

TURBO-COMPRESSOR

Section
2

Group
25

Repairs and
Maintenance

Turbo-compressor
B21F-Turbo

1981-

VOLVO

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IMPORTANT!

Satisfactory lubrication is essential for the durability of the turbo-compressor. It is lubricated by engine oil pressure. There are two important rules to observe when driving a turbo-compressor equipped engine:

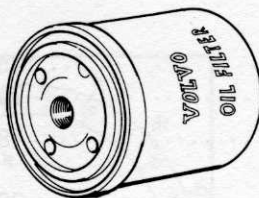
- **Let engine idle after start.**

This will provide initial lubrication. Do not race engine immediately after start.

- **Let engine return or drop to idle speed before shut-off.**

If the engine is shut off while running at high rpm, the turbo-compressor will run for a long time. This will harm the turbo-compressor as the engine does not provide continued lubrication after stopping.

Idling before shut-off will also reduce turbine temperatures.

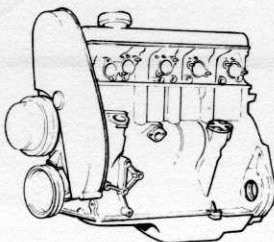
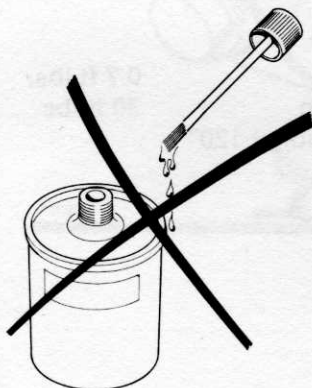


131620

Lubrication.

Proper lubrication is of vital importance. The turbo-compressor is connected to the standard engine lubricating oil system. Oil supply and pressure must be adequate, therefore the requirement not to run the turbo-compressor at high speeds at start and stop should be observed. Lubricating oil must be clean. It is important to replace oil and oil filter at regular intervals.

Engine lubricating oil of correct **quality** and **viscosity** must be used. See Specification in Maintenance Service Manuals.



131623

Never use sealing compounds when repairing engine.

It can get into engine lubricating system and clog oil passages in turbo-compressor.

Specifications

Maximum discharge pressure 42–48 kPa 6–6,8 psi
 Measured while driving, throttle pedal
 fully depressed and brake pedal depressed
 to achieve engine speed 4000 rpm.

Pressure regulator.

Starts to open wastegate at compressor
 pressure 41 kPa 6 psi

Wastegate actuator.

Control rod stroke of 10 mm 3/8"
 ... achieved just before overload protection
 switch cuts out fuel pump relay.

**Pressure switch for enrichment at
 acceleration.**

Closes (and grounds terminal 7 of Lambda
 sond electronic module) when compressor
 pressure reaches 20.3 kPa 2.9 psi

Overload protection switch.

Opens ground circuit for fuel pump relay
 at pressure 70 kPa 10 psi

Spark timing.

Max. advance 15°
 Max retard 8°
 ... at compressor pressure 36 kPa 5.1 psi

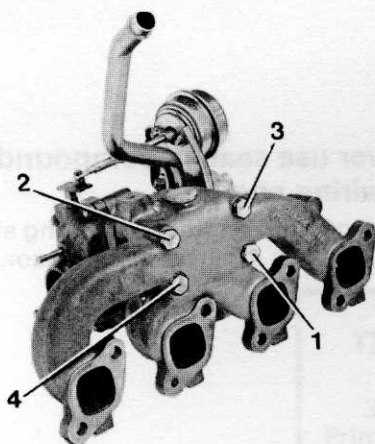
Tightening torques

Use lock fluid P/N 116035-9
 ... on following bolt connections:

Nuts, retaining front exhaust pipe to turbo	25 Nm	18 ft.lbs.
Bolts, retaining turbine housing	20 Nm	15 ft.lbs.
Bolts, retaining compressor housing	18 Nm	13 ft.lbs.
Bolts, retaining rear housing, with waste- gate, to turbine housing	20 Nm	15 ft.lbs.

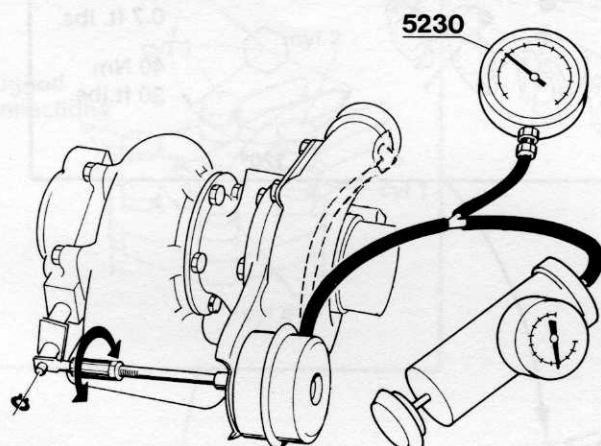
Bolts, retaining turbo-compressor to
 manifold:

- Lubricate bolt threads and contact
 surfaces with rustproofing agent P/N 282036-3
- Tighten bolts in three stages and in
 sequence shown below:



Stage 1	1 Nm	0.7 ft.lbs.
Stage 2	40 Nm	30 ft.lbs.
Stage 3	Additional 120°	

Special tools



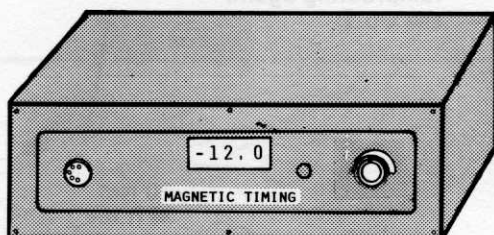
130914

Pressure gauge

capable of accurately measuring pressures 0–100 kPa = 0–15 psi.

Pressure pump

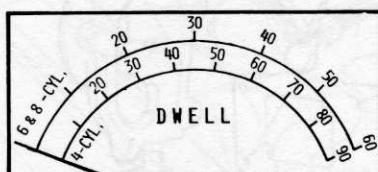
to pump pressures for gauge above. Standard radiator pressure pump can be used.



130683

Magnetic timing unit

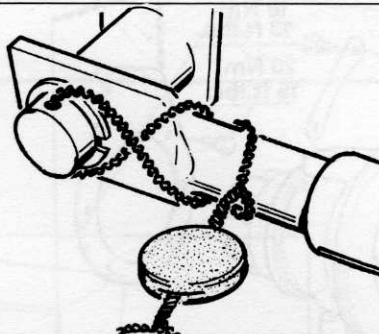
If not available, standard timing light can be used with decreased accuracy.



130847

Good quality dwell meter

capable of accurately measuring 70° with 4-cyl setting. Used to measure lambda system duty cycle.

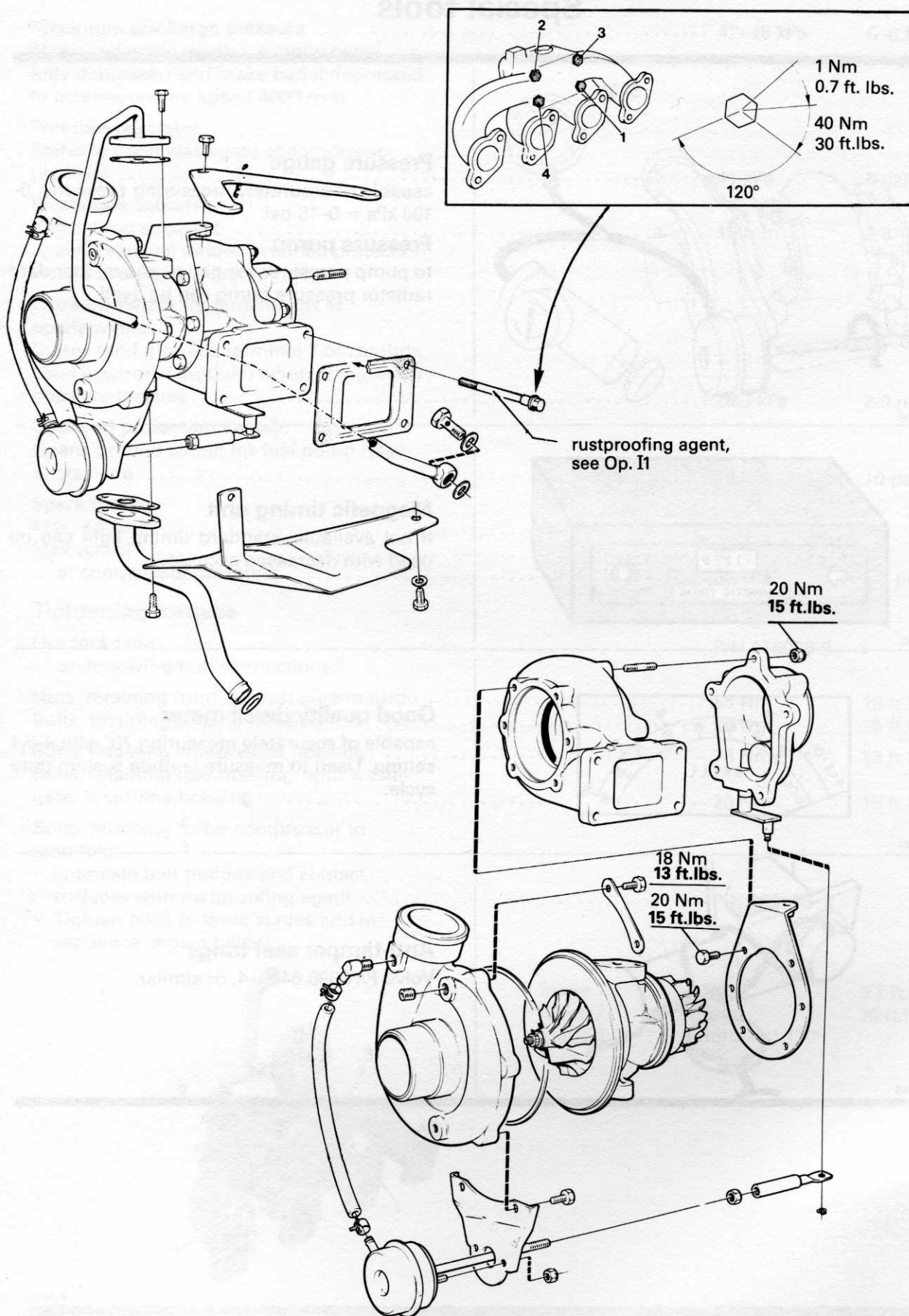


130848

Anti-tamper seal tongs

Volvo P/N 998 6408-4, or similar.

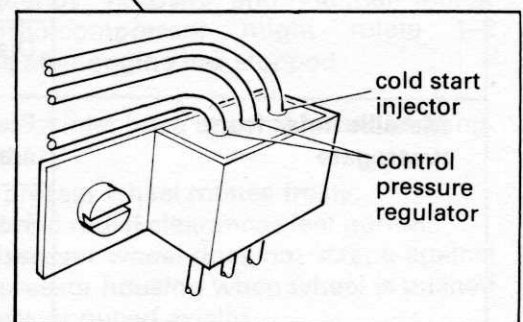
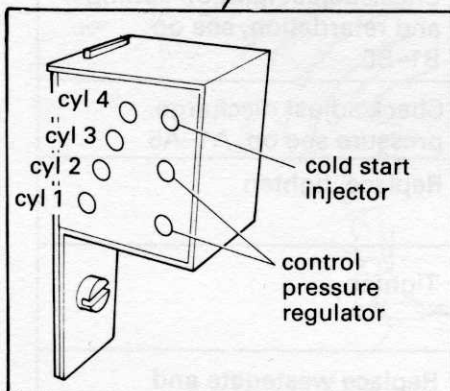
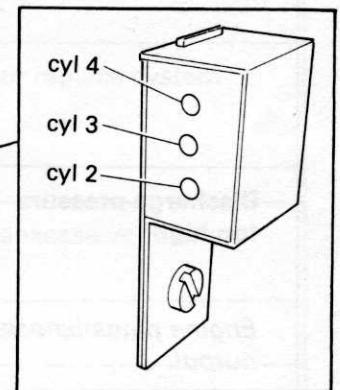
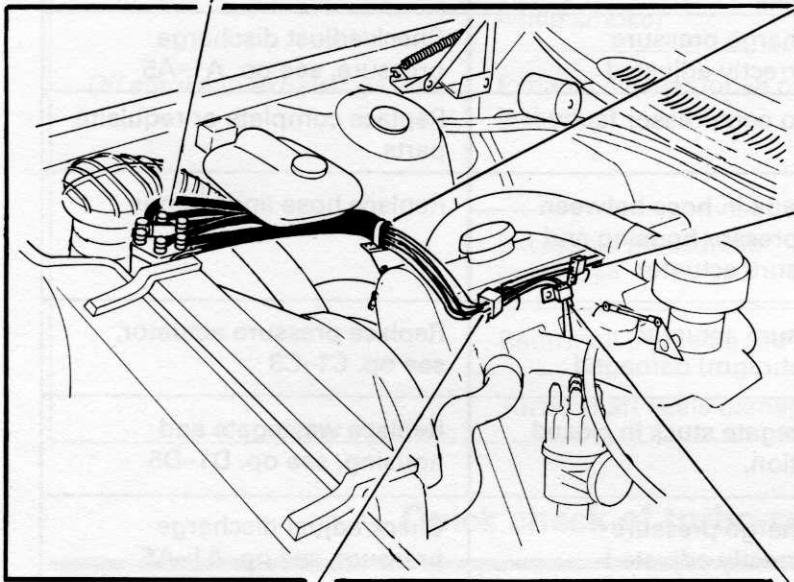
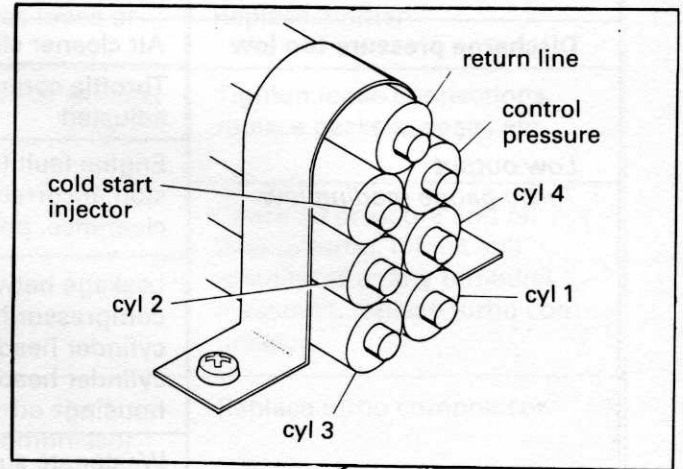
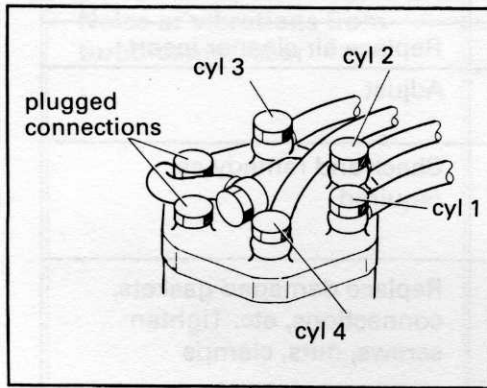
Turbo-compressor, exploded view



130849

Routing of fuel lines

Clean connections thoroughly before disconnecting lines.
Make sure that fuel lines do not rub against other parts.

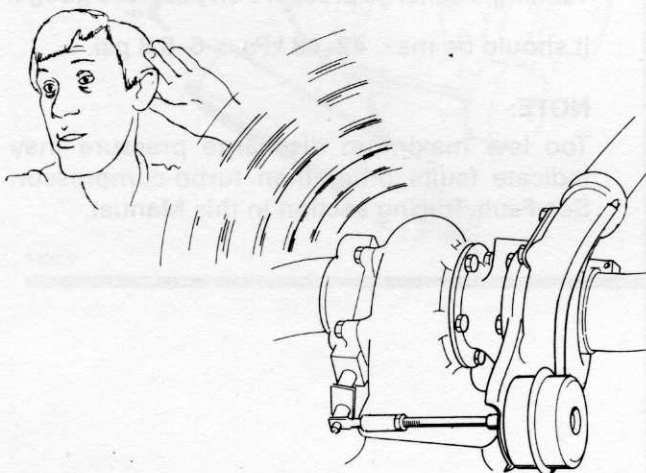


Fault tracing

FAULT Symptom	Reason	Check/remedy
Discharge pressure too low <i>Low output</i> <i>Turbo gauge reading low.</i>	Air cleaner clogged	Replace air cleaner insert
	Throttle control incorrectly adjusted	Adjust
	Engine fault (low compression, incorrect valve clearance, poor fuel supply)	Check and remedy as required
	Leakage between compressor housing and cylinder head or between cylinder head and turbine housing	Replace damaged gaskets, connections, etc. Tighten screws, nuts, clamps
	Wastegate stuck in open position (fully or partly)	Replace wastegate and housing, see op. D1–D5
	Exhaust system partly blocked	Replace
	Discharge pressure incorrectly adjusted	Check/adjust discharge pressure, see op. A1–A5
	Turbo compressor faulty	Replace complete or requisite parts
Discharge pressure too high <i>Engine pings (knocks) at high output.</i> <i>Turbo gauge pointer moves into red sector.</i> <i>Pressure sensor cuts-out (engine stops).</i>	Leakage in hose between compressor housing and pressure actuator	Replace hose and clamps
	Pressure actuator (diaphragm) damaged	Replace pressure actuator, see op. C1–C3
	Wastegate stuck in closed position.	Replace wastegate and housing, see op. D1–D5
	Discharge pressure incorrectly adjusted	Check/adjust discharge pressure, see op. A1–A5
Engine knocks	Fuel not suitable (octane number too low)	Replace fuel
	Ignition setting/retardation incorrect	Check/adjust ignition setting and retardation, see op. B1–B6
	Discharge pressure too high	Check/adjust discharge pressure see op. A1–A5
Metallic noise from wastegate	Preheating plates loose or cracked	Replace, tighten
	Housing for wastegate or exhaust pipe loose	Tighten
	Wastegate loose in guide	Replace wastegate and housing, see op. D1–D5

FAULT Symptom	Reason	Check/remedy
Noise or vibrations from turbo-compressor	Pre-heating plates loose or cracked	Replace, tighten
	Leakage in intake or exhaust system	Tighten loose connections, replace gaskets, seals, etc.
	Poor lubrication of turbo compressor	Check oil pressure and oil flow to turbo. If fault still remains after any remedial measures, replace turbo compressor.
	Inbalance on turbo shaft, turbine wheel or compressor wheel because of damage	Replace turbo compressor
Oil leakage at turbo shaft seals	Air cleaner clogged (oil leakage on inlet side gives white smoke)	Replace air cleaner insert
<i>Oil smoke in exhaust gases</i>	Exhaust system loose or leaks	Tighten or replace system
	Excessive pressure in crankcase	Clean crankcase ventilation
	Return oil pipe clogged	Clean return oil line
	Turbo shaft seals damaged	Replace turbo compressor

Quick check of turbo-compressor



Switch off engine and at the same time listen to turbo-compressor.

With engine at idle, turbo-compressor will normally coast down in 15–20 seconds. If engine RPM is high, oil temperature high—and consequently viscosity and internal friction low—turbo-compressor might rotate 1–2 minutes after engine has stopped.

If not:

Disconnect inlet hose at compressor housing. Check that:

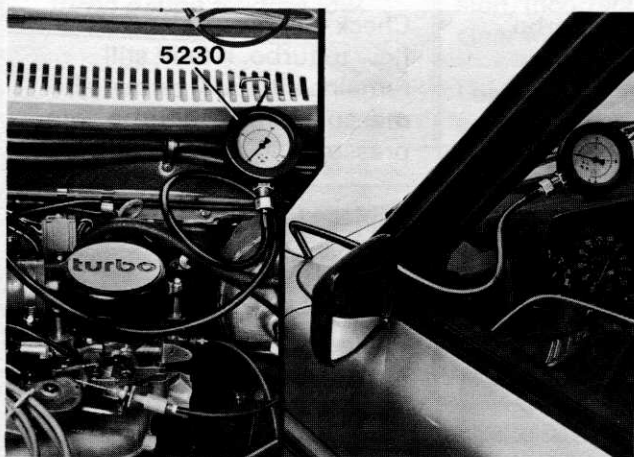
- Compressor wheel rotates freely.
- Axial and radial clearances feel normal.
- Compressor wheel does not scrape against compressor housing when wheel is pushed radially or pulled axially.

Checking/adjusting discharge pressure

Special tool: pressure gauge 5230

CAUTION:

Excessive discharge pressure may damage the engine.



131583

A1

Connect pressure gauge (Volvo 5230)

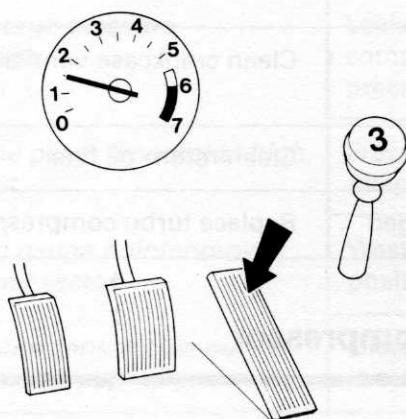
Connect pressure gauge to hose from intake manifold to pressure sensor. Route hose into the car so that gauge can be read from driver's position.

A2

Run engine until warm

Drive on roads until engine is at normal operating temperature.

A3



131619

Check discharge pressure.

Drive in third gear at approx. 1500 rpm.

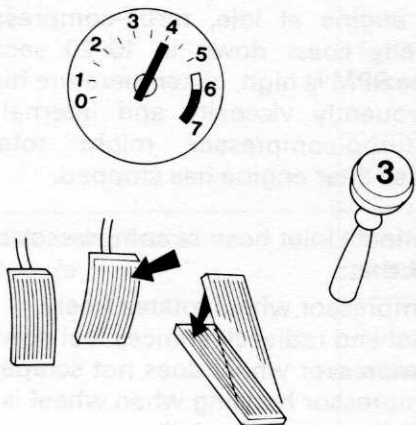
Then depress accelerator pedal to floor.

Keep accelerator pedal depressed, apply brakes at **4000 rpm**. Maintain that rpm while reading discharge pressure on pressure gauge.

It should be max. **42–48 kPa = 6–6.8 psi**.

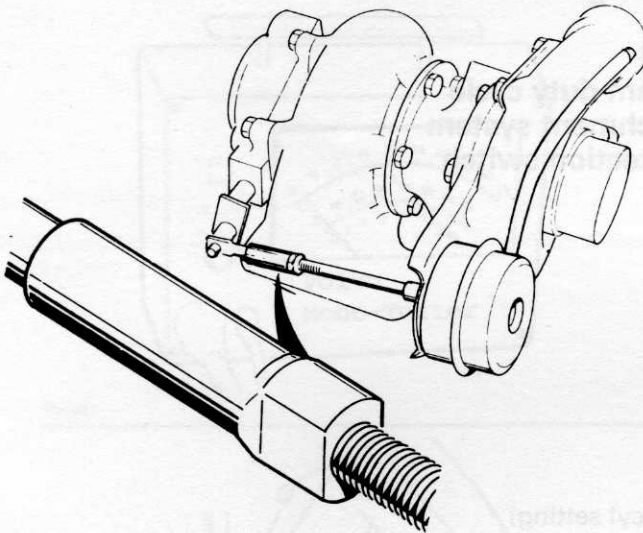
NOTE:

Too low maximum discharge pressure may indicate faults other than turbo-compressor. See Fault Tracing section in this Manual.



130856

Adjusting discharge pressure.

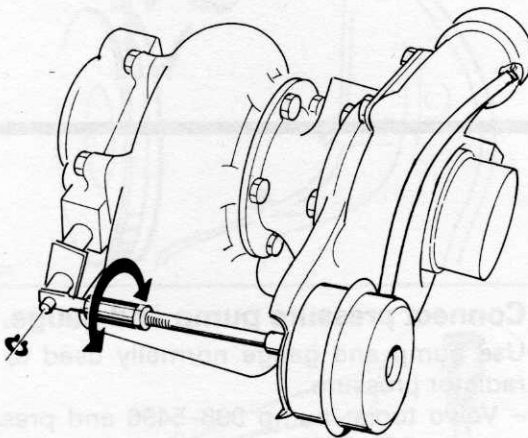


130851

NOTE:

Pressure actuator installed in production cannot be adjusted. Sleeve is crimped to actuator rod.

Pressure actuator must be replaced, see instructions, section "Replacing pressure actuator" in this manual.



130916

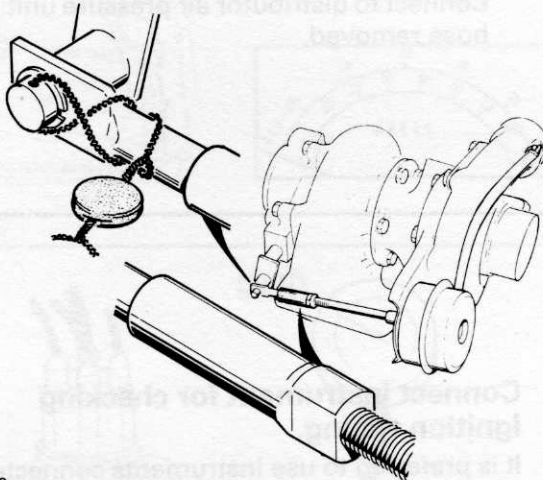
A4

Adjustable, non-production pressure actuator:

Loosen lock nut. Remove lock ring. To adjust, turn sleeve on pressure actuator rod. One turn on sleeve will alter pressure approx. **2 kPa = 0.28 psi**.

Screwing **IN** sleeve **IN**creases discharge pressure, screwing **OUT** sleeve decreases discharge pressure.

After adjustment: install new lock ring and tighten lock nut.



130919

A5

Anti-tamper seal.

It is important to wind wire tightly round actuator rod, as shown. Otherwise seal will loosen due to vibrations.

Volvo anti-tamper seal tongs, part number 998 6408-4, have "Volvo" stamped on grips.

NOTE:

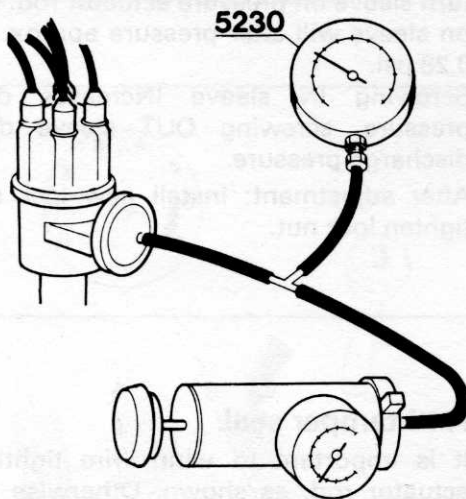
Tampering with Emission Control components may be a violation to Federal regulation's law.

Checking:

- Timing retard
- Lambda system duty cycle
- Full load enrichment system
- Overload protection switch

Equipment:

Pressure pump. (Volvo P/N 998-5496)
Pressure gauge (Volvo P/N 999-5230)
Magnetic Timing Unit (alt. timing light)
High quality dwell meter (scale min. 70° on 4-cyl setting)



B1

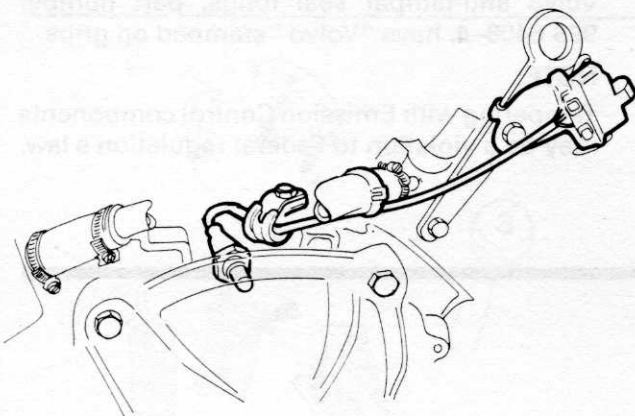
Connect pressure pump and gauge.

Use pump and gauge normally used to test radiator pressure.

- Volvo tools: pump 998-5496 and pressure gauge 999-5230.

Connect to distributor air pressure unit. Plug hose removed.

130639

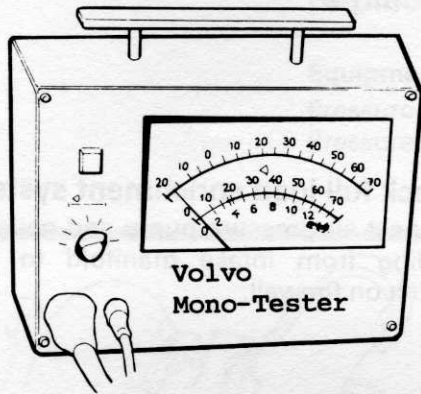


B2

Connect instrument for checking ignition timing.

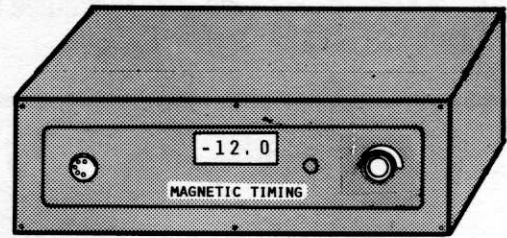
It is preferred to use instruments connected to engine's timing sensor. Provides increased accuracy and safety. In addition, following checks can be made by one man.

130675

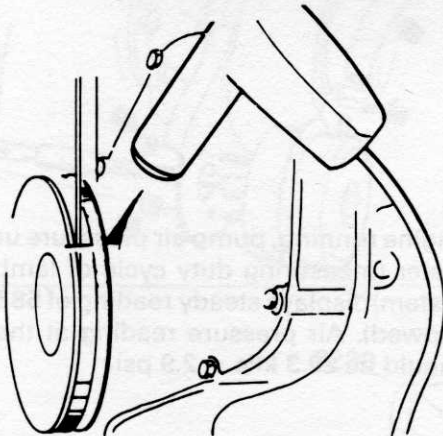


130640

Instruments used are Volvo Mono-Tester or "Magnetic Timing Units" equipped with proper adapter.



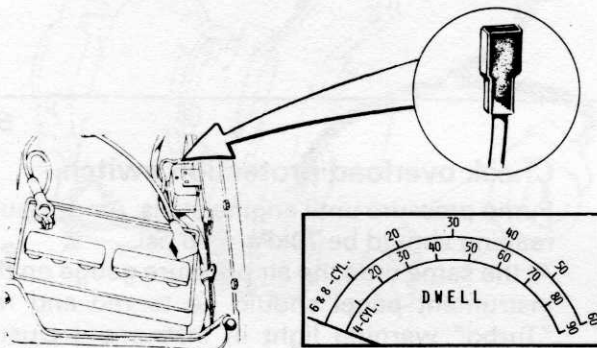
130683



129305

Standard timing light.

Can be used if no other instruments are available. Decreased accuracy is a consequence.



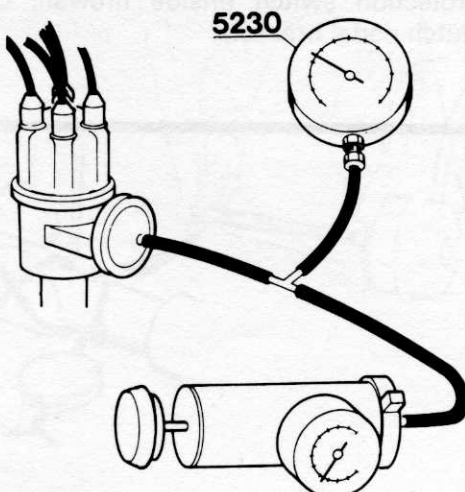
130676

B3

Connect instrument to check Lambda system duty cycle.

For this purpose a high quality dwell meter can be used. Scale must extend to at least 70° (4-cyl, setting).

Dwell meter is connected to Lambda sond service pick-up.



130639

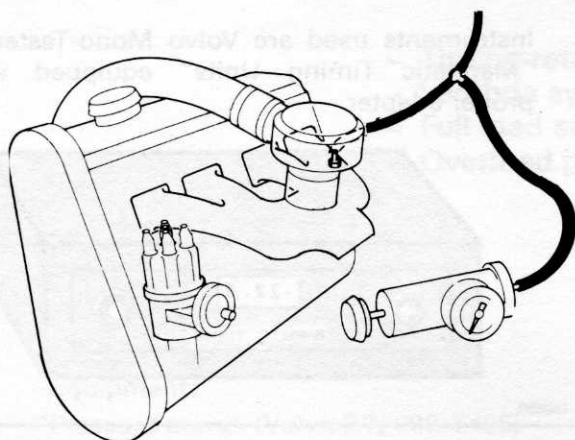
B4

Check timing retard.

Start engine, run at idle. Note ignition timing. Pump pressure to 36 kPa = 5.1 psi.

Ignition timing should retard 6-10°. In case of incorrect reading: check distributor, replace distributor pressure unit, as appropriate. Re-install and clamp pressure hose.

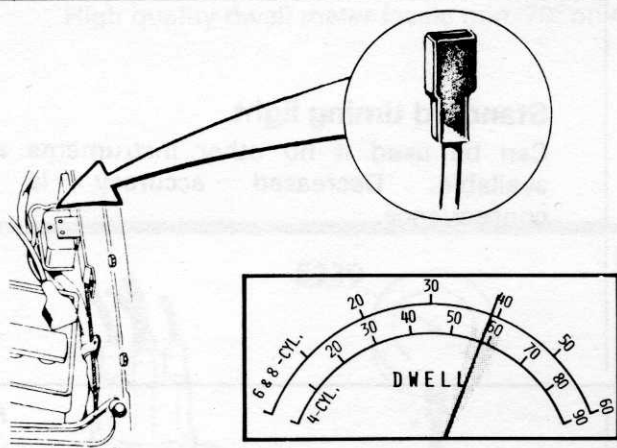
B5



129643

Check full load enrichment system.

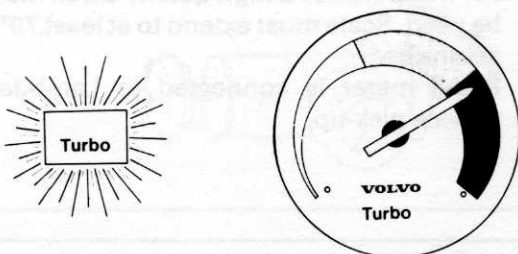
Connect air pressure pump and gauge in line leading from intake manifold to pressure switch on firewall.



130677

Engine running, pump air pressure until dwell meter (measuring duty cycle of lambda sensor system) displays steady reading of **58.5°** (56–62° allowed). Air pressure reading at that instant should be **20.3 kPa = 2.9 psi**.

B6



130678

Check overload protection switch.

Pump pressure until engine stalls. Air pressure reading should be **70kPa = 10 psi**.

At the same time the air pressure gauge on the instrument panel should go to red and red "Turbo" warning light in instrument cluster should illuminate.

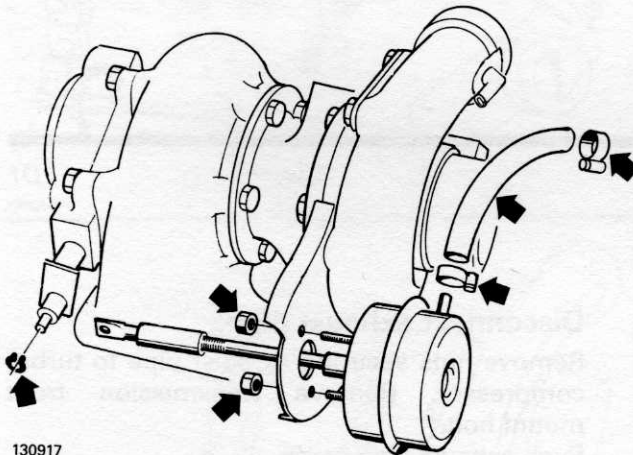
In case of incorrect reading: replace overload protection switch (inside firewall, close to clutch pedal bracket).

Replacing pressure actuator

Equipment:

Pressure pump (Volvo P/N 998-5496)

Pressure gauge (Volvo P/N 999-5230)

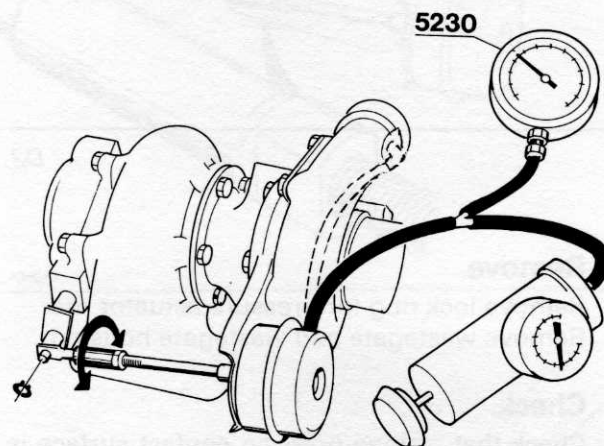


130917

C1

Use standard procedures to replace pressure actuator.

Install **new** nuts. Check pressure hose for damage, replace as necessary. **DO NOT** install hose clamp, **DO NOT** connect hose to compressor.



130914

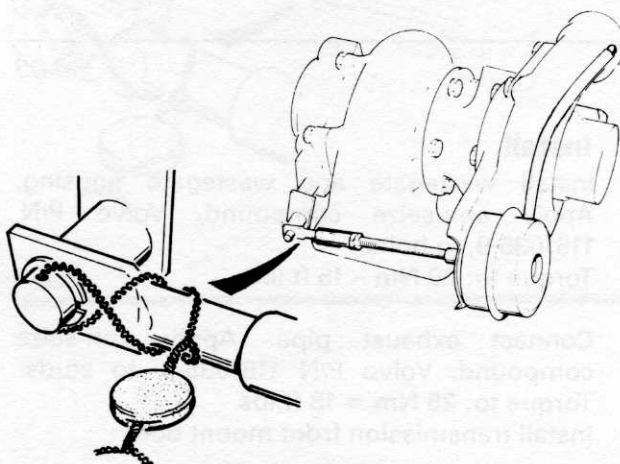
C2

Adjusting discharge pressure.

Connect pressure pump and pressure gauge to pressure actuator.

Pump pressure to **41 kPa = 6 psi**. Push wastegate lever forward to wastegate closed position. Adjust rod end to fit precisely on lever pin. Install **new** lock ring. Tighten lock nut.

Disconnect pressure pump and pressure gauge. Connect and clamp hose to compressor.



130852

C3

Anti-tamper seal.

It is important to wind wire tightly round actuator rod, as shown. Otherwise seal will loosen due to vibrations.

Volvo anti-tamper seal tongs, Paart Number 998 6408-4, have "Volvo" stamped on grips.

NOTE:

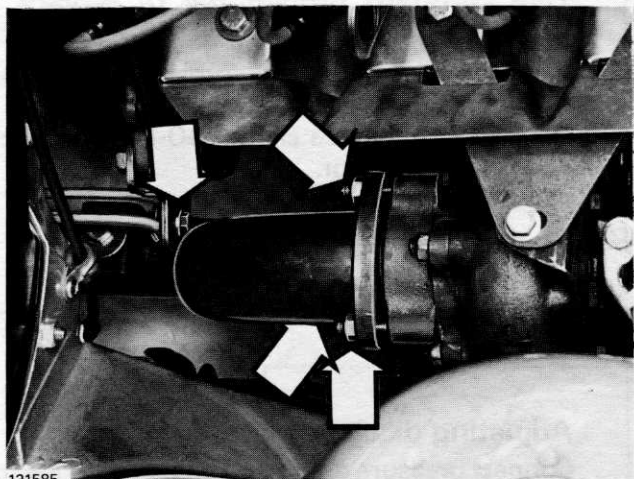
Tampering with emission control components may be a violation to Federal regulation's law.

Replacing wastegate and wastegate housing

Equipment:

Pressure pump (Volvo P/N 998-5496)

Pressure gauge (Volvo P/N 999-5230)

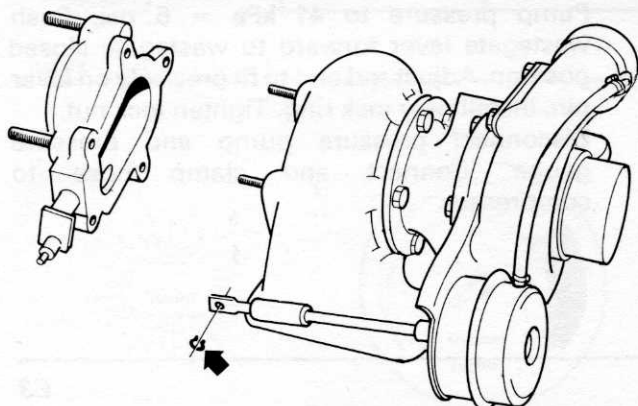


D1

Disconnect exhaust pipe.

Remove nuts securing exhaust pipe to turbo-compressor. Remove transmission front mount bolt.

Push exhaust pipe aside.



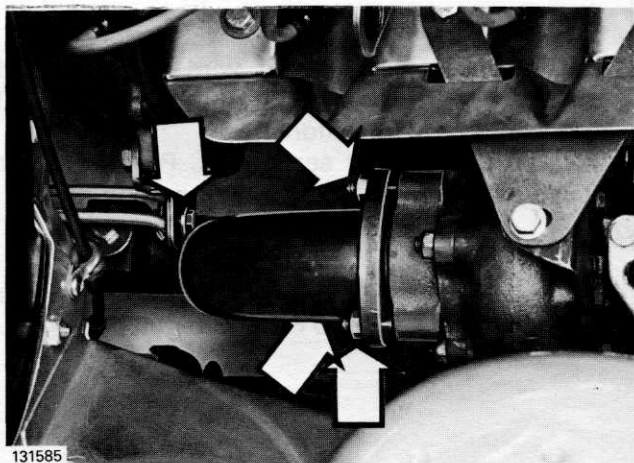
D2

Remove.

Remove lock ring for pressure actuator rod. Remove wastegate and wastegate housing.

Check.

Check that turbine housing contact surface is smooth and that wastegate seat is not burned.



D3

Install.

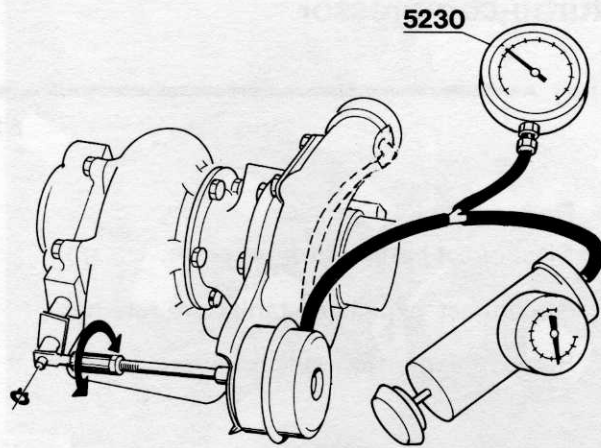
Install wastegate and wastegate housing. Apply anti-seize compound, Volvo P/N 1161035-9, to bolts.

Torque to: **20 Nm** – 15 ft.lbs.

Connect exhaust pipe. Apply anti-seize compound, Volvo P/N 1161035-9, to studs. Torque to: **25 Nm** = 18 ft.lbs.

Install transmission front mount bolt.

D4



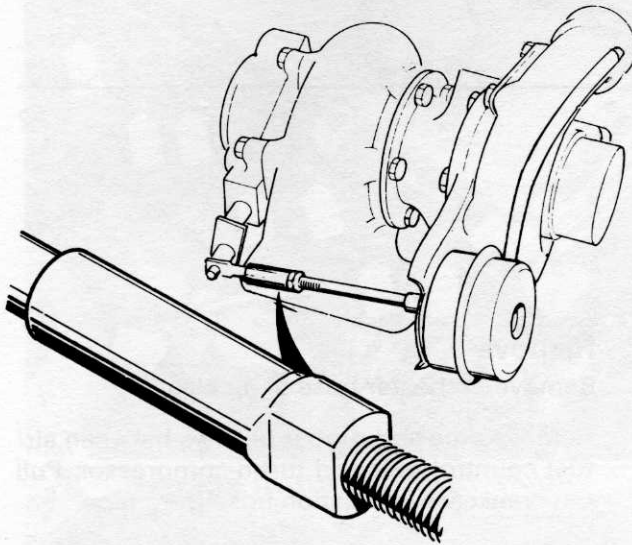
130914

Adjust pressure actuator.

Connect pressure pump and pressure gauge to pressure actuator.

Pump pressure to **41 kPa = 6 psi**. Push wastegate lever forward to wastegate closed position. Adjust rod end to fit precisely on lever pin. Install new lock ring. Tighten lock nut.

Disconnect pressure pump and pressure gauge. Connect and clamp hose to compressor.



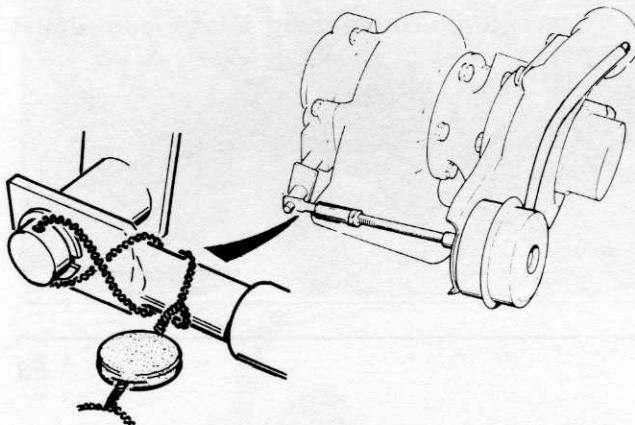
130851

NOTE:

Pressure actuator installed in production cannot be adjusted. Sleeve is rivetted to actuator rod.

Pressure actuator must be replaced, see instructions, section "Replacing pressure actuator" in this manual.

D5



130852

Anti-tamper seal.

It is important to wind wire tight round actuator rod, as shown. Otherwise seal will loosen due to vibrations.

Volvo anti-tamper seal tongs, Part Number 998 6408-4, have "Volvo" stamped on grips.

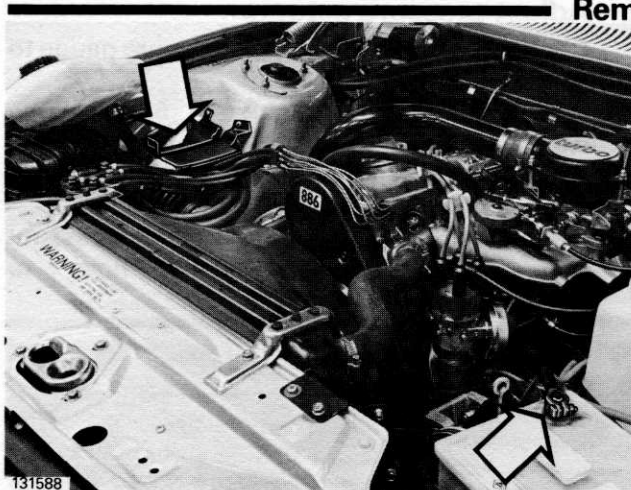
NOTE:

Tampering with emission control components may be a violation to Federal regulation's law.

Removing/installing turbo-compressor

Removing

E1

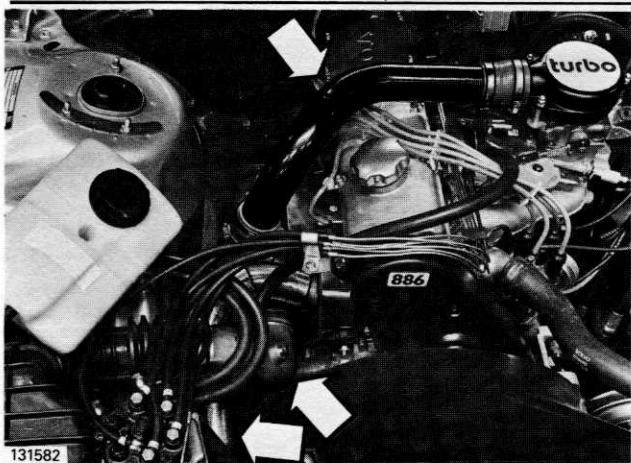


Remove.

Disconnect battery ground cable.

Disconnect expansion tank from retainer.

Remove expansion tank retainer. 3 screws.



E2

Remove

Remove preheater hose to air cleaner.

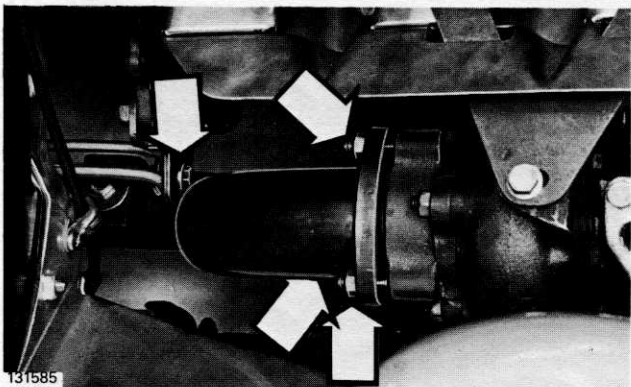
Remove pipe and rubber bellows between air/fuel control unit and turbo-compressor. Pull out crankcase ventilation hose from pipe.

Remove pipe and pipe connector between turbo-compressor and intake manifold.

Cover turbo-compressor intake and outlet ports.

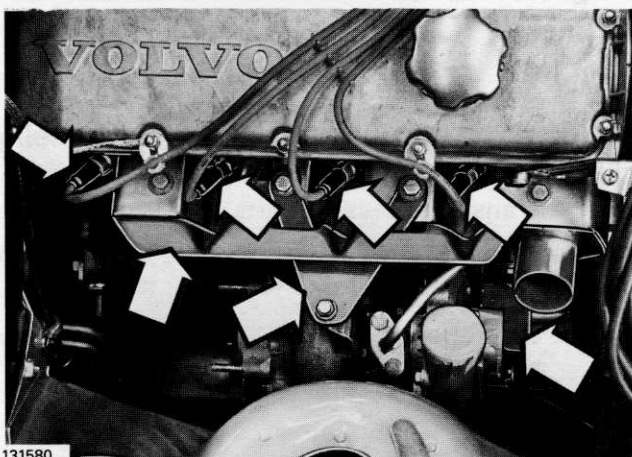


E3



Disconnect exhaust pipe.

Disconnect exhaust pipe and push aside.



131580

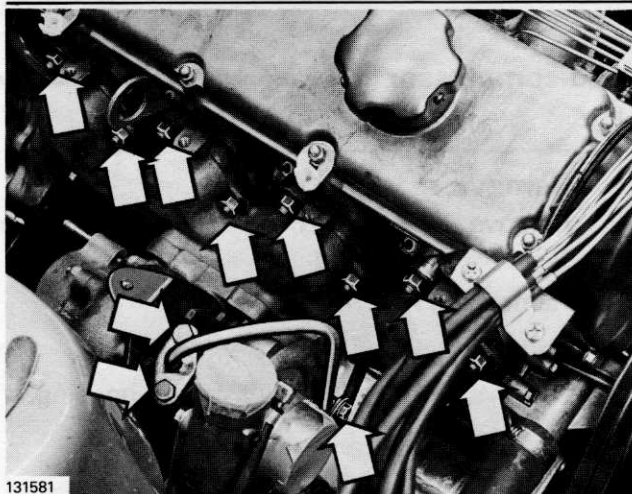
E4

Remove.

Disconnect high tension wires at spark plugs.

Remove upper heat shield. Remove brace between turbo and manifold.

Remove lower heat shield (one retaining screw underneath manifold).



131581

E5

Remove delivery oil pipe.

Remove oil pipe clamp, retaining screws on turbo and pipe connection screw in cylinder block under manifold. DO NOT allow any dirt to enter oilways.

Remove manifold retaining screws and washers. Let one nut remain in position to keep manifold in position.

Remove delivery oil pipe. Cover opening on turbo.



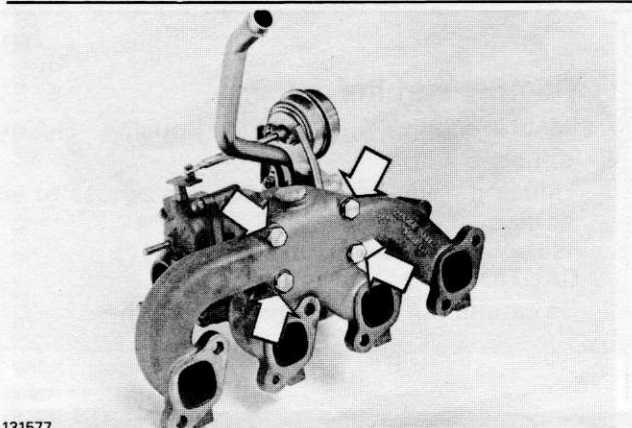
131593

E6

Disconnect air/fuel control unit.

Loosen clamps. Move air/fuel control unit with lower section of air cleaner up to right side wheel housing (place appropriate kind of protection on the wheel housing).

Remove air cleaner filter.



131577

E7

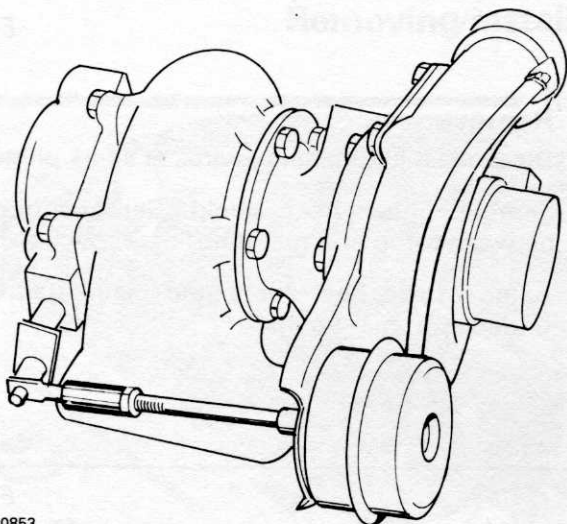
Remove turbo-compressor and manifold.

Remove remaining nut and washer. Lift assembly forward and up.

Remove manifold gaskets. Disconnect return oil pipe O-ring from cylinder block.

E8

Disconnect turbo-compressor from manifold.



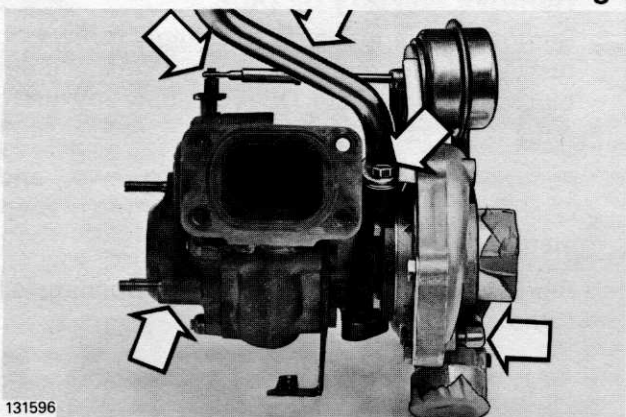
130853

If turbo-compressor assembly is being replaced:

- Transfer necessary parts. Replace gaskets.
- Plug all openings in the old turbo-compressor prior to return for repair.
- See operations I1- I13 for installing new turbo-compressor.

Disassembling turbo-compressor

F1



131596

Remove.

Remove pressure hose from nipple on compressor housing.

Remove oil return pipe.

Remove lock ring on wastegate lever.

Remove wastegate and wastegate housing.

F2



131589

Remove compressor housing.

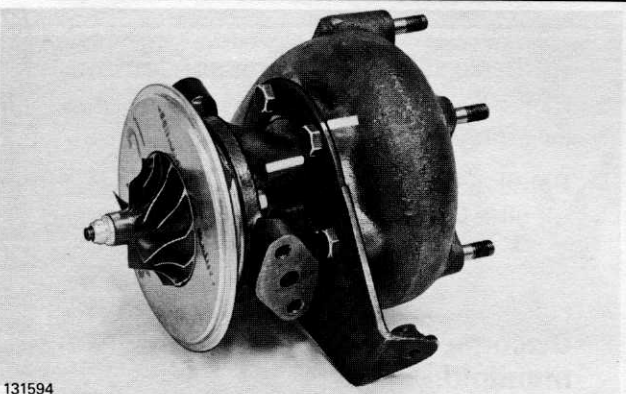
Mark location of pressure actuator on compressor housing and bracket. This must be done accurately to ensure parts are reinstalled to initial position. Otherwise turbo-compressor will not fit to engine.

Housing must be turned to gain access to all bolts.

CAUTION!

Be careful not to damage turbine wheel.

F3



131594

Remove turbine housing.

Mark location of turbine housing clearly opposite a bolt.

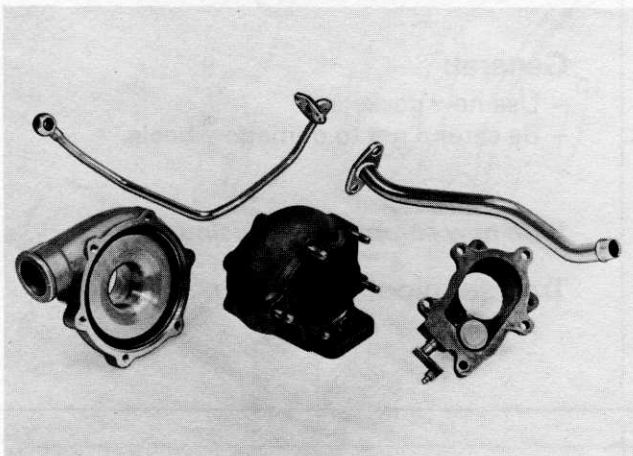
Housing must be turned to gain access to all bolts.

CAUTION!

Be careful not to damage turbine wheel.

Cleaning and inspecting

G1



131598

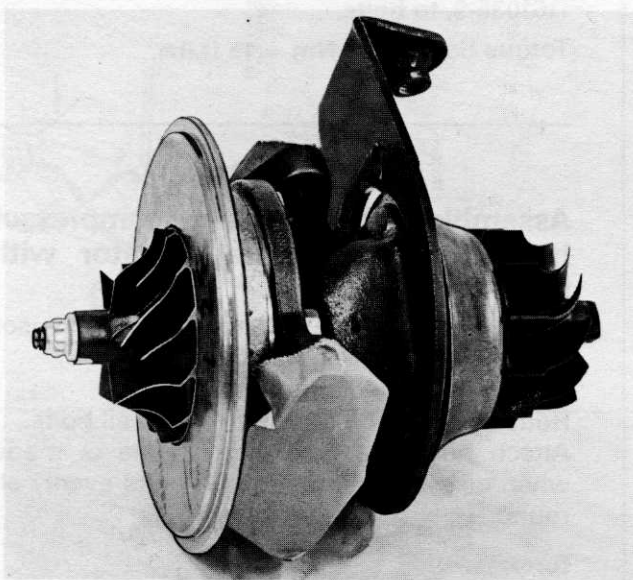
Clean and check:

- Turbine and compressor housings.
- Delivery oil pipe and return oil pipe.
- Wastegate and wastegate housing.

Check these parts for:

- Damage, cracks.
- Wear (that turbine or compressor wheel does not strike housing, etc).
- Smooth contact surfaces.
- Burning damage to wastegate (plate and its contact surface).
- Jamming wastegate lever.
- Clean oil and air passages, free from restrictions.

G2



131584

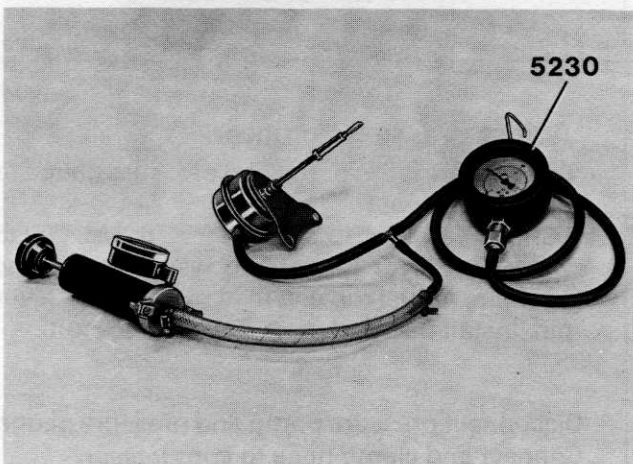
Clean turbine and compressor wheels.

First cover oilways in turbine housing with tape to prevent dirt from entering.

Be very careful when cleaning wheels to avoid damage.

Check for damage and wear. In case of damage, bearing housing assembly complete with wheels must be replaced. Wheel blades must under no circumstances be aligned. Check that shaft runs easily and does not stick. Note that there should always be a clearance between shaft and housing due to design of floating bearings.

G3



131597

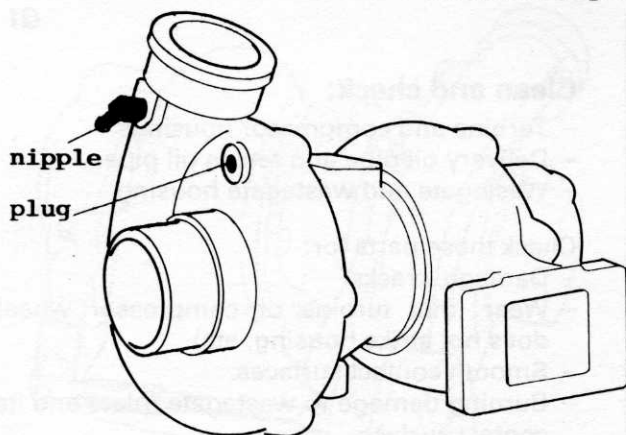
Check pressure actuator.

Connect pressure pump and pressure gauge. Pump pressure and note when actuator rod starts to move. This should happen at a pressure of approx. **41 kPa = 6 psi**.

Pump pressure to **70 kPa**. This test pressure should remain constant for at least 10 seconds.

Assembling turbo-compressor

H1



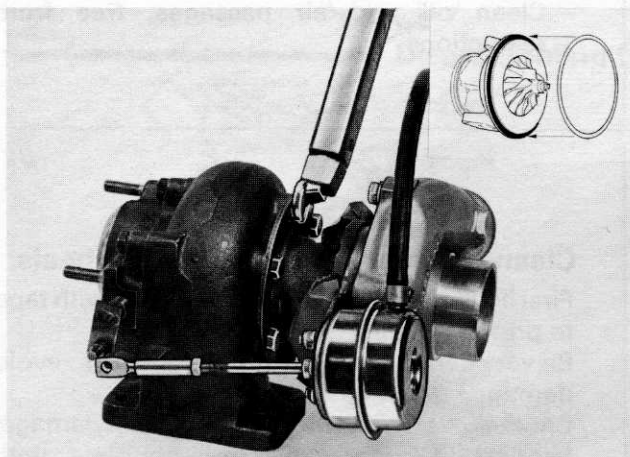
130855

General:

- Use new gaskets.
- Be careful not to damage wheels.

With new compressor housing:**Transfer nipple and plug.**

H2



131579

Install turbine housing and wastegate.

Apply anti-seize compound, Volvo P/N 1161035-9, to bolts.

Torque bolts to **20 Nm** = 15 ft.lbs.

H3

Assemble turbine housing, compressor housing and pressure actuator with bracket.

Install **new** gasket between compressor housing and bearing housing.

Apply anti-seize compound to bolts.

Housings must be turned to install all bolts.

Attach housings according to marks made when disassembling. Tighten bolts evenly all round.

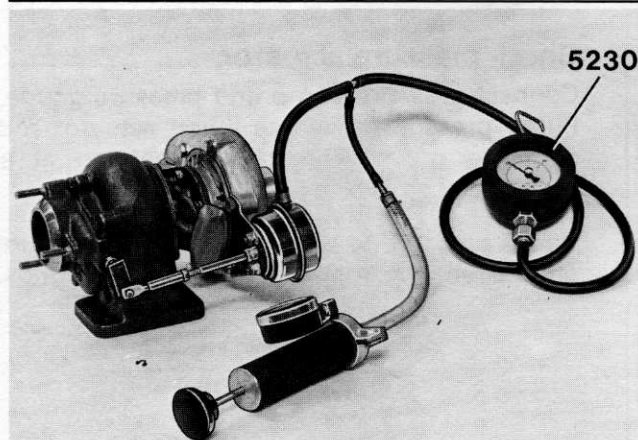
Torques:

- turbine housing **20 Nm** = 15 ft.lbs.
- compressor housing **18 Nm** = 13 ft.lbs.

Special tools for torquing:

- torque wrench P/N 1158687-2
- open end wrench P/N 1158961-1

H4



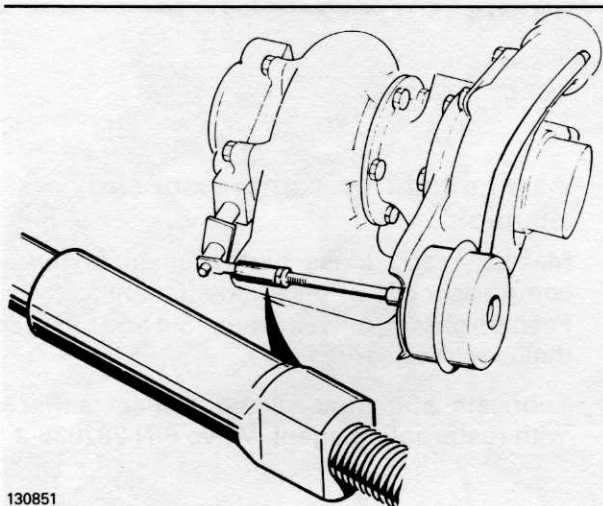
131601

Adjust pressure actuator.

Connect pressure pump and pressure gauge to pressure actuator.

Pump pressure to **41 kPa** = 6 psi. Push wastegate lever forward to wastegate closed position. Adjust rod end to fit precisely on lever pin. Install **new** lock ring. Tighten lock nut.

Disconnect pressure pump and pressure gauge. Connect and clamp hose to compressor.

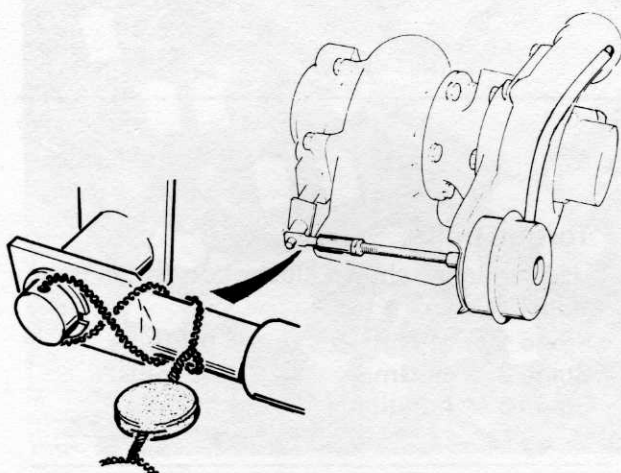


130851

NOTE!

Pressure actuator installed in production cannot be adjusted. Sleeve is crimped to actuator rod.

Pressure actuator must be replaced, see instructions, section "Replacing pressure actuator" in this manual.



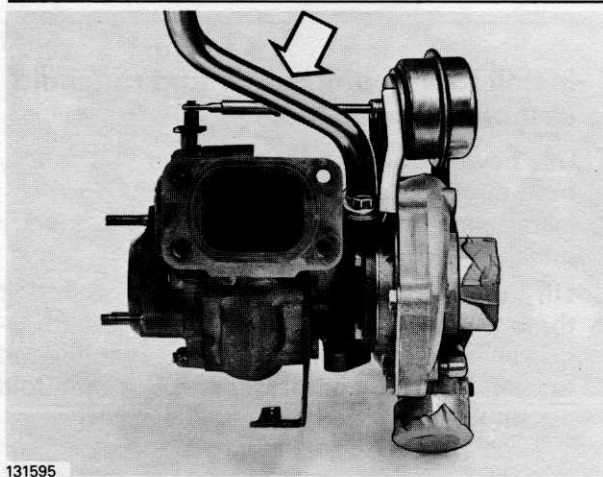
130852

H5

Anti-tamper seal.

It is important to wind wire tight round actuator rod, as shown. Otherwise seal will loosen due to vibrations.

Volvo anti-tamper seal tongs, Part Number 998 6408-4, have "Volvo" stamped on grips.



131595

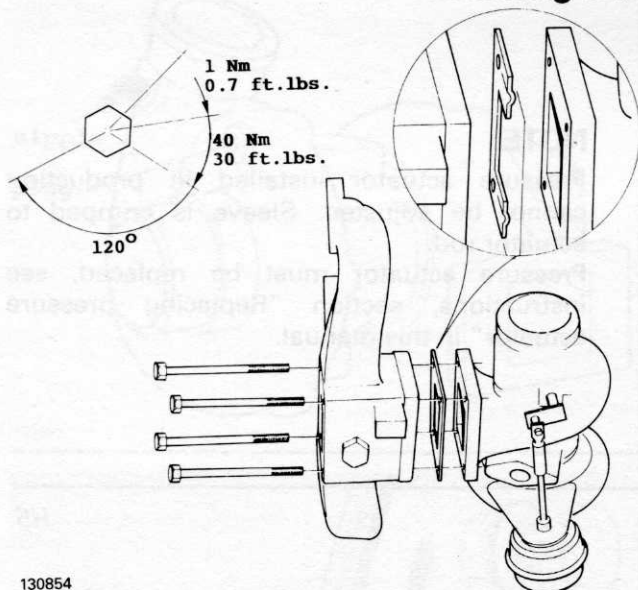
H6

Install oil return pipe.

Use **new** gasket. Make sure gasket hole does not restrict return oil flow.

Installing turbo-compressor

I1



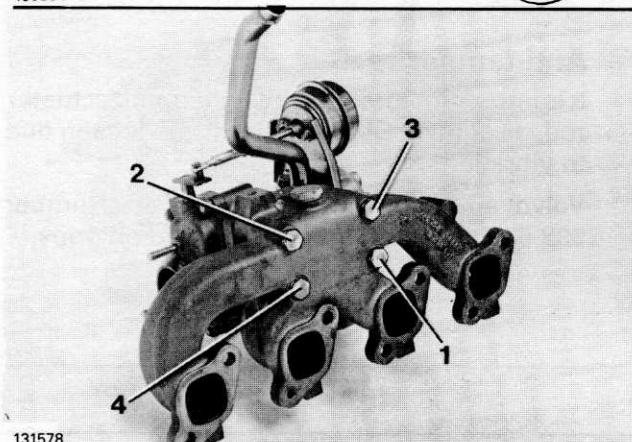
130854

Assemble turbo-compressor and manifold.

Make sure no loose parts remain in turbo-compressor. Cover inlet and outlet holes. Position gasket between manifold and turbo so that extension faces turbo.

Lubricate bolt threads and contact surfaces with rustproofing agent, Volvo P/N 282036-3.

I2



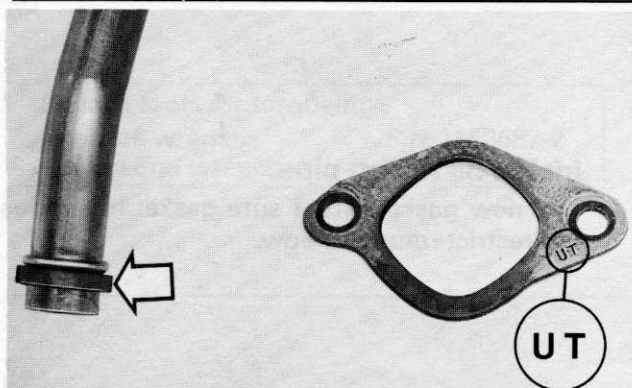
131578

Torque bolts.

Use sequence shown illustration and in three stages:

Stage 1	1 Nm	0.7 ft.lbs.
Stage 2	40 Nm	30 ft.lbs.
Stage 3	Additional 120°	

I3



131591

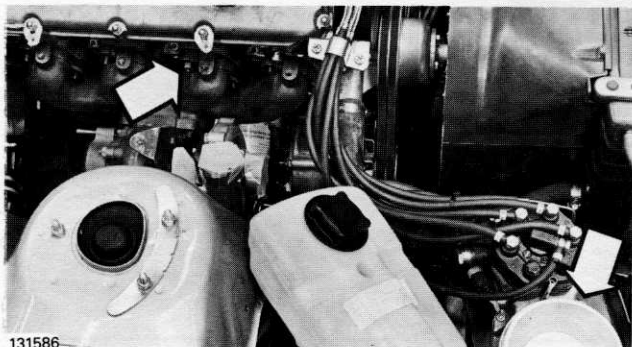
Install turbo-compressor and manifold assembly.

Use new manifold gaskets, word "UT" away from engine.

Install new O-ring on oil return pipe. Lightly grease O-ring.

Lift return oil pipe into position. Guide it through hole in cylinder block. Make sure O-ring seats properly. Install one washer and nut to hold turbo-compressor and manifold assembly in position.

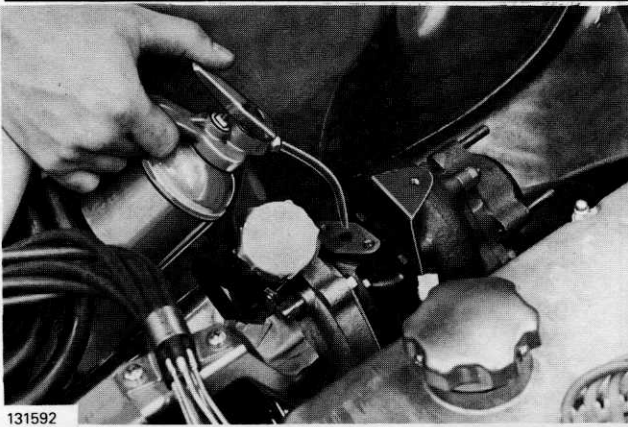
I4



131586

Install air/fuel control unit.

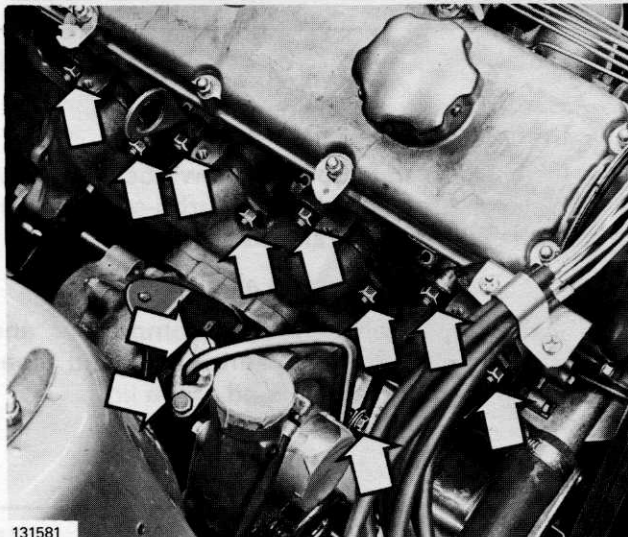
Install air cleaner filter. Attach air/fuel control unit.



131592

15

Fill turbo-compressor oil inlet with oil.



131581

16

Install delivery oil pipe and manifold nuts.

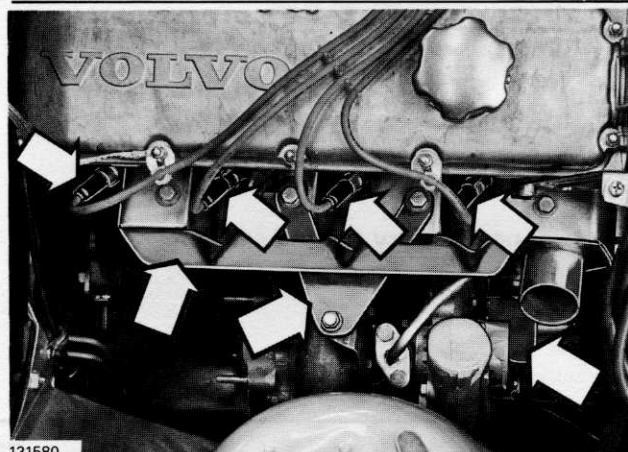
Use new gaskets for delivery oil pipe and new manifold nuts.

Position delivery oil pipe. Install connection screw finger tight. Make sure no dirt enters pipe or clings to bolt.

Install manifold washers and nuts. Do not forget lifting eye. Make sure O-ring on oil return pipes is positioned properly.

Connect delivery oil pipe to turbo-compressor, use new seals. Install delivery oil pipe clamp.

Tighten connection for delivery oil pipe.



131580

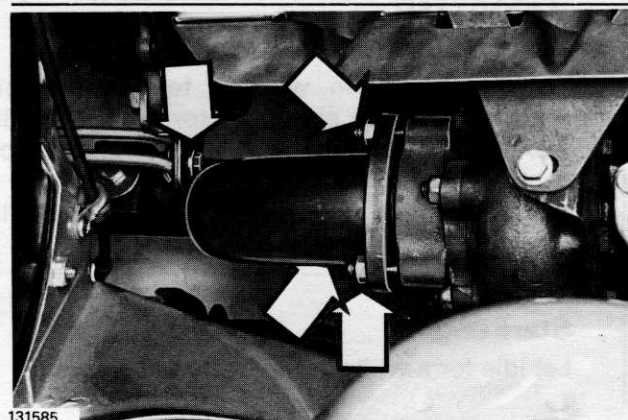
17

Install.

Install upper and lower heat shields.

Install brace between manifold and turbo-compressor.

Connect high tension wires at spark plugs.



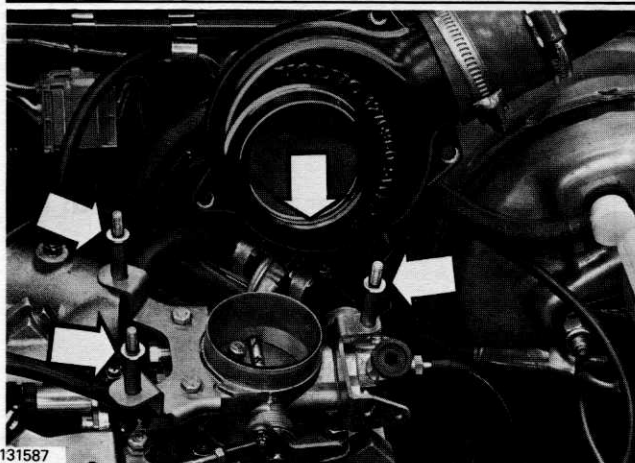
131585

18

Install.

Connect exhaust pipe. Apply anti-seize compound, Volvo P/N 1161035-9, on studs. Torque to **25 Nm** – 18 ft.lbs.

Install transmission front mount.



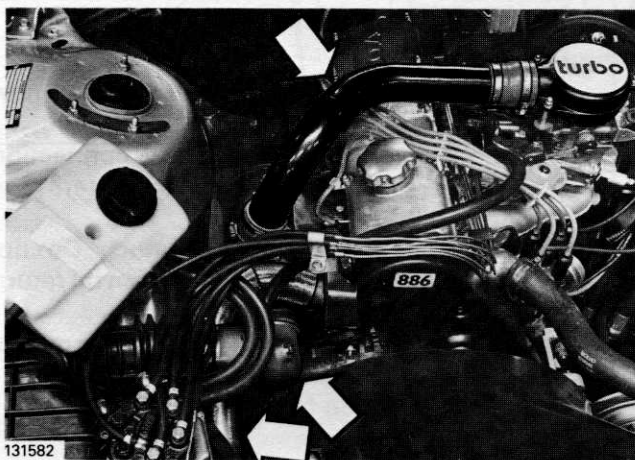
I9

Check.

Make sure throttle housing stud washers are correctly positioned.

Make sure O-ring seats correctly and is undamaged.

Make sure connecting hoses and pipes are in good condition and do not contain any loose particles. Replace hardened or cracked hoses.



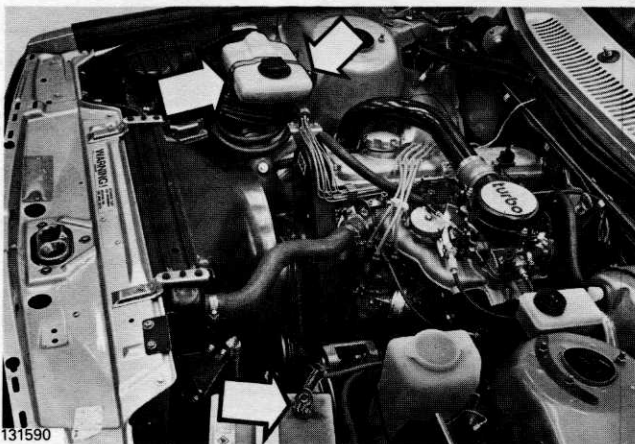
I10

Install.

Install pipe and rubber bellows between air/fuel control unit and turbo-compressor. Connect hose for crankcase ventilation.

Install preheater hose to air cleaner.

Install pipe between turbo-compressor and intake manifold. Make sure hoses and pipes and hose clamps tightened.

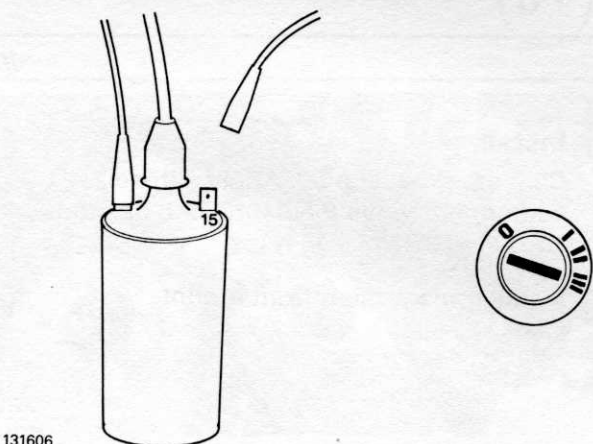


I11

Install.

Install retainer for expansion tank and expansion tank.

Connect battery ground cable.



I12

IMPORTANT:

Run starter motor.

Disconnect brown wire at terminal 15 on ignition coil. Run starter motor for approx 30 seconds to ensure that turbo-compressor receives lubricating oil.

Reconnect wire at terminal 15 on ignition coil.

I13

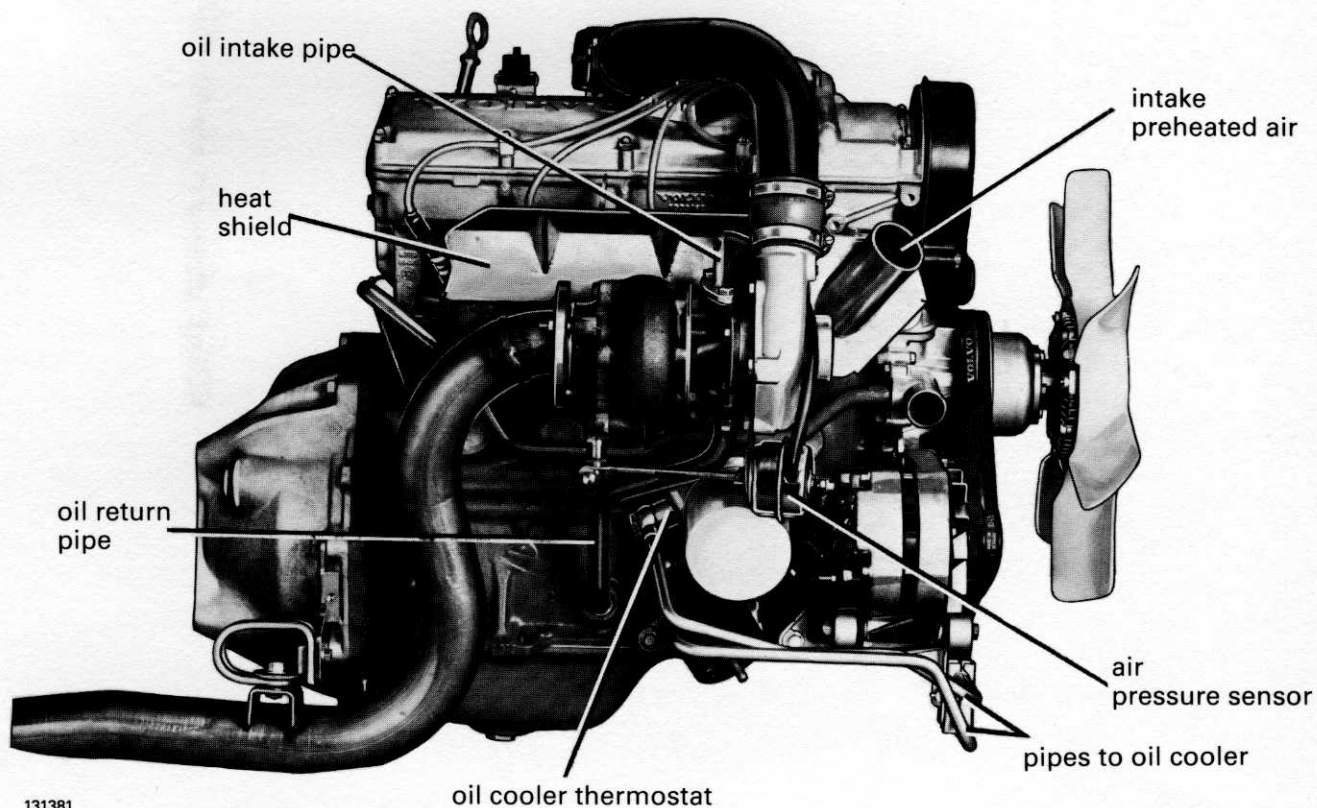
Start engine.

Let idle for a while before increasing speed.

131606

Turbo engine

(Catalytic converter
not shown.)



131381

NOTES



MAINTENANCE CERTIFICATION
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U.S.A. 1999



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