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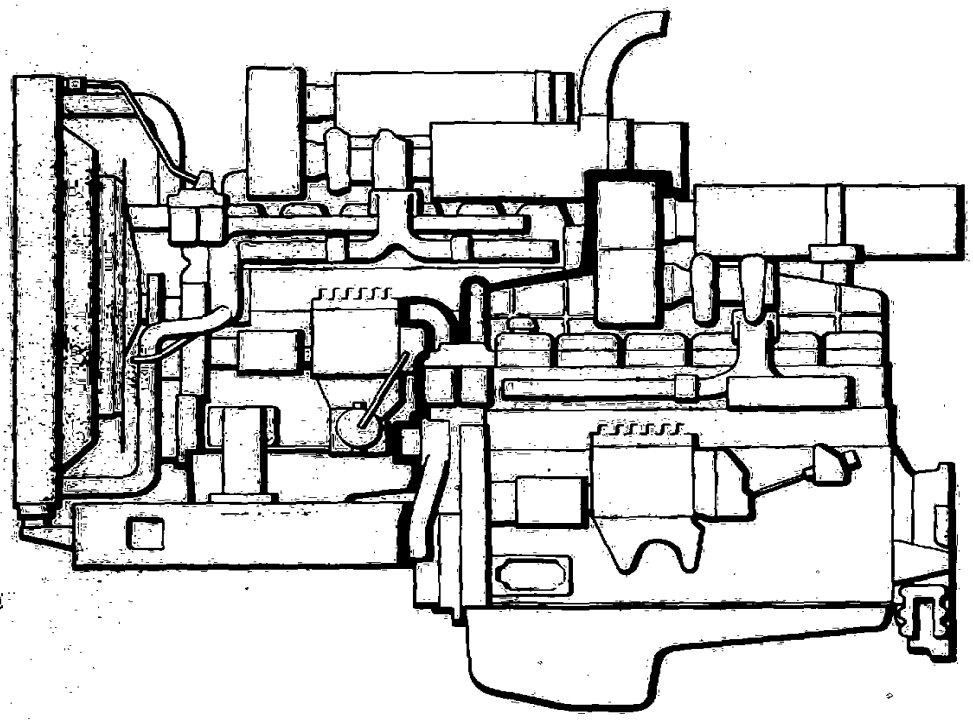
INSTRUCTION BOOK

DIESEL ENGINES

TD100G,-GG,-GP,-HP · TID100KG,-KP · TD121G,-GG,-GP · TD120HP · TID121KG,-KP · TID121LG,-LP



VOLVO PENTA

Introduction

Read this book

This instruction book provides helpful information for running and maintaining your Volvo Penta product(s).

The contents herein do not apply to any particular specification. Each engine is supplied from Volvo Penta in accordance with the order.

Check engine and components to be able to find relevant parts of this book. **Read this book carefully before taking the engine into operation.**

Warranty

A service and warranty book which states the Volvo Penta International Limited Warranty should have been provided by the selling dealer. If you have not received this publication contact the nearest Volvo Penta Importer for a copy.

Some markets provide due to local laws and regulations other warranty conditions which are issued by the local Volvo Penta importer as a supplement to the Volvo Penta warranty. Contact the local Volvo Penta importer to obtain such conditions where applicable.

For products operating in the USA special warranty conditions and documents apply. To be sure of obtaining the correct US documentation contact the local *distributor.*

Warranty Registration Card – Delivery card

The Warranty Registration Card (US markets) Delivery Card (other markets) should be filled out and sent in by the selling dealer. Ensure this has been done, as refusal of warranty can occur if no proof of delivery date can be provided.

Volvo Penta service

Volvo Penta has built up an extensive dealer net to support you with service and parts. These dealers have the necessary special tools, test equipment and stocks of parts to provide the service. When requesting service or parts always quote the complete type and serial No. from the number plate.

Owner

Name:.....

Address: .....

Tel: .....

Nearest Volvo Penta Service Dealer

Name:.....

Address: .....

Tel: .....

Engine data

Type of engine:..... Serial No:.....

Disengageable clutch type/No:.....

Volvo Penta reserves the right to make changes without prior notice.
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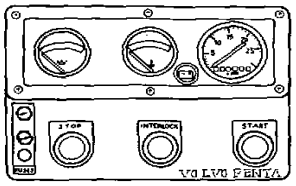
INSTRUCTION BOOK

Diesel engines

(Current for engines produced from Dec. 1987 and on)

TD100G,-GG,-GP,-HP · TID100KG,-KP · TD121G,-GG,-GP TD120HP · TID121KG,-KP · TID121LG,-LP



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CAUTION

Some engine models have no built-in key switch. A lockable space for the engine or a lockable battery switch must be used to prevent unauthorized starting. Never touch the starter button when the engine is running.

PRESENTATION

The engines are 6 cylinder, 4 stroke diesel engines. They are direct injected and have thermostat controlled water cooling. The engines have wet, replaceable cylinder liners and separate cylinder heads, one for each cylinder. The engines are lubricated by a pressure lubricating system, where an oil pump feeds the lubricating oil to all the lubricating points. On 120 and 121 models the pistons are cooled by the lubricating oil being fed through special nozzles located in the engine block.

Engines with an I in the engine designation are also equipped with an intercooler which reduces the temperature of the inlet air, making it possible to increase the engine output even more. The combustion and exhaust temperatures are also reduced. All engines are equipped with an exhaust driven turbocharger, being lubricated and cooled by the engine lubricating oil.

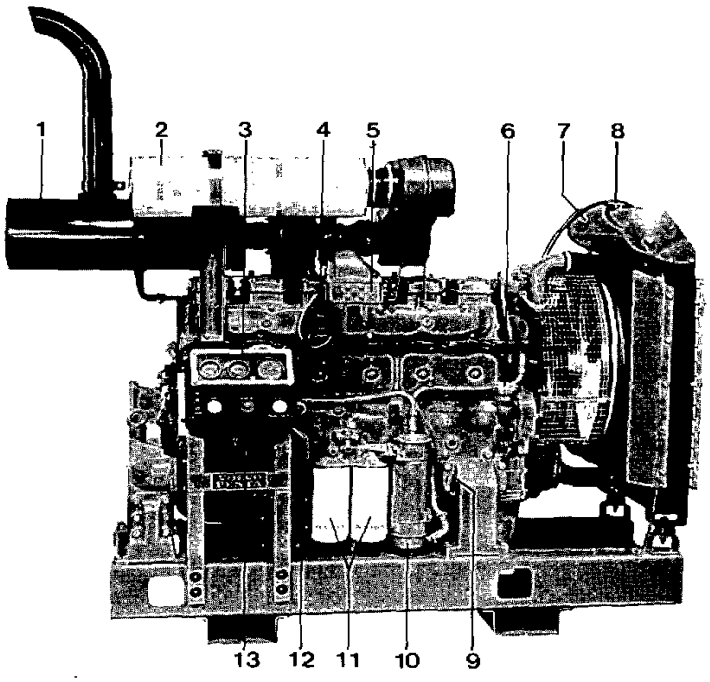


Fig. 1. TD100HP*

1. Silencer
2. Air filter
3. Instrument panel
4. Relay for preheater
5. Preheater
6. Filler, oil
7. Expansion tank
8. Filler, coolant
9. Oil dipstick
10. Oil cooler
11. Oil filter
12. Pipe for crankcase ventilation
13. Starter motor

* The letter P denotes an engine of so called "Power Pack" verssion.

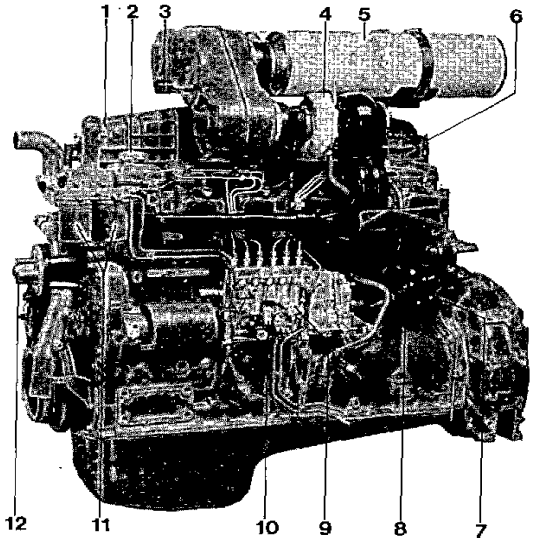
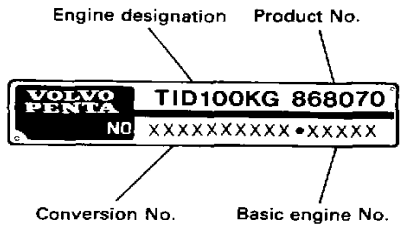


Fig. 2. TID100KG*

1. Intercooler
2. Filler, oil
3. Pressure drop indicator
4. Turbocharger
5. Air filter
6. Venting cock, coolant
7. Drain dock
8. Stop solenoid
9. Injection pump
10. Feed pump
11. Fuel filter
12. Fan hub

* The letter G denotes an engine intended for genset-operation.

Location of number plate: On the left hand side of the engine block, rear part.



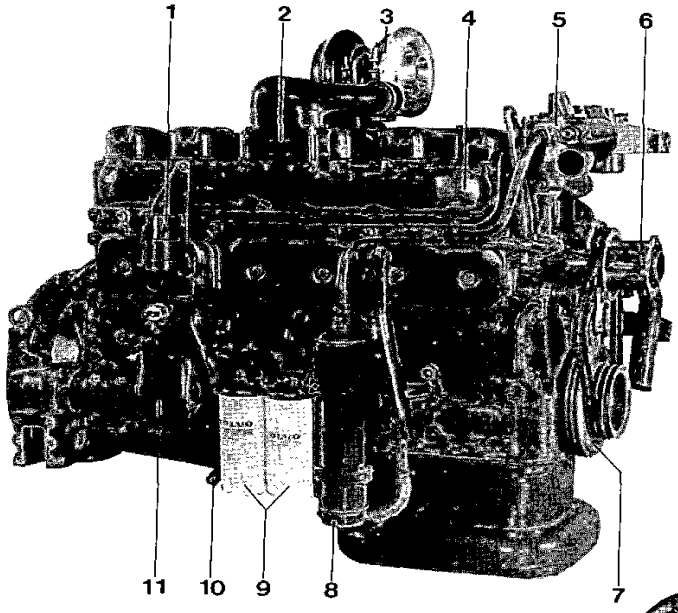


Fig. 3. TD121G

1. Relay for preheater
2. Preheater
3. Turbocharger
4. Inlet manifold
5. Thermostat housing
6. Fan hub
7. Vibration damper
8. Oil cooler
9. Oil filter
10. Pipe for crankcase ventilation
11. Starter motor

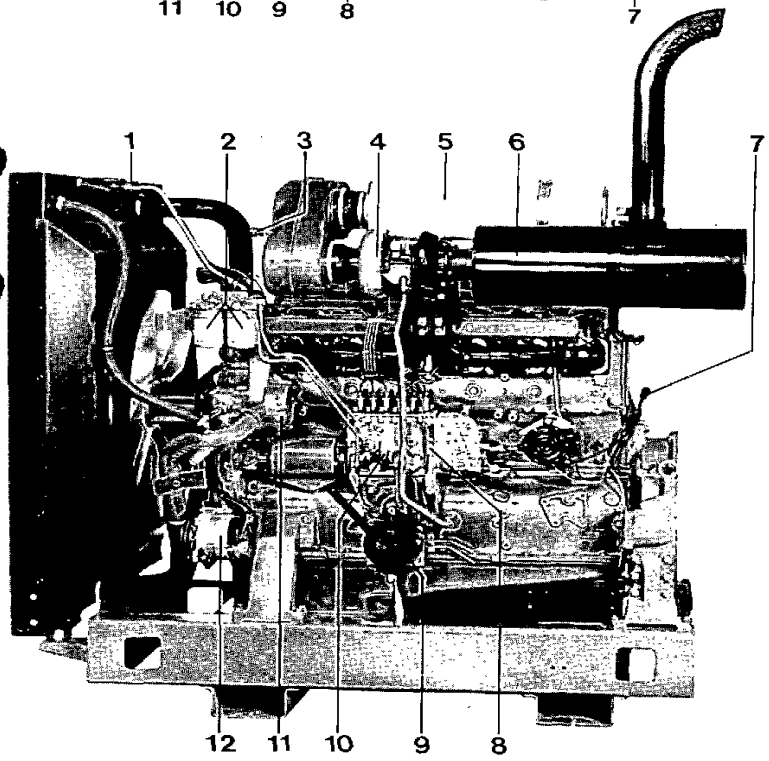
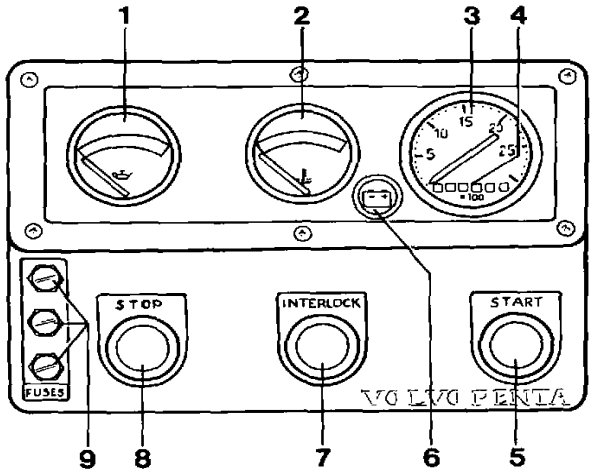


Fig. 4. TID121LP*

1. Filler, coolant
2. Fuel filter
3. Pressure drop indicator
4. Turbocharger
5. Air filter
6. Silencer
7. Speed control
8. Injection pump
9. Oil scavenging pump
10. Feed pump
11. Coolant pump
12. Alternator

* The letter P denotes an engine of so called "Power Pack" version.



Instrument panel

Instruments

The instruments for supervision of the oil pressure, coolant temperature, engine speed, operation time and the start and stop controls are located in the instrument panel.

1. Oil pressure, normally 3–5 kp/cm² (300–500 kPa (43.5–72.5 psi), green sector (when idling 1.5 kp/cm² (150 kPa/21 psi).
2. Coolant temperature, normally 75–95°C (167–203°F) (green sector) during running.
3. Rev. counter, engine speed. Multiply the reading by 100 to get revs per minute.
4. Hour counter, housed in the rev counter.
5. Start button. (Must never be touched when engine is running).
6. Indicator lamp for the battery..The battery is not charged, when the lamp is lit.
7. Interlock. The automatic stop is disengaged when this button is pressed. **When starting, this button must be depressed until a stable oil pressure is obtained.** The same button also engages the pre-heater.
8. Stop button. When this is pressed the pump is set to zero feed via the stop solenoid and the engine stops.
9. Automatic fuses (press to re-set if they have released). The fault must be remedied if the fuse releases again.

Quality requirements

Fuel – lubricants – coolant

Diesel fuel satisfying the demands according to DIN 51601, CEC-ERF-D1, ASTM-D975-No 2-D or the Volvo Group Standard 97863-02 should be used. Always try to use a fuel with the lowest possible sulphur content.

Note. The sulphur content of the fuel effects the oil change intervals, see page 9.

During wintertime special fuels, recommended by well-known oil companies should be used.

Lubricating oil with quality according to the below table must be used.

Designation	Standard
CD*	API (American Petroleum Institute)
MIL-L-2104C	US Government's Military Spec.

* In case extended oil change intervals are to be followed a VDS approved CD oil must be used. See Maintenance Scheme on page 9.
Note! VDS: Volvo Drain Specification.

Lubricating grease – a lithium based grease must be used as lubricating grease for the disengageable clutch. Volvo Penta Special Grease or Shell Alvania 2, Mobilith 22, ESSO ROMEX MP.

Coolant – risk of freezing: use 50 % Volvo Penta anti-freeze and 50 % water. This mixture can be used all year round. When there is no risk of freezing, water mixed with the **Volvo Penta anti-corrosion additive 1141526-2** can be used. Mixing ratio 1:30. Never mix anti-corrosion additive with anti-freeze liquid. Foam can be formed which reduces the cooling capacity. Top up with a can (1/2 litre) every 400th hour of operation.

The cooling water should be changed and the cooling system flushed clean once every year.

RUNNING

Running in

When the engine is new, it should be run in normale use, but not at full load for more than short periods during the first 10 hours. Always awoid unnecessary running on idling speed. Check the instrument often during this period in order to discover any abnormal conditions in time.

NOTE! The valve clearance on a new or re-conditioned engine should be checked for the first time after 100–200 hours of operation.

Any disengageable clutch should be specially checked during the first days of operation. Adjustment of the clutch may prove necessary to compensate for the wearing-in of the discs. See point 4, page 9 (800 hours).

Before starting

1. Before starting, check:

   A. **Lubricating oil level.**
   Check during running.
   Read off the dipstick at the side marked, "OPERATING".
   Check with engine turned off.
   Read off the dipstick at the side marked "STOP" when the engine has been stopped for at least 3–4 minutes.
   The level should be between the "Min" and "Max" marks on the oil dipstick. Do not run at too low level. The engine can seize which leads to expensive repairs. Do not fill over the "Max" level either.

   When gearbox or suchlike is installed, the level must also be checked for this equipment.

   B. **Coolant level.** The level must be approx. 5 cm (2") below the cap's sealing surface, or between the MIN and MAX marks of the expansion tank.

   ⚠ NOTE! If the engine is hot, open the cap carefully. Hot water or steam may spray out and cause burns.

   C. **Air filter indicator.** If the air filter indicator shows a completely red "window" the filters must be replaced. Re-set the indicator after replacement.

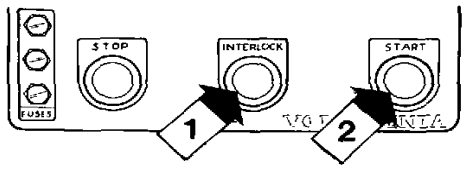
   D. **Fuel quantity.** Fill up with fuel, if necessary. Never let the engine stop due to lack of fuel. If this happens, the system must be vented to be able to start again.

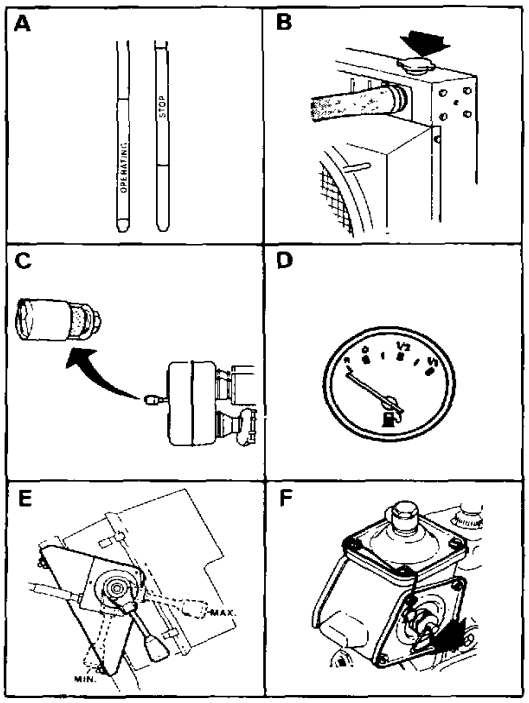
2. Switch on the main switch.
3. Release any clutch and set the speed control to approx. half throttle (E) (does not apply to engines with fixed speed).
4. **Engines with smoke limiter**: Engage the cold starting device (F) if the engine is cold and the temperature below +5°C (+41°F). Engage the cold starting device by **pulling the shaft** (fitted with an eyelet).
5. Check the alarm equipment, if fitted.

Starting

1. Press the button "Interlock" and hold it for approx. 50 secs (this applies for a **cold engines** as the pre-heating is engaged with the same button as the interlocking).
2. Hold the button "Interlock" depressed. At the same time press the "Start" button for max. 40 secs.
3. Release the start button when the engine has started. The button "Interlock" must be depressed until the oil pressure is stable, otherwise the engine will stop automatically. In case of severe cold, the button for pre-heating i.e. "Interlock" can be pressed for a few minutes after start.
   Do not race the engine! 1300–1500 rpm is recommended until the engine starts getting warm. Do not run the engine at critically low revs either. This applies especially when the engine is connected to equipment with large inertia.
4. Connect any disengageable clutch at max. 800 rpm.

⚠ **Warning!** Never use start spray or suchlike to facilitate starting. There can be an explosion in the inlet manifold, resulting in bodily injury. Never touch the start button when the engine is running.

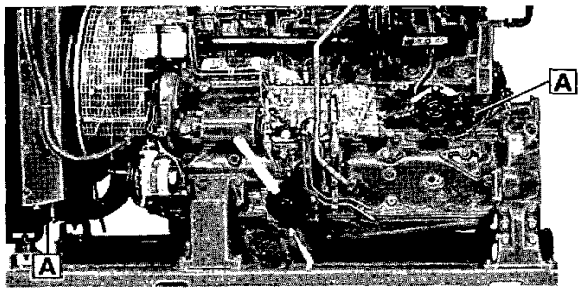




During running

Check that the instruments show normal readings. The engine **must never be run** with too low oil pressure or with *a high coolant temperature.*

NOTE! The lubricating oil level must be checked at least **every 8th hour** for engines in continuous operation.



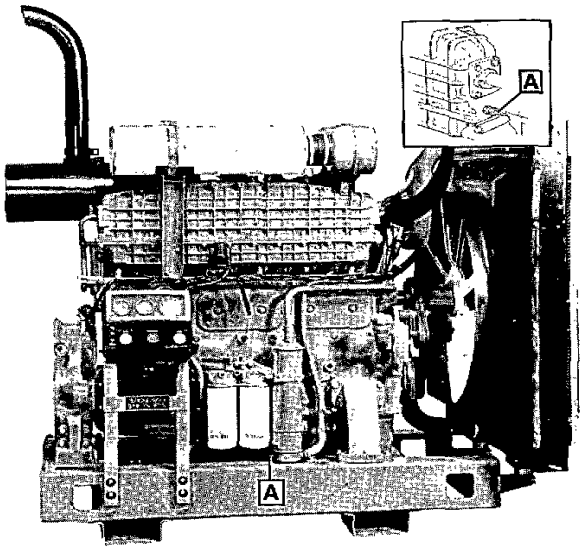
A = Drain cock/plug for coolant on the engine block and under the radiator

Stopping

1. **Always let the engine run without load for a few minutes before stopping to even out the temperatures.**

   Harmful "afterboiling" is then avoided and at the same time the turbo is allowed to cool down a little which contrubutes to a long and troublefree running.
2. Disengage the engine, if possible.
3. Press the stop button and hold it until the engine has stopped.

   If the engine is out of operation for several days, the main switch should be disconnected. **The main switch must never be switched off while the engine is running.** The charging regulator can be damaged.
4. **In case of severe cold** – set the throttle control to max. position after the engine has stopped. This can facilitate the next start as it is easier to push the control rod to cold start position while the engine is warm. (Does not apply to engines with set engine speed).



A = Drain plug for coolant on oil cooler (can also be located underneath the oil cooler). Drain cock for coolant on the intercooler.

Precautions against freezing

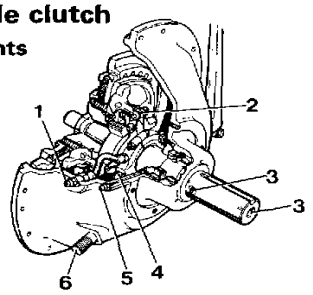
Check in good time that the coolant has sufficient anti-freezing properties. As a rule the coolant should contain 50 % water and 50 % Volvo Penta anti-freeze, which will protect against freezing down to approx. –40°C (–40°F). The freezing point can be lowered to max. –56°F (–69°F) (60 % anti-freeze). **No kind of spirit is allowed to be used in the cooling system.**

Draining the cooling system

Before draining the engine must be stopped and the filler cap removed. Then open the drain cocks on the engine and radiator, see figure. Do not forget the drain plug under the oil cooler. Check the installation to find if there are any additional cocks on pipes to heaters, etc. Make sure that all *the coolant drains off to avoid freezing damage in case* water only has been used in the system.

Disengageable clutch

Lubrication points



1. Release bearing, grease nipple
2. *Link*
3. Alternative locations of grease nipple for inner support bearing. Later versions might have "greased for life" bearings, in which case there is no nipple.
4. *Yoke end*
5. Main bearings, grease nipple
7. Cross shaft

TAKING THE ENGINE OUT OF SERVICE

Inhibiting an engine out of service

Out of service for a period up to two months

Should the out of service period not exceed 2 months it is sufficient to start the engine and run it warm approx. every 14th day.

If there is a risk of freezing the anti-freezing properties of the coolant should be checked to avoid damage.

Out of service period exceeding two months

If the out of service period should extend up to 8 months there is no need for any special inhibiting oil. Volvo Penta engine lubricating oil include sufficient anti-corrosion additives for this period. Change the engine oil and replace the oil filter before the engine is taken out of service. Check that the coolant has adequate protection against freezing.

If inhibiting is intended for a longer period, special inhibiting oil, as sold by the oil companies, should be used.

Attach a notice on the engine stating date of inhibiting, type of oil and method of inhibiting.

If necessary, place covers over the air intake, exhaust manifold and engine.

Recommissioning

1. Remove any covers from the engine, air intake and exhaust manifold.
2. Wash off any external preservative fluid with white spirit.
3. Close the drain cocks and fill the cooling system if the cooling system has been drained.
4. Fill the engine with the correct grade of lubricating oil if necessary. Fit new oil filters, if they were not changed in connection with the change of oil to Volvo Penta lubricating oil, when inhibiting. Check the oil level in the gear or clutch.
5. Connect the batteries.
6. Fit new fuel filters, vent the fuel system and start the engine. See under "Running". Run the engine warm at high idling before running with load.
7. Check for oil, fuel or coolant leakage.

ELECTRICAL SYSTEM

Starting using auxiliary battery

Warning!

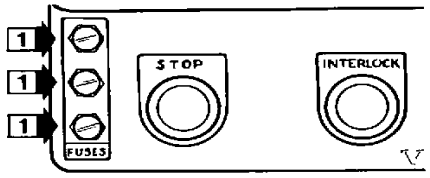
⚠ The batteries (especially the auxiliary batteries) contain oxyhydrogen gas, which is highly explosive. A spark, which can result from connecting the cables to the auxiliary battery incorrectly, is sufficient for a battery to explode and cause damage.

1. Check that the cables to the auxiliary battery are connected (either in series or in parallel) so that the rated voltage coincides with the engine's system voltage.
2. Start by connecting the red cable (+) to the auxiliary battery and then to the discharged battery. Then connect the black cable (–) to the auxiliary battery and then finally to a point **a bit away from the discharged batteries**, e.g. at the main switch on the minus cable or at the connection point of the minus cable to the starter motor.
3. Start the engine. **NOTE! Do not touch the connections during the starting attempt (risk for sparks) and do not stand bent over any of the batteries.**
4. Remove the cables in exactly the reverse order as described in point 2. **NOTE! Under no circumstances remove the ordinary battery cables from the ordinary batteries!**

Electrical welding

Disconnect the cables to the alternator and insulate the cable ends. Never connect the negative clamp to the engine, nor in such a way that current passes through any of the bearings.

Fuses

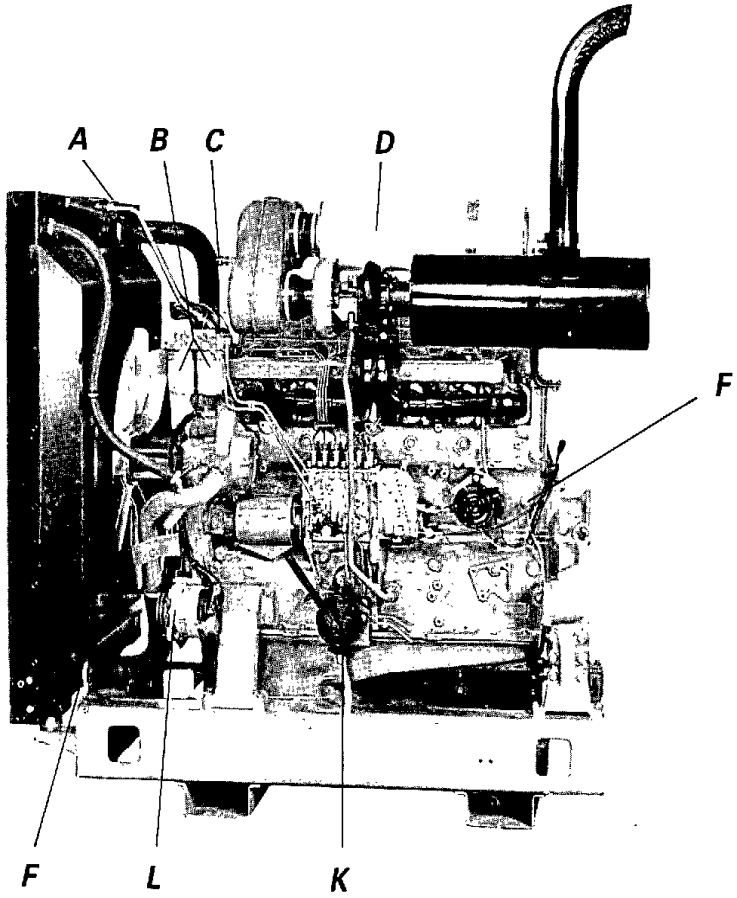


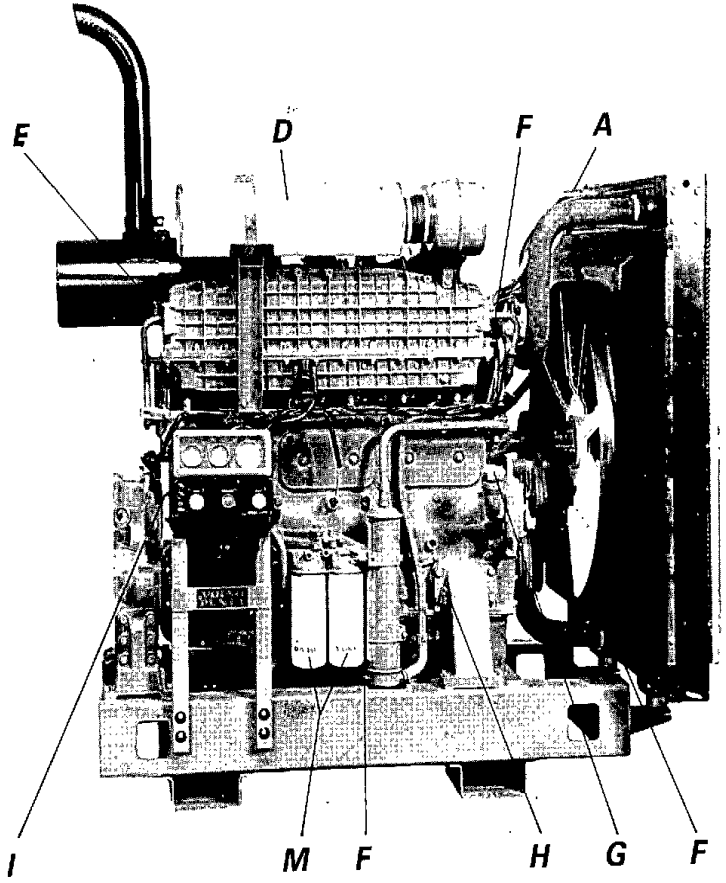
The engines are fitted with 3 automatic fuses, located in the instrument box. If a fuse releases, due to temporary overload, it is reset by pressing button (1).

If the fuse relases again, there is a fault that must be remedied.

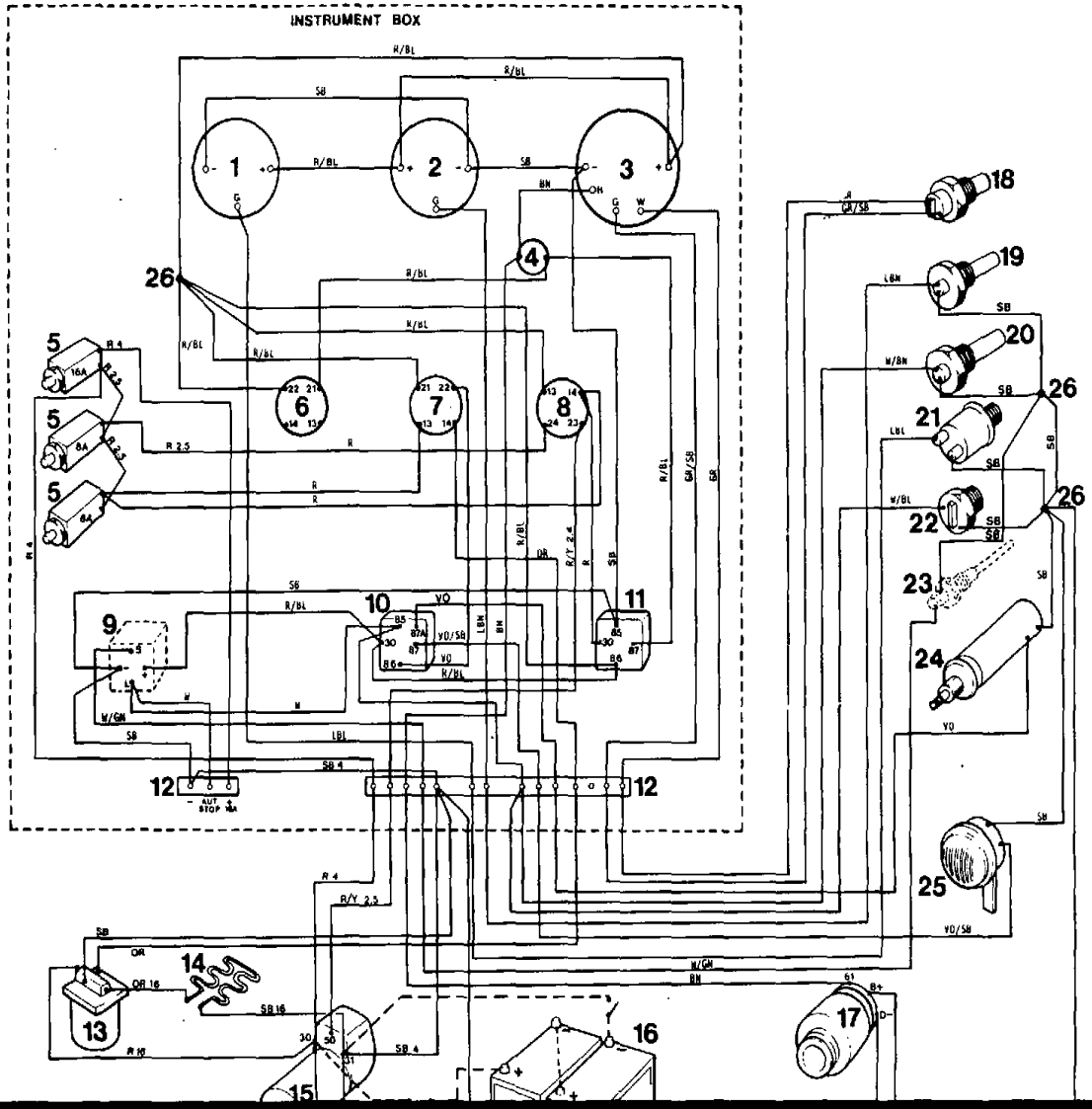
MAINTENANCE SCHEME

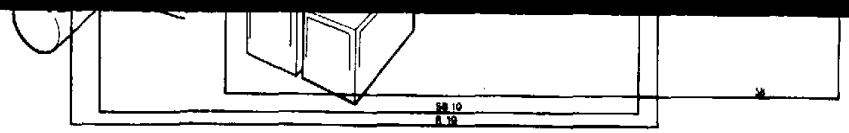
The descriptions apply in general for both 100 and 120/121 engine series

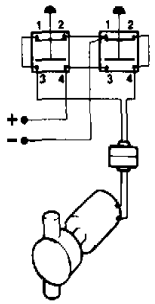




WIRING DIAGRAM







Suggested connection of the oil scavenging pump (scavenging and filling). Cable area 1.5 mm^2.

Cable colours

BL	= Blue	OR	= Orange
LBL	= Light blue	VO	= Lilac
BN	= Brown	R	= Red
LBN	= Light brown	SB	= Black
GN	= Green	W	= White
GR	= Grey	Y	= Yellow

Cable areas in mm^2 are stated after the colour code in the wiring diagram. Where no area is stated, 1.5 mm^2 applies.

Relation mm^2/AWG*

* American Wiring Gauge

mm^2	1.0	1.5	2.5	10	16
AWG	16 (17)	15 (16)	13	7	5

Wiring diagram

Instrument panel and engine

1. Oil pressure gauge
2. Coolant temperature gauge
3. Hour/rev counter
4. Warning lamp, charging
5. Automatic fuse (manuel reset)
6. Stop button
7. Interlock button
8. Start button
9. Reley for coolant level switch (optional equipm.)
10. Relay for coolant temperature switch, oil pressure switch
11. Holding current relay for operating current and instruments
12. Connection plinth (extra mains outlet, fused for 16A. Outlet for automatic stop, makes with fault).
13. Relay for pre-heater element.
14. Pre-heater element.
15. Starter motor
16. Battery
17. Alternator
18. Rev counter sender
19. Coolant temperature sender
20. Coolant temperature switch (normally open)
21. Oil pressure sender
22. Oil pressure switch (normally open)
23. Level switch, coolant (optional equipm.)
24. Stop solenoid (live during running)
25. Signal horn
26. Connection

The battery cables' area is dependent on the location of the battery.
For a cable length of max. 2 m, the area = 70 mm^2.
For cable length 4 m, the area = 120 mm^2.

TECHNICAL DATA

General

	100 series	120, 121 series
Number of cylinders	6	6
Swept volume, litres (in^3)	9.60 (585)	11.98 (731)
Low idling speed, r.p.m. approx	525	525
Valve clearance mm (") engine cold or at operating temperature,		
intake	0.40 (0.0157)	0.40 (0.0157)
outlet	0.70 (0.0275)	0.70 (0.0275)

Fuel system

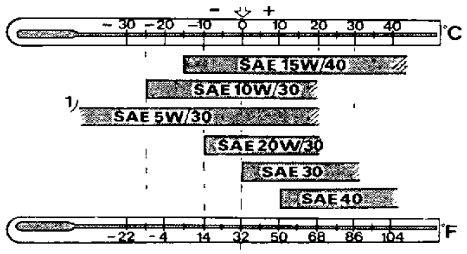
Injection pump, setting ... B.T.D.C.	TD100G,-GP,-HP TID100KP: 20° TD100GG, TID100KG: 22°	121G,-GG,-GP, 120 HP: 26° 121KG,-KP: 24° 121LG,-LP: 17°
Injection pump, stroke position ... mm (")	TD100G,-GP,-HP, TID100KP: 3.5 (+0.1) (0.1378 + 0.0039) TD100GG, TID100KG: 2.6 (+0.1) (0.1024 + 0.0039)	121G,-GG,-GP, 120HP: 2.4 (+0.1) (0.094+0.0039) 121KG,-KP: 2.6 (+0.1) (0.102+0.0039) 121LG,-LP: 3.0 (+0.1) 0.1181+0.0039)
Injectors, opening pressure ... MPa (kp/cm^2=p.s.i.)	26 (265=3768)	27 (275=3910)
setting pressure (new spring). MPa (kp/cm^2=p.s.i.)	26.5–27.7 (270–282 = 3839–4010)	27.5–28.3 (280–288 = 3981–4095)

Lubricating system

Oil pressure,		
hot engine at operational speed ... kPa (kp/cm^2=p.s.i.)	300–500 (3–5=43–71)	
hot engine at idling speed ... kPa (kp/cm^2=p.s.i.)	min 150 (1.5=21)	
Oil capacity incl. lubr. oil filter and oil cooler, appr.:		
Standard oil sump ... litres (Imp.gals/US gals)	25 (5.5/6.6)	38 (8.4/10.0)
Oil sump for large inclinations ... litres (Imp.gals/US gals)	27 (5.9/7.1)	–
Oil quality acc. to API system ...	CD *	

* See also pages 4 and 9 for extended oil change intervals.

Viscosity at different outside air temperatures ...
(The temperature values applies to constant air temperatures)



1) Synthetic or semi-synthetic oil.
NOTE! Only SAE 5W/30 must be used.

Cooling system

Coolant capacity with VP standard radiator approx ..... litres (Imp.gals/US gals)	100G,-GG,-GP,-HP: 35 (7.7/9.2) 100KG,-KP: 40 (8.8/10.6)	121G,-GG,- GP, 120HP: 50 (11.0/13.2) 121KG,-KP: 52 (11.4/13.7) 121LG,-LP: 54 (11.9/14.3)
tropical radiator approx ..... litres (Imp.gals/US gals)	100G,-GG,-GP,-HP: 50 (11.0/13.2) 100KG,-KP: 52 (11.4/13.7)	– –
Thermostats start opening at ..... °C (°F)	80–84 (176–183)	
fully open at ..... °C (°F)	93–97 (199–207)	

* All engines are fitted with a sleeve thermostat.

Electrical system

System voltage V	24	
Alternator ..... A/V	55/28 (alt 45/28)	
Battery capacity ..... Ah	143	210
Battery electrolyte density at +20°C (68°F):		
fully charged battery ..... g/cm^3	1.265–1.29	
to be re-charged at ..... g/cm^3	1.230	

Notes

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