

INSTRUCTION BOOK

Diesel Engines

TAD1030G/P, TWD1210G/P, TWD1211G/P, TAD1230G/P

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.

**AB VOLVO PENTA
Technical Information**

Owner

Name: Tel:

Address:

Nearest Volvo Penta Service Dealer

Name: Tel:

Address:

Engine data

Engine type:

Serial Nos.:

Volvo Penta reserve the right to make changes without prior notice.

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Electrical system

	TAD1030G/P	TWD1210/1211G/P	TAD1230G/P
System voltage		24 V	
A.C. alternator, voltage/max. power		28V/60A	
rated output, approx.		1700 W	
Battery capacity		2 pcs in-series 12 V, max. 152 Ah	
Battery electrolyte density at +25°C:			
fully charged battery		1.28 g/cm ³ (1.24 g/cm ³)*	
battery recharges at		1.24 g/cm ³ (1.20 g/cm ³)*	

*Note: refers to batteries with tropic acid.

Clutches

Disengageable clutches at rear of engine (accessory)

Type designation	AP D14A1	-	
Type	Twin plate clutch	-	
Ratio	1:1	-	
Size	355 mm (14")	-	
Weight, approx.	159 kg	-	
Type designation	-	AP T14A1	-
Type	-	Triple plate clutch	-
Ratio	-	1:1	-
Size	-	355 mm (14")	-
Weight, approx.	-	209 kg	-

Instruction Book

Diesel Engines

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CAUTION!

The instrument panel has no key switch. The engine room shall therefore be locked to prevent unauthorized starting of the engine. Alternatively a lockable main switch can be used.

Presentation

The engines are in-line, 6-cylinder, 4-stroke, diesel engines with direct injection. The engines are designed with oil cooled pistons and wet, replaceable cylinder liners, separate cylinder heads, one for each cylinder and exhaust driven turbo chargers.

Engine models TAD1030 and TAD1230 are equipped with an intercooler, located behind the radiator and cooled by air via a thrust type of fan. Engine models TWD1210 and TWD1211 are equipped with an intercooler, cooled by water.

The intercooler is reducing the temperature of the intake air, thus allowing a higher air volume to enter the cylinder contributing to higher output with exhaust temperatures and emissions still at appropriate levels.

The engines are provided with an electric starter element to facilitate the starting and to reduce emissions when starting in cold weather.

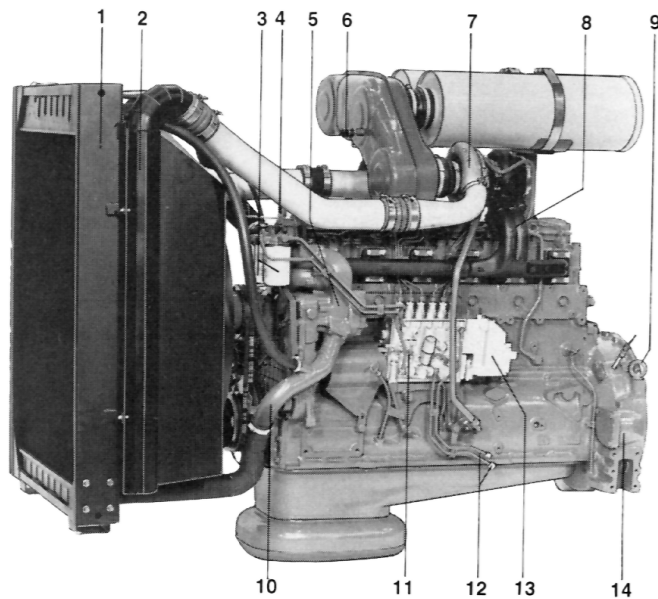


Fig. 1. TAD1030G

1. Tropical radiator
2. Intercooler
3. Fuel filters
4. Lift eyelet
5. Coolant pump
6. Pressure drop indicator for air filter
7. Turbocharger
8. Exhaust manifold
9. Lift eyelet
10. Coolant pipe, inlet
11. Injection pump
12. Fuel pipes for tank connection
13. Electronic speed governor
14. Flywheel housing

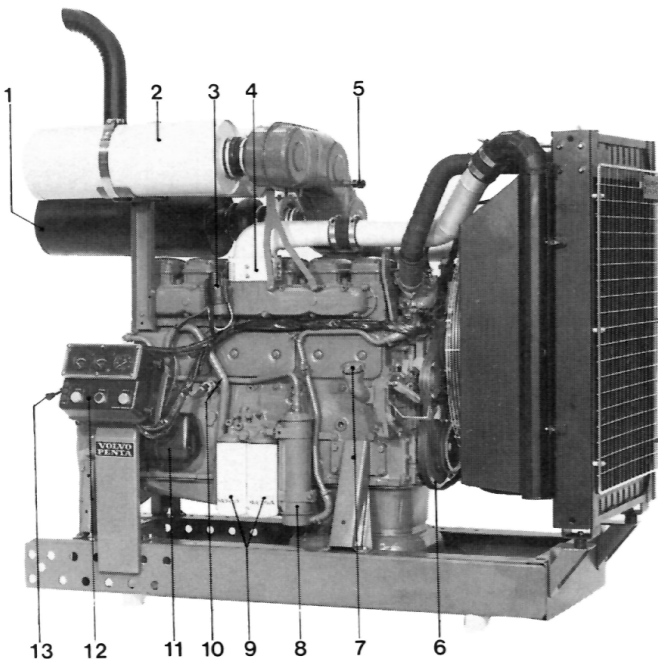


Fig. 2. TAD1030P

1. Silencer
2. Air filters
3. Relay for electric starter element
4. Starter element
5. Pressure drop indicator for air filters
6. Vibration damper
7. Filler cap for lubricating oil
8. Oil cooler
9. Lubricating oil filters
10. Pipe for crankcase ventilation
11. Starter motor
12. Instrument panel
13. Speed control

Technical data

General

Type designation	TAD1030G/P	TWD1210/1211G/P	TAD1230G/P
Number of cylinders	6	6	6
Swept volume	9.60 ltr	11.98 ltr	11.98 ltr
Low idling speed, approx.		Gen: 1300 rpm Pow: 600 rpm	
Valve clearance, engine off, cold or at operating temp.			
inlet		0.40 mm	
outlet		0.70 mm	
Weight, engine only (dry) approx.	Gen: 1107 kg Pow: 1062 kg	Gen: 1140 kg Pow: 1105 kg	Gen: 1250 kg Pow: 1215 kg

Fuel system

Injection pump, setting	Gen: 15° B.T.D.C. Pow: 15° B.T.D.C.	20° B.T.D.C. ¹⁾ 22° B.T.D.C. ²⁾	14.5° B.T.D.C. 14.5° B.T.D.C.
stroke position	3.45 (±0.05) mm	3,55 (±0.05)	4.05 (±0.05) mm
Injectors, opening pressure	25.5 MPa, (260 kp/cm ²)	27 MPa, (275 kp/cm ²)	25.5 MPa, (260 kp/cm ²)
adjustment pressure (new spring)	26 (+0.8) MPa, (265 (+8) kp/cm ²)	27.5 (+0.8) MPa, 280 (+8) kp/cm ²	26 (+0.8) MPa, (265 (+8) kp/cm ²)
nozzle hole diameter	5 pcs 0.30 mm	5 pcs 0.38 mm	5 pcs 0.38 mm

¹⁾ TWD1211G: 22°

²⁾ TWD1211P: 18°

Cooling system

Volume of cooling system incl. VP standard cooler, approx.	37.5 ltr	TWD1210: 49 ltr TWD1211: 55 ltr	48 ltr
Thermostats, number	1	1	1
marking	Red	Blue (1211P: Red)	Red
Thermostats, begin to open at	82°C	75°C (1211P: 82°C)	82°C
fully open at	95°C	88°C (1211P: 95°C)	95°C

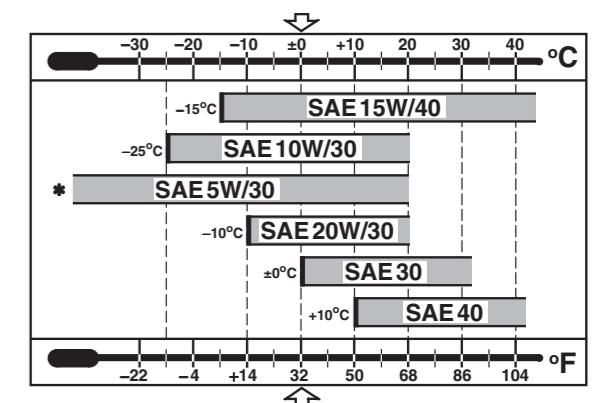
Lubricating system

Oil pressure, warm engine at operating revs	300–500 kPa (3–5 kp/cm ²)
idling speed	min. 150 kPa (1.5 kp/cm ²)
Oil change volume, approx.:	
without oil filters	34 ltr
with oil filters	38 ltr
Volume difference, min–max	9 ltr

Oil quality VDS (Volvo Drain Specification), alt. CD or CE as per API system

Viscosity at different ambient air temperatures (Temperatures refer to stable ambient temperature).

* Refers to semi-synthetic oil.
NOTE! Only SAE 5W/30 may be used.



Inhibiting

Inhibiting up to two months

If the period of inhibition is assumed to be not longer than two months it is sufficient to start the engine and run warm about every two weeks.

Check/replenish the cooling system's freeze protection to avoid damage in the event of low temperatures.

Check the charge status of the batteries. A flat battery can easily be damaged as a result of freezing.

Inhibiting more than two months

1. Run the engine to normal operating temperature.
2. Stop the engine and drain off or pump out the lubricating oil from the oil pan.
3. **Max. inhibition period of 8 months:** replace the lubricating oil filters and fill the engine to the normal level with Volvo Penta lubricating oil. Run warm after the oil change.
4. **Inhibition period of more than 8 months:** fill inhibiting oil in the engine to just over the lower mark on the dipstick. Inhibiting oils are marketed by the oil companies.

Connect the fuel lines (suction and return line) to a can filled with 1/3 inhibiting oil and 2/3 diesel fuel. Certain oil companies have a ready-mixed oil for this purpose.

Vent the fuel system. See item 18 in the maintenance schedule on page 17. Start the engine and run on high idling speed until approx. 2 litres have been consumed from the can.

Stop the engine and drain off or pump out the inhibiting oil from the oil pan. Connect the standard fuel lines.

5. Check that the coolant has a sufficient freeze protection. Replenish if necessary. Alternatively, the coolant can be drained off.
6. Check that the batteries are well charged. A flat battery can easily be damaged as a result of freezing.

A battery always has a certain inherent discharge, which increases with rising temperatures. Batteries which are stored should therefore be kept at the lowest temperature possible. They shall be kept dry and clean, and normally be charged every other month. Alternatively, the batteries can be charged with a maintenance charge of approx. 1 mA per Ah.

Preferably remove the batteries and hand them in for maintenance charging as per the instructions of the manufacturer.

See also item 2 under the heading "Important information on the electrical system" on page 15.

7. Improve where necessary the external rust protection by applying rust protection oil. The surfaces shall be clean and dry before they are treated.

NOTE! Certain inhibiting oils are inflammable. Certain oils are also dangerous to inhale. Ensure adequate ventilation. Use a safety mask during spraying.

8. Attach a note to the engine stating the date, type of inhibiting, and the inhibiting oil used.
9. Cover the air inlet to the engine, the exhaust pipe and the engine, if so required.

Re-commissioning

1. Remove covers from engine, air inlet and exhaust pipe.
2. Wash off external inhibiting agent with white spirit.
3. Close the drain cock and fit the drain plugs.
Fill the cooling system if the coolant has been drained off. See "Replenishing of coolant" on page 14. See page 8 for coolant.
4. Fill where necessary with lubricating oil of the correct quality in the engine. Fit new oil filters if the filters were not changed in connection with the oil change during inhibition.
5. Check the batteries as per the instructions on page 15. See also item 6 in the maintenance schedule on page 17. Connect the batteries.
6. Fit new fuel filters and vent the fuel system. See items 17 and 18 in the maintenance schedule on page 17.
7. Start the engine (see "Operating") and run warm at high idling speed before the engine is loaded.
8. Check that no oil, fuel, or coolant leakage occurs.

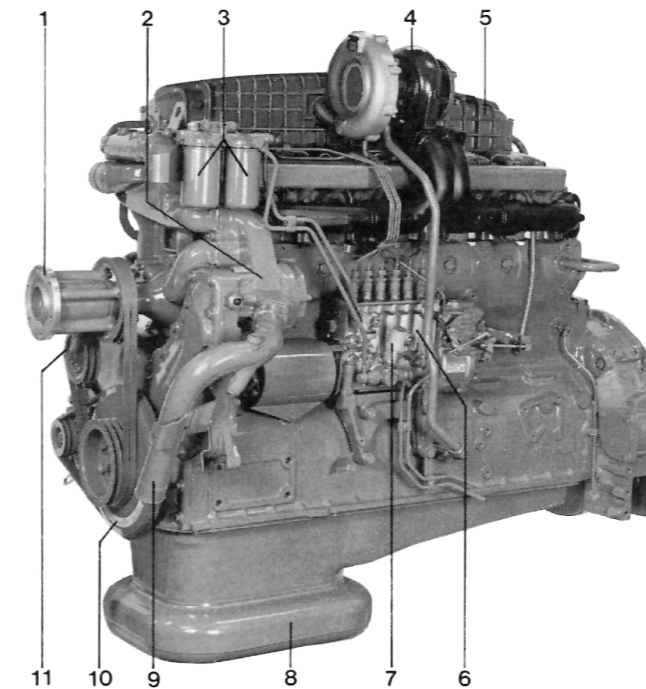
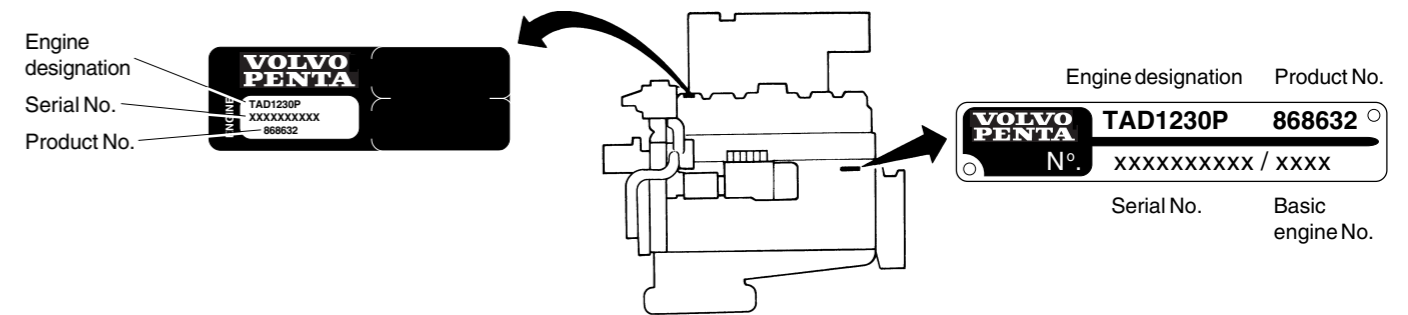


Fig. 3. TWD1210G/TWD1211G

1. Fan hub
2. Coolant pump
3. Fuel filters
4. Turbocharger
5. Intercooler
6. Injection pump
7. Feed pump (hand pump)
8. Oil pan
9. Coolant pipe, inlet
10. Vibration damper
11. Belt tensioner

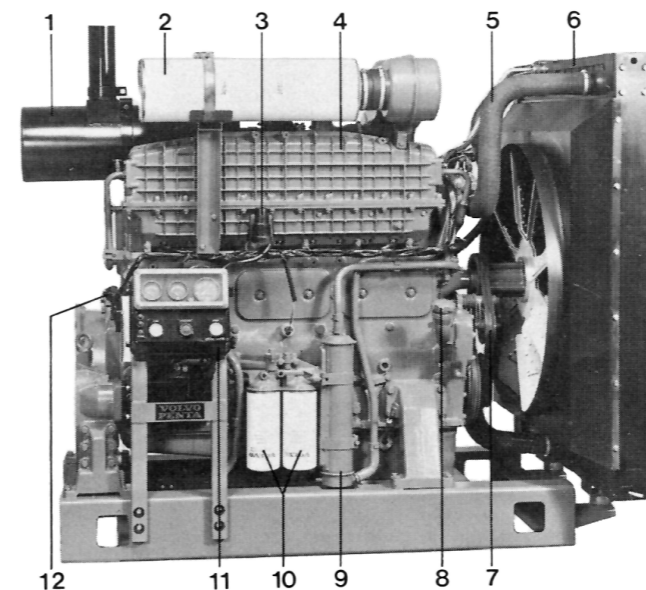


Fig. 4. TWD1210P/TWD1211P

1. Silencer
2. Air filter
3. Relay for electric starter element
4. Intercooler
5. Coolant pipe, outlet
6. Tropical radiator
7. Belt tensioner
8. Filler cup for lubricating oil
9. Oil cooler
10. Lubricating oil filters
11. Instrument panel
12. Speed control

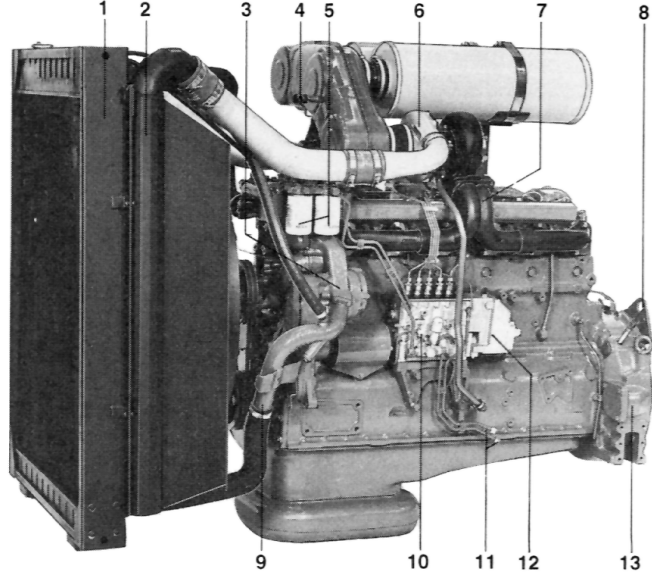


Fig. 5. TAD1230G

1. Tropical radiator
2. Intercooler
3. Coolant pump
4. Pressure drop indicator for air filters
5. Fuel filters
6. Turbocharger
7. Exhaust manifold
8. Lift eyelet
9. Coolant pipe, inlet
10. Injection pump
11. Fuel pipes for tank connection
12. Electronic speed governor
13. Flywheel housing

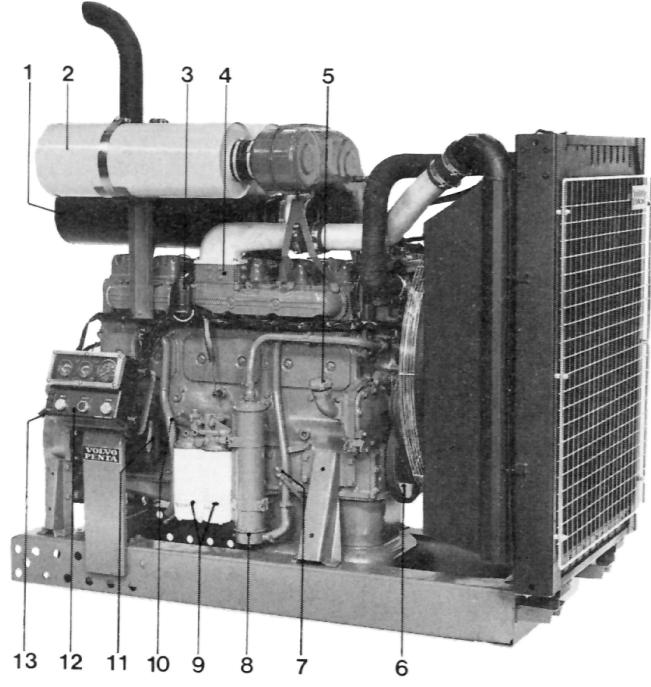


Fig. 6. TAD1230P

1. Silencer
2. Air filter
3. Relay for electric starter element
4. Starter element
5. Filler cap for lubricating oil
6. Vibration damper
7. Oil dipstick
8. Oil cooler
9. Lubricating oil filters
10. Pipe for crankcase ventilation
11. Starter motor
12. Instrument panel
13. Speed control

- Instrument panel and engine**
1. Oil pressure gauge
 2. Coolant temperature gauge
 3. Rev counter with built-in hour counter
 4. Warning lamp, charging
 5. Semi-automatic fuses (manual resetting)
 6. Stop button
 7. Interlock button
 8. Start button
 9. Relay for coolant level switch (accessory)
 10. Relay for coolant temperature switch, oil pressure switch
 11. Holding current relay (operating current and instruments)
 - 12.A Terminal for engine cables
 - 12.B Terminal (extra power outlet, fused for 16A. Outlet for automatic stop, closing in the event of fault).
 13. Relay for starter element
 14. Starter element
 15. Starter motor
 16. Batteries
 17. Alternator
 18. Rev counter sender
 19. Coolant temp. sender
 20. Coolant temp. switch (normally open)
 21. Oil pressure sender
 22. Oil pressure switch (normally open)
 23. Level switch, coolant (accessory)
 24. Stop solenoid (charged during operation)
 25. Horn
 26. Union
 27. Alarm separator (accessory)
 28. Warning lamp, high coolant temp. (accessory)
 29. Warning lamp, low coolant level (accessory)
 30. Warning lamp, low lubricating oil pressure (accessory)
 31. Union

Battery cable areas are related to battery positioning.

Distance, starter motor – batteries:

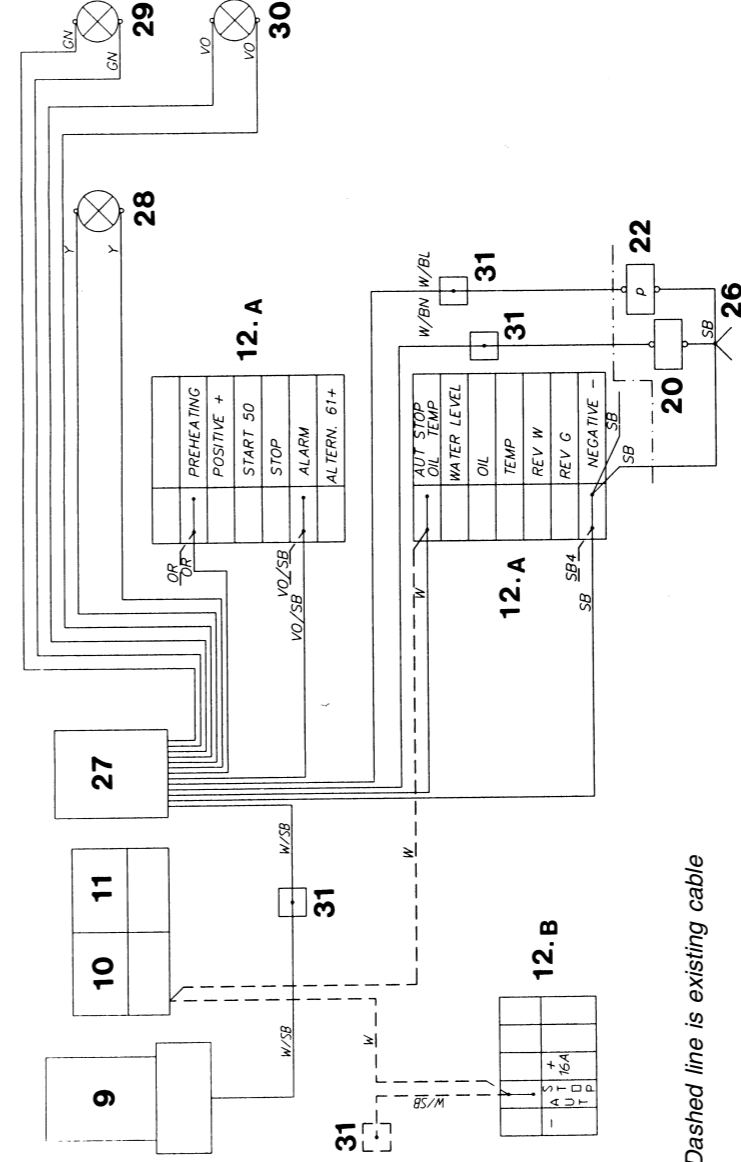
max. 2 m, area = 70 mm²

max. 4 m area = 120 mm²

Conversion mm²/AWG*

*American Wiring Gauge

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



Dashed line is existing cable

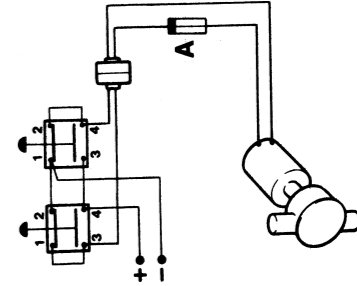
Wiring diagram (parts).

Connection of alarm separator (accessory) to instrument panel

Cable areas in mm² (given after colour code in wiring diagram).
1.5 mm² when no other area is given.

Cable colours

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

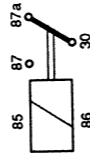
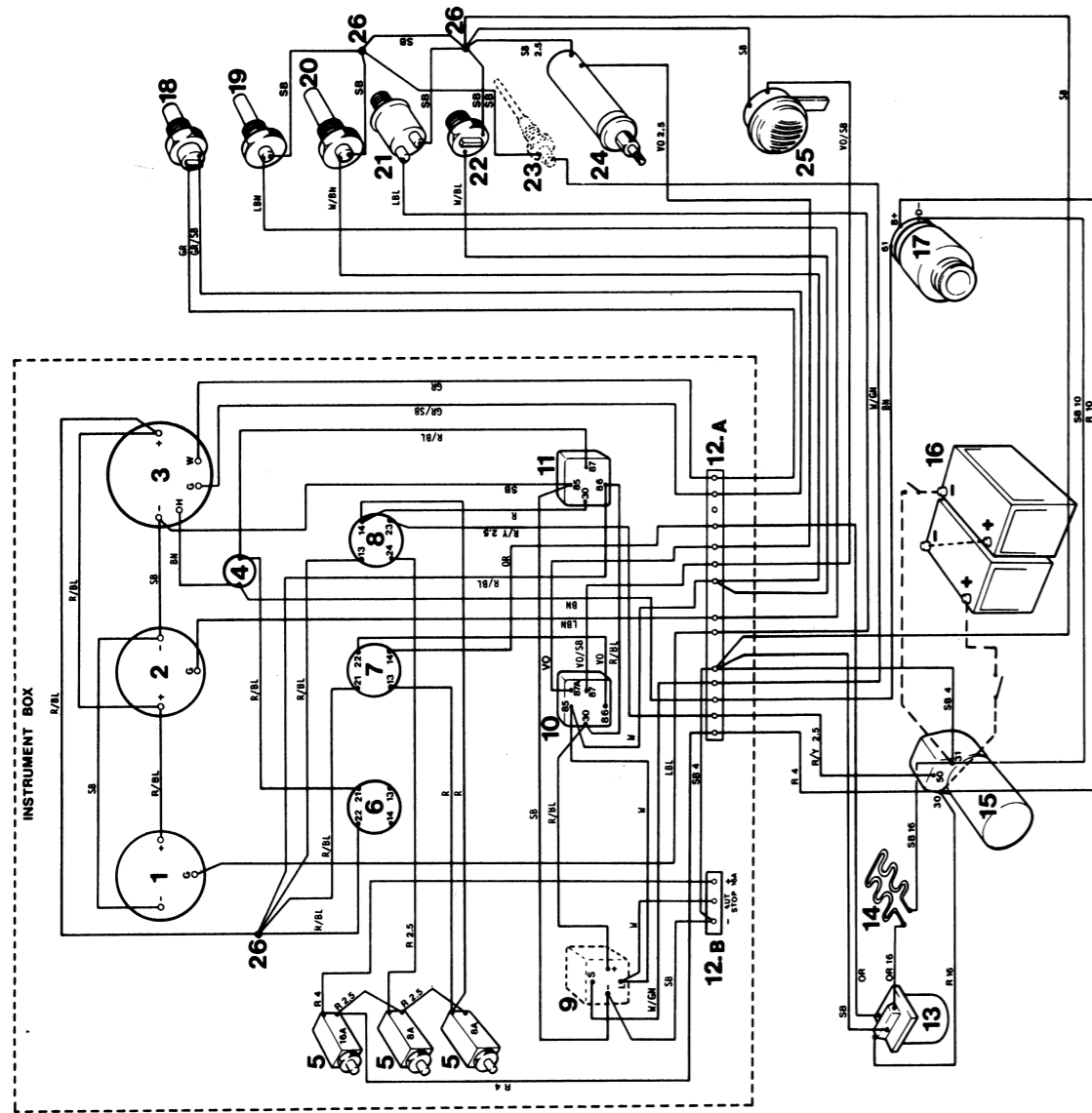


Recommended connection of oil scavenging pump (scavenging and filling).

A. Fuse (8A/24V or 15A/12V).

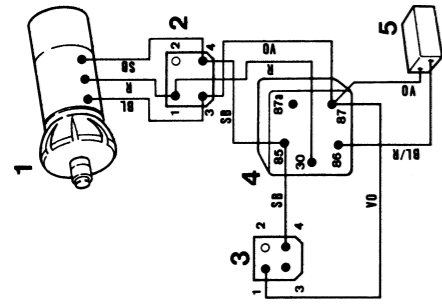
Wiring diagrams

(Concerning Electronic Speed Governor, see page 6)



Skeleton diagram.

Relays, pos. 10 and 11



Connection of stop solenoid and time relay, partial diagram

1. Stop solenoid
2. Contact piece
3. Contact piece (connect to engine cable harness)
4. Time relay
5. Delay unit

Wiring diagram.
Instrument panel and engine

Installation

General installation instructions

For more detailed installation information refer to Volvo Penta Installation Manual.

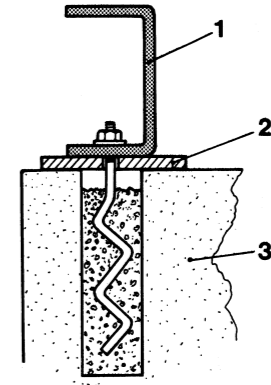


Fig. 7. Bracing of the engine frame

1. Engine frame
2. Steel spacer plate
3. Base (reinforced concrete)

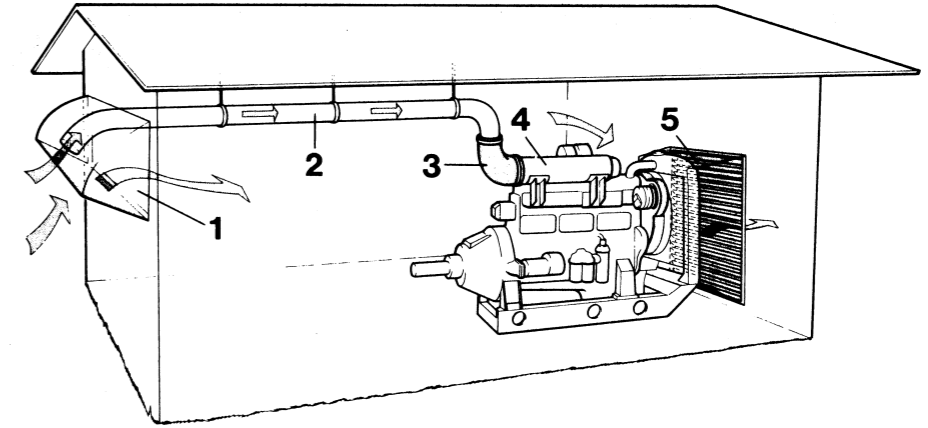


Fig. 8. Engine room with air intake and air discharge (thrust fan)

1. Air intake
2. Intake pipe
3. Connection elbow
4. Air filter
5. Air discharge (with air drum to avoid re-circulation of cooling air)

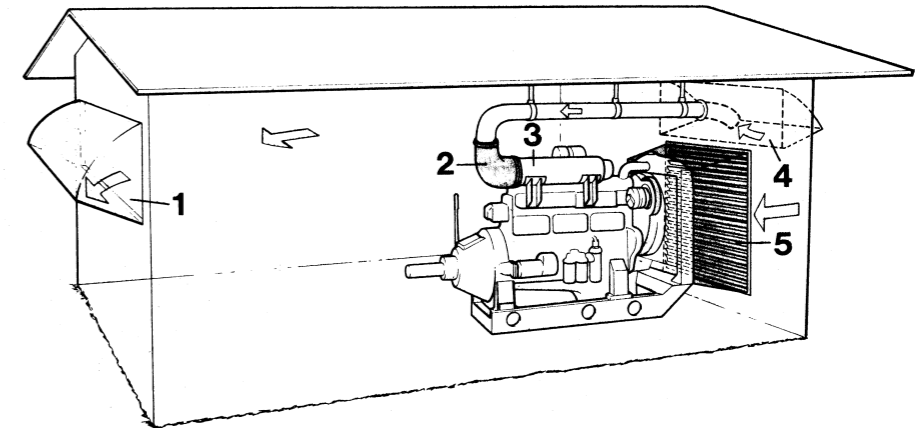


Fig. 9. Engine room with air intake and air discharge (suction fan)

1. Air outlet
2. Connection elbow
3. Air filter
4. Protective cover
5. Air intake (with air drum to avoid re-circulation of cooling air)

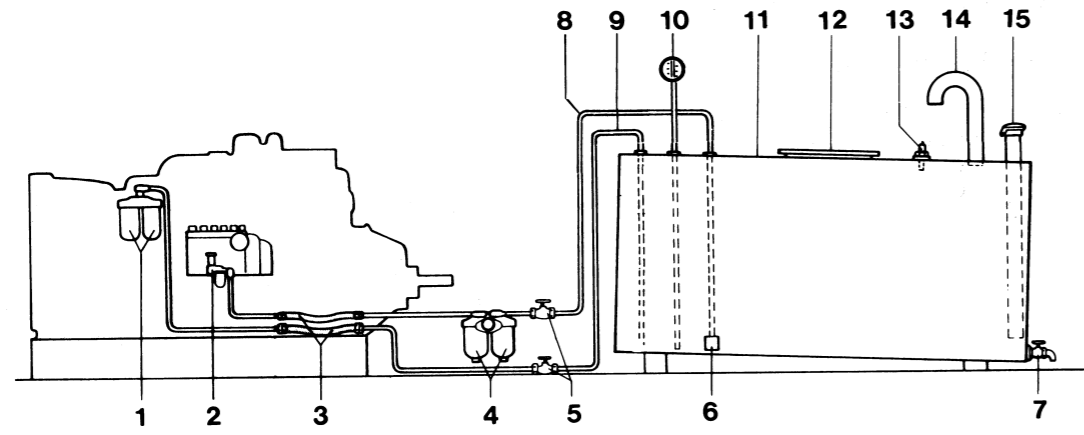


Fig. 10. Fuel system

- | | | |
|--|----------------------------|------------------------------------|
| 1. Fuel fine-filters | 6. Suction strainer | 11. Fuel tank |
| 2. Feed pump (max. suction height 2 m) | 7. Drain cock | 12. Inspection port |
| 3. Flexible fuel hoses | 8. Return pipe | 13. Electronic overflow protection |
| 4. Extra fuel pre-filters | 9. Return pipe from engine | 14. Venting pipe |
| 5. Fuel cocks | 10. Fuel gauge | 15. Replenishing pipe |

Electronic speed governor

Wiring

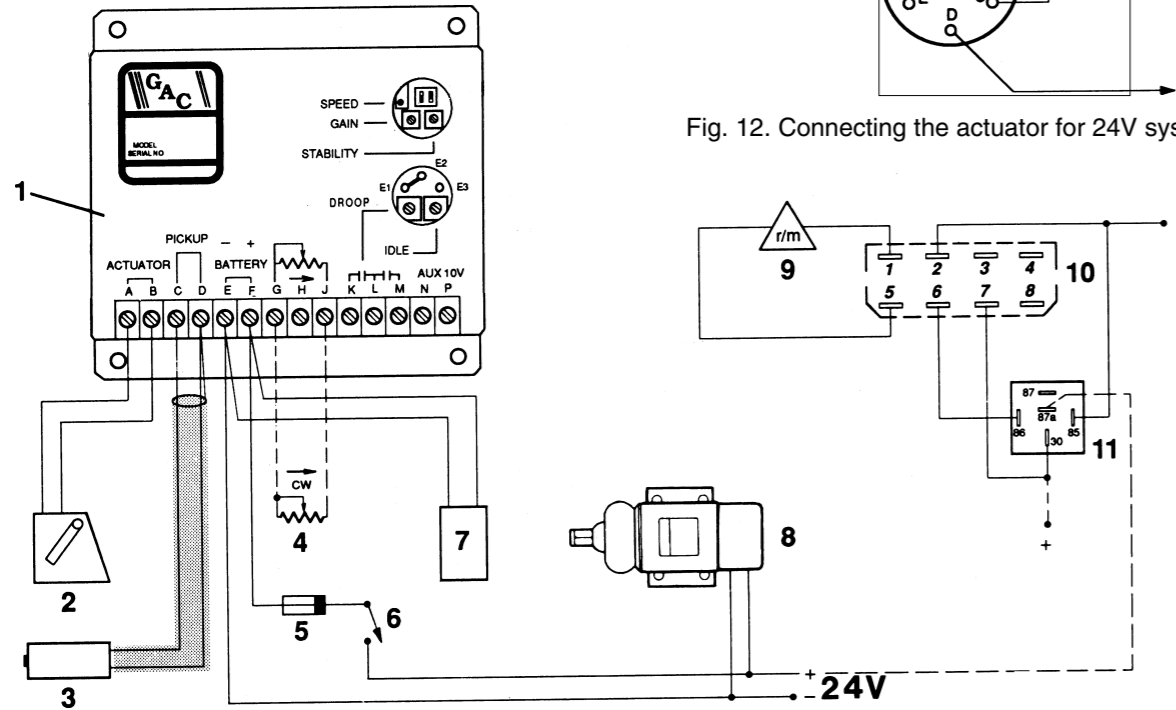


Fig. 11. The stop solenoid (8) connected live during operation (optional). Engine stops with switch (6).

Note. Later version stop solenoid has a built-in transient protection. Therefore, only a separate transient protection (7) for the Control Unit is required.

- | | | |
|------------------------------|------------------------------------|---|
| 1. Control Unit | 5. Fuse (fast) 8A | 9. Engine speed pickup for overspeed protection |
| 2. Actuator | 6. Main switch | 10. Engine speed switch (overspeed protection) |
| 3. Pickup | 7. Transient protection (849394-2) | 11. Relay |
| 4. Multi-turn potentiometer* | 8. Stop solenoid | |

*Not from Volvo Penta

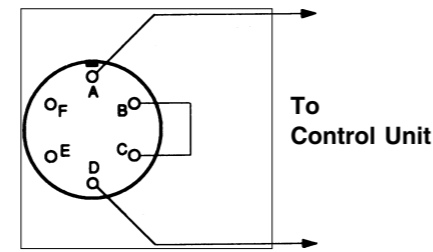
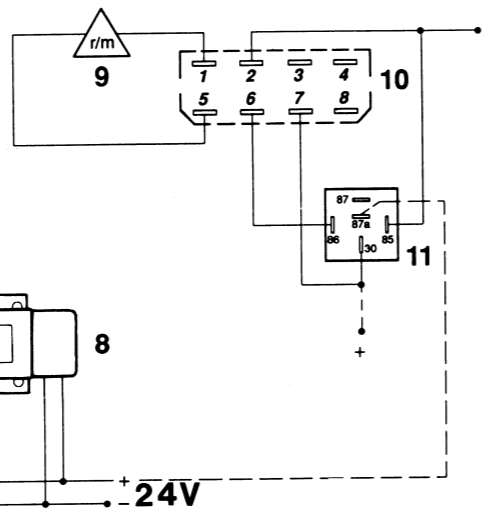
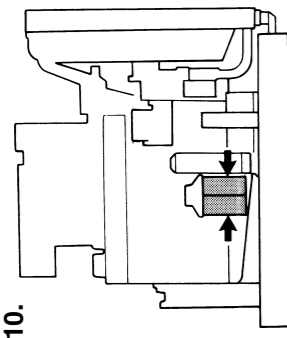
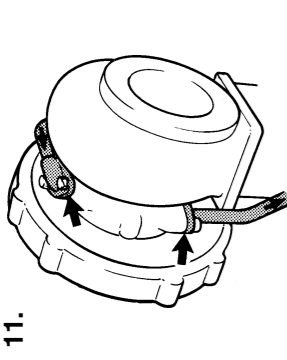
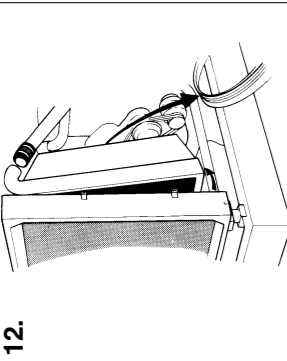
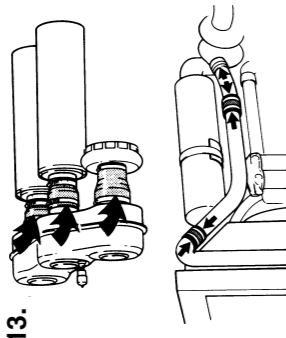
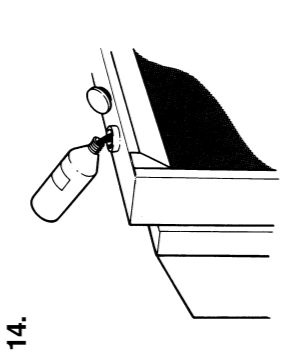
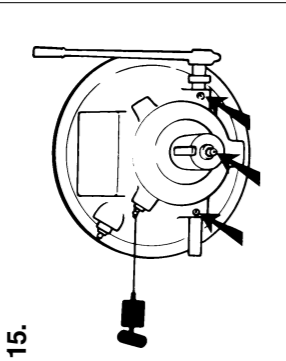
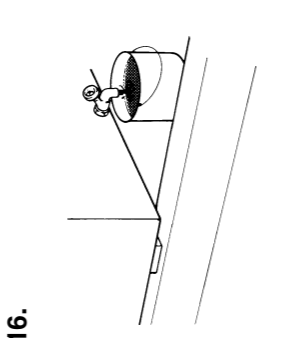
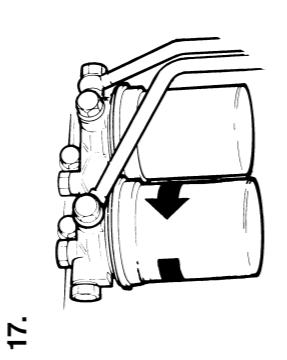
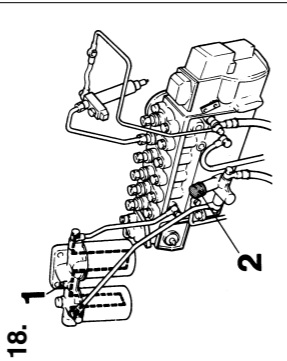
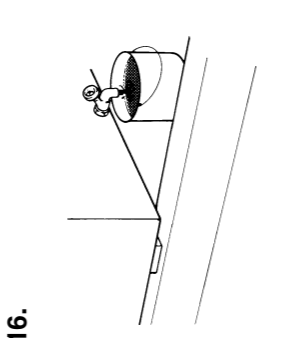
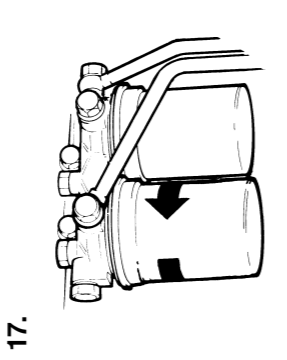
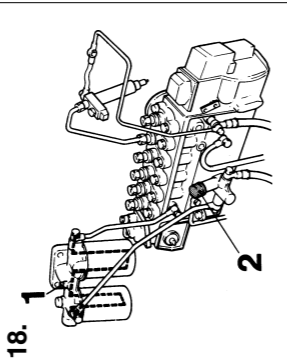


Fig. 12. Connecting the actuator for 24V system voltage



		The numbers under "Procedures" refer to diagrams below.	
		<p>21. 15-25 Nm 50 Nm</p>	<p>25.</p>
		<p>20.</p>	<p>23.</p>
		<p>19.</p>	<p>22.</p>
Operating time	Procedures	<p>19. Check/adjust disengageable clutch. Warning! Adjustment shall be carried out with engine off. The engaging force at the end of the lever shall be 34-41 kp (twin plate clutch), or 36-45 kp (triple plate clutch). Adjustment: remove inspection cover. Release the catch (A) and turn the red adjuster ring (B) clockwise. Lock the catch. The plates must not slip after engagement.</p> <p>20. Allow authorized personnel to check valve clearance. Engine off! Cold or at operating temperature.</p> <p>21. Allow authorized personnel to check injectors. Replace with adjusted injectors if necessary. Hand in old injectors to authorized workshop. Tightening torque: injectors 50 Nm (5 kpm), pressure pipes 15-20 Nm (1.5-2.0 kpm).</p> <p>22. Allow authorized personnel to check condition of turbocharger and carry out general inspection of the engine and its equipment.</p> <p>23. Replace coolant filter (accessory)*. Close the cocks 1 and 2. Remove the filter with special tool. Oil in gasket with oil and screw on the new filter by hand. Tighten 1/2 - 3/4 of a turn when gasket bites. Open cocks. Start and check that no leakage occurs. Check coolant level. * Not in connection with change of coolant.</p> <p>24. Clean cooling system/change coolant. Check that no leakage occurs. High coolant temperature can be the result of low coolant level, defective thermostats, defective cooling fan or blocking of intercooler/radiator or other parts of the cooling system. See page 8 for coolants.</p> <p>25. Change of air filter on compressor (accessory). Release hose clip, remove filter and scrap. Fit new filter and re-tighten clip.</p>	

Operating time	Procedures	The numbers under "Procedures" refer to diagrams below.		
Every 400 hours	<p>10. Change oil filters. Remove the oil filters with special tool. Grease the gasket and screw on the new filters by hand. Tighten 3/4 turn when gasket bites. Replenish oil, start and check that no leakage occurs. Stop engine and check oil level.</p> <p>11. Check that oil lines to and from the turbocharger do not leak.</p> <p>12. Check that radiator and intercooler (air-cooled) are not blocked on outside.* Release intercooler in the event of severe fouling. Remove fan guard. Release intercooler pipes from intercooler. Release intercooler from radiator and tip backwards. Clean with water and mild detergent. Observe care so that radiator fins are not damaged. Note: Do not use high-pressure wash.</p> <p>13. Check that air pipes and hose connections do not leak. Check all hoses for damage. Replace if necessary. Re-tighten all clips.</p> <p>14. Add anti-corrosion protection to cooling system.** Fill 1/2 ltr anti-corrosion protection (part. No. 1141526-2).</p> <p>15. Grease disengageable clutch (if used). Grease inner support bearing (if grease nipple available), main bearings, disengaging shaft and moving parts in clutch mechanism. Grease lightly (20-30 g for main bearings). Quality: see under item 5 above. Apply a few drops of oil to inner link arms. * The need for cleaning is strongly related to operating conditions. The time interval should therefore be adjusted on the basis of experience for each separate engine after some time of use. ** NOTE! Only when there is no antifreeze in engine. Note: anti-corrosion protection does not need to be added in engines with coolant filter (accessory).</p>	  	  	  
Every 800 hours	<p>16. Drain sediment chamber in fuel tank whenever possible.</p> <p>17. Change fuel filters. Remove the fuel filters with special tool. Grease gasket and screw on the new filter by hand. Tighten 1/2 turn when gasket bites. Observe care to keep clean! No waste particles shall enter fuel system. Vent the system (see item 18 below).</p> <p>18. Venting the fuel system. Open the vent-screw (1). Apply hand pump (2) and pump until no air bubbles flow out in fuel. Close screw while fuel is flowing out. Pump an additional 10-20 strokes. Check that no leakage occurs.</p>	  		

Electronic speed governor

Before the first start

Check that the wiring is correct according to figs 11 and 12.

Provided that a fast fuse is used in the battery cables as shown in the Wiring Diagram (fig. 11) reversed polarity will not ruin the Control Unit. **However, other incorrect connections can cause irreparable damage to the Control Unit.**

1. Set the switch "C1" (fig. 13) to the "ON" position. **Note!** Move the switch to the "OFF" position if there is fast instability in the system.
2. Set the switch "C2" to the "ON" position. In this position the sensitivity is being reduced in order to eliminate fast erratic engine behaviour which can be caused by a very soft or worn coupling between engine and generator.
3. Set the potentiometers "GAIN" and "STABILITY" (fig. 13) to the centre position.
4. Temporarily strap terminals "L" and "M" on the Control Unit to get low idle (approx. 400 rpm).

2. After the engine has been checked and its function is normal, remove the strap between the "L" and "M" terminals on the Control Unit. The speed will increase to approx. 1567 rpm or 1870 rpm depending on the operating speed ordered.

For new, not previously adjusted Control Unit, the "SPEED" potentiometer should be turned 15-20 turns clockwise from its end position.

3. Perform a final adjustment of the "GAIN" and "STABILITY" in the Control Unit as follows:

- Run the engine without load and turn the "GAIN" control **clockwise** until instability occurs. Then turn back the control until stability is obtained and then an additional 1/8 turn.

- Adjust the "STABILITY" control in the same way as for the gain above.

NOTE! When adjusting the sensitivity "GAIN", the set speed may be changed. Adjust, if necessary, using the "SPEED" potentiometer.

After these adjustments have been completed, load can be applied.

It may be necessary to repeat the previous adjustments. Normally, there is a critical point for these adjustments with an unloaded, cold engine.

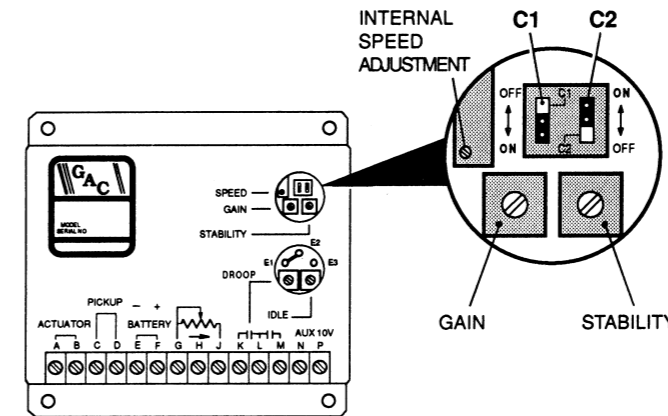


Fig 13. Control Unit

First start

1. Connect the batteries and start the engine. The governor should keep the engine at idle. If desired, the idle speed can be increased by turning the "IDLE" potentiometer clockwise. Note, this is a **single turn potentiometer**. Turn carefully and **not** to its end position.

Warning! Long periods of running at critical speeds can damage any flexible coupling fitted, the engine or the generator.

NOTE!

Turning the "GAIN" control clockwise will increase the governor reaction with changes in load. **Turning counter-clockwise** will give a slower reaction.

Turning the "STABILITY" control clockwise will shorten the time for the system's recovery after a change in load. **Turning counter-clockwise** will give a longer recovery time for the system.

Fuel, Oils, Coolant

Fuel specification

The fuel must meet national and international standards for commercial fuel, such as:

- EN590 (with nationally adapted environmental and cold requirements)
- ASTM-D975-No 1-D, 2-D.
- JIS KK 2204

Sulphur content: In accordance with the legal requirements in each country. If the sulphur content exceeds 0.5 percent by weight, the **oil change intervals** are changed, please refer to page. 16.

Note. Fuel with an extremely low sulphur content (urban diesel in Sweden, City diesel in Finland) can cause a loss of power of about 5% and an increase in fuel consumption of 2-3%.

Lubricating oil, engine

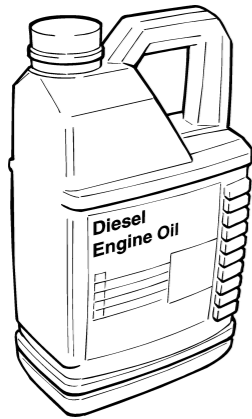
Lubricating oil of a quality as per the following table shall be used:

Designation	Standard
VDS*	Volvo Drain Specification
CD, CE	API (American Petroleum Institute)
MIL-L-2104D	US Government's Military Spec.

* If long oil change intervals are applied a VDS oil must be used. See also maintenance schedule and "Technical Data".

The use of an oil of a quality which does not comply with the above stated requirements is an inferior solution, both with a view to economy and operating reliability.

With respect to viscosity and volumes, see "Technical Data" on page 23 .



Oil for power steering system, hydraulic pump (accessory)

ATF oil* shall be used for the power steering system.

*ATF= Automatic Transmission Fluid (oil for automatic gearboxes).

Coolant

The coolant has a double purpose. On the one hand it shall protect the cooling system from freezing, and secondly it prevents corrosion. **To avoid freezing and corrosion damage to the engine the following recommendations must be followed:**

Freeze risk

Use a mixture of 50% Volvo Penta antifreeze (glycol) and 50% pure water (as neutral as possible). **This mixture provides protection from freezing down to approx. -40°C and should be used all year round.**

Note: At least 40% antifreeze shall be used in the system to ensure satisfactory corrosion protection.

Mix the antifreeze with water in a separate container before filling in the cooling system.

With respect to replenishing of coolant, see instructions on page 14.

NOTE! Glycol is hazardous to health (dangerous to consume).

No freeze risk

When there is no freeze risk water with the addition of Volvo Penta anti-corrosion agent* (part. No. 1141526-2) must be used where a mixture of water/glycol is not used all year round. Mixing ratio 1:30.

With respect to replenishing of coolant, see instructions on page 14. Run engine warm after replenishing to ensure best effect.

NOTE! Anti-corrosion agent is hazardous to health (dangerous to consume)

*Note: Never mix anti-corrosion agent with antifreeze (glycol). The formation of foam can seriously diminish the cooling effect.

Replacement of coolant

Replacement of coolant and flushing of the system shall be carried out at least once a year. See also under heading "Cooling system" on page 13, and the maintenance schedule.

Maintenance schedule

The time intervals are guide-lines which are applicable under normal operating conditions. For new or newly overhauled engine see under heading "Running-in" on page 10.

All procedures below, with the exception of items 20, 21 and 22, shall be carried out at least once a year if the operating time in the schedule is not reached. For items 20, 21 and 22 at least once every other year is applicable.

Note! Stop the engine before service work is begun!

Operating time	Procedures	1.	2.	3.	4.	5.	6.	7.	8.	9.
Daily before starting	<p>1. Check lubricating oil level in engine.* Between marks on dipstick. Oil quality: VDS, CD or CE as per API system.</p> <p>2. Check coolant level.* Level shall lie approx. 5 cm below sealing surface of filler cap.</p> <p>3. Check that radiator and intercooler (air-cooled) are not clogged on the outside. See item 12 below for cleaning.</p> <p>4. Check clogging on air filters.* Check that filters are not clogged. Replace filters when indicator remains in fully red sector (1) after engine is stopped. Reset indicator after changing filters by pressing button (2). NOTE! Do not touch filters before indicator shows red sector. Scrap the old filters. Not to be cleaned or reused. Note. For operating in extremely dirty environments (e.g. coal mines) a special air filter is required (not marketed by Volvo Penta). * Every 8 hours during continuous operation.</p>									
Every 50 hours	<p>5. Grease release bearing on disengageable clutch.* Grease lightly so that no grease is forced out. Grease with lithium base: Mobilux EP2, Statoil Uniway EP2N, Texaco Multifak EP2, Q8 Rembrandt EP2.</p> <p>6. Check batteries. Battery water approx. 10 mm over cell plates. Warning! Always use protective glasses when handling batteries. Batteries contain explosive gas and strongly corrosive sulphuric acid. Naked flames or sparks in the vicinity of the batteries can cause explosion.</p> <p>7. Check that no leakage of coolant, lubricating oil or fuel occurs. * Applicable for more than 15–20 switchings per day. Otherwise every 400 hours.</p>									
Every 200 hours	<p>8. Change oil in engine.* Oil quality: engine oil VDS, alt. CD or CE as per API system. Drain off the oil when engine is warm. Warning! Hot oil can cause burn injuries.</p> <p>9. Check/tension V-belts. Release screws (A) before tensioning of alternator belts. The belts shall be able to be pushed down approx. 10 mm between the pulleys. Worn belts working in pairs shall both be replaced. Fan belts have an automatic belt tensioner. * The oil change interval is strongly related to fuel and lubricating oil quality, and also to operating conditions. See table above.</p>									

Preventative maintenance

To ensure maximum operating reliability and service-life it is important that the engine and its equipment are maintained as per the maintenance schedule. This provides instruction as to when and how maintenance is to be carried out.

Always use an authorized Volvo Penta workshop, which has the necessary equipment and trained personnel.

A well executed service and maintenance programme ensures greater operating economy and fewer unscheduled interruptions to operations.

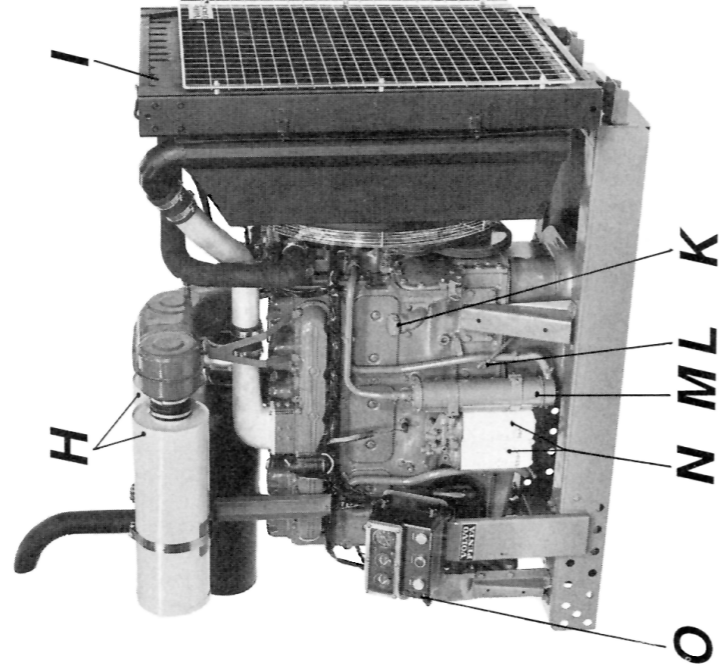
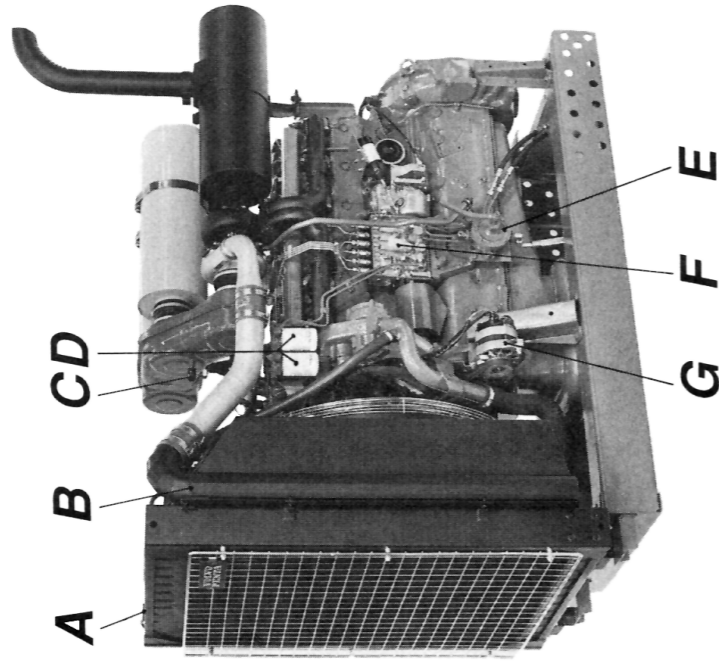
Oil change intervals

Depending on time, sulphur content of the fuel, and quality of the lubricating oil.

Note. If longer oil change intervals than what are given here are required, the condition of the oil must be checked by the oil manufacturer by regular lubricating oil tests.

Oil quality	Sulphur content of fuel in % by weight	
	< 0.5%	0.5–1.0% > 1.0%*
VDS	24 months or 400 h	24 months or 200 h
API: CD or CE	12 months or 200 h	12 months or 100 h

* Lubricating oil with TBD > 15 is recommended when using fuel with sulphur content > 1.0% by weight. (TBN = Total Base Number).

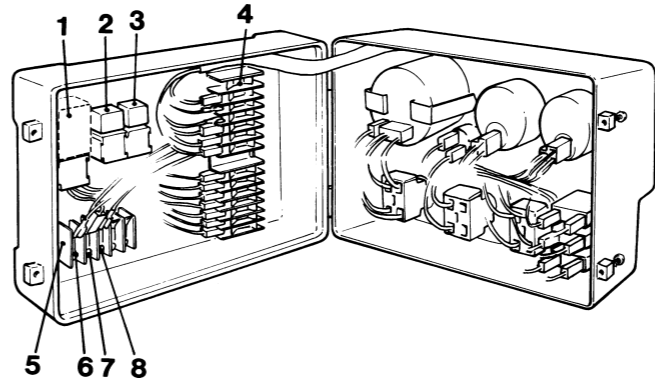


- A. Coolant. Cap for checking and replenishing.
- B. Intercooler.
- C. Indicator indicating the clogging of the air filters.
- D. Fine-filters for fuel.
- E. Oil scavenging pump.
- F. Feed pump.
- G. Alternator.
- H. Air filters.
- I. Radiator.
- K. Engine lubricating oil. Filler cap.
- L. Oil dipstick.
- TAD1030: located on left hand side of engine.
- M. Oil cooler.
- N. Lubricating oil filters.
- O. Semi-automatic fuses. Press button if fuse has triggered.

Instrument panel, opened

Note: the bold figures (in brackets) refer to the component designation in the wiring diagram on page 20.

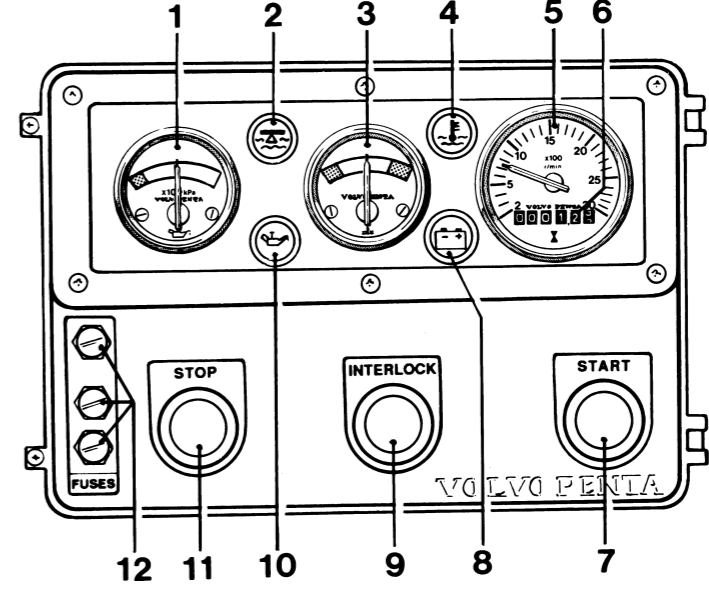
1. Relay for level switch, coolant (accessory) (9).
2. Relay for automatic stop (coolant temperature switch, oil pressure switch, and switch for low coolant level, accessory) (10).
3. Holding current relay (operating current and instruments) (11).
4. Terminal block for engine cabling (12.A).
5. Terminal block for automatic stop and extra power outlet (max. 16A) (12.B).
6. Minus (-) for extra power outlet, (black wire).
7. Connection for extra switches – automatic stop, (white wire).
8. Plus (+) for extra power outlet, (red wire). Max. 16A.



1. Oil pressure gauge. Normally within green sector (300–500 kPa).
2. Warning lamp for low coolant level (accessory).
3. Coolant temperature gauge. Normally within green sector (70–95°C).
4. Warning lamp for high coolant temperature (accessory).
5. Rev counter, engine speed. Multiply the reading by 100 to obtain rpm.
6. Hour counter. Built into the rev counter housing. Shows the engine's operating time.
7. Start button (green). **Note:** the start button must **never** be pressed when the engine is running. The starter motor and ring gear on the flywheel can be seriously damaged.

8. Warning lamp which lights if charging current from the alternator ceases.
9. Interlock button (black). The automatic stop is disconnected when this button is pressed. **The button must be held down when starting until the oil pressure has reached normal.**
Note: the button also connects the electric starter element (pre-heating).
10. Warning lamp for low oil pressure (accessory).
11. Stop button (red). When the button is pressed the stop solenoid is connected. This breaks the fuel supply from the injection pump and the engine stops.
Note: if the engine has been stopped by triggering the automatic stop the alarm will also be silenced by pushing the stop button.
12. Semi-automatic fuses (2 pcs 8A and 1 pc 16A). If a fuse has triggered it can be manually reset by pushing the button on the fuse.

Instruments



Instrument panel

The instruments for monitoring the engine's oil pressure, coolant temperature, rpm and operating time, including start and stop controls, are collected on the instrument panel. This is placed on a column at the rear of the engine frame on the right-hand side.

Running-in

When the engine is new it shall be operated in normal operation, but **full load shall not be applied more than for short periods during the first 10 hours**, if possible. Unnecessary idling with an unloaded engine shall also be avoided.

Check the instruments carefully during this period so that any irregular conditions can be discovered in good time.

Check also that no leakage occurs.

NOTE! On a new or newly overhauled engine the valve clearance shall be checked for the first time after 100–200 hours of operation. Re-tighten the injectors at the same time (50 Nm/5 kpm).

When a disengageable clutch is installed this should be given an additional check during the first days. Adjustment may be necessary to compensate for wear on the plates. See item 19 in the maintenance schedule on page 17.

Procedures prior to starting

1. Check the oil level in the engine.* The level shall lie between the two lines on the dipstick. **The oil level must never fall below the lower mark.**

TWD1210/1211, TAD1230: the dipstick can be removed either during operation (side marked "OPERATING") or when the engine is stopped* (side marked "STOP").

*Reading to be carried out not before at least 3 minutes after stop.

2. Check that the drain cock(s) is closed and that all drain plugs are fitted.

With respect to positioning of cocks and plugs see diagrams on page 13.

3. Check the coolant level. The level shall lie approx. 5 cm below the filler cap's sealing surface. With respect to replenishing see page 14.

Warning! Open the filler cap very carefully if the engine is warm. Steam or hot liquid can spray out.

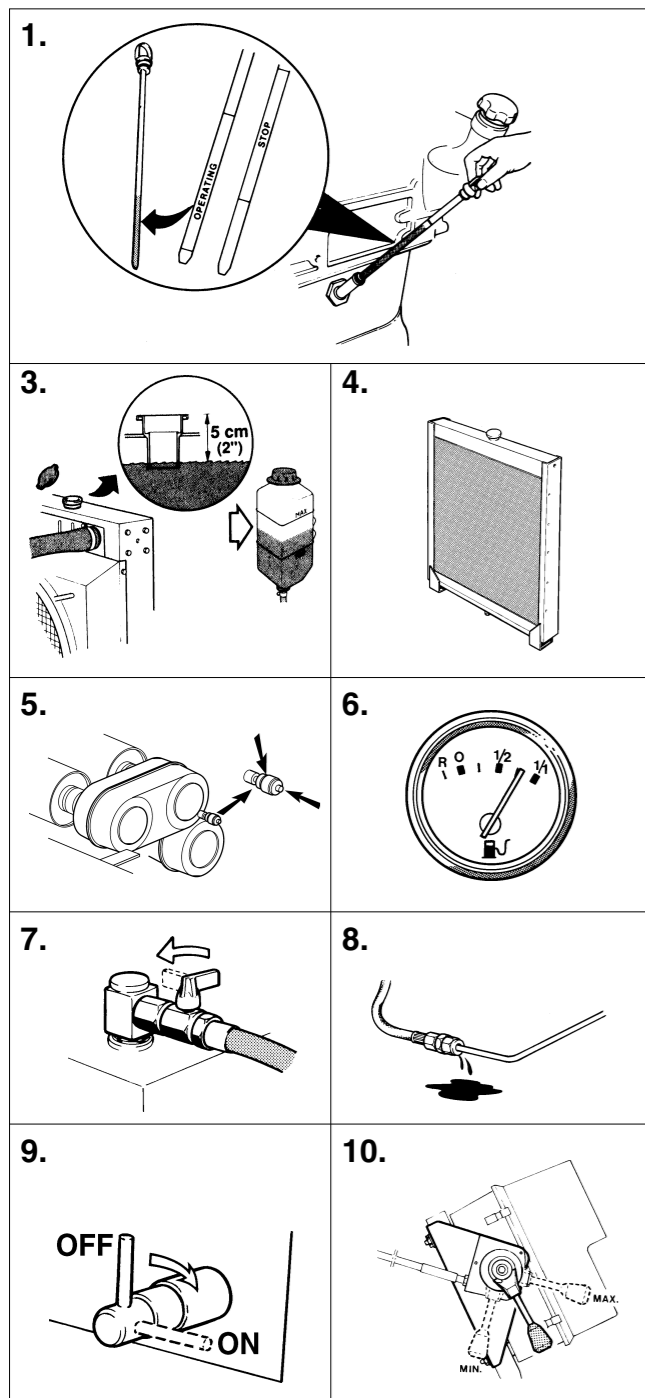
4. Check that the radiator and the intercooler (TAD1030, TAD1230) are not clogged on the outside.

5. Check the condition of the air filters. Replace the filters when the indicator shows a completely red sector. Reset the indicator after changing the filters by pressing the button.

6. Check the fuel volume. Replenish with fuel as required. Never allow the engine to stop from lack of fuel. If this happens the fuel system must be vented* to enable start.

* See item 18 in the maintenance schedule on page 17.

7. Open the fuel cocks.
8. Check that no leakage of water, fuel or oil occurs.
9. Switch on the main switches.
10. Disengage the disengageable clutch (where appropriate) and set the speed control in idling position.
11. Check the alarm equipment if available.



Starting with auxiliary batteries

Warning!

The batteries (especially auxiliary batteries) contain oxy-hydrogen gas which is very explosive. A spark, which can be caused by the incorrect connection of the auxiliary batteries, is sufficient to explode a battery and cause damage.

1. Check that the auxiliary batteries are connected (in series, or in parallel) so that the rated voltage correspond with the engine's system voltage.
2. First connect the red auxiliary cable (+) to the auxiliary battery and then to the flat battery. Now connect the black auxiliary cable (-) to the auxiliary battery, and finally to **a point a reasonable distance from the flat batteries** (e.g. at the main switch on the minus cable or at the connection of the minus cable to the starter motor).
3. Start the engine. **NOTE! Do not interfere with the connections when trying to start (risk for sparks) and do not lean over any of the batteries.**
4. Remove the cables in the exact reverse order to which they were fitted. **NOTE! Do not under any circumstances remove the cables to the standard batteries.**

Electric welding

Remove the plus and minus cables from the batteries. Now remove all cables to the alternator.

Always connect the welding clip to the component which is to be welded and as close the weld as possible. The clip shall never be connected to the engine or so that the current can pass over any bearing.

Warning! After welding: always connect the cables to the alternator again **before** the battery cables are replaced.

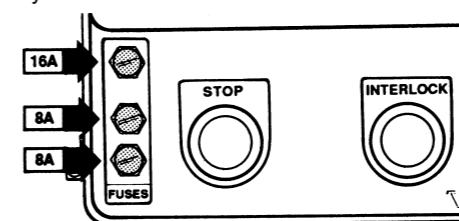
Fuses

The engine is equipped with three semi-automatic fuses* placed in the instrument box. The fuses break the current in the event of overloading.

Resetting of the fuses takes place manually by pressing the button on the respective fuse.

Note: If any of the fuses triggers repeatedly this implies fault which must be corrected.

* 2 pcs 8A for the engine and instrument panel, and 1 pc 16A for accessory.



Semi-automatic fuses

Important information on the electrical system

Warning! Stop the engine and disconnect the power with the main switches before interfering with the electrical system.

1. **Main switches.** Never break the power circuit between alternator and batteries when the engine is running. The main switches shall for this reason never be switched off before the engine has stopped. If the power circuit is broken when in operation the voltage regulator can be destroyed and the alternator seriously damaged.
2. **Batteries.** Never confuse the plus and minus poles of the batteries when fitting the batteries. This can result in serious damage to the electrical equipment. Refer to the wiring diagram. The battery poles shall be well cleaned and the cable lugs always tightened and well greased. There must be no loose connections.

Quick charging of batteries shall be avoided. If quick charging must be used, both battery cables shall always be removed first.

NOTE! Follow the stipulated safety regulations when charging batteries. During charging the cell-plugs should be unscrewed but remain in the plug holes. Ventilate well, especially if the batteries are charged in a closed room. Always break the charging current **before** the charging clips are removed.

Warning! The battery compartment must never be exposed to a naked flame or electric spark. Never smoke in the vicinity of the batteries. During charging the batteries generate hydrogen gas, which on contact with air forms oxyhydrogen gas. This gas is highly inflammable and very explosive.

Always use protective goggles when charging or handling batteries. The battery electrolytes contain strongly corrosive sulphuric acid. On contact with the skin, wash with soap and plenty of water. If battery acid has come into your eyes, rinse immediately with plenty of water and seek medical attention immediately.

Checking of batteries and electrical connections

The lifetime of the batteries is to a large extent related to how they are maintained. Keep batteries dry and clean. Impurities on the batteries can result in spark-over and discharge the batteries, especially in wet weather.

Clean the battery poles and connections with appropriate wire brushes. Poor contact can result in an unnecessary loss of voltage. Tighten the cable lugs well and spray the battery poles and connections with anti-corrosion agent, or brush with Vaseline.

Check that the batteries are well secured.

Check also that all other electrical connections are free from oxidization and that there are no loose connections. Spray when necessary these connections with water-repellent spray (Volvo Penta universal oil).

Replenishing of coolant

Warning: Open the filler cap very carefully if the engine is warm. Steam or hot fluid can spray out.

Note. Check that the drain cock is closed and that the drain plugs are fitted and tightened before replenishing the coolant system.

Replenishing shall be carried out when the engine is stopped. TWD1210/1211: Open the venting cock (see diagram on page 13). Do not replenish too quickly to avoid air-locks in the system. The air shall be enabled to flow out through the venting cock (TWD1210/1211) or filler opening.

If a heater is connected to the engine's cooling system the

heat control valve shall be opened and the system vented during replenishing.

Fill with coolant to approx. 5 cm under the sealing surface of the filler cap. For coolants, see heading "Coolant" on page 8.

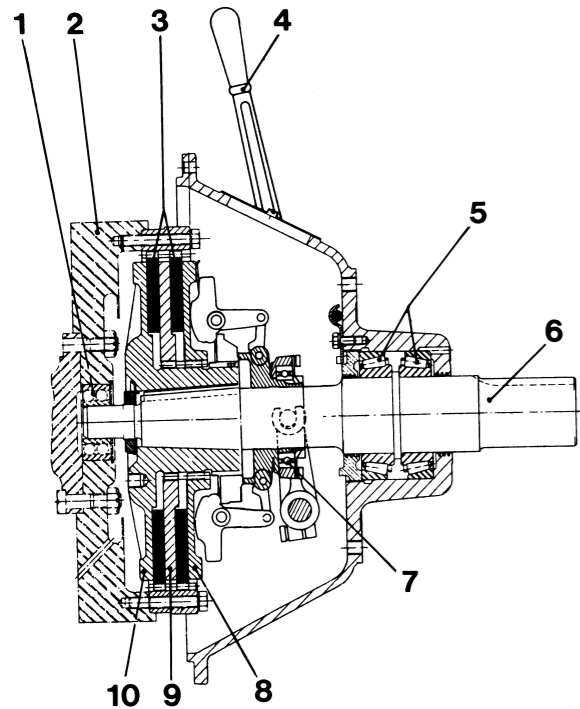
The engine must not be started before the system is vented and completely replenished.

Start and run the engine warm. TWD1210/1211: Open the venting cock (see diagram on page 13) for a moment after starting for the venting of any remaining air. Check the coolant level and replenish if necessary.

Replenish with the same mixture already used in the cooling system.

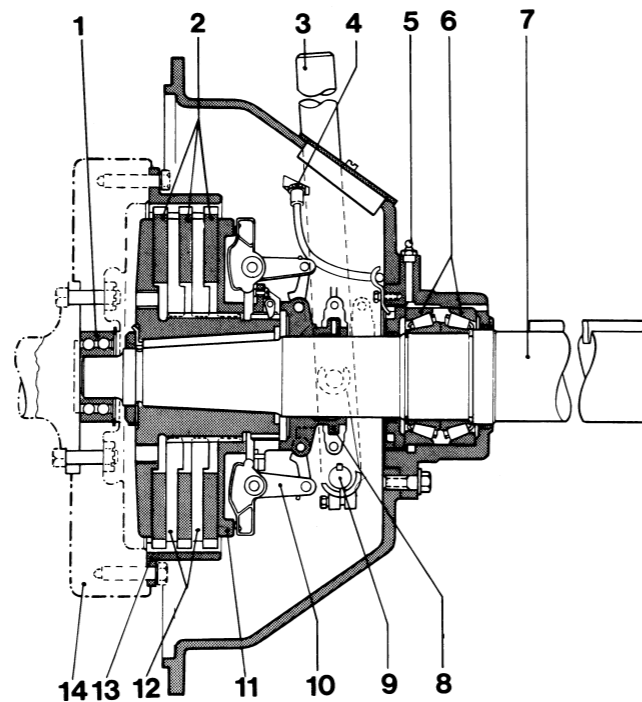
Disengageable clutches

At rear of engine (accessory)



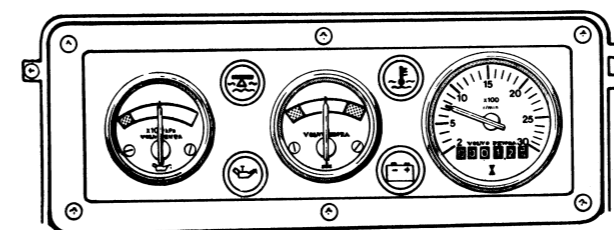
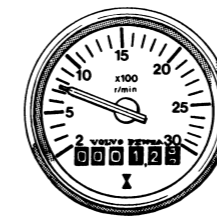
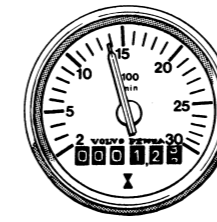
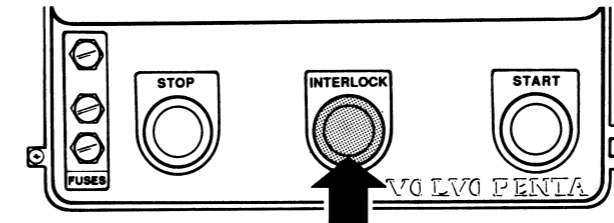
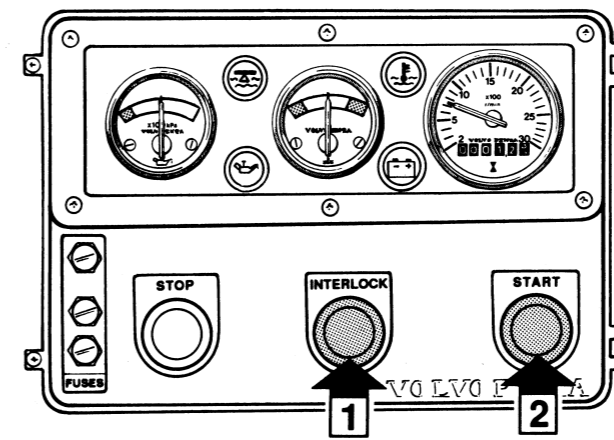
Disengageable twin-plate clutch

- | | |
|-----------------------------------|------------------------------|
| 1. Inner support bearing | 6. Drive shaft |
| 2. Flywheel | 7. Release bearing |
| 3. Plates (2 pcs) | 8. Rear thrust plate |
| 4. Lever for engaging/disengaging | 9. Intermediate thrust plate |
| 5. Main bearings | 10. Drive ring |



Disengageable triple-plate clutch

- | | |
|---|---|
| 1. Inner support bearing | 8. Release bearing (ball bearing release) |
| 2. Plates (3 pcs) | 9. Cross shaft |
| 3. Lever for engaging/disengaging | 10. Lever |
| 4. Grease nipple and hose for release bearing | 11. Rear thrust plate |
| 5. Grease nipple for the main bearings | 12. Intermediate thrust plates |
| 6. Main bearings | 13. Drive ring |
| 7. Drive shaft | 14. Flywheel |



Starting the engine

(Starting procedure may vary dependig on application i.e. genset/stand-by etc.).

Engine with alarm separator (accessory): press the interlock button and check that the warning lamps on the instrument panel go on.

1. Cold engine: press the interlock button (black) and hold down about 50 sec. This connects the electric starter element (pre-heating).

Warning! Never use start spray or the like in view of explosion risk in the inlet pipe and danger of personal injury.

Warm engine: go directly to item 2.

2. Hold the interlock button down. Press down at the same time the "Start" button (green), (max. 40 sec.).

3. Release the start button immediately when the engine starts. The interlock button must, however, always be held down about 5 sec. after start (engine with coolant level switch, accessory), or until the the oil pressure has stabilized (other engines). The automatic stop will otherwise connect and stop the engine.

Note: in the event of severe cold, pre-heating can where necessary be connected for several minutes after start by holding the interlock button down.

NOTE! The start button must **never** be held down when the engine is running. The starter motor and gear ring on the flywheel can be seriously damaged.

4. Do not race the engine after start! Run the engine instead unloaded at approx. 1300–1500 rpm for several minutes to ensure that all components are satisfactorily lubricated.

Do not run the engine with critically low revs. This is particularly applicable for an engine connected to equipment with high inertia.

5. Connect the disengageable clutch (if available) at **max. 800 rpm.**

Starting with auxiliary batteries

With respect to starting with auxiliary batteries, see instructions on page 15.

During operation

Check that the instruments show normal readings (indicators within green sector). The warning lamps shall be off.

Note: in the event of low oil pressure, high coolant temperature or low coolant level*, the engine will be automatically stopped by the automatic stop at the same time as the warning horn is activated.

NOTE! For engines which are run continuously the lubricating oil level must be checked at least every 8 hours.

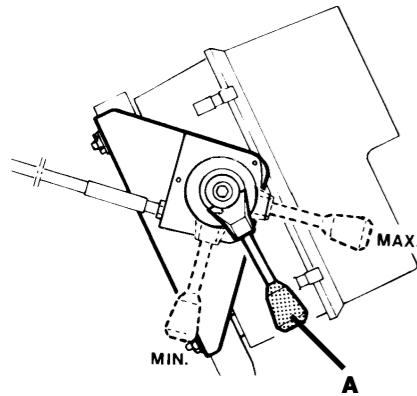
Warning! Never start or run the engine with the oil filler cap off, in view of the risk for oil splash.

*The coolant level switch is an accessory.

Speed control (Power Pack)

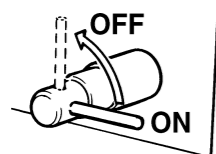
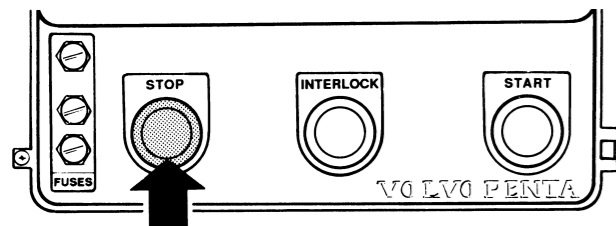
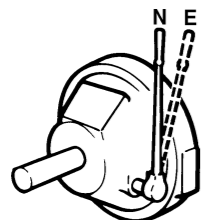
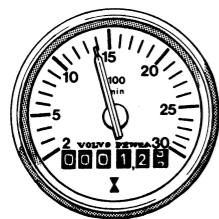
The speed can be adjusted by hand with a mechanical control mounted on the left of the instrument column on the right-hand side of the engine.

Changing of engine revs: move the control lever (A) upwards until the required revs are obtained; see Fig.



Control for adjusting engine revs

A. Control lever



Operating with low load

Avoid long-term idling or operating with low load. Such operating conditions can result in increased oil consumption or subsequent leakage from the inlet and exhaust pipe.

This is caused by oil passing the turbocharger's seals and enter the inlet pipe together with the charging air at low load (low turbo charge).

As a result of this carbon can be deposited on the valves, piston crowns and in exhaust ports.

At low loads the combustion temperature also becomes low so that a complete combustion of the fuel cannot be ensured, with fuel dilution of the lubricating oil as a result.

To limit the above consequences when operating at low load the following procedures shall be taken:

1. Reduce operating with low load to a minimum. If periodic test runs of the engine is carried out each week without load, the operating time shall be restricted to approx. 10 minutes.
2. Run the engine at full load for approx. 4 hours once a year. The carbon deposits in the engine and exhaust pipe will therefore have the opportunity to be combusted.

Note: if these items are carried out in addition to normal inspection there will be no risk for interruptions to operations as a result of operating with low loading.

Stop

1. Allow the engine to run several minutes without load at approx. 1300–1500 rpm before stopping. This is important to achieve an inner temperature equalization in the engine. Detrimental "after-boiling" is thereby avoided, at the same time as the turbocharger cools somewhat. This contributes towards an extended operating time without interruptions.

2. Disengage the engine if possible.

Disengageable clutch:

N = Neutral position
E = Engaged

3. Press the stop button (red) and hold down until the engine has stopped.

4. **Note:** When the engine is not operated for several days the main switches should be switched off.

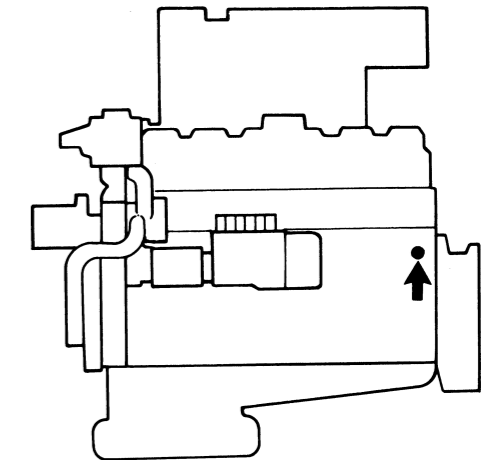
The main switches must never be switched off when the engine is in operation. The voltage regulator and alternator can be seriously damaged.

Cooling system

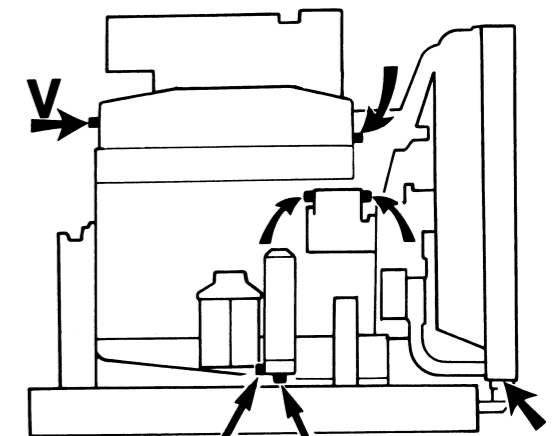
Freeze protection and anti-corrosion protection, cleaning

The coolant shall be changed at least once a year to avoid the deterioration of the cooling capacity as a result of deposits in the cooling system. An additional reason to change the coolant is to avoid the risk of corrosion damage in the cooling system, since the anti-corrosion protection additives become consumed with time.

The system shall be carefully flushed with water when changing the coolant. Flush until the water running out of the drain outlet is clean.



Drain cock on the cylinder block



TWD1210/1211
TAD1230 TAD1030

Drain plugs on oil cooler, radiator and compressor (accessory)

TWD1210/1211: Drain cock on the intercooler, front end
Venting cock, V, on the intercooler, rear end

Freeze risk

Check in good time that the coolant is sufficiently freeze resistant. The freezing point can be reduced to approx. max. -56°C (60% antifreeze).

See also under heading "Coolant" on page 8. **Spirit shall not be used in the cooling system.**

Draining of coolant

Before draining, the engine shall be stopped and the filler cap unscrewed.

Warning! Open the filler cap very carefully if the engine is warm. Steam or hot fluid can spray out.

Now open the drain cock(s) and remove the drain plugs. TWD1210/1211: Also open the venting cock. Unscrew and empty the coolant filter (accessory) where appropriate.

For positioning of cocks and plugs, see under heading "Drain points" below and diagrams.

Note. There may be deposits inside the cock/plug, which must be cleaned. Connect a hose to the drain cocks to avoid spilling water on the engine and electrical parts.

Check that all coolant actually runs out in order to avoid freeze damage where Volvo Penta antifreeze is not used in the system.

Drain points

Drain cocks:

- On left-hand side of the cylinder block, rear part.
- TWD1210/1211: At front end of the intercooler.

Drain plugs:

- Under the radiator.
- Under the oil cooler.
- 2 pcs (front and rear) on the compressor (accessory)

Venting cock:

- TWD1210/1211: At rear end of the intercooler (V).

Coolant filter (accessory):

- Individual positioning.