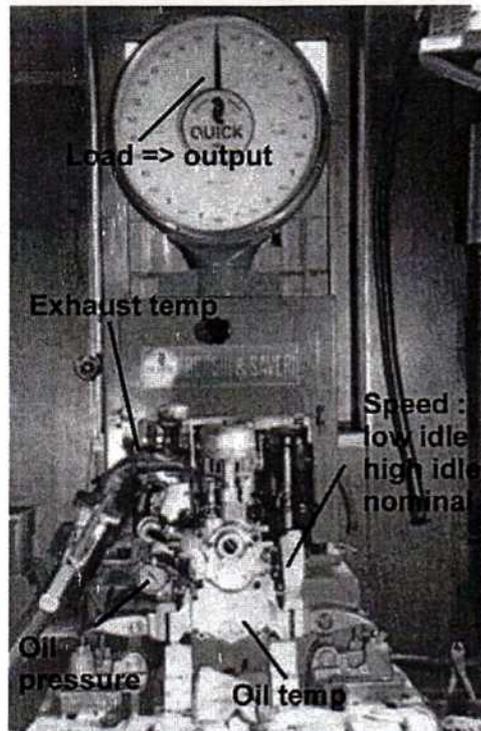


Note

Running-in instruction :

- => 5 min idle speed, no load
- => 10 min half speed, half load
- => 20 min full speed, nominal load => output setting !
- => 2 min idle speed for cooling down

During test run check for proper function, unusual noise and leakages.



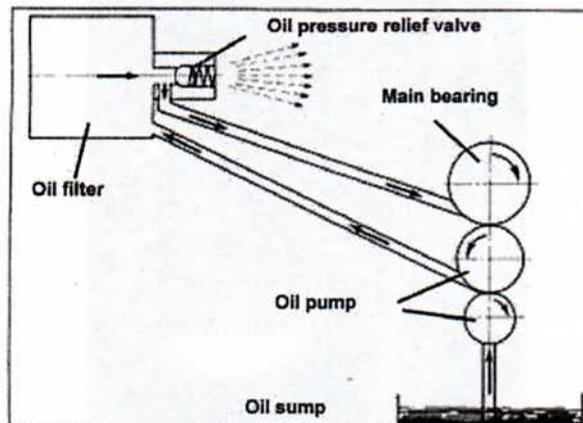
2. Lubrication system, basic info

32W – engines:

A gear pump sucks the oil from the sump and conveys the oil through the oilfilter to the main bearing and conrod bearing. Piston, piston pin, cylinder liner and rocker arms are splash lubricated. Max.oil pressure (4,5 bar) is controlled by a relief valve (mounting support of the oilfilter).

15 / 18W – engines, differences:

Oil strainer instead of oil filter. Oil pump with integrated pressure relief system.



Note

All engines require heavy duty lub oils of at least CC, preferably CD quality. (API classification). For correct viscosity and oil change intervalls refer to **Operating Manual !**

3. Oil pressure check

The oil pressure depends mostly on the wearing conditions of the bearings. Before checking the oil pressure make sure that the oil level is topped and oil with correct viscosity is used.

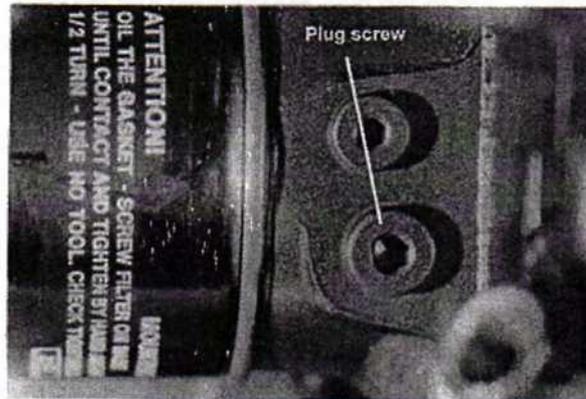
Remove the oil channel plug screw and connect oil pressure gauge with adaptor.

Oil pressure values, hot engine):

Idle speed => min press. 0,5 bar (7 PSI)

Nominal speed => min press. 1,8 bar (23 PSI)

If oil pressure is too low first check the pressure relief valve before starting further dismantling of the engine.



15/18W – engines :

Plug screw located on crankcase side.

4. Fuel system, basic

The fuel flows from the (ext.) tank through the fuel feed pump (option), fuel filter to the injection pump. Higher supplied quantity will flow back via return line. Returning fuel carries heat away from the system.

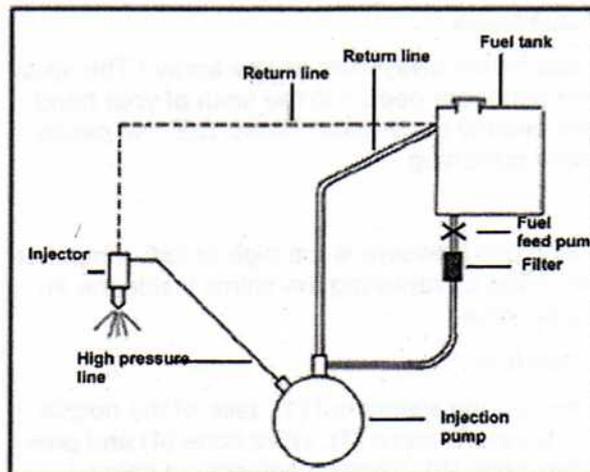
Returning fuel also ensures a constant bleed in the fuel system.

From the injection pump fuel is fed through the high pressure line to the injector. Higher supply will be carried back through the return line.

Injector pressure settings:

15/18W – engines : 200 bar

32W – engines : 175 bar



5. Fuel filter

The fuel filter prevents the entry of dirt into the injection pump. The normal lifespan of a fuel filter is approx. 1000 operating hours, however it depends on the purity of the fuel used.

Prior to changing fuel filter, clean the fuel lines from dirt with a rag. Close off the line between filter and tank with a clamp.

Pull the inlet and outlet line from the filter. Discard the used filter ! Don't try to clean it !

Reassemble and check correct connection.



Watch out for the correct direction of flow (signed on filter Housing).

6. Fuel injector, injector nozzle

The injector nozzle injects the fuel in a fine mist and under a high pressure into the combustion space. Due to the high mechanical and thermal stress, the nozzle requires regular maintenance.

Carbon residues on the nozzle tip are removed with a brass wire brush.

The spray holes can be cleaned with a special needle (Bosch tool).



To check the injection pressure, connect the complete injector to a nozzle tester. Follow operating instructions. The fuel must be ejected evenly atomized without dripping at the specified pressure.



Keep hands away from nozzle spray ! The spray can penetrate deep into the flesh of your hand and destroy the tissues. Diesel fuel can cause blood poisoning.

If injection pressure is too high or low, it must be corrected by replacing the shims inside the injector valve.

Procedure :

Unscrew the sleeve nut (1), take off the nozzle (2), pressure piece (3), valve cone (4) and pressure spring (5). Replace adjustment shims !

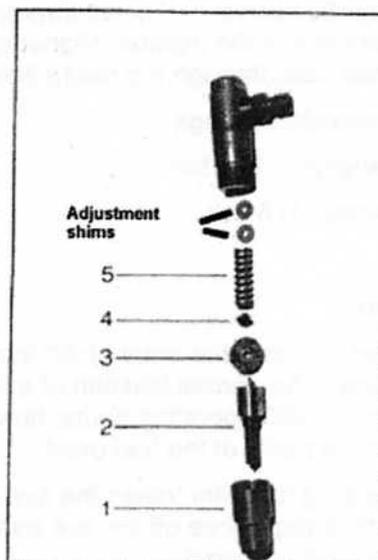
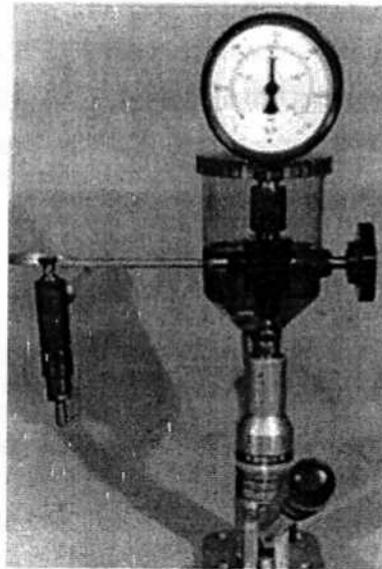
Thicker shim => higher pressure

Thinner shim => lower pressure

An alteration of 0.1 mm (0.004") will bring a change of approx. 10 bar (145 PSI).

When reassembling take care that the pins on the pressure piece are correctly located in nozzle body and nozzle holder. If the nozzle leaks, dribbs or does not atomize properly, change the complete nozzle.

All kinds of repair are not recommended.



7. Excess starting fuel button

For ease of starting all engines are fitted with an excess starting pull button.

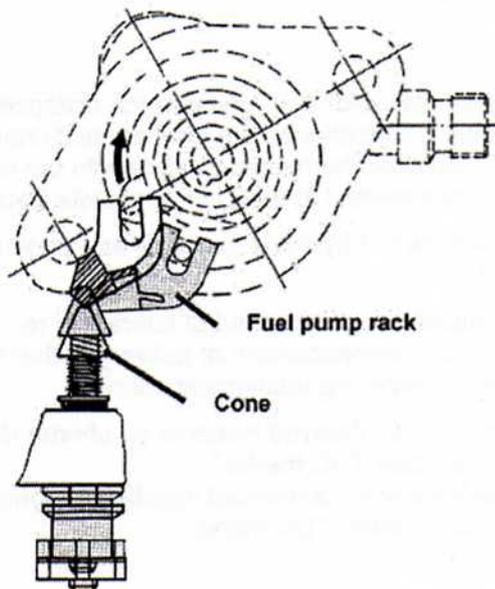
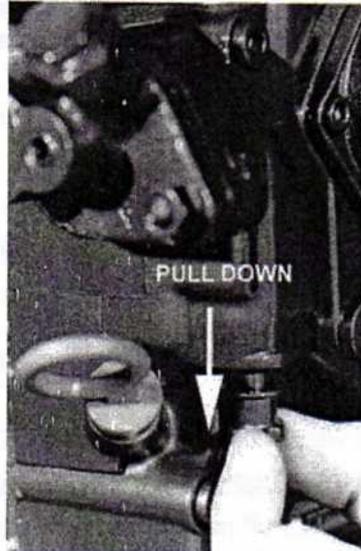
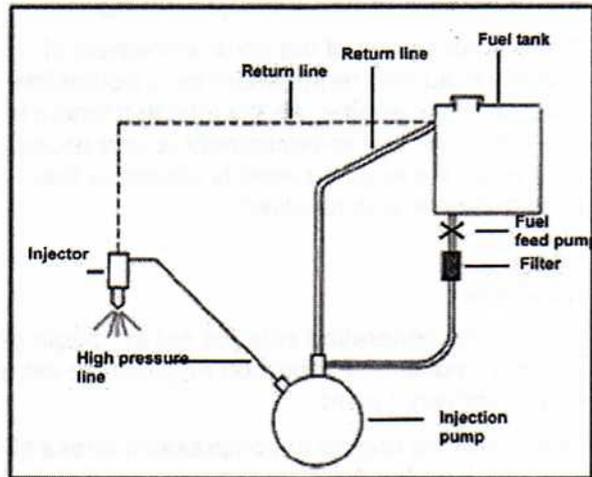
A cone limits the travel of the fuel rack. When the starting fuel button is pulled down prior to start, the cone allows the fuel rack to travel to a higher fuel quantity position.

As soon as the engine reaches its high idle speed the governor moves the fuel rack towards stop, the starting fuel button disengages and returns to its normal operating position.

Therefore it is necessary to start the engine without load in order to reach max rpm. Otherwise the starting fuel button will not disengage and continuously overload the engine.

Also the engine output is adjusted via the cone of the starting fuel button. Depending on the installation depth of the cone the fuel rack travel is shorter (= less output) or longer (= higher output). This output adjustment is done on the factory's test-bench. Under no circumstance—this setting should be altered.

If the excess fuel button or the complete gear cover was renewed, the engine output must be re-adjusted on a test bench.



8. Adjustment of fuel injection timing

The correct setting of the commencement of delivery is a basic requirement for a troublefree function of the engine. As the injection timing is fixed, a check and re-adjustment is only necessary when the engine speed is altered or the camshaft gear was renewed.



Note

Engines for generating sets are set at "begin of delivery" point. Propulsion engines are set at end of delivery "point" !

First crank the engine to compression stroke till TDC mark on the flywheel is approx. at 5 o'clock position. Close fuel supply line. Remove the allen head screw from injection pump head and the copper washer inside. Fit drip tube (=> tools).

Set the acceleration lever at max speed.



Attention

Excess starting fuel button must not be pulled !

Open fuel supply line. Slowly crank the engine rotationwise and observe the drip tube. First the fuel flows free => drips => stops => drips and flows again.

Last drips before stop : begin of delivery point !

First drips after stop : end of delivery point !

The delivery cut-off point is correct when approx. 1 drop per second comes out of the tube.

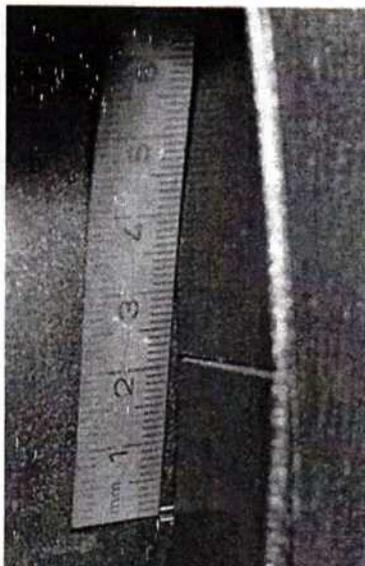
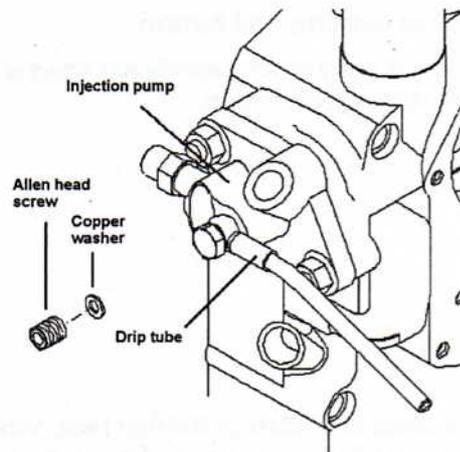
Use a flexible ruler and measure the distance between TDC marks on the flywheel and crankcase. Compare the measured data with the values recommended at the Technical Data Table.

Observe correct flywheel diameter and engine speed !

If the measured value is out of tolerance, re-adjust the commencement of delivery, either by adding or removing adjustment shims.

Adding shims : delayed injection => shorter distance between TDC marks !

Removing shims : advanced injection => longer distance between TDC marks !



TEST RUN, ADJUSTMENTS

If shims have been added or removed the installation depth must be checked.

Measure distance from the mounting flange down to the edge inside the roller tappet. This value plus the thickness of the installed adjustment shims should be between 57,5 mm (2.263") and 59,1 mm (2.327") !

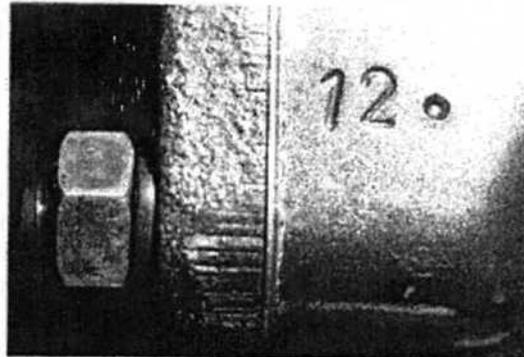
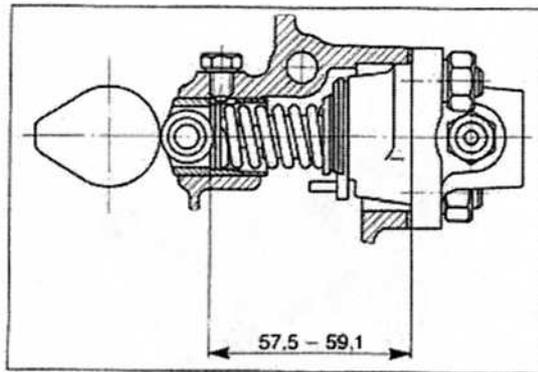
If it is not possible to set the correct injection timing via adjustment shims, then most probably the alignment of the camshaft gear is not correct. Or TDC marks is wrong.



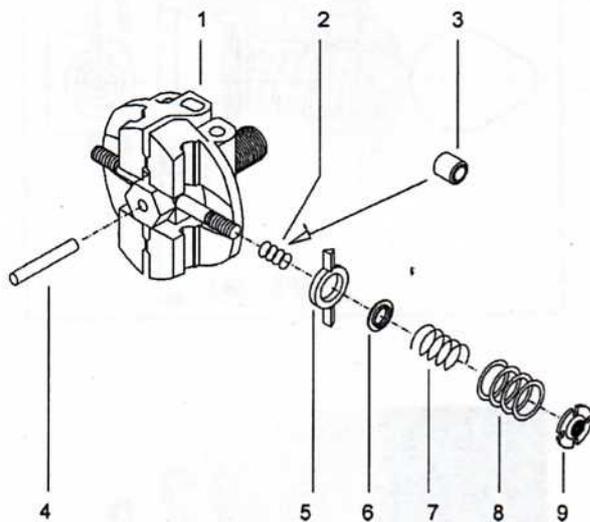
Attention

The thickness of the adjustment shims is stamped on the mounting flange of the injection pump. Example : "12" => 1,2 mm !

This value, however, refers only to the originally fitted pump. When a pump has been changed or the injection timing was altered, the new corrected Thickness should be stamped on !



TEST RUN, ADJUSTMENTS



9. Governor

1. Governor body
2. Governor spring, middle speed range in case of variable speed governor
3. Spacer, instead of item 2, end speed governor
4. Governor pin
5. Spring bridge
6. Guide bush
7. Governor spring, max speed
8. Governor spring, idle speed
9. Cross slotted nut

The purpose of the governor is to maintain the specified speed of the engine. Therefore, centrifugal and resilient spring forces are used to control the amount of fuel injected by the injection pump.

According to the application, there are several types of governor available :

1. Fixed full speed governor

Only one speed is governed. For applications such as generating sets, pumps, ...

2. Idle and full speed governor (2 stage)

Besides the full load speed the idling speed is also governed. For applications with constant speed operation and idle speed relief. Such as compressors, freezer units, ...

3. All speed governor (variable speed)

Governs the complete range of speed from idle up to full speed. For applications such as industrial engines, vehicles, propulsion, ...

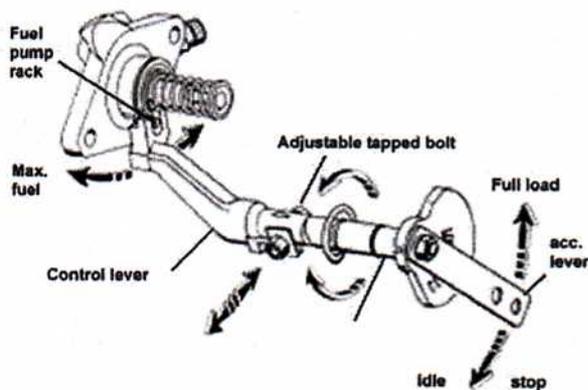
10. Construction and function of governor and control system

The governor consists mainly of two flyweights and a set of springs which counteract the centrifugal force exerted by the flyweights.

The governor is direct assembled to the crankshaft – governor speed synchron with the engine speed. The rotation drives the flyweights => governor pin is pushed via lever transmission till contacting the adjustable tappet bolt of the control lever.

Through this lever the injection pump rack is pushed towards idle / stop position. The control lever pivots on the eccentric regulation shaft.

Due to the control lever pivoting on the eccentric shaft the distance between tapped bolt and governor pin increases when the acceleration lever is moved towards full load position.



A small tension spring assembled to the lever system ensures that there is always contact between the tapped bolt and the governor pin. The fuel pump rack is controlled whenever the engine is running.

More fuel means higher speed, i.e. the governor pin is being pushed out further and pressed against the tapped bolt, resulting in a movement of the control lever / fuel pump rack towards the idle position. Less fuel is injected and the speed drops governor pin moves back and the complete governing loop starts again.

11. Governor setting

Each time the governor has been repaired and / or the gear cover or speed control assy removed and reassembled, the governor must be reset.

Procedure :

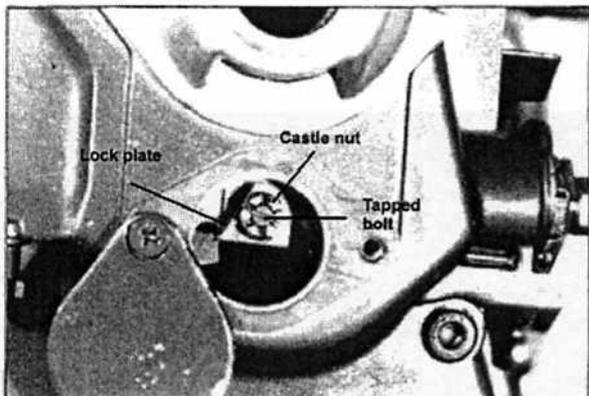
Remove the governor cover plate on the gear housing. Crank the engine until the slot between the governor flyweights is in vertical position. Move the acceleration lever to full speed position. Bend up the lock plate and unscrew the castle nut by holding the tapped bolt with a screwdriver.

Screw out tapped bolt till tapped rests on control lever. Insert a middle sized screwdriver inside the flyweight slot. Impress the flyweights to maximum opening !

Now screw in the tapped bolt until it just come in contact with the governor pin => No play to be felt when pushing onto the control lever with your fingers. Release the flyweights and screw in the tapped bolt 1/2 a turn further.

Maintain the tapped bolt in this position and tighten the castle nut, bend the lock plate and reassemble the cover plate.

The correct setting of the clearance between tapped bolt and governor pin is essential for the proper function of the engine. If the clearance is too wide the engine can overspeed, is it too small the engine will not reach ist full speed / output.



12. Speed setting

To increase speed tighten the cross slotted nut on the governor shaft. (turn clockwise)..... To reduce speed loosen the slotted nut (turn anti-clockwise).

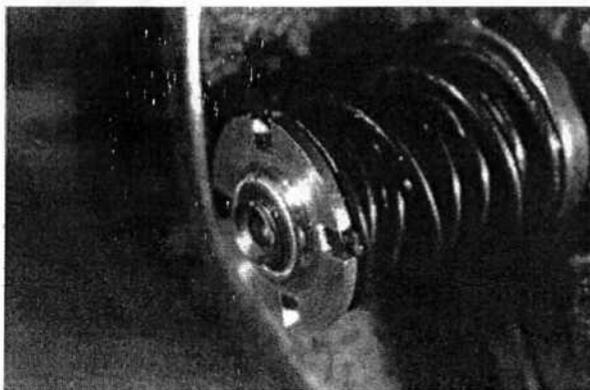
Procedure :

For correct speed setting the use of the governor adjustment tool is recommended ! Don't use other tools (screwdriver, i.e.) not to bend the governor shaft. In all cases the slotted nuts on both sides of the governor weights have to be resetted.

Remove fuel injection pump and fuel lines if necessary. Turn flywheel that the slotted nut is in front of the inj. pump bore. Insert the governor tool and correct speed as required.

$\frac{1}{4}$ of a turn => speed variation of 20 rpm !
Max possible speed variation approx. 100 rpm.

For larger speed change the governor springs must be replaced. Replace the cross slotted nuts whenever a nut has been unscrewed. Every change in speed setting should be controlled on a test bench or – at least – with a revolution counter.



Attention

The cross slotted nut must be at least flat with the end of the governor shaft. Otherwise the self securing effect of the nut is not working. Normally the shaft should protrude out of the cross slotted nut.

13. Acceleration lever

The acceleration lever is fixed in its position on the eccentric shaft with a pin. The ratchet plate behind the lever is not fixed and only kept in place by the M8 – thread lock nut.

As the ratchet plate is used as a buffer for the engine shut down, the correct position between plate and lever is important. The lower edge of the lever should leave one and a half notches visible.

If more notches are visible the shut of the engine may be hammered or – in badest case – it's not possible to stop the engine with the acceleration lever. If no notch is visible, damages on the eccentric shaft and control lever may occur.

To re-locate the ratchet plate loosen the lock nut, hold acceleration lever and move the plate till correct position. Tighten the lock nut holding the acc. lever, as otherwise the regulation linkage will be bend.

