Chapter 4 Part A
Fuel and exhaust systems - carburetted engines

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Specifications

Carburettor make	Nikki
Carburettor model	
3.0 litre models	21J360-38
4.2 litre models	
Manual	21J360-23
Automatic	21J360-24
Fuel pump pressure	
3.0 litre engine	20 kPa (approx.)
4.2 litre engine	25 to 36 kPa
Fuel pump volume, 4.2 litre	2.6 L/minute
Fast idle speed	
3.0 litre engine	1850 to 2150 rpm
4.2 litre engine	
Automatic	1800 to 2200 rpm
Manual	1600 to 2000 rpm
Fast idle actuator engine speed (A/C on)	
3.0 litre engine	750 to 850 rpm
4.2 litre engine	
Automatic	1,050 to 1,150 rpm
Manual	850 to 950 rpm
Fast idle dash pot contact engine speed	
3.0 litre engine	1,900 to 2,100 rpm
4.2 litre engine	1,600 to 1,800 rpm
Vacuum break clearance	
3.0 litre models	3 mm
4.2 litre models	5 mm

1 General information

Warning: *Petrol is extremely flammable, so take extra precautions when you work on any part of the fuel system. Don't smoke or allow open flames or bare light bulbs near the work area, and don't work in a garage where a natural gas-type appliance (such as a water heater or a clothes dryer) with a pilot light is present. Since petrol is carcinogenic, wear latex gloves when there's a possibility of being exposed to fuel, and, if you spill any fuel on your skin, rinse it off immediately with soap and water. Mop up any spills immediately and do not store fuel-soaked rags where they could ignite. When you perform any kind of work on the fuel system, wear safety glasses and have a Class B type fire extinguisher on hand.*

The fuel system on all carburetted models consists of a fuel tank mounted in the rear, a fuel pump and a carburettor. The fuel pump is a mechanical unit mounted on the engine and driven from the fuel pump on 4.2 litre engines. On 3.0 litre engines, the fuel pump is electric, mounted in the fuel tank. A combination of metal and rubber fuel hoses is used to connect these components.

The carburettor is a two-barrel type, operated by a cable. There is also a hand-operated throttle cable located on the dash.

2 Fuel pump/fuel pressure check

Warning: *Petrol is extremely flammable, so take extra precautions when you work on any part of the fuel system. See* **Warning** *in Section 1.*

Note: *It is a good idea to check the fuel pump and lines for any obvious damage or fuel leakage. Also check all hoses from the tank to the pump, particularly the suction hoses at the fuel tank and pump which, if they have are cracked, may not allow fuel to the fuel pump. It is also possible for the fuel pump diaphragm to rupture internally and leak fuel into the crankcase. If you have excess fuel consumption or fuel smell, and you can't find any external leaks, check the condition of the engine oil for any signs of fuel mixing with the engine oil; the oil level will usually be abnormally high and the oil will be thinned out and have a fuel smell.*

3.0 litre engine

1 Relieve the fuel system pressure by removing the fuel pump fuse from the driver side kick panel fuse box.

2 Start the engine and allow it to idle until it stalls.

3 Crank the engine for another three seconds.

4 Refit the fuel pump fuse. This completes the procedure for relieving the fuel pressure. It is now safe to disconnect fuel fittings on this model.

5 Disconnect the fuel supply hose where it connects to the vapour separator at the carburettor. Cap the outlet of the vapour separator. The vapour separator resembles a small fuel filter with three spigots located at the carburettor.

6 Connect a fuel pressure gauge to the fuel supply hose.

7 Turn the ignition switch ON and read the fuel pressure. The pressure must be approximately the value listed in this Chapter's Specifications.

8 Remove the gauge and place the fuel hose into an approved petrol container.

9 Energise the fuel pump again and observe the quantity of fuel pumped into the container to check the fuel pump volume.

10 If the fuel pump does not appear to operate, turn the ignition switch to ON and listen for its buzzing from the area of the fuel tank. If it operates, check for a clogged fuel filter or a collapsed line.

11 If you cannot hear it run, remove the access cover from the fuel tank (refer to Section 4).

12 Disconnect the wiring from the fuel pump and check for voltage between the green and red wire and earth with the ignition switch ON. If there is no voltage, check the fuel pump fuse and the engine control fuse in the fuse box. Also check the fuel pump electronic control unit, located below the fuse box.

13 If there is voltage, yet the fuel pump will not operate, renew it.

4.2 litre engine

Refer to illustration 2.14

14 Disconnect the fuel line from the carburettor and refit a T-fitting. Connect a fuel pressure gauge to the T-fitting with a section of fuel hose **(see illustration)**.

15 Pinch the small fuel return hose at the fuel pump using locking pliers or remove the hose and plug it.

16 Start the engine and allow it to idle. The pressure on the gauge should fall within the values listed in this Chapter's Specifications. It should remain constant and return to zero slowly when the engine is shut off. **Note:** *If the engine will not start, crank the engine until you get a reading on the gauge.*

17 An instant pressure drop indicates a faulty outlet valve and the fuel pump must be renewed.

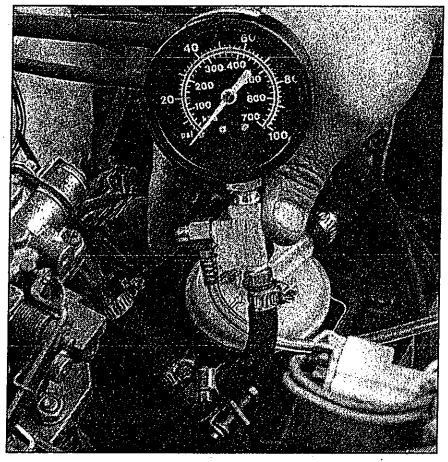
18 If the pressure is too high, check the air vent to see if it is plugged before renewing the pump.

19 If the pressure is too low, be sure the fuel hoses and lines are in good shape and not plugged, then renew the pump.

20 Remove the gauge and place the fuel hose into a container.

21 Crank the engine with the starter and observe the quantity of fuel pumped into the container to check the fuel pump volume. Compare the reading to the Specifications listed in this Chapter.

22 Observe the fuel pump to see if there is any fuel escaping from the weep hole. If there is, it must be renewed at once.



2.14 Connect the fuel pressure gauge into the fuel inlet line with a T-fitting

3 Fuel lines and fittings - inspection and renewal

Warning: *Petrol is extremely flammable, so take extra precautions when you work on any part of the fuel system. See* **Warning** *in Section 1.*

Inspection

1 Once in a while, you will have to raise the vehicle to service or renew some component (an exhaust pipe hanger, for example). Whenever you work under the vehicle, always inspect the fuel lines and fittings for possible damage or deterioration.

2 Check all hoses and pipes for cracks, kinks, deformation or obstructions.

3 Make sure all hose and pipe clips attach their associated hoses or pipes securely to the underside of the vehicle.

4 Verify all hose clamps attaching rubber hoses to metal fuel lines or pipes are snug enough to insure a tight fit between the hoses and pipes.

Renewal

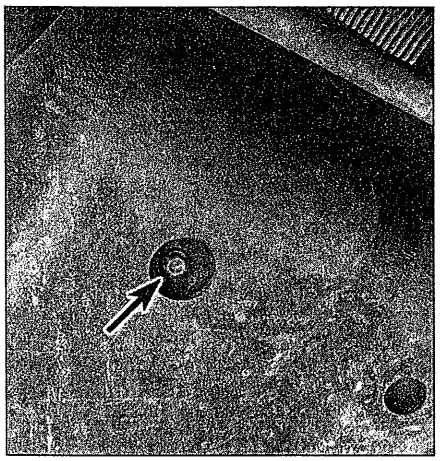
5 If you must renew any damaged sections, use hoses approved for use in fuel systems or pipes made from steel only (it's best to use an original-type pipe from a dealer that's already flared and pre-bent). Do not refit substitutes constructed from inferior or inappropriate material, as this could result in a fuel leak and a fire.

6 Always, before detaching or disassembling any part of the fuel line system, note the routing of all hoses and pipes and the orientation of all clamps and clips to insure that renewal sections are refitted in exactly the same manner.

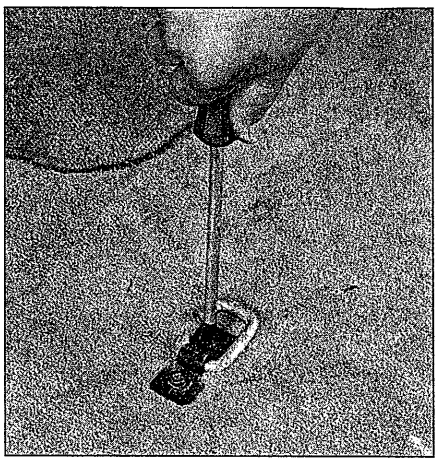
7 Before detaching any part of the fuel system, be sure to relieve the fuel tank pressure by removing the fuel filler cap.

8 Always use new hose clamps after loosening or removing them.

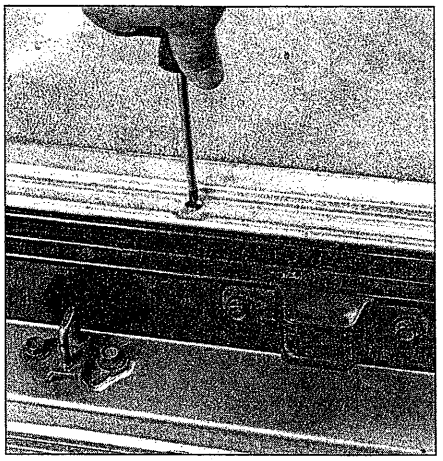
9 While you're under the vehicle, it's a



4.3 The fuel tank is equipped with a drain plug (arrow) - drain it into an approved safety container

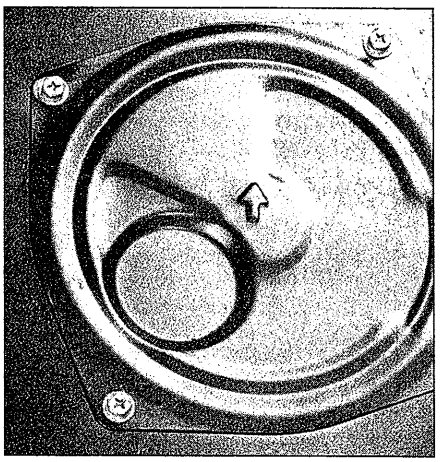


4.4 Remove the tie-downs from the rear floor area

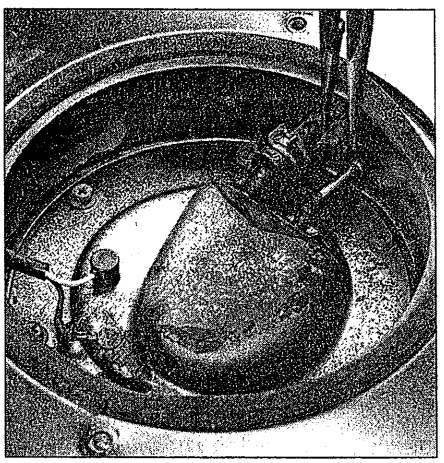


4.5a The rear trim strip must be removed

4.5b When the carpet is folded back, the access panel is revealed



4.6 Remove the four screws securing the access panel



4.7a Disconnect the hoses at the tank

good idea to check the following related components:

a) *Check the condition of the fuel filter - make sure that it's not clogged or damaged (see Chapter 1).*
b) *Inspect the evaporative emission control (EVAP) system. Verify that all hoses are attached and in good condition* (see Chapter 6).

4 Fuel tank - removal and refitting

Refer to illustrations 4.3, 4.4, 4.5a, 4.5b, 4.6, 4.7a and 4.7b

Warning: *Petrol is extremely flammable, so take extra precautions when you work on any part of the fuel system. See* **Warning** *in Section 1.*

Note: *The following procedure is much easier to perform if the fuel tank is empty. Most tanks have a drain plug for this purpose. If the tank does not have a drain plug, or if the drain plug is damaged, drain the fuel into an approved fuel container using a commercially available siphoning kit (NEVER start the siphoning action by mouth) or wait until the fuel tank is nearly empty.*

1 Remove the fuel tank filler cap to relieve fuel tank pressure. On 3.0 litre models, relieve the fuel system pressure (refer to Section 2).

2 Detach the cable from the negative terminal of the battery.

3 If the tank has a drain plug, remove it and allow the fuel to collect in an approved petrol container **(see illustration).**

4 Remove the tie-downs from the floor of the rear of the vehicle **(see illustration).**

5 Remove the carpet edge trim from the rear door area **(see illustration).** Fold the carpet forward **(see illustration).**

6 Remove the fuel tank access cover and set it aside **(see illustration).**

7 Disconnect the hoses and the wiring **(see illustrations). Note:** *Be sure to plug the hoses to prevent leakage and contamination of the fuel system.*

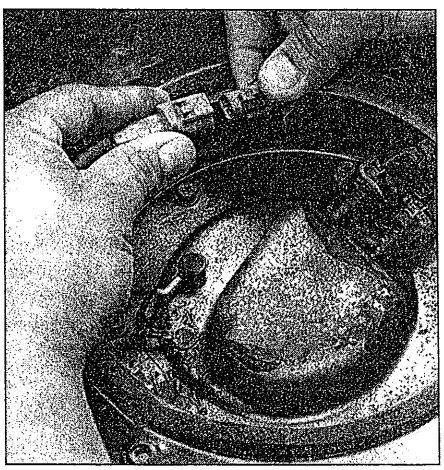
8 Raise the vehicle and place it securely on jackstands.

9 Remove the stone shield from the right side wheel housing.

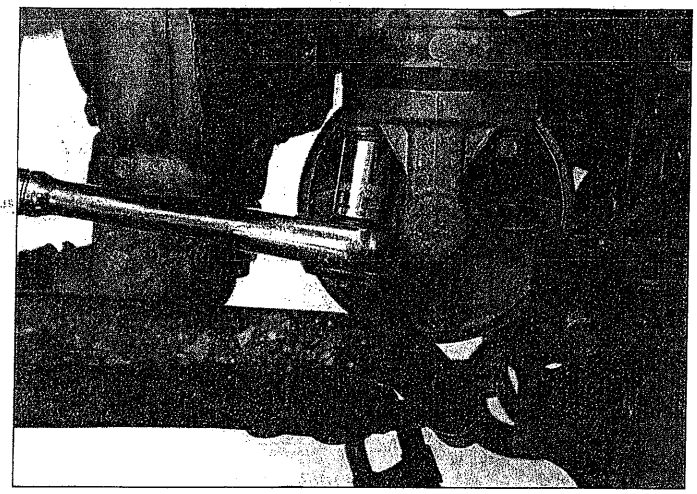
10 Loosen the clamps which secure the filler and vapour tubes.

11 Remove the fuel tank protector from the bottom of the fuel tank.

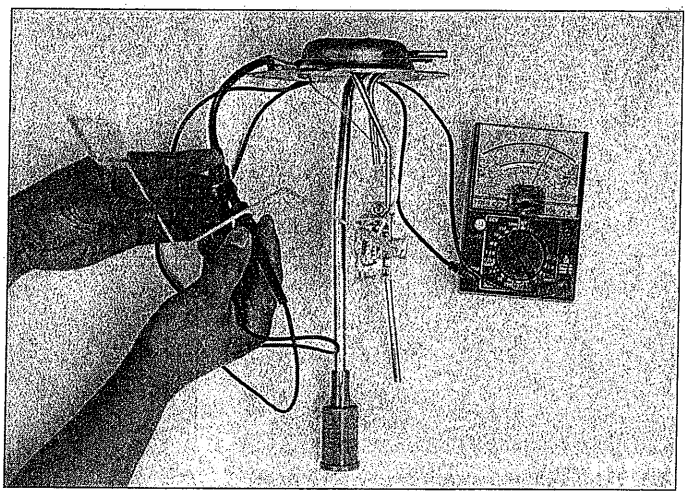
12 Support the fuel tank with a floor jack or have an assistant help you to steady it. Position a piece of wood between the jack head



4.7b Disconnect the wiring at this connector - not at the tank itself



6.9 The 4.2 litre fuel pump is a conventional mechanical unit mounted to the side of the engine with an insulator



7.8a Hold the float in the FULL position and record the ohmmeter reading

and the fuel tank to protect the tank. Remove the fuel tank retaining bolts and lower the tank carefully. Make certain that the tubes and hoses are free as it comes out.

13 Refitting is the reverse of removal.

5 Fuel tank cleaning and repair - general information

1 All repairs to the fuel tank or filler neck should be carried out by a professional who has experience in this critical and potentially dangerous work. Even after cleaning and flushing of the fuel system, explosive fumes can remain and ignite during repair of the tank.

2 If the fuel tank is removed from the vehicle, it should not be placed in an area where sparks or open flames could ignite the fumes coming out of the tank. Be especially careful inside garages where a natural gas-type appliance is located, because the flame could cause an explosion.

6 Fuel pump - removal and refitting

Warning: *Petrol is extremely flammable, so take extra precautions when you work on any part of the fuel system. See* **Warning** *in Section 1.*

3.0 litre engine

1 Remove the access cover from the floor of the rear of the vehicle (refer to Section 4). Relieve the fuel system pressure (refer to Section 2).

2 Disconnect the fuel hoses and the wiring (see Section 4).

3 Remove the fuel pump/fuel level sender bolts from the fuel tank cover.

4 Very slowly and carefully lift the entire assembly from the fuel tank. Do not allow the float arm to become bent while removing it (see Section 7).

5 Remove the fuel pump from the assembly.

6 Refitting is the reverse of removal. Check the condition of the cover O-ring and renew it if necessary.

4.2 litre engine

Refer to illustration 6.9

7 Disconnect the negative battery cable.

8 Remove the hoses from the fuel pump. Label the two larger hoses to avoid confusion later.

9 Remove the fuel pump and its insulator from the engine **(see illustration)**.

10 Check the insulator for damage and renew it if necessary.

11 Clean the fuel pump, insulator and engine mounting surfaces thoroughly. Renew the gaskets.

12 Refitting is the reverse of removal.

7 Fuel level sending unit - check and renewal

Warning: *Petrol is extremely flammable, so take extra precautions when you work on any part of the fuel system. See* **Warning** *in Section 1.*

Check

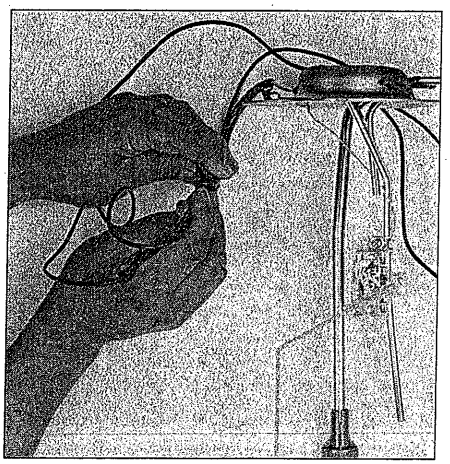
Refer to illustrations 7.8a and 7.8b

1 Before performing any tests on the fuel level sending unit, completely fill the tank with fuel.

2 Remove the access cover from the floor of the rear of the vehicle (refer to Section 4).

3 Disconnect the fuel level sending unit electrical connector located near the top of the fuel tank. Do not disconnect the wires from the fuel tank itself.

4 Position the ohmmeter probes onto the G and E terminals of the electrical connector and check the resistance. On 3.0 litre models, these are the two terminals closest to the tab on the connector.



7.8b With the float in the EMPTY position, again record the ohmmeter reading

5 With the fuel tank completely full, the resistance should be about 5 ohms.

6 Drive it until the tank is nearly empty and then reconnect the ohmmeter.

7 Check the resistance. The resistance of the sending unit should be about 80 ohms.

8 If the readings are incorrect, renew the sending unit. **Note:** *The test can also be performed with the fuel level sending unit removed from the fuel tank. Using an ohmmeter, check the resistance of the sending unit with the swing arm completely down (tank empty) and with the arm up (tank full). The resistance should change steadily from 80 ohms to approximately 5 ohms* **(see illustrations)**.

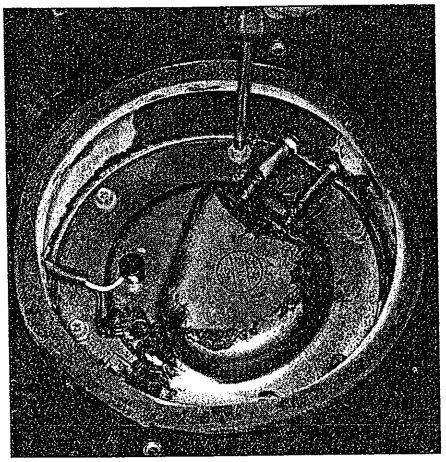
Renewal

Refer to illustrations 7.11, 7.12a and 7.12b

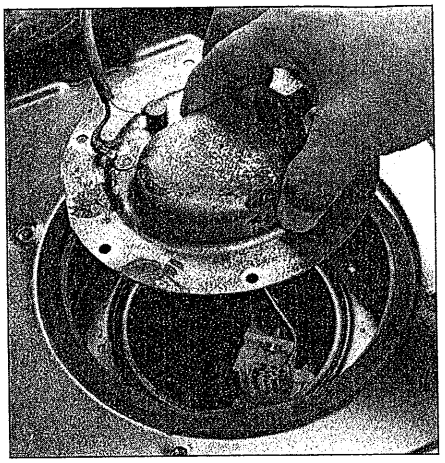
9 On 3.0 litre vehicles, relieve the fuel system pressure (refer to Section 2).

10 Disconnect the hoses and wiring (see Section 4).

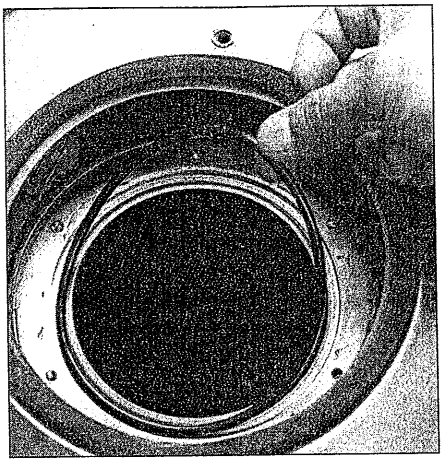
11 Remove the cover screws from the top of the fuel tank **(see illustration)**.



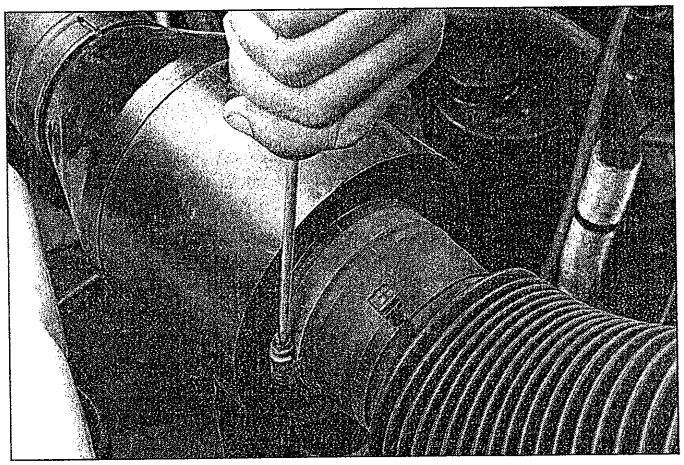
7.11 The fuel tank cover can be removed after disconnecting the wiring and hoses



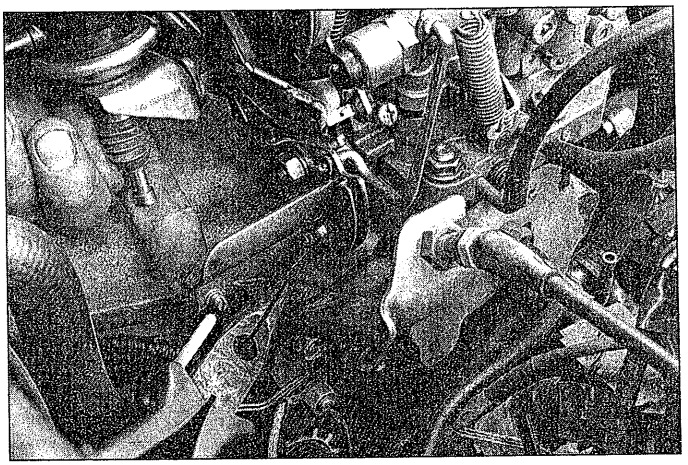
7.12a Be extremely careful as you lift the assembly from the fuel tank - it is very delicate



7.12b Always check the condition of the O-ring - it must not be cracked or hardened



8.6 Loosen the cyclone pre-air filter clamps and pull the duct and the air pre-heater off before unbolting it from the wheel housing



9.1 Hold the throttle fully open and then disconnect the cable from it

12 Carefully angle the sending unit out of the opening without damaging the fuel level float located at the bottom of the assembly **(see illustrations).**

13 Disconnect the electrical connectors from the sending unit.

14 Remove the screw from the side of the sending unit bracket and separate the sending unit from the assembly.

15 Refitting is the reverse of removal.

8 Air cleaner housing - removal and refitting

Refer to illustration 8.6

Note: *Refer to Chapter 1 for removal and service procedures for the air filter and the cyclone pre-air filter.*

1 Remove the air filter from the air cleaner housing (see Chapter 1).

2 Remove the bolt securing the air cleaner to the heat riser.

3 Disconnect any vacuum hoses or electrical connectors that would interfere with air cleaner removal and mark them with pieces of numbered tape for reassembly purposes.

4 Remove the bolts from the air cleaner bracket to the engine.

5 Lift the air cleaner assembly from the engine compartment.

6 Loosen the clamp at the cyclone pre-air cleaner and then remove the heat riser unit **(see illustration).**

7 Remove the cyclone pre-air cleaner from the inner wheel housing.

8 Refitting is the reverse of removal.

9 Accelerator cable and hand throttle cable - removal, refitting and adjustment

Accelerator cable

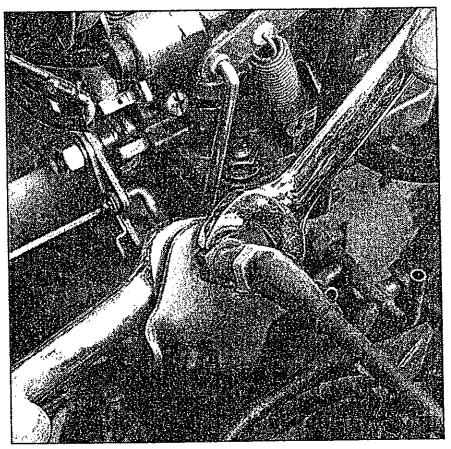
Refer to illustrations 9.1 and 9.2

Removal

1 Remove the accelerator cable from the throttle linkage by first opening the throttle full and then disconnecting the cable **(see illustration).**

2 Loosen the accelerator cable locknuts and remove the cable from the bracket assembly **(see illustration).**

3 Remove the cable from the throttle pedal inside the vehicle.



9.2 Two spanners will be needed to remove the cable housing from the adjustment bracket

4 Remove the cable brackets.
5 Pull the cable assembly through the firewall into the vehicle.

Refitting

6 Refitting is the reverse of removal. **Note:** *To prevent possible interference, flexible components (hoses, wires, etc.) must not be routed within 50 mm of moving parts, unless routing is controlled by brackets, etc.*
7 Operate the accelerator pedal and check for any binding condition by completely opening and closing the throttle.
8 If necessary, at the engine compartment side of the firewall, apply sealant around the accelerator cable to prevent water and hot air from entering the passenger compartment.

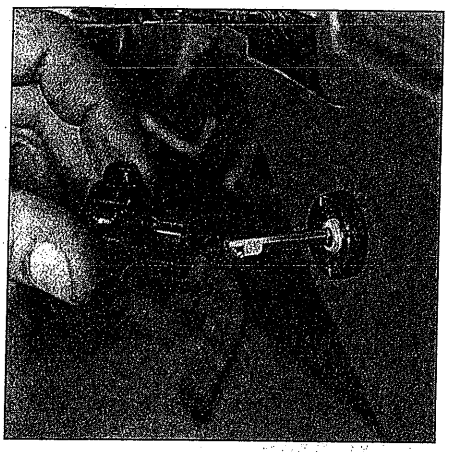
Adjustment

9 There is no specific adjustment on this type of accelerator cable but it is necessary to check that there is a small amount of freeplay in the cable when the throttle pedal is released completely and that the carburettor throttle is near full open when the pedal is pressed to the floor.
10 Have an assistant operate the throttle pedal while you observe the carburettor and the cable. Make certain that the hand throttle is fully released.

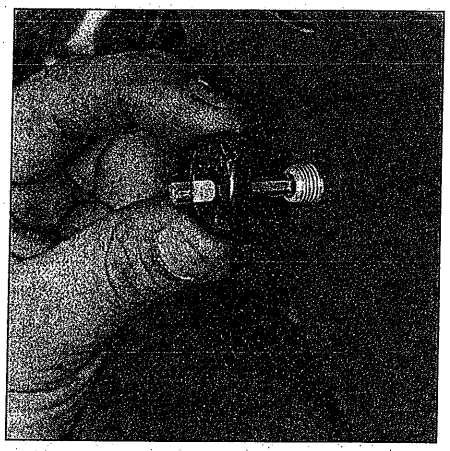
Hand throttle cable

Refer to illustrations 9.12a and 9.12b

11 The hand throttle cable is removed and refitted in a similar manner. Disconnect the lower end from the throttle pedal.
12 Remove the hand throttle control knob from the cable end shaft by removing the outer cover of the knob first **(see illustrations)**.
13 Unscrew the retaining nut from the dash.
14 Pull the shaft through the dash opening.
15 Make certain that the adjustment of the hand throttle cable allows adequate freeplay in the cable so that the carburettor can fully return to the idle position when the knob is turned fully counter-clockwise.



9.12a Pull the cover from the hand throttle knob and then remove the knob



9.12b The retainer unscrews to allow the cable to be pushed through the dash

10 Carburettor - diagnosis and overhaul

Warning: *Petrol is extremely flammable, so take extra precautions when you work on any part of the fuel system. See* **Warning** *in Section 1.*

Diagnosis

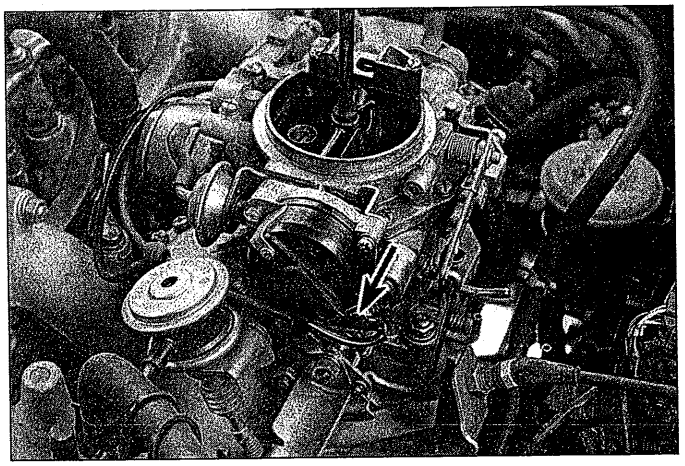
1 A thorough road test and check of carburettor adjustments should be done before any major carburettor service. Specifications for some adjustments are listed on the Vehicle Emissions Control Information (VECI) label found in the engine compartment.
2 Carburettor problems usually show up as flooding, hard starting, stalling, severe backfiring and poor acceleration. A carburettor that's leaking fuel and/or covered with wet looking deposits definitely needs attention.
3 Some performance complaints directed at the carburettor are actually a result of loose, out-of-adjustment or malfunctioning engine or electrical components. Others develop when vacuum hoses leak, are disconnected or are incorrectly routed. The proper approach to analysing carburettor problems should include the following items:

a) *Inspect all vacuum hoses and actuators for leaks and correct refitting* (see Chapters 1 and 6).
b) *Tighten the inlet manifold and carburettor mounting nuts/bolts evenly and securely.*
c) *Perform a compression test and vacuum test* (see Chapter 2C).
d) *Clean or renew the spark plugs as necessary* (see Chapter 1).
e) *Check the spark plug wires* (see Chapter 1).
f) *Inspect the ignition primary wires.*
g) *Check the ignition timing (follow the instructions printed on the Emissions Control Information label).*
h) *Check the fuel pump pressure/volume* (see Section 2).
i) *Check the heat control valve in the air cleaner for proper operation* (see Chapter 1).
j) *Check/renew the air filter element* (see Chapter 1).
k) *Check the PCV system* (see Chapter 6).
l) *Check/renew the fuel filter* (see Chapter 1). *Also, the strainer in the tank could be restricted.*
m) *Check for a plugged exhaust system.*
n) *Check EGR valve operation* (see Chapter 6).
o) *Check the choke - it should be completely open at normal engine operating temperature* (see Chapter 1).
p) *Check for fuel leaks and kinked or dented fuel lines* (see Chapters 1 and 4).
q) *Check accelerator pump operation with the engine off (remove the air cleaner cover and operate the throttle as you look into the carburettor throat - you should see a stream of petrol enter the carburettor).*
r) *Check for incorrect or bad petrol.*
s) *Check the valve clearances (if applicable) and camshaft lobe lift* (see Chapters 1 and 2).
t) *Have a dealer service department or other repair shop check the electronic engine and carburettor controls.*

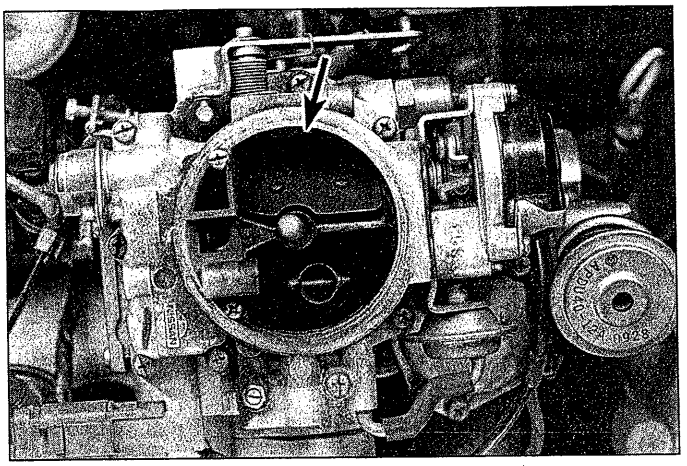
4 Diagnosing carburettor problems may require that the engine be started and run with the air cleaner off. While running the engine without the air cleaner, backfires are possible. This situation is likely to occur if the carburettor is malfunctioning, but just the removal of the air cleaner can lean the fuel/air mixture enough to produce an engine backfire. **Warning:** *Do not position any part of your body, especially your face, directly over the carburettor during inspection and servicing procedures. Wear eye protection!*

Overhaul

5 Once it's determined that the carburettor needs an overhaul, several options are available. If you're going to attempt to overhaul the carburettor yourself, first obtain a good-quality carburettor rebuild kit (which will include all necessary gaskets, internal parts, instructions and a parts list). You'll also need some special solvent and a means of blowing out the internal passages of the carburettor with air.
6 An alternative is to obtain a new or rebuilt carburettor. They are readily available from dealers and auto parts stores. Make absolutely sure the exchange carburettor is identical to the original. A tag is usually attached to the top of the carburettor or a number is stamped on the float bowl. It will help determine the exact type of carburettor you have. When obtaining a rebuilt carburettor or a rebuild kit, make sure the kit or carburettor matches your application exactly. Seemingly insignificant differences can make a large difference in engine performance.
7 If you choose to overhaul your own carburettor, allow enough time to disassemble it



11.8 Test the choke wire (arrow) for battery voltage with the engine running



11.14 Take the measurement for the vacuum break adjustment between the choke blade and the wall of the air horn (arrow)

carefully, soak the necessary parts in the cleaning solvent (usually for at least one-half day or according to the instructions listed on the carburettor cleaner) and reassemble it, which will usually take much longer than disassembly. When disassembling the carburettor, match each part with the illustration in the carburettor kit and lay the parts out in order on a clean work surface. Overhauls by inexperienced mechanics can result in an engine which runs poorly or not at all. To avoid this, use care and patience when disassembling the carburettor so you can reassemble it correctly.

8 Because carburettor designs are constantly modified by the manufacturer in order to meet increasingly more stringent emissions regulations, it isn't feasible to include a step-by-step overhaul of each type. You'll receive a detailed, well illustrated set of instructions with the carburettor overhaul kit.

11 Carburettor adjustments and checks

Note: *These carburettor adjustments are strictly in-vehicle adjustments. During overhaul, refer to the instructions included in the overhaul kit for complete procedures and any additional adjustments that are required.*

Fast idle speed

1 Warm up the engine.

2 With the engine turned off, open the throttle slightly and then position the fast idle cam to the second step.

3 Start the engine but do not operate the throttle or the fast idle cam setting will be lost.

4 Check the idle speed with an accurate tachometer. Compare the reading with the value listed in this Chapter's Specifications.

5 Adjust the fast idle speed by turning the fast idle adjustment screw until the engine rpm is correct.

Idle mixture

Note: *Be sure to check the ignition timing, the condition of the spark plugs and spark plug wires and, if necessary, perform a complete tune-up before attempting to make the following carburettor adjustment. Often, problems with the mixture are due to a vacuum leak (see* Troubleshooting *at the front of this manual and the vacuum gauge checks in Chapter 2C).*

6 Refer to Chapter 1 for idle speed and mixture adjustments.

Automatic choke

Refer to illustration 11.8

7 Refer to Chapter 1 for basic maintenance checks of the automatic choke. It should be fully closed when the engine is cold and not running and fully open when it is warm. The index marks on the cover of the choke thermostat must be aligned.

8 If the choke does not open, check for battery voltage at the wire connected to the choke **(see illustration)**. The engine must be running for this test.

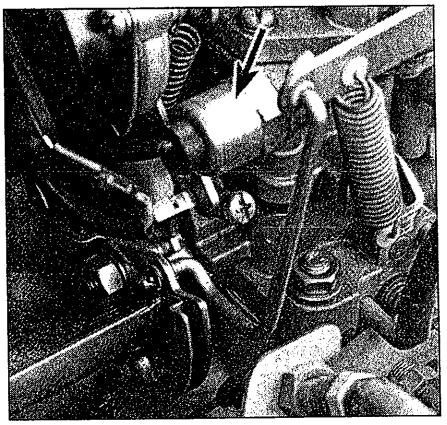
9 If there is power to the choke and the choke fails to open, then the choke thermostat is defective. Renew it.

10 If there is no power to the choke, check the wiring in the circuit and the choke relay. The choke relay is located in the relay centre near the battery.

Vacuum break

Refer to illustration 11.14

11 Make certain that the engine is cold. Open the throttle and allow it to return. The choke should be totally closed.



11.15 The fuel cut solenoid (arrow) is located on the side of the carburettor body

12 Use a hand vacuum pump to apply vacuum to the vacuum break diaphragm.

13 Gently push the rod towards the choke breaker.

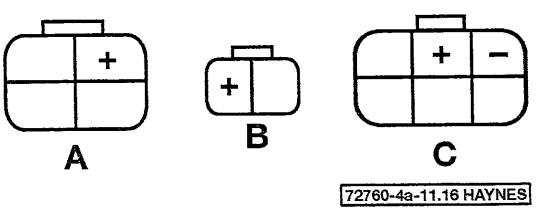
14 Use the shank of a drill bit to measure the clearance between the bore and the choke blade **(see illustration)**. Compare it to the figure listed in the Specifications in this Chapter.

Fuel cut solenoid valve

Refer to illustrations 11.15 and 11.16

15 Disconnect the wiring to the fuel cut solenoid **(see illustration)**.

16 Touch fused jumper wires from the battery to the terminals shown **(see illustration)**. The fuel cut solenoid should energise when the power is applied. If it does not, renew it.



11.16 The fuel cut wiring connectors with the terminal positions

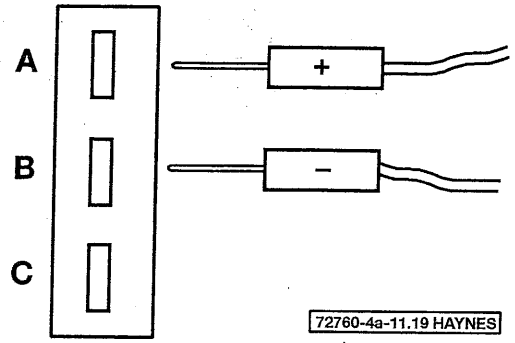
A 4.2 litre manual transmission
B 4.2 litre automatic transmission
C 3.0 litre model

4A

Throttle valve switch (automatic transmission models)

Refer to illustration 11.19

17 Warm-up the engine and check the idle speed (refer to Chapter 1). Turn the engine off.
18 Disconnect the wiring from the throttle sensor and also the throttle valve switch.
19 Attach an ohmmeter as shown **(see illustration)**. Start the engine and allow it to idle, there should be continuity (zero resistance) between terminals A and B.
20 Raise the engine RPM slightly (100 to 400 RPM) and check that it switches open (infinite resistance).
21 If it doesn't, rotate the throttle switch until it the meter indicates an open circuit. Connect all of the wiring after rechecking the setting.



11.19 The throttle switch test connections

Choke manual control

22 Check that the choke is completely open when the knob is pushed in and that it is fully closed when it is pulled out.

Accelerator pump

23 Operate the throttle manually with the engine turned off.
24 Look into the top of the carburettor with the choke held fully open. There should be a steady stream of fuel sprayed.
25 If the fuel stream is poor in quality, the accelerator pump must be serviced.

Fast idle actuator

Refer to illustration 11.28

26 Warm-up the engine and allow it to idle in neutral with the air conditioner off.
27 Turn the air conditioner on. The idle speed should increase. Refer to the Specifications in this Chapter for the correct fast idle actuator engine speed.
28 Turn the adjusting screw to make an adjustment **(see illustration)**. The screw is located on the top of the actuator on automatic transmission models. On manual models, it is at the actuator lever.

Fast idle dashpot

29 Warm-up the engine. Check the idle speed and mixture (refer to Chapter 1).
30 Rotate the throttle by hand and observe the engine speed when the tip of the dash pot touches the lever on the throttle. Compare the speed to the value listed in this Chapter's Specifications.
31 Turn the adjusting screw on the end of the dash pot to make adjustments.
32 Rev the engine and check that the engine speed drops from 2,000 rpm to 1,000 rpm in about three seconds.

Fuel level check

Refer to illustration 11.33

33 With the vehicle level and the engine idling, observe the level of the fuel through the sight glass in the carburettor side cover. It should be approximately in the middle of the glass **(see illustration)**.

Fuel return solenoid (3.0 litre engine)

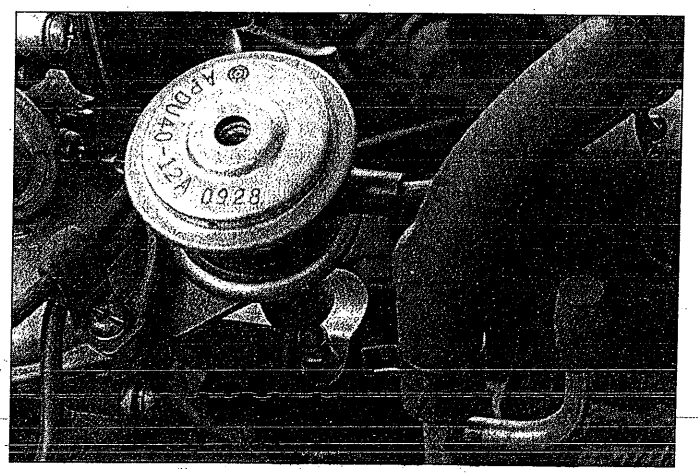
34 The fuel return solenoid should allow a large quantity of fuel to be returned to the fuel tank at low engine speeds. As the engine speed increases above 1,250 to 1,400 rpm, the amount returned should diminish.
35 To check the solenoid, remove the return hose and observe the flow of fuel into a container as the engine speed is raised above idle.
36 Connect a fused jumper wire to the wiring connector. With battery voltage applied, it should be easy to blow through the hose. With battery power removed, it should be difficult.

12 Carburettor - removal and refitting

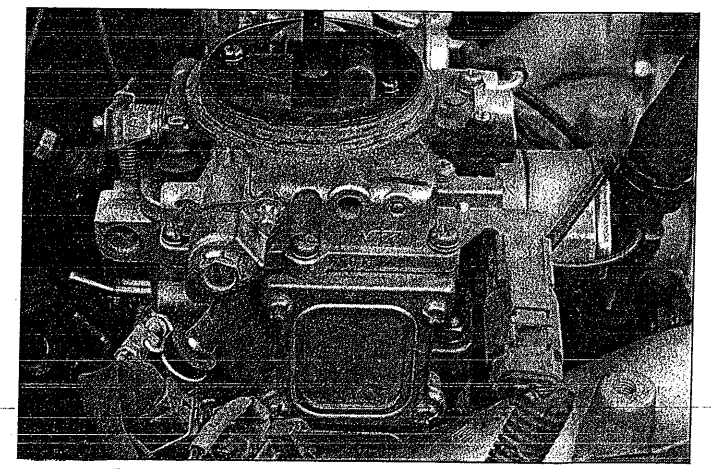
Warning: *Petrol is extremely flammable, so take extra precautions when you work on any part of the fuel system. See* **Warning** *in Section 1.*

Removal

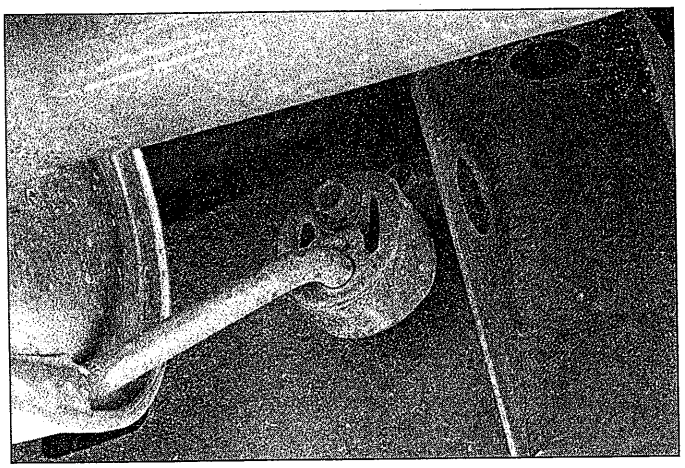
1 Disconnect the negative battery cable.
2 Remove the fuel filler cap to relieve fuel tank pressure. On 3.0 litre models, follow the fuel pressure relief procedure in Section 2.
3 Remove the air cleaner housing (see Section 8).
4 Disconnect the accelerator cable from the throttle lever (see Section 9).
5 Clearly label all vacuum hoses and fittings, then disconnect the hoses.
6 Disconnect the fuel line from the carburettor.
7 Label the wires and terminals, then unplug all the electrical connectors.
8 Remove the mounting fasteners and detach the carburettor from the inlet mani-



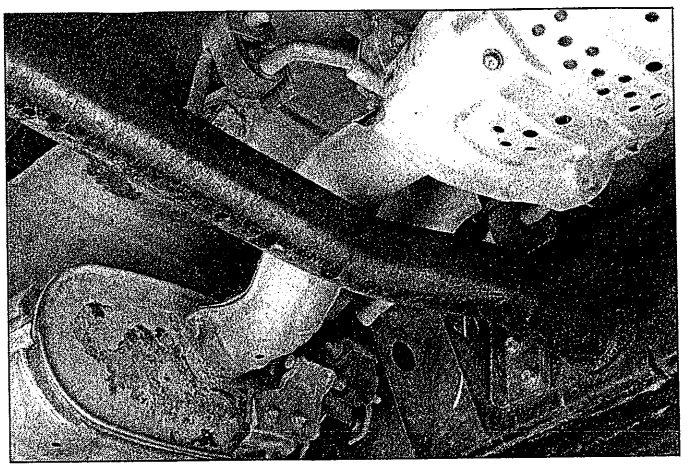
11.28 Location of the fast idle actuator



11.33 The fuel level can be seen through the sight glass located on the side cover



13.2a Check all of the rubber mounts for deterioration



13.2b Inspect the ends of the muffler for signs of rust - a screwdriver can be used as a probe if the material looks thin

fold. Remove the carburettor mounting gasket. Stuff a rag into the inlet manifold openings to prevent debris from entering.

Refitting

9 Use a gasket scraper to remove all traces of gasket material and sealant from the inlet manifold (and the carburettor, if it's being refitted), then remove the shop rag from the manifold openings. Clean the mating surfaces with lacquer thinner or acetone.

10 Place a new gasket on the inlet manifold.

11 Position the carburettor on the gasket and refit the mounting fasteners.

12 To prevent carburettor distortion or damage, tighten the fasteners securely in a criss-cross pattern, 1/4-turn at a time.

13 The remaining refitting steps are the reverse of removal.

14 Check and, if necessary, adjust the idle speed (see Chapter 1).

15 If the vehicle is equipped with an automatic transmission, refer to Chapter 7B for the kickdown linkage adjustment procedure.

16 Start the engine and check carefully for fuel leaks.

13 Exhaust system - servicing and general information

Refer to illustrations 13.2a, 13.2b and 13.2c

Warning: *Inspection and repair of exhaust system components should be done only after enough time has elapsed after driving the vehicle to allow the system components to cool completely. Also, when working under the vehicle, make sure it is securely supported on jackstands.*

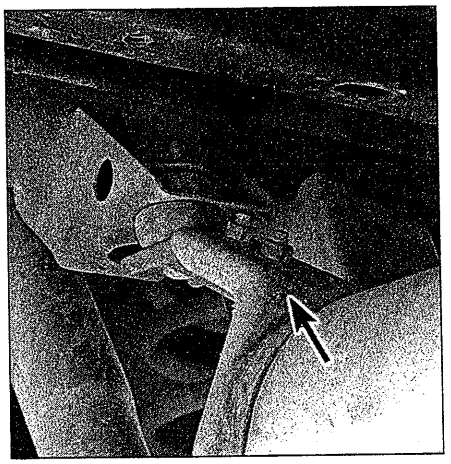
1 The exhaust system consists of the exhaust manifold, the exhaust pipe, the muffler, the tailpipe and all connecting pipes, brackets, hangers and clamps. The exhaust system is attached to the body with mounting brackets and rubber hangers. If any of the parts are improperly refitted, excessive noise and vibration will be transmitted to the body.

2 Conduct regular inspections of the exhaust system to keep it safe and quiet. Look for any damaged or bent parts, open seams, holes, loose connections, excessive corrosion or other defects which could allow exhaust fumes to enter the vehicle **(see illustrations)**. Deteriorated exhaust system components should not be repaired; they should be renewed.

3 If the exhaust system components are extremely corroded or rusted together, welding equipment will probably be required to remove them. The convenient way to accomplish this is to have a muffler repair shop remove the corroded sections with a cutting torch. If, however, you want to save money by doing it yourself (and you don't have a welding outfit with a cutting torch), simply cut off the old components with a hacksaw. If you have compressed air, special pneumatic cutting chisels can also be used. If you do decide to tackle the job at home, be sure to wear safety goggles to protect your eyes from metal chips and work gloves to protect your hands.

4 Here are some simple guidelines to follow when repairing the exhaust system:

a) Work from the back to the front when removing exhaust system components.



13.2c Look at the steel mounts (arrow) to see if they are beginning to crack

b) Apply penetrating oil to the exhaust system component fasteners to make them easier to remove.

c) Use new gaskets, hangers and clamps when refitting exhaust system components.

d) Apply anti-seize compound to the threads of all exhaust system fasteners during reassembly.

e) Be sure to allow sufficient clearance between newly refitted parts and all points on the underbody to avoid overheating the floor pan and possibly damaging the interior carpet and insulation. Pay particularly close attention to the catalytic converter and heat shield.

Notes

Chapter 4 Part B
Fuel and exhaust systems - fuel injected petrol engines

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CHECK ENGINE light	See Chapter 6
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Electronic Combustion Control System (ECCS) - general information	9
Exhaust manifold - removal and refitting	See Chapter 2A
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General information	1
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Underbonnet hose check and renewal	See Chapter 1

Specifications

Fuel pressure, engine idling	
Vacuum sensing hose detached	294 kPa
Vacuum sensing hose attached	214 to 255 kPa
Fuel injector resistance	10 to 14 ohms
Fuel pump resistance	0.5 ohms (approx.)
Idle Speed	See Chapter 1
Throttle position sensor resistance	
Throttle closed	1,000 ohms
Throttle open	9,000 ohms
Throttle valve switch operation point (in neutral)	750 to 1,050 rpm
AAC valve resistance	10 ohms (approx.)
Air regulator resistance	70 to 80 ohms

Torque specifications

	Nm
Throttle body mounting bolts	
First step	9 to 11
Second step	18 to 22
Fuel rail mounting bolts	10 to 12
Inlet manifold plenum bolts	16 to 19

1 General information

The fuel system consists of a fuel tank, an electric fuel pump (located in the fuel tank), fuel injectors, a fuel pressure regulator, an air cleaner assembly and a throttle body unit.

Electronic Combustion Control System (ECCS)

Electronic fuel injection uses timed impulses to inject the fuel directly into the intake port of each cylinder. The injectors are controlled by the Electronic Control Unit (ECU). The ECU monitors various engine parameters and delivers the exact required amount of fuel, into the intake ports. The throttle body serves only to control the amount of air passing into the system. Because each cylinder is equipped with an injector mounted immediately adjacent to the inlet valve, much better control of the fuel/air mixture ratio is possible.

Fuel pump and lines

Fuel is circulated from the fuel tank to the fuel injection system, and back to the fuel tank, through a pair of metal lines running along the underside of the vehicle. An electric fuel pump is attached to the fuel sending unit inside the fuel tank. A vapour return system routes all vapours and hot fuel back to the fuel tank through a separate return line.

The fuel pump will operate as long as the engine is cranking or running and the ECU is receiving ignition reference pulses from the electronic ignition system (see Chapter 5). If there are no reference pulses, the fuel pump will shut off after 5 seconds.

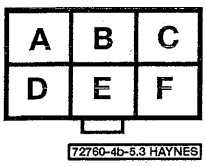
Exhaust system

The exhaust system includes an exhaust manifold fitted with an exhaust oxygen sensor, a catalytic converter, an exhaust pipe, and a muffler.

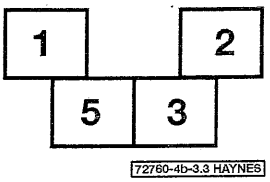
The catalytic converter is an emission control device added to the exhaust system to reduce pollutants. A single-bed converter is used in combination with a three-way (reduction) catalyst. Refer to Chapter 6 for more information regarding the catalytic converter.

2 Fuel pressure relief

Warning: *Petrol is extremely flammable, so take extra precautions when you work on any part of the fuel system. Don't smoke or allow open flames or bare light bulbs near the work area, and don't work in a garage where a natural gas-type appliance (such as a water heater or a clothes dryer) is present. Since petrol is carcinogenic, wear latex gloves when there's a possibility of being exposed to fuel, and, if you spill any fuel on your skin, rinse it off immediately with soap and water. Mop up any spills immediately and do not store fuel-soaked rags where they could ignite. The fuel system is under constant pressure, so, if any fuel lines are to be disconnected, the fuel pressure in the system must be relieved first. When you perform any kind of work on the fuel system, wear safety glasses and have a Class B type fire extinguisher on hand.*



3.2 Connect an voltmeter to terminals A (+) and B (-) of the fuel pump chassis harness connector - battery voltage should be present for 5 seconds when the ignition key is switched ON



3.3 Fuel pump relay terminal locations. Connect a fused 12 volt jumper wire to terminal 1 and an earth jumper to terminal 2 - there should then be continuity across terminals 3 and 5

Mop up any spills immediately and do not store fuel-soaked rags where they could ignite. The fuel system is under constant pressure, so, if any fuel lines are to be disconnected, the fuel pressure in the system must be relieved first. When you perform any kind of work on the fuel system, wear safety glasses and have a Class B type fire extinguisher on hand.

1 Before servicing any fuel system component, you must relieve the fuel pressure to minimise the risk of fire or personal injury.

2 Remove the fuel filler cap - this will relieve any pressure built up in the tank.

3 Locate the fuel pump fuse. It is located in the electrical relay centre near the battery. Remove the fuse.

4 Start the engine and wait for the engine to stall, then operate the starter for approximately ten seconds. Refit the fuel pump fuse.

5 The fuel system is now depressurised.

Note: *Place a rag around the fuel line before removing any hose clamp or fitting to prevent any residual fuel from spilling onto the engine.*

6 Before working on the fuel system, disconnect the cable from the negative terminal of the battery.

3 Fuel pump/fuel pressure - check

Warning: *Petrol is extremely flammable, so take extra precautions when you work on any part of the fuel system. Don't smoke or allow open flames or bare light bulbs near the work area, and don't work in a garage where a natural gas-type appliance (such as a water heater or a clothes dryer) with a pilot light is present. Since petrol is carcinogenic, wear latex gloves when there's a possibility of being exposed to fuel, and, if you spill any fuel on your skin, rinse it off immediately with soap and water. Mop up any spills immediately and do not store fuel-soaked rags where they could ignite. The fuel system is under constant pressure, so, if any fuel lines are to be disconnected, the fuel pressure in the system must be relieved first. When you perform any kind of work on the fuel system, wear safety glasses and have a Class B type fire extinguisher on hand.*

Fuel pump circuit check

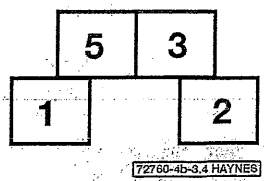
Refer to illustrations 3.2, 3.3 and 3.4

1 Turn the ignition ON and listen at the fuel tank for the sound of the fuel pump running. The fuel pump should operate for 5 second after the ignition is switched on, then shut off.

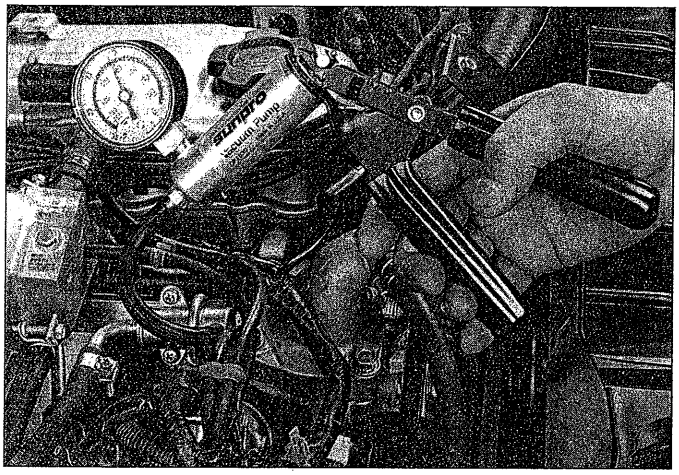
2 If the fuel pump does not operate, locate the fuel pump connector at the fuel tank, disconnect the connector and connect a voltmeter to terminals A (negative) and B (positive) of the chassis harness connector **(see illustration)**. Turn the ignition On, battery voltage should be indicated on the meter. If battery voltage is indicated and the fuel pump does not operate when connected, renew the fuel pump. If battery voltage is not indicated, check for continuity between the chassis harness terminal A and earth. If continuity is not present, repair the earth circuit and retest (the fuel pump earthing point is located inside the passenger compartment behind the right kick panel).

3 If the fuel pump is not receiving battery voltage on terminal B of the fuel pump connector, check the fuel pump relay in the engine compartment. Remove the relay and connect an ohmmeter to terminals 3 and 5 **(see illustration)**. Using fused jumper wires, apply battery voltage and earth connections to terminals 1 and 2 of the relay. The relay should click and continuity should be indicated on the meter (zero resistance). If the relay does not operate, renew the relay.

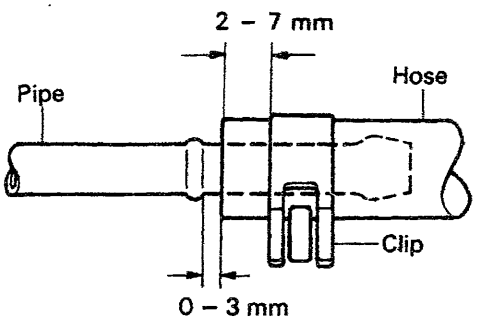
4 If the relay is good, check for battery voltage to the relay. With the ignition switched ON and the relay removed, there should be battery voltage at terminals 1 and 5 in the relay socket **(see illustration)**. If no



3.4 With the ignition ON there, should be battery voltage at terminals 1 and 5 of the fuel pump relay socket



3.7 A hand vacuum pump like this is the best way to apply vacuum to the fuel pressure regulator



4.6 When attaching a section of rubber hose to a metal fuel line, be sure to overlap the hose as shown and secure it to the line with a new hose clamp of the proper type

voltage is present at the relay socket, check for an open circuit between the relay socket and the ignition switch and/or fuse box (don't forget to check the fuses and fusible links). Check for continuity between terminal number 2 of the relay socket and the ECU. If the circuits are good the ECU is probably defective.

Fuel pressure check

Refer to illustration 3.7

5 Relieve the fuel system pressure (see Section 2).

6 Disconnect the fuel inlet hose at the fuel rail and connect a fuel pressure gauge with a T-fitting and short section of hose between the fuel inlet hose and the fuel rail.

7 Disconnect and plug the vacuum hose from the fuel pressure regulator and connect a hand-held vacuum pump to the regulator **(see illustration)**. Start the engine and read the fuel pressure gauge without vacuum applied to the fuel pressure regulator. Apply vacuum to the regulator and check the fuel pressure again. The fuel pressure should decrease as vacuum increases. Compare your readings with the values listed in this Chapter's Specifications. **Note:** *On 1994 and previous models, there is a vacuum cut-off switch (PRVR. switch) refitted between the fuel pressure regulator and the vacuum source. If it is functioning properly, it will increase the fuel pressure during the first few minutes after hot start-up to 294 kPa.*

8 Reconnect the vacuum hose to the regulator and check the fuel pressure at idle, comparing your reading with the value listed in this Chapter's Specifications. Disconnect the hose and watch the gauge - the pressure should jump up to the maximum specified pressure as soon as the hose is disconnected. If the pressure at idle was too high (with the hose disconnected), connect a vacuum gauge to the hose and check for vacuum. If there is no reading on the gauge, check the air intake plenum and inlet manifold for a vacuum leak.

9 If the fuel pressure is LOW, pinch the fuel return line shut and watch the gauge. If the pressure doesn't rise, the fuel pump is defective or there is a restriction in the fuel feed line (possibly the fuel filter).

10 If the indicated fuel pressure is too high, relieve the fuel pressure (see Section 2), disconnect the fuel return line and blow through it to check for blockage. If there is no blockage, renew the fuel pressure regulator (see Section 11).

11 Carefully remove the fuel pressure gauge. Be sure to cover the fitting with a rag before loosening it. Wipe up any spilled petrol.

12 Start the engine and check for leaks.

4 Fuel lines and fittings - inspection and renewal

Warning: *Petrol is extremely flammable, so take extra precautions when you work on any part of the fuel system. Don't smoke or allow open flames or bare light bulbs near the work area, and don't work in a garage where a natural gas-type appliance (such as a water heater or a clothes dryer) t is present. Since petrol is carcinogenic, wear latex gloves when there's a possibility of being exposed to fuel, and, if you spill any fuel on your skin, rinse it off immediately with soap and water. Mop up any spills immediately and do not store fuel-soaked rags where they could ignite. The fuel system is under constant pressure, so, if any fuel lines are to be disconnected, the fuel pressure in the system must be relieved first. When you perform any kind of work on the fuel system, wear safety glasses and have a Class B type fire extinguisher on hand.*

Inspection

1 Once in a while, you will have to raise the vehicle to service or renew some component (an exhaust pipe hanger, for example). Whenever you work under the vehicle, always inspect fuel lines and all fittings and connections for damage or deterioration.

2 Check all hoses and pipes for cracks, kinks, deformation or obstructions.

3 Make sure all hoses and pipe clips attach their associated hoses or pipes securely to the underside of the vehicle.

4 Verify all hose clamps attaching rubber hoses to metal fuel lines or pipes are snug enough to assure a tight fit between the hoses and pipes.

Renewal

Refer to illustration 4.6

5 If you must renew any damaged sections, use original equipment renewal hoses or pipes constructed from exactly the same material as the section you are refitting. Do not refit substitutes constructed from inferior or inappropriate material or you could cause a fuel leak or a fire.

6 Always, before detaching or disassembling any part of the fuel line system, note the routing of all hoses and pipes and the orientation of all clamps and clips to assure that renewal sections are refitted in exactly the same manner. When attaching hoses to metal lines, overlap them as shown **(see illustration)**.

7 Before detaching any part of the fuel system, be sure to relieve the fuel line and tank pressure by removing the fuel tank cap and following the procedure in Section 2. Cover the fitting being disconnected with a rag to absorb any fuel that may spray out.

5 Fuel pump - removal and refitting

Refer to illustration 5.3

Warning: *Petrol is extremely flammable, so take extra precautions when you work on any part of the fuel system. Don't smoke or allow open flames or bare light bulbs near the work area, and don't work in a garage where a natural gas-type appliance (such as a water heater or a clothes dryer is present. Since*

petrol is carcinogenic, wear latex gloves when there's a possibility of being exposed to fuel, and, if you spill any fuel on your skin, rinse it off immediately with soap and water. Mop up any spills immediately and do not store fuel-soaked rags where they could ignite. The fuel system is under constant pressure, so, if any fuel lines are to be disconnected, the fuel pressure in the system must be relieved first. When you perform any kind of work on the fuel system, wear safety glasses and have a Class B type fire extinguisher on hand.

1 Relieve the fuel system pressure (refer to Section 2).

2 The fuel pump used on fuel injected models is very similar to that used on 3.0 litre carburetted models. Refer to Chapter 4A for this procedure.

6 Fuel level sending unit - check and renewal

Warning: *Petrol is extremely flammable, so take extra precautions when you work on any part of the fuel system. Don't smoke or allow open flames or bare light bulbs near the work area, and don't work in a garage where a natural gas-type appliance (such as a water heater or a clothes dryer) is present. Since petrol is carcinogenic, wear latex gloves when there's a possibility of being exposed to fuel, and, if you spill any fuel on your skin, rinse it off immediately with soap and water. Mop up any spills immediately and do not store fuel-soaked rags where they could ignite. The fuel system is under constant pressure, so, if any fuel lines are to be disconnected, the fuel pressure in the system must be relieved first. When you perform any kind of work on the fuel system, wear safety glasses and have a Class B type fire extinguisher on hand.*

1 Relieve the fuel system pressure (refer to Section 2).

2 The fuel level sending unit used on fuel injected models is very similar to that used on 3.0 litre carburetted models. Refer to Chapter 4A for this procedure.

7 Air cleaner assembly - removal and refitting

1 Detach the clips and remove the air filter element from the housing (see Chapter 1).

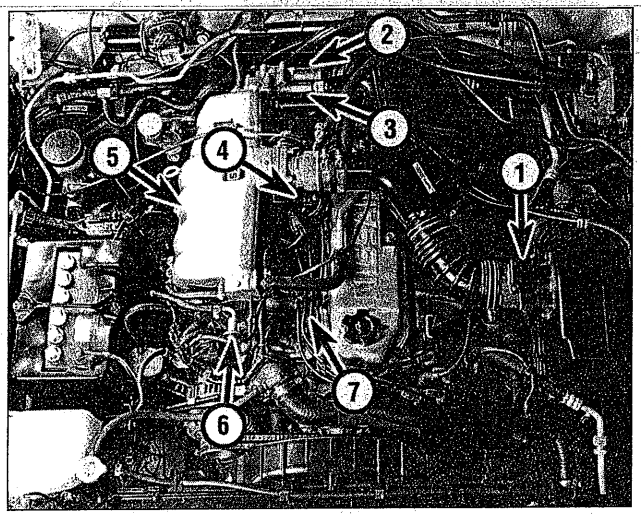
2 Disconnect the wiring at the air flow meter.

3 Loosen the clamp and disconnect the air intake hose from the air flow meter assembly.

4 Remove the housing from the engine compartment.

5 Remove the fasteners and remove the lower air cleaner assembly from the engine compartment.

6 Refitting is the reverse of removal.



9.1 Locations of the fuel system components in the engine compartment

1 *Air flow meter*
2 *Auxiliary Air Control (AAC) valve*
3 *Fast Idle Compensating Device (FICD) solenoid valve*
4 *Throttle sensor*
5 *Air regulator (below)*
6 *Fuel pressure regulator*
7 *Fuel injector (one of six)*

8 Accelerator cable - removal, refitting and adjustment

The throttle cable used on fuel injected models is very similar in function to that used on carburetted models. Refer to Chapter 4A for this procedure.

9 Electronic Combustion Control System (ECCS) - general information

Refer to illustration 9.1

1 These models are equipped with an Electronic Combustion Control System (ECCS). The ECCS system is composed of three basic subsystems: fuel system, air induction system and electronic control system **(see illustration)**.

Fuel system

2 An electric fuel pump located inside the fuel tank supplies fuel under constant pressure to the fuel rail, which distributes fuel evenly to all injectors. From the fuel rail, fuel is injected into the intake ports, just above the inlet valves, by fuel injectors. The amount of fuel supplied by the injectors is precisely controlled by an Electronic Control Unit (ECU). A pressure regulator controls system pressure in relation to inlet manifold vacuum. A fuel filter between the fuel pump and the fuel rail filters fuel to protect the components of the system. The ECU controls the fuel pump by earthing the coil of the fuel pump relay, energising the fuel pump.

Air induction system

3 The air induction system consists of an air filter housing, the throttle body and the duct connecting the two. The throttle plate inside the throttle body is controlled by the driver. There is an air flow meter located in the inlet air duct which informs the ECU of the quantity of air passing into the engine. The ECU then adjusts injector opening duration ignition timing based on this information as well as information from several other sensors.

Electronic control system

4 This system controls the fuel injection and other systems by means of an Electronic Control Unit (ECU), which employs a microcomputer. The ECU receives signals from a number of information sensors which monitor such variables as intake air flow, throttle angle, coolant temperature, engine rpm, vehicle speed and exhaust oxygen content. These signals help the ECU determine the injection duration and ignition timing necessary for the optimum air/fuel ratio. Some of these sensors and their corresponding ECU-controlled relays are not contained within EFI components, but are located throughout the engine compartment. For further information regarding the ECU and its relationship to the engine electrical and ignition system, see Chapter 6.

10 Electronic Combustion Control System - check

Refer to illustrations 10.6a, 10.6b, 10.7, 10.8 and 10.9

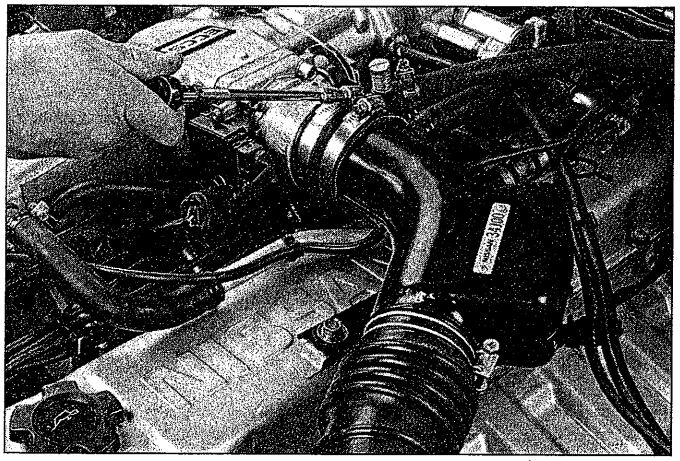
1 Check the earth wire connections for tightness. Check all wiring and electrical connectors that are related to the system. Loose electrical connectors and poor grounds can cause many problems that resemble more serious malfunctions.

2 Check to see that the battery is fully charged, as the control unit and sensors depend on an accurate supply voltage in order to properly meter the fuel.

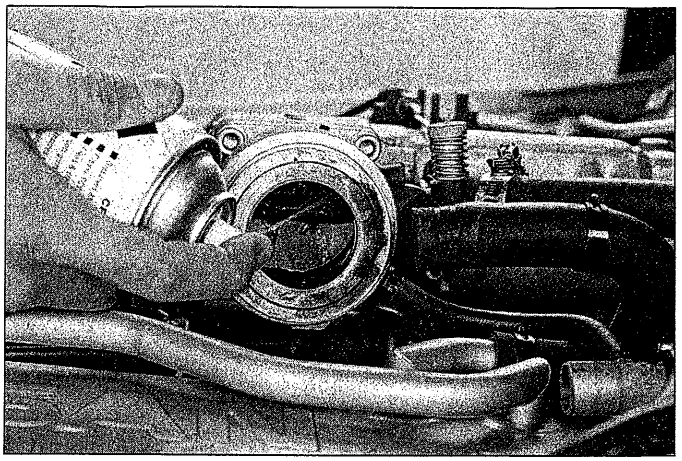
3 Check the air filter element - a dirty or partially blocked filter will severely impede performance and economy (see Chapter 1).

4 If a blown fuse is found, renew it and see if it blows again. If it does, search for a earthed wire in the harness related to the system.

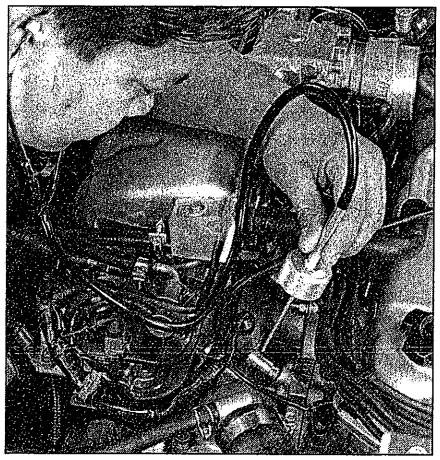
5 Check the air intake duct from the air



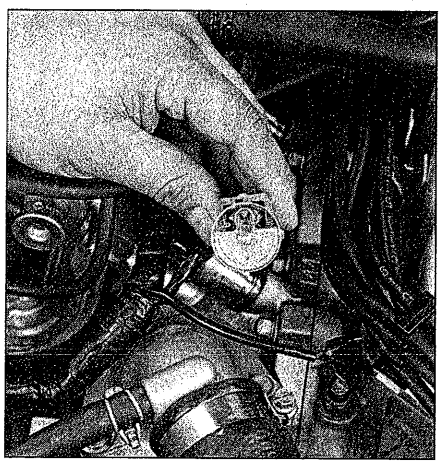
10.6a Disconnect the air inlet duct from the throttle body - it should be possible to pull it gently aside to allow servicing of the throttle body



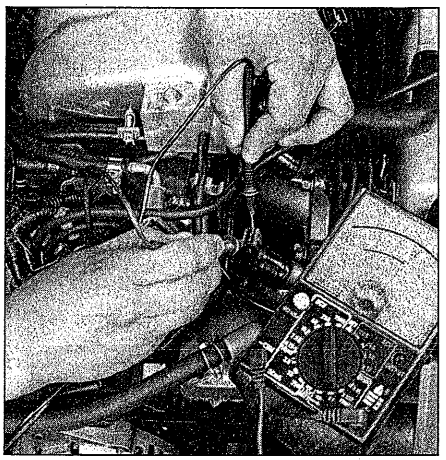
10.6b Use carburettor cleaner with a rag or toothbrush to remove all traces of carbon and debris from the bore of the throttle body - it must be kept clean to allow proper performance



10.7 Place a stethoscope on each injector - they should all make an audible clicking as they operate. Be careful of getting the equipment entangled in the fan as you do this



10.8 A "noid" light is the best way to check if an injector is receiving power - the noid will flash with every injector pulse



10.9 If an injector fails to click even though it is getting power, check its resistance with an ohmmeter

cleaner housing to the inlet manifold for leaks, which will result in an excessively lean mixture. Also check the condition of the vacuum hoses connected to the inlet manifold.

6 Remove the air intake duct from the throttle body and check for carbon and residue build-up inside the throttle body. If it's dirty, clean it with aerosol carburettor cleaner (make sure the can says it's safe for use with oxygen sensors and catalytic converters) and a toothbrush **(see illustrations)**.

7 With the engine running, place a stethoscope against each injector, one at a time, and listen for a clicking sound, indicating operation **(see illustration)**. If you don't have an automotive stethoscope you can use a long screwdriver; just place the tip of the screwdriver against the injector body and press your ear against the handle.

8 If there is a problem with an injector, purchase a special injector test light ("noid" light) and refit it into the injector electrical connector **(see illustration)**. Start the engine and make sure that each injector connector flashes the noid light. This will test for the proper voltage signal to the injector.

9 With the engine OFF and the fuel injector electrical connectors disconnected, measure the resistance of each injector **(see illustration)**. Each injector should read near the figure listed in this Chapter's Specifications. If not, the injector is probably faulty.

10 The remainder of the system checks should be left to a dealer service department or other qualified repair shop, as there is a chance that the control unit may be damaged if the tests are not performed properly.

11 Electronic Combustion Control System (ECCS)- component check and renewal

Warning: *Petrol is extremely flammable, so take extra precautions when you work on any part of the fuel system. Don't smoke or allow open flames or bare light bulbs near the work area, and don't work in a garage where a natural gas-type appliance (such as a water heater or a clothes dryer) is present. Since petrol is carcinogenic, wear latex gloves when there's a possibility of being exposed to fuel, and, if you spill any fuel on your skin, rinse it off immediately with soap and water. Mop up any spills immediately and do not store fuel-soaked rags where they could ignite. The fuel system is under constant pressure, so, if any fuel lines are to be disconnected, the fuel pressure in the system must be relieved first. When you perform any kind of work on the fuel system, wear safety glasses and have a Class B type fire extinguisher on hand.*

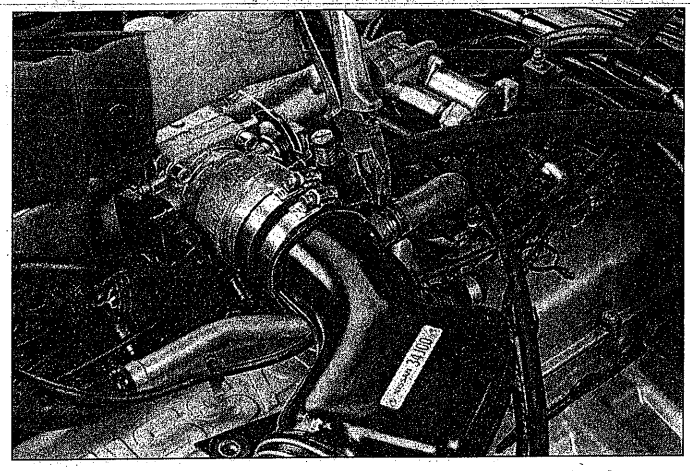
Caution: *If the stereo in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.*

Throttle body

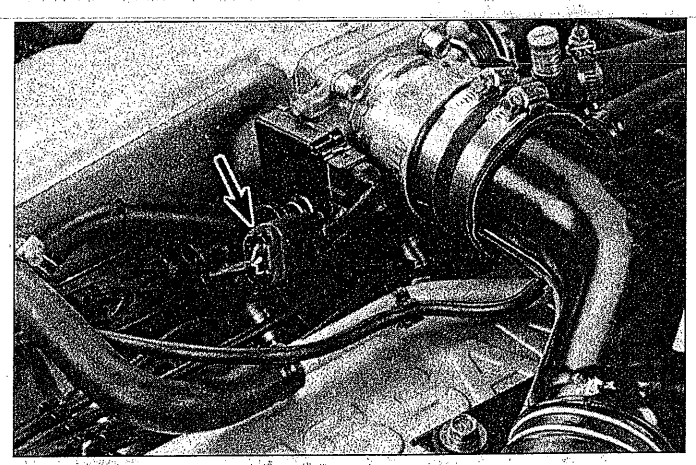
Refer to illustration 11.5

Check

1 Verify that the throttle linkage operates smoothly.



11.5 Disconnect the breather hose from the air intake duct, loosen the clamps and remove the duct from the throttle body



11.14 There are two wiring connectors on the throttle sensor, The one with the pigtail (arrow) is for the throttle sensor - the other is for the idle switch

2 Start the engine, then closely inspect the sealing surfaces of the throttle body for signs of a vacuum leak. Spraying an aerosol carburettor cleaner on the area will help - if the engine speed rises when cleaner is applied to a certain area, then there is a vacuum leak there.

3 Check the mounting bolts for the proper torque.

Renewal

Warning: *Wait until the engine is completely cool before beginning this procedure.*

4 Detach the cable from the negative terminal of the battery.

5 Loosen the hose clamps and remove the air intake duct **(see illustration)**.

6 Detach the accelerator cable from the throttle lever by holding the throttle open and then removing the cable from the throttle body.

7 Drain about half of the coolant in the system (refer to Chapter 1). Disconnect the coolant hoses that attach to the throttle body. Disconnect the vacuum hose.

8 Disconnect the wiring from the two sensors on the throttle body.

9 Remove the throttle body mounting bolts.

10 Detach the throttle body and gasket from the inlet manifold.

11 Using a soft brush and carburettor cleaner, thoroughly clean the throttle body casting, then blow out all passages with compressed air. **Caution:** *Do not clean the throttle position sensor with anything. Just wipe it off carefully with a clean, soft cloth.*

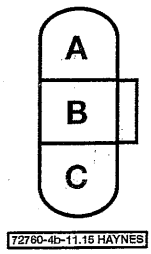
12 Refitting of the throttle body is the reverse of removal.

13 Be sure to tighten the throttle body mounting bolts to the torque listed in this Chapter's Specifications.

Throttle sensor

Refer to illustrations 11.14, 11.15 and 11.20

Note: *There are two wiring connectors attached to the throttle sensor. The connector at the end of the short harness is for the throttle sensor. The connector located directly on the throttle sensor is for the idle switch.*



11.15 The connector for the throttle sensor looks like this - connect your ohmmeter between terminals B and C

Check

14 Disconnect the electrical connector at the end of the short harness from the throttle sensor **(see illustration)**.

15 Connect an ohmmeter to terminals B and C **(see illustration)**.

16 Measure the resistance between the indicated terminal pairs with the throttle closed and with the throttle fully open. Compare your readings to those listed in this Chapter's Specifications. Renew the sensor if the readings are not within specifications.

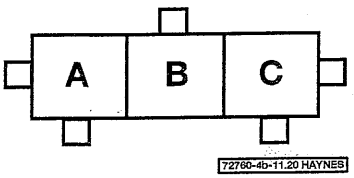
17 If there is a spike in the reading as you rotate the throttle, renew the sensor.

18 The sensor can be backprobed while it is connected and with the ignition turned ON. Measure the voltage at terminal B. It should vary smoothly from 0.3 to 5 volts as the throttle is opened.

19 To test the idle switch portion of the sensor, disconnect the connector from the body of the sensor.

20 Connect an ohmmeter between terminals A and B **(see illustration)**. With the throttle closed, there should be continuity (zero resistance).

21 Open the throttle slightly, the meter should switch to an open circuit (infinite resistance). If the operation of the switch is not correct, attempt to adjust the sensor before renewing it.



11.20 Idle switch connector - the ohmmeter should be connected to terminals A and B for testing and adjustment

Adjustment

22 Connect an ohmmeter to terminals A and B of the idle switch **(see illustration 11.20)**. Disconnect the AAC valve wiring.

23 Connect a hand held tachometer to the engine. Start the engine.

24 Slowly open the throttle and note the speed at which the idle switch opens as indicated on the ohmmeter. Compare your readings to the value listed in this Chapter's Specifications.

25 If the idle switch does not open within the specified range, loosen the mounting bolts and rotate the switch to adjust it. If it cannot be adjusted to specifications, renew the sensor.

Renewal

26 Disconnect both wiring connectors. Remove the mounting screws.

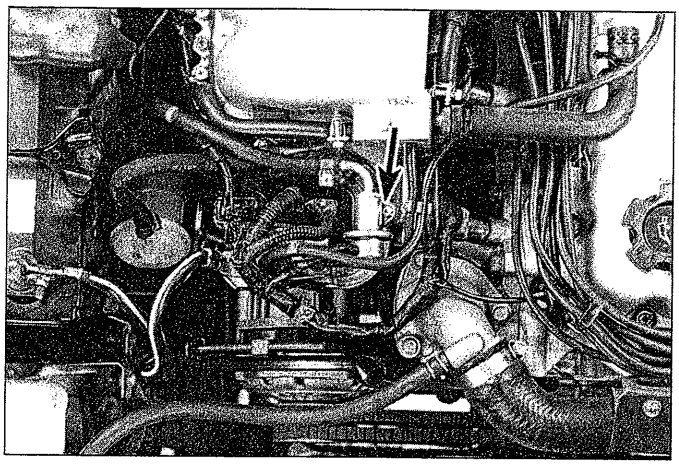
27 Refitting is the reverse of removal. Make certain that the shaft of the sensor registers correctly on the throttle shaft as you refit it.

28 Adjust the sensor.

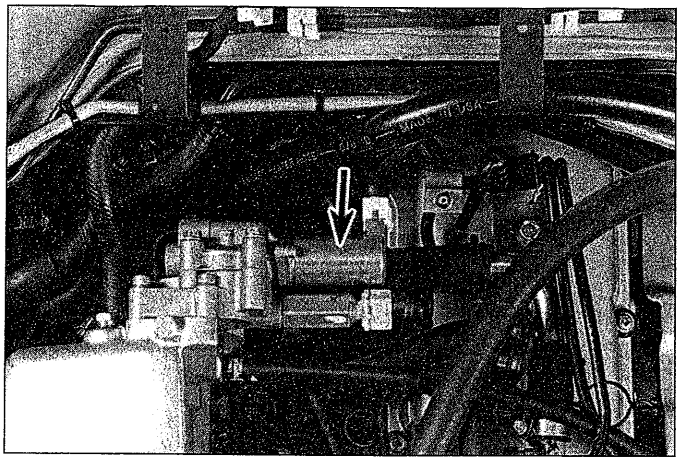
Fuel pressure regulator

Check

29 Refer to the fuel pump/fuel pressure check procedure (see Section 3).



11.31 The fuel pressure regulator is mounted on the front of the engine - disconnect the vacuum and fuel lines, then remove the mounting bolts



11.37 The AAC valve (arrow) is located at the rear of the inlet plenum

Renewal

Refer to illustration 11.31

30 Relieve the fuel system pressure (see Section 2) and detach the cable from the negative terminal of the battery (see the **Caution** at the beginning of this Section).

31 Detach the vacuum sensing hose from the regulator **(see illustration)**.

32 Place a metal container or shop towel under the fuel return hose.

33 Remove the fuel line from the fuel pressure regulator.

34 Remove the pressure regulator mounting screws and detach the pressure regulator from the fuel rail.

35 Use a new O-ring and make sure that the pressure regulator is refitted properly on the fuel rail.

36 The remainder of refitting is the reverse of removal.

Auxiliary Air Control (AAC) valve

Check

Refer to illustration 11.37

37 Disconnect the wiring from the AAC valve **(see illustration)**.

38 Connect an ohmmeter across the two terminals of the unit. Compare the reading to the value listed in this Chapter's Specification.

39 Remove the unit and check it for smooth operation of the plungers and an unbroken spring.

40 Make certain that all passages are clear.

Renewal

41 Disconnect the hose and the wiring harness.

42 Remove the mounting bolts and lift the valve from the idle air adjusting unit.

43 Refitting is the reverse of removal. Renew the gasket.

Fast Idle Compensating Device (FICD)

Check

44 Disconnect the wiring harness from the unit.

45 Connect one of the terminals to earth and apply battery voltage with a fused jumper wire to the other.

46 There should be a clear clicking sound from the FICD.

47 Remove the unit and check for a sticky plunger and a broken spring.

Renewal

48 Disconnect the wiring connector.

49 Unscrew the FICD from the idle air adjusting unit.

50 Refitting is the reverse of removal. Renew the gasket.

Air regulator

Check

51 Disconnect the wiring harness from the unit. (It is beneath the inlet manifold).

52 Use an ohmmeter to test the resistance between the two terminals. Compare the reading to the figure listed in the Specifications in this Chapter.

53 Remove the air regulator and check it for clogging.

Renewal

54 Disconnect the wiring harness.

55 Disconnect the hoses.

56 remove the mounting bolts and lift the regulator from the inlet manifold.

Fuel rail

Check

57 Refer to the fuel injection system checking procedure (see Section 10).

Renewal

58 Relieve the fuel system pressure (see Section 2).

59 Detach the cable from the negative terminal of the battery.

60 Disconnect the throttle cable from the throttle body.

61 Remove the throttle body.

62 Remove the earth cable and the bracket for the injector harness connector.

63 Disconnect the fuel supply and return hoses.

64 Disconnect the spark plug wires from the spark plugs. Label them, if necessary and position them aside.

65 Disconnect the injector wiring connectors and the fuel temperature harness connector.

66 Remove the fuel rail mounting bolts.

67 Remove the fuel rail with the fuel injectors attached.

Fuel injector renewal

68 Use a knife which has been heated to cut through the braided reinforcement on the injector connecting hose. Do not cut into the injector.

69 Pull the hose off.

70 To refit a new injector, lubricate both ends of the new fuel hose and push it firmly onto the injector and the fuel rail by hand.

71 Refitting is the reverse of removal. Renew the grommets and O-rings.

72 Tighten the fuel rail mounting bolts to the torque listed in this Chapter's Specifications.

Air inlet plenum

73 Remove the inlet manifold from the engine (refer to Chapter 2A).

74 Invert the manifold and remove the bolts securing the plenum to the lower inlet manifold. There are bolts which are accessible from below and above.

75 Refitting is the reverse of removal. Make certain to use a new gasket and to tighten the fasteners to the torque listed in this Chapter's specifications.

Notes

Chapter 4 Part C
Fuel and exhaust systems - diesel engines

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Idle speed adjustment	See Chapter 1
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Specifications

Coolant temperature sensor resistance	
At 0-degrees C	5,600 ohms
At 20-degrees C	2,500 ohms
At40-degrees C	1,200 ohms

Torque specifications

	Nm
Fuel injectors	54 to 64
Coolant temperature sensor	15 to 25
Glow plugs	15 to 20
Fuel injection pump nuts	19 to 25
Fuel injection pump bracket bolts	32 to 42
Fuel injection tube nuts	20 to 25
Fuel injection pump gear nut	59 to 69

1 General information, precautions and fuel system cleaning

General information

The fuel system is comprised of a fuel tank, a fuel injection pump, an engine compartment-mounted fuel filter, fuel supply and return lines and eight fuel injectors.

The injection pump is driven at half crankshaft speed by a gear train at the front of the engine. Fuel is drawn from the fuel tank through the filter by the injection pump, which then distributes the fuel under very high pressure to the injectors via separate lines.

The injectors are spring loaded mechanical valves which open when the pressure of the fuel supplied to them exceeds a specific limit. Fuel is then sprayed into the combustion chamber. The high compression developed by the rising piston superheats the mixture to the point of combustion.

The basic injection timing is set by the position of the injection pump on the engine. When the engine is running, the pump is advanced and retarded by the pump itself. It is influenced primarily by the accelerator position and engine speed.

The engine is stopped by means of a fuel cut solenoid which interrupts the flow of fuel to the injection pump when it is de-energized.

The engine idle speed can be raised by using a hand throttle which is located on the dash.

Precautions

Many of the operations described in this Chapter involve the disconnection of fuel lines which may cause fuel to leak. Before commencing work, refer to the Warnings and Cautions given below and the information in Safety first at the beginning of this manual.

Warning 1: *Diesel fuel is flammable, so take extra precautions when you work on any part of the fuel system. Don't smoke or allow open flames or bare light bulbs near the work area. Don't work in a garage where a natural gas appliance such as a water heater or a clothes dryer is present. Since diesel fuel is carcinogenic, wear latex gloves when there is a possibility of being exposed to fuel. If you spill fuel on your skin, rinse it immediately with soap and water. Mop up any spills immediately and do not store fuel-soaked rags where they could ignite. When you perform any work on the fuel system, wear safety glasses and keep a Class B type fire extinguisher on hand.*

Warning 2: *Fuel injectors operate at extremely high pressures and the jet of fuel produced at the nozzle is capable of piercing the skin with potentially fatal results. Never work with pressurized injectors - any pressure testing of the fuel system must be done by a diesel fuel systems specialist.*

Caution: *Under no circumstance should diesel fuel be allowed to come in contact with coolant hoses - wipe off accidental spillage immediately. Hoses that have been contaminated with fuel for an extended period should be renewed. Diesel fuel systems are particularly sensitive to contamination from dirt, air and water. Pay particular attention to cleanliness when working on any part of the fuel system to prevent the entry of dirt. Thoroughly clean the area around fuel fittings before disconnecting them. Store dismantled components in sealed containers to prevent contamination and the formation of condensation. Use only lint-free rags and clean fuel for cleaning. Avoid using compressed air when cleaning components in place.*

Diesel fuel contamination

Before you renew an injection pump or some other expensive component, find out what caused the failure. If water contamination is present, buying a new pump or other component won't do much good. The following procedure will help you pinpoint whether water contamination is present:

a) Remove the fuel filter and inspect the contents for the presence of water or petrol (refer to Chapter 1).

b) If the vehicle has been stalling, performance has been poor or the engine has been knocking loudly, suspect fuel contamination. Petrol or water must be removed by flushing (see below).

c) If you find a lot of water in the fuel filter, remove the injection pump fuel return line and check for water there. If the pump has water in it, flush the system.

d) Small quantities of surface rust won't create a problem. If contamination is excessive, the vehicle will probably stall.

e) Sometimes, contamination in the system becomes severe enough to cause damage to the internal parts in the pump. If the damage reaches this stage, have the damaged parts renewed and the pump rebuilt by an authorized fuel injection shop or buy a rebuilt pump.

Storage

Good quality diesel fuel contains inhibitors to stop the formation of rust in the fuel lines and the injectors. So long as there are no leaks in the fuel system, it is generally safe from water contamination. Diesel fuel is usually contaminated from water as a result of careless storage. There is little you can do about the storage practices of service stations where you buy diesel fuel, but if you keep a small supply of diesel fuel on hand at home, as many diesel owners do, follow these simple rules:

a) Diesel fuel "ages" and goes stale. Don't store containers of diesel fuel for long periods of time. Use it up regularly and replace it with fresh fuel.

b) Keep fuel storage containers out of direct sunlight. Variations in heat and humidity promote condensation inside fuel containers.

c) Don't store diesel fuel in galvanized containers. It may cause the galvanizing to flake off, contaminating the fuel and clogging filters when the fuel is used.

d) Label containers properly as containing diesel fuel.

Fighting fungi and bacteria with biocides

If there is water in the fuel, fungi and/or bacteria can form in diesel fuel in warm or humid weather. Fungi and bacteria plug fuel lines, fuel filters and injection nozzles; they can also cause corrosion in the fuel system.

If you've had problems with water in the fuel system and you live in a warm and humid climate, have your dealer correct the problem. Then use a diesel fuel biocide to sterilize the fuel system in accordance with the manufacturer's instructions. Biocides are available from your dealer, service stations and auto parts stores. Consult your dealer for advice on using biocides in your area and for recommendations on which ones to use.

Cleaning the fuel system

Water in the fuel system

1 Disconnect the negative battery cable. Position it so that it cannot contact the positive cable.

2 Drain the fuel tank into an approved container and dispose of it properly.

3 Remove the fuel sending unit (refer to Chapter 4A).

4 Thoroughly clean the fuel tank. If it is rusted inside, send it to a repair shop or renew it. Clean or renew the fuel pick-up screen in the fuel tank.

5 Refit the fuel tank but do not connect the fuel lines to it yet.

6 Remove the fuel filter (refer to Chapter 1).

7 Temporarily disconnect the fuel return line at the injection pump and again, using low air pressure, blow out the lines toward the rear of the vehicle.

8 Reconnect the main fuel and return lines at the tank. Fill the tank to a fourth of its capacity. Refit the cap.

9 Discard the fuel filter.

10 Connect the fuel line to the fuel pump.

11 Reconnect the battery cable.

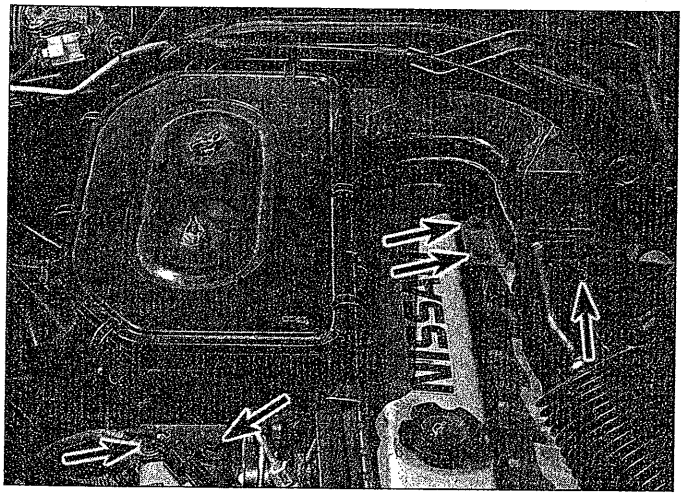
12 Purge the fuel pump and pump-to-filter line by cranking the engine until clean fuel runs out. Catch the fuel in a closed metal container.

13 refit a new fuel filter.

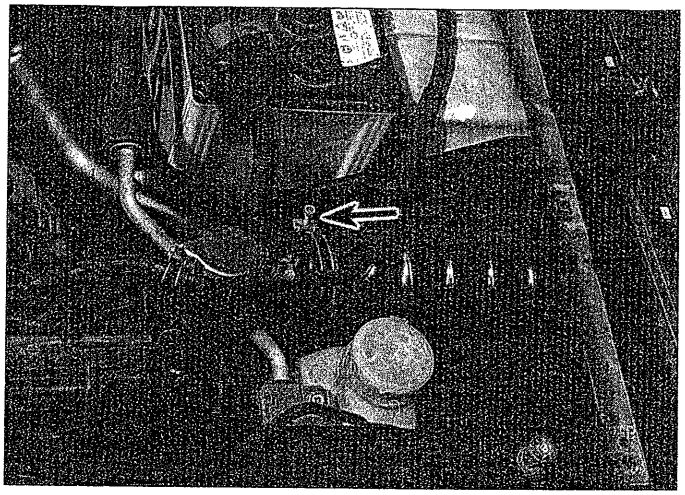
14 Refit a hose from the fuel return line (from the injection pump) to a closed metal container with a capacity of at least eight litres.

15 Crank the engine until clear fuel appears at the return line. Don't crank the engine for more than 30 seconds at a time. If it is necessary to crank it again, allow a three-minute interval before resuming.

17 Crank the engine until clear fuel appears at each nozzle. Don't crank the engine for more than 30 seconds at a time. If it is necessary to crank it again, allow a three-minute interval before resuming.



2.3 Remove the air cleaner mounting screws (arrows)



2.6 Loosen the precleaner duct clamp (arrow)

Petrol in the fuel system

Warning: *Diesel fuel is flammable, so take extra precautions when you work on any part of the fuel system. Don't smoke or allow open flames or bare light bulbs near the work area. Don't work in a garage where a natural gas appliance such as a water heater or a clothes dryer is present. Since diesel fuel is carcinogenic, wear latex gloves when there is a possibility of being exposed to fuel. If you spill fuel on your skin, rinse it immediately with soap and water. Mop up any spills immediately and do not store fuel-soaked rags where they could ignite. When you perform any work on the fuel system, wear safety glasses and keep a Class B type fire extinguisher on hand.*

If petrol has been accidentally pumped into the fuel tank, it should be drained immediately. Petrol in the fuel in small amounts, up to 30 percent, isn't usually noticeable. At higher ratios, the engine may make a knocking noise which will get louder as the ratio of petrol increases. Here is how to rid the fuel system of petrol:

18 Drain the fuel tank into an approved container and fill the tank with clean, fresh diesel fuel.

19 Detach the fuel line between the fuel filter and the injection pump.

20 Connect a short pipe and hose to the fuel filter outlet and run it to a closed metal container.

21 Crank the engine to purge petrol out of the fuel pump and fuel filter. Do not crank the engine for more than 30 seconds at a time. Allow three minutes between interval to allow the starter to cool.

22 Remove the pipe and hose and refit the fuel line previously removed.

23 Try to start the engine. If it doesn't start, purge the injection pump and lines: Crack the fuel line fittings open a little, just enough for fuel to leak out. Depress the accelerator pedal to the floor and, holding it there, crank the engine until all petrol is removed, i.e. diesel fuel leaks from the fittings. Tighten the fittings. Limit cranking to 30 seconds with three minute intervals between cranking.

Warning: *Avoid sources of ignition and have a fire extinguisher nearby.*

24 Start the engine and run it at idle for fifteen minutes.

2 Air cleaner and precleaner - removal and refitting

Refer to illustrations 2.1 and 2.6

Air cleaner

1 Disconnect the hose which attaches to the valve cover **(see illustration)**.

2 Disconnect the air duct from the air cleaner.

3 Unbolt the air cleaner from the engine.

4 Loosen the clamp which secures the air cleaner assembly to the inlet manifold. Lift it from the engine compartment.

5 Refitting is the reverse of removal.

Precleaner

6 Disconnect the air duct from the precleaner **(see illustration)**.

7 Unbolt the precleaner from the engine. Lift it from the engine compartment.

8 Refitting is the reverse of removal.

3 Accelerator cable and hand throttle cable - removal, refitting and adjustment

Accelerator cable

Removal and refitting

Refer to illustration 3.2

1 Disconnect the cable jacket from the bracket on the fuel injection pump.

2 Disconnect the cable from the injection pump while turning the throttle arm to allow slack **(see illustration)**.

3 Unclip the cable at its attachment points.

4 Disconnect the cable assembly from the accelerator pedal.

5 Unbolt the cable mounting bracket from the bulkhead. Pull it into the vehicle.

6 Refitting is the reverse of removal. Adjust the cable as follows.

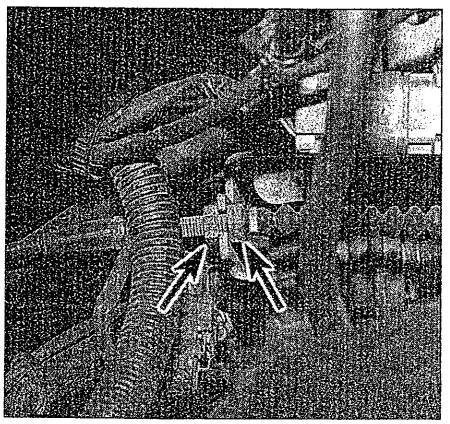
Adjustment

Note: *Before beginning, verify that the hand throttle cable is totally slack and that the lever on the fuel injection pump is seated on the idle stop screw.*

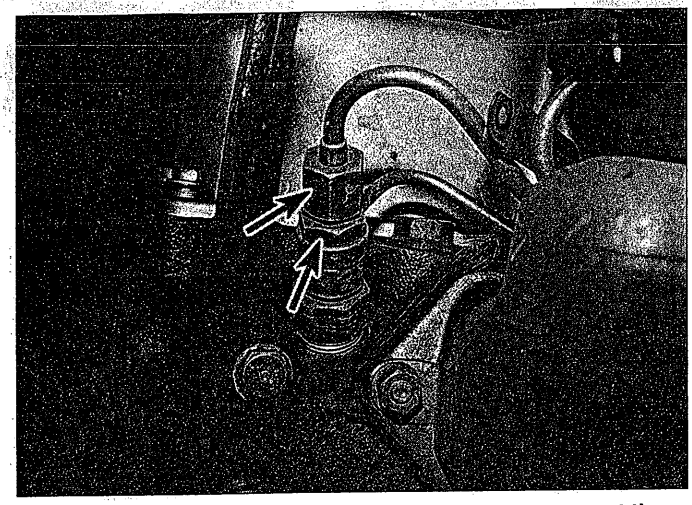
7 Have an assistant hold the accelerator pedal to the floor. Check that the injection pump arm touches the max engine speed screw.

8 If the arm does not touch the screw, loosen the adjustment lock-nuts on the cable and adjust them until it does.

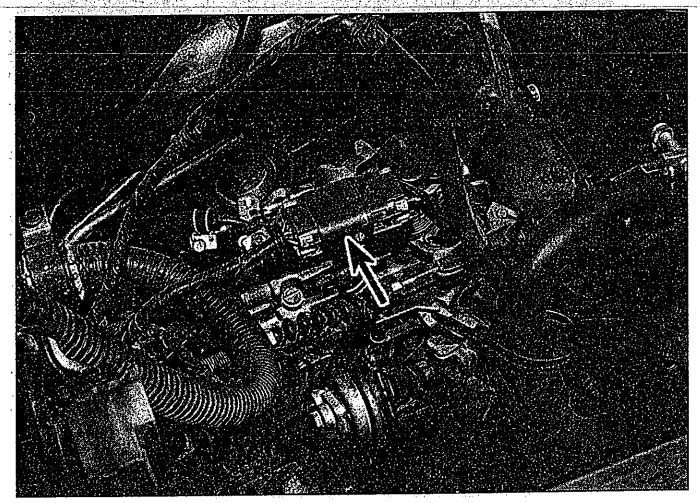
9 Release the accelerator pedal. Verify that there is a small amount of slack at the pedal. Again adjust the lock-nuts, if required, to give the required free play.



3.2 Loosen the cable lock nuts and remove the cable from the injection pump



6.1 Remove the line to the injector using two spanners at the points shown by the arrows



7.2 Disconnect the electrical connections at the injection pump (arrow)

Hand throttle cable

Removal and refitting

10 Disconnect the cable from the accelerator pedal.
11 Disconnect the cable assembly from the mounting bracket.
12 Pull out on the hand throttle control knob.
13 Hold the portion of the cable immediately behind the knob with pliers. Twist the knob clockwise while pushing it in to remove it.
14 Remove the mounting nut at the dash.
15 Pull the cable into the vehicle.
16 Refitting is the reverse of removal. **Note:** *There is no adjustment procedure for the hand throttle cable.*

4 Fuel tank - removal and refitting

Warning 1: *Diesel fuel is flammable, so take extra precautions when you work on any part of the fuel system. See* **Warnings** *in Section 1.*
Warning 2: Repairs to the fuel tank or filler neck should only be performed by a professional with the proper training to carry out this critical and potentially dangerous work. Even after cleaning and flushing, fumes can remain and could explode during repair of the tank.
Warning 3: If the fuel tank is removed from the vehicle, it should not be placed in an area where sparks or open flames could ignite the fumes coming out of the tank. Be especially careful inside garages where a gas appliance is located because the pilot light or flame could cause an explosion.
1 Disconnect the negative battery cable. Position it so that it cannot contact the positive cable.
2 Raise the vehicle and support it securely on jackstands.
3 Remove the tie-down hooks and the carpet edge retainers from the rear of the vehicle. Pull the carpet forward to expose the fuel tank access panel.
4 Remove the access panel.
5 Label and then disconnect the fuel hoses from the sending unit.
6 Disconnect the wiring from the fuel tank.
7 Using the drain plug, drain the fuel tank into an approved metal container.
8 Remove the shield mounting bolts from the fuel filler tube in the right wheel housing.
9 Remove the clamps from the filler tube and the vapor line where they attach to the fuel tank. Pull the hoses free.
10 Remove the filler tube shield.
11 Have an assistant support the empty tank or place a floor jack beneath it.
12 Remove the tank mounting bolts. Carefully lower the tank.
13 Refitting is the reverse of removal.

5 Fuel tank cleaning and repair - general information

1 Repairs to the fuel tank or filler neck should only be performed by a professional with the proper training to carry out this critical and potentially dangerous work. Even after cleaning and flushing, fumes can remain and could explode during repair of the tank.
2 If the fuel tank is removed from the vehicle, it should not be placed in an area where sparks or open flames could ignite the fumes coming out of the tank. Be especially careful inside garages where a gas appliance is located because the pilot light or flame could cause an explosion.

6 Fuel injectors - removal and refitting

Warning: *Diesel fuel is flammable, so take extra precautions when you work on any part of the fuel system. See* **Warnings** *in Section 1.*

Removal

Refer to illustration 6.1
1 Loosen the nuts which secure the fuel lines to the injectors and the fuel injector. It will be necessary to hold the injector or pump with one spanner while the nut is loosened with another **(see illustration).**
2 After removing the brackets, remove the fuel lines from the engine.
3 Remove the union retaining nuts on each injector. It will be necessary to hold the injector with one spanner while the nut is loosened with another.
4 Disconnect the fuel return hose from its tube. Remove the tube.
5 Clean around each injector thoroughly to prevent debris from falling into the engine after the injectors are removed.
6 Remove the injectors using a deep socket.

Refitting

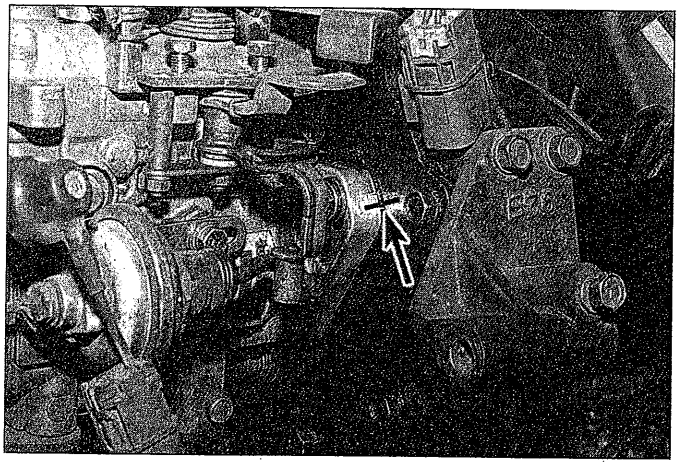
7 Make sure that there is no debris on any of the sealing surfaces of the injectors or the cylinder head.
8 Refit two new washers to the bottom of each injector. A dab of grease will hold them in position while they are being refitted.
9 Refitting is the reverse of removal. Tighten the injectors to the torque listed in the Specifications in this Chapter.

7 Fuel injection pump - removal and refitting

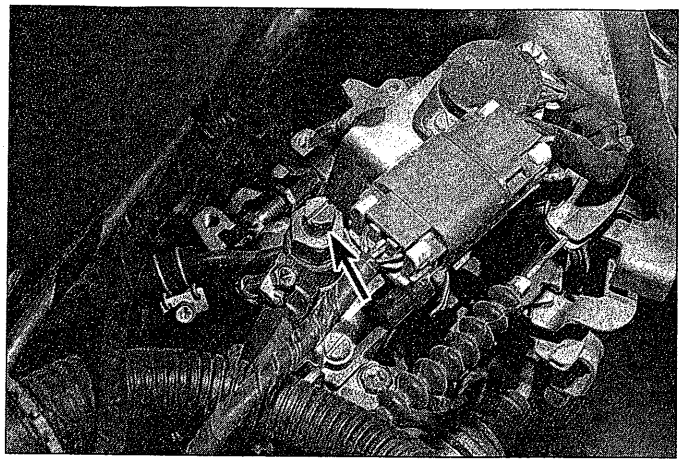
Warning: *Diesel fuel is flammable, so take extra precautions when you work on any part of the fuel system. See* **Warnings** *in Section 1.*
Caution: *Do not attempt to disassemble the injection pump. All repairs to the pump should be carried out by a dealer service department or a diesel engine specialist.*

Removal

Refer to illustration 7.2
1 Disconnect the negative battery cable. Position it so that it cannot contact the positive cable.
2 Disconnect the wiring harness from the pump **(see illustration).**



7.13 Align the pump housing mark with the mark on the front engine plate (arrow)



9.1 To bleed the system loosen the bleed screw on top of the injection pump (arrow)

3 Place a container or rags under the injection pump.
4 Disconnect both suction and discharge hoses from the pump. Plug both fittings to avoid contamination of the pump.
5 Disconnect and remove all of the injector tubes from the engine (refer to Section 6).
6 Disconnect the throttle cable from the pump arm (refer to Section 3).
7 Position the number one cylinder at TDC on the compression stroke (refer to Chapter 2).
8 Remove the cover from the front of the pump. The Z mark on the idler gear must be positioned between the two Zs on the injection pump gear.
9 Remove the injection pump drive gear using a puller if required. **Caution:** *Do not drop the gear key does not drop into the engine.*
10 Remove the pump mounting fasteners.
11 Pull the pump toward the rear of the vehicle to remove it.

Refitting

Refer to illustration 7.13

12 Renew all gaskets. Make certain that the timing marks on the gears are aligned as the pump is placed into position. The left mark on the crankshaft pulley must still be aligned with the mark on the front cover.
13 Refitting is the reverse of removal. To set the injection pump timing, align the timing mark on the outside of the injection pump with the mark on the rear of the front engine plate **(see illustration)**.
14 Tighten all fasteners to the torques listed in the Specifications in this Chapter. Check the pump timing (refer to Step 13).
15 Bleed the fuel system (refer to Section 9).

8 Fuel cut solenoid - check and renewal

Check

1 Turn the ignition OFF.
2 Disconnect the wiring harness from the fuel cut solenoid.
3 Connect a test light to the non-injector side of the connector. The test light should not be illuminated.
4 Turn the ignition ON. The test light should now be illuminated. If it is not, check the wiring to the connector and the engine control fuse.

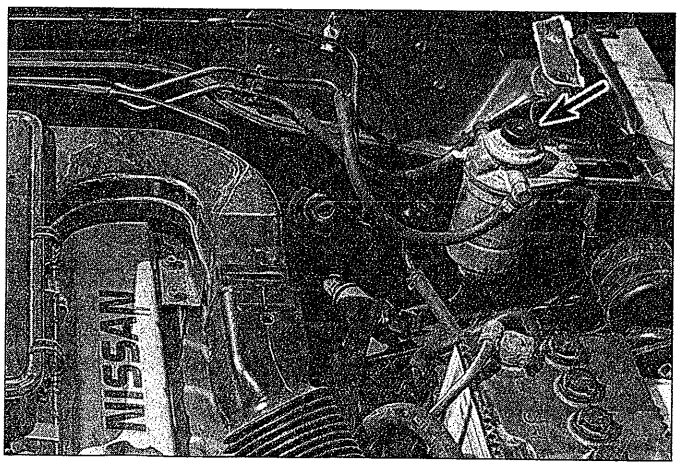
Removal and refitting

5 The solenoid is housed inside the fuel injection pump assembly. Remove the pump and have it repaired by an approved shop or replace it with a rebuilt unit. Refer to Section 7.

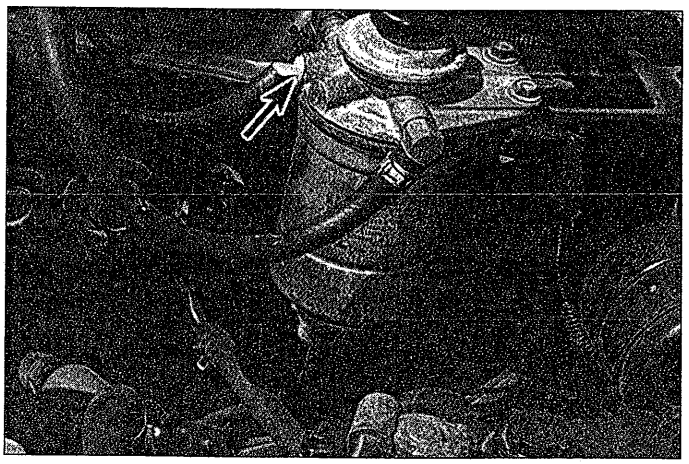
9 Fuel system - bleeding

Refer to illustrations 9.1, 9.3 and 9.5

1 Loosen the bleed screw located at the uppermost part of the fuel injection pump **(see illustration)**.
2 Place rags or a metal container beneath the pump.
3 Slowly use the pump on top of the fuel filter assembly to force fuel through the system **(see illustration)**.
4 When clear fuel which does not contain foam or bubbles comes out of the pump, tighten the screw.
5 Place the rags or container beneath the fuel filter assembly. Loosen the bleed screw on the fuel filter housing, immediately below the pump knob **(see illustration)**.
6 Perform the same operation as above.



9.3 Use the lift pump on the fuel filter head to bleed the air through the system (arrow)



9.5 Loosen the bleed screw from the filter head (arrow)

Tighten the bleed screw.
7 Keep pumping until you can feel that there is resistance in the system.
8 Clean up any spilled fuel.

10 Preheat system - general information

To assist cold starting, diesel engines are equipped with a preheat system. This is comprised of a glow plug for each cylinder, a preheat control module, a coolant temperature sensor, a relay and a light on the instrument panel.

The glow plugs are small electrical heating elements, encapsulated in a metal case with a probe at one end and an electrical connector at the other. Each inlet port has a glow plug threaded into it. The glow plug probe is positioned directly in line with the incoming air charge. When the glow plug is energized, the air passing over it is heated, allowing its optimum combustion temperature to be achieved more readily after it reaches the cylinder.

The duration of the preheating is governed by the preheat control unit which monitors the temperature of the engine via the coolant temperature sensor. It alters the preheating conditions to suit the engine temperature.

Preheating is triggered by the ignition key being turned ON. A dash-mounted lamp informs the driver that preheating is taking place. The lamp turns off when sufficient preheating has taken place to allow the engine to start. The control unit will switch off the glow plug's power if the engine is not started within a short time to prevent battery drain and glow plug burn-out.

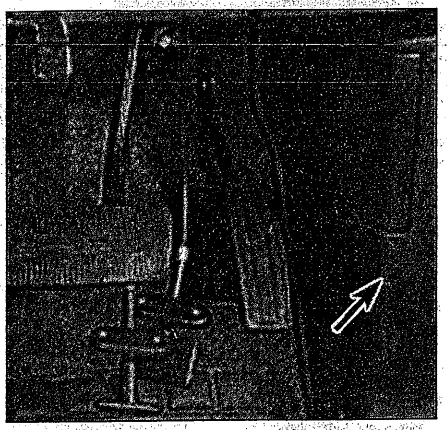
After the engine has been started, the glow plugs continue to operate for a period of time. This helps to improve fuel combustion while the engine is warming up. This results in quieter, smoother running and reduced exhaust emissions.

11 Preheat system control unit - check and renewal

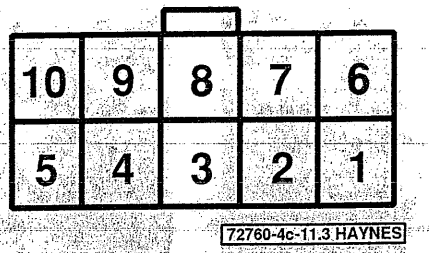
Check

Refer to illustration 11.1 and 11.3

1 The control unit is located behind the driver's interior kick panel directly below the relay and fuse centers **(see illustration)**. Release the panel clips and remove the panel.
2 Disconnect the wiring harness from the control unit.
3 Connect an ohmmeter between terminals 2 and 4 on the wiring harness **(see illustration)**. The resistance should approximately equal that of the coolant temperature sensor. If it is not, check the sensor wiring circuit and the sensor itself.
4 Connect the ohmmeter between terminal 4 and a good earth on the body of the vehicle. With the ignition OFF, there should be near zero resistance.
5 Connect a voltmeter between terminals 4 and 7. When the ignition is OFF, there should be zero. When the key is turned ON, there should be approximately 12 volts.
6 Connect the voltmeter between terminals 1 and 4. When the starter is energized, there should be 12 volts indicated.
7 If any of the above tests do not check out, correct the electrical problem that exists outside of the control unit.
8 Connect the wiring harness to the control unit for the remaining tests.
9 Backprobe a test light into terminals 4 and 9.
10 Turn the ignition ON. The light should be illuminated for several seconds and then go out.
11 with the harness still connected, connect the test light between terminals 3 and 7. Turn the ignition ON. The test light should be illuminated for several seconds and then go out.
12 Turn the ignition OFF, then reconnect the test light to terminals 4 and 9. Turn the ignition ON. The test light should blink several times and then stay on.
13 Turn the key briefly to START but do not allow the engine to start. Turn the key back to ON. The test light should blink several times.
14 If any of the tests performed with the wiring harness connected do not check out, renew the control unit.



11.1 Remove the right kick panel (arrow) to gain access to the controller on the bottom of the kick panel



11.3 Terminal numbering for the fuel injection control unit wiring connector

Renewal

15 Disconnect the wiring harness from the control unit and remove the mounting screws.
16 Refitting is the reverse of removal.

12 Glow plug relay - check and renewal

Check

1 The glow plug relay is a conventional electrical relay located next to the battery behind an access cover on the inner fender. To check it, first remove the cover and then remove the relay from the fender.
2 Hold the relay in your hand while an assistant turns the ignition ON. It should have a noticeable click. If it does not click, proceed with the remaining tests.
3 Disconnect the wiring harness from the relay.
4 Connect an ohmmeter between the black wire in the connector and earth. There should be almost zero resistance. If resistance exists, check the earth wiring circuit.
5 Connect a test light to the red and white wire. With the ignition ON, there should be power present. This wire is fed by a fusible link adjacent to the battery.
6 Connect the test light to the green and white wire. With the ignition ON, there should be power present. This circuit is controlled by fuses in the underbonnet fuse center and the kick panel fuse center.

Renewal

7 If the relay is defective, connect a new one into the wiring harness and test it before proceeding.
8 If it checks good, secure it to the inner fender panel and refit the access cover.

13 Coolant temperature sensor - check and renewal

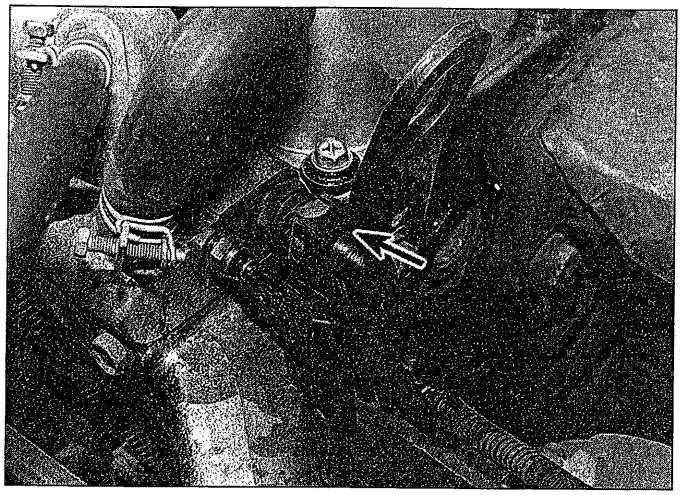
Check

Refer to illustration 13.1

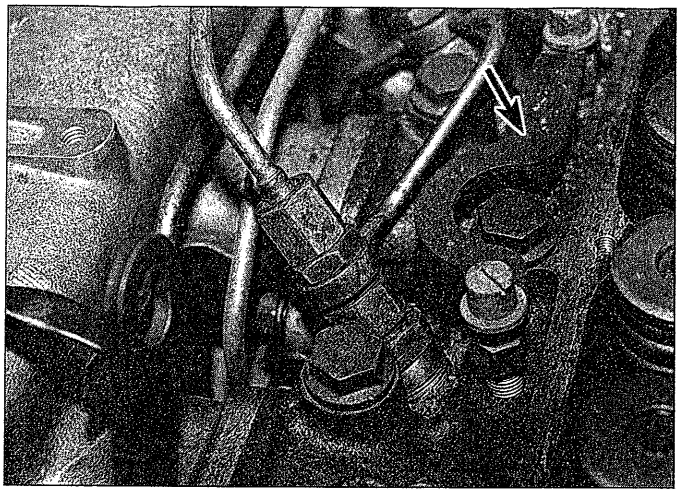
1 The sensor is located in the thermostat housing **(see illustration)**. Disconnect the wiring from the sensor.
2 Using an ohmmeter, check the resistance of the sensor. Compare your reading to those listed in the Specifications in this Chapter. Renew it if necessary.
3 If you are unsure about the results, refer to Step 5 and remove the sensor.
4 Place it in a pan of water which can be heated. Compare the resistances at various temperatures to those listed in the Specifications in this Chapter.

Renewal

5 Wait until the vehicle has completely cooled.



13.1 Typical coolant temperature sensor location (arrow)



14.1 Check for power at the bridging strap (arrow)

6 Place a container and rags under the sensor to catch coolant spillage. Alternatively, some coolant can be drained from the engine (refer to Chapter 1).
7 Apply sealer to the threads of the new sensor and place it close at hand.
8 Disconnect the wiring, then remove the sensor from the thermostat housing.
9 To minimize coolant loss, quickly refit the new sensor.
10 Tighten it to the torque listed in this Chapter's Specifications.

14 Glow plugs - check and renewal

Check

Refer to illustration 14.1

1 Use a test light on the glow plug bridging strap to verify that power is reaching the glow plug in question **(see illustration)**.
2 Disconnect the negative battery cable. Position it so that it cannot contact the positive cable.
3 Remove the bridging straps from the glow plugs. Do not lose the washers used.
4 Using an ohmmeter or a self-powered test light, check to see if there is continuity between the glow plug post and earth. Continuity (near zero resistance) should exist. If it does, not renew the glow plug.

Renewal

5 Remove the glow plug straps if not already done (refer to Steps 2 and 3).
6 Clean around the glow plugs so that debris does not fall into the engine. Use a deep socket to unscrew the glow plugs.
7 Refitting is the reverse of removal. Tighten the glow plugs to the torque listed in this Chapter's Specifications.
8 When connecting the strap and the feed cable, make sure that the insulators are properly positioned. There should be no contact between the strap/feed wire and the post. Tighten the nut securely.

Notes