

EMISSION CONTROL

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GENERAL PRECAUTIONS.

1. Know the importance of periodical maintenance.
 - a. Every service item in the periodic maintenance list must be performed.
 - b. Failing to do even one item can cause the engine to run poorly and increase exhaust emission.
2. Determine if you have an engine or emission system problem.
 - a. Engine problems are usually not caused by the emission control systems.
 - b. When troubleshooting, always check the engine and the ignition system first.
3. Check hose and wiring connections first.
The most frequent cause of problems is simply a bad wiring or vacuum hose connection. Always make sure that all connections are secure and correct.
4. Observe the following precautions to avoid damage to the parts:
 - a. To disconnect vacuum hoses, pull on the end, not the middle of the hose.
 - b. To pull apart electrical connectors, pull on the end, not the middle of the hose.
 - c. Be careful not to drop electrical components, such as sensors or relays. If they are dropped on a hard surface, they should be replaced and not reused.
 - d. When steam cleaning an engine, protect the distributor, crank sensor, coil, air filter, air intake.
 - e. Never use an impact wrench to remove or install thermo switches, thermo sensors or other sensors.
 - f. When checking continuity at a wire connector, insert the tester probe carefully to prevent terminals from bending.
 - g. When using a vacuum gauge, never force the hose onto a connector that is too large. Use a step-down adaptor instead. Once the hose has been stretched, it may leak.
5. Tag hoses before disconnecting them:
 - a. When disconnecting vacuum hoses, use tags to identify hoses and mark how they should be reconnected.
 - b. After completing a job, double check that the vacuum hoses are properly connected.

6. When replacing components use a new component if a secondhand component cannot be tested.

7. Perform work safely.

a. If the vehicle is to be jacked up only at the front or rear end, be sure to block the wheels.

b. After the vehicle is jacked up always support it on stands. It is extremely dangerous to do any work on the vehicle raised on a jack alone, even for a small job that can be finished quickly.

c. Disconnect the battery cable from the negative terminal of the battery to make work safer when replacing electrical parts or working on parts near an electrical source.

PRECAUTIONS WITH A CATALYTIC CONVERTER

WARNING: If large amounts of unburnt petrol flow into the catalytic converter, it may overheat and create a fire hazard.

To prevent this, observe the following precautions and explain them to your customer.

1. Use only unleaded petrol.

2. Avoid prolonged idling.

Avoid running the engine at fast idle speed for more than 10 minutes and at idle speed for more than 20 minutes.

3. Avoid spark jump test.

a. Perform spark jump test only when absolutely necessary and as quickly as possible.

b. Never race the engine while testing.

5. Avoid prolonged engine compression measurement.

Engine compression tests must be made as quickly as possible.

5. Do not run engine when fuel tank is nearly empty.

This may cause the engine to misfire and create an extra load on the catalytic converter.

6. Avoid coasting with ignition turned off and prolonged engine braking.

7. Do not dispose of used catalytic converter along with parts contaminated with petrol or oil.

PROBLEM SOLVING.

EXCESSIVE OIL CONSUMPTION

Problem	Possible causes	Remedy
Excessive oil consumption	Oil leak	Repair oil leak, example renew a seal
	PCV line blocked	Check PCV system
	Piston rings worn or broken	Install new piston rings
	Valve stem oil seal worn or faulty	Check and replace oil seals
	Valves faulty	Check valves for wear Check valve guides

EXCESSIVE FUEL CONSUMPTION

Problem	Possible causes	Remedy
Excessive fuel consumption	Fuel leak	Damaged fuel tank Damaged fuel pipes
	Air cleaner clogged	Check and replace air cleaner
	Ignition timing	Test "Electric spark timing" code 42
	Spark plugs faulty	Replace spark plugs
	Spark plug leads	Replace spark plug leads
	Carbon cannister system faulty	Check and repair carbon cannister system
	Brake drag	Check and repair brakes
	Slipping clutch	Check clutch, replace if necessary
	Automatic Transmission slipping	Check transmission adjust and repair if necessary

ENGINE WILL NOT START

Problem	Possible causes	Remedy
Engine will not crank or cranks slowly	Starting system faulty	Check starting system for electrical faults
	Ignition system faulty	Ignition check in this chapter
	Electric spark timing	Check code 42
Engine will not start, cranks over OK	No fuel at injectors	Check fuel lines Check fuel filter Check operation of fuel pump Faulty fuel regulator
	Ignition faults	Carry out "diagnostic circuit check" code 41
	Spark plugs faulty	Replace spark plugs
	Spark plug leads faulty	Test and replace if necessary spark plug leads
	Electrical fault	Pull apart plugged connections, clean terminal contacts, push plugs back.
	ECM faulty	Carry out " Engine! on but will not flash diagnosis "

ROUGH IDLING

Problem	Possible causes	Remedy
Rough idle	Spark plugs faulty	Replace spark plugs
	Spark plug leads faulty	Replace spark plug leads
	Faulty ECM	Carry out " Engine! on but will not flash diagnosis
	Fuel problems	Check fuel lines
		Check fuel filter
		Check operation of fuel pump
	Fuel injectors	Faulty fuel regulator
		Test and replace injector if faulty
	Faulty IAC	Test fuel regulator
		Test IAC circuit
	Faulty oxygen sensor	Test oxygen sensor code 13
	Ignition faulty	Carry out "diagnostic circuit check" code 41
	Ignition timing	Test "Electric spark timing" code 42
	Engine over hot	Check cooling system
	Engine valves faulty	Compression check, engine head rebuild
	Compression low	

EMISSION SYSTEM

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ENGINE LACKS POWER

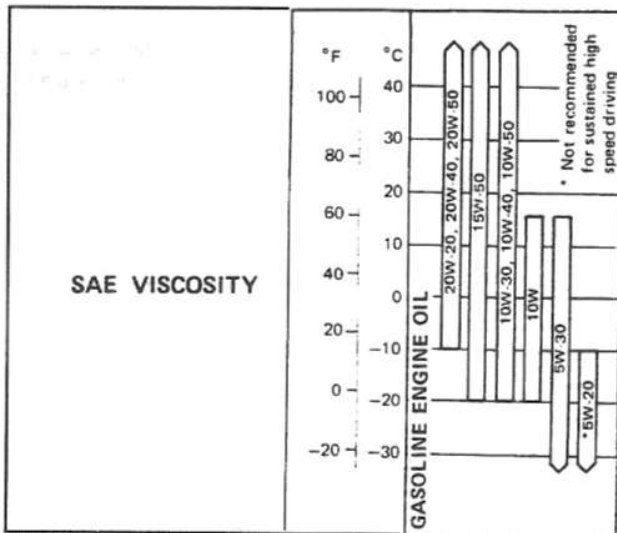
Problem	Possible causes	Remedy
Poor acceleration	Spark plugs faulty	Replace spark plugs
	Spark plug leads faulty	Replace spark plug leads
	Fuel problems	Check fuel lines Check fuel filter Check operation of fuel pump Faulty fuel regulator
	Fuel injectors	Test and replace injector if faulty Test fuel regulator
	Faulty IAC	Test IAC circuit
	Faulty oxygen sensor	Test oxygen sensor code 13
	Ignition faultily	Carry out "diagnostic circuit check" code 41
	Inginition timing	Test "Electric spark timing" code 42
	Engine over hot	Check cooling system
	Exhaust system	Faulty catalytic converter

ENGINE BACKFIRES

Problem	Possible causes	Remedy
Engine backfires or muffler explosion	Insufficient fuel flow	Lean fuel mix code 45 MAP sensor faulty Fuel pump faulty Block fuel filter Fuel pipes damaged
	Incorrect ignition timing	Check "Electric spark control code-42"
	Check air flow	Check IAC sensor Check air cleaner element
	Faulty ECM	Carry out " Engine! on but will not flash diagnosis "

OIL CONSUMPTION TO HIGH**High Oil Loss**

- (1) Tighten bolts and/or replace gaskets and seals as required for external leaks.
- (2) Check oil with car on a level surface and allow drain down time to ensure a correct reading of dipstick.
- (3) Severe usage such as towing or continuous high speed driving will normally cause oil consumption to increase.
- (4) PCV system failure.
- (5) Use recommended S.A.E viscosity.



- (6) Valve guides and/or valve stem seals worn, or seals omitted. Ream guides and install oversize service valves and/or new valve stem seals.

- (7) Allow enough time for the piston rings to seat. Replace worn or broken rings as needed, if rings have been incorrectly installed, worn or broken, or not seated.
- (8) Piston incorrectly installed or misfitted.

Gaskets.

- (1) Incorrectly tightened fasteners or damaged/dirty threads.

- (2) Worn or damaged gasket (cracking or porosity).
- (3) Fluid pressure/level too high.
- (4) Incorrect sealant used (when required)

Inspection of Seals.

- (1) Damaged seal bore (burred, nicked, scratched)
- (2) Worn or loose bearing which causes excessive seal wear.

- (3) Worn or damaged seal or incorrect installation.

- (4) Fluid pressure/level too high.

Oil Leak Investigation

Oil leaks are easily located and repaired by visually finding the leak, replacing or repairing the required parts.

- (1) Determine whether the fluid is transmission lubricant, engine oil, power steering fluid etc.

- (2) Run the car at normal operating temperature and park the car over a large sheet of paper. After a few minutes, you should be able to find the approximate location of the leak by drippings on the paper.

- (3) Using a degreaser or steam to clean the area of the leak, drive the car for a few kilometres. The visually inspect the suspected part.

Dye & Light Oil Leak Detection.

Purchase a commercially available kit.

- (a) Follow kit directions and add required amount of dye into leaking component oil.

- (b) Drive the vehicle under normal operating conditions to allow the oil leak to be detected.

- (c) As the kit light is shone onto the suspected area. The dyed oil will allow you to detect exactly where the leak is occurring.

Low Oil Pressure

- (1) Blocked oil filter.
- (2) Incorrect oil viscosity for expected temperature, or oil diluted with moisture or unburned fuel mixtures.
- (3) Excessive bearing clearance.
- (4) If the oil level is low, fill to mark on dipstick.
- (5) Oil pump dirty/worn, or oil pump suction pipe screen blocked, or hole in oil pump suction pipe.
- (6) Incorrect or failing oil pressure sender.

ENGINE KNOCKS

Try to detect if the noise comes from within the engine. This should be able to be detected by holding a long screw driver handle to your ear (preferably a screw driver that the steel shaft goes all the way through the handle). Hold the other end of the screw driver against the engine block, you should be able to detect a louder and sharper knock if the problem is within the engine.

Light engine knock as engine is warming up only.

Piston knock will give a particular knock and disappear as the engine warms up. This could be acceptable, however it can be eliminated by honing cylinder bore and replacing piston if the piston to cylinder gap is over specification. Excessive piston pin clearance can also give a light engine knock.

Hydraulic valve lifters will give a light knock if they are allowing the oil to leak from them, this will usually disappear as they prime themselves with engine oil.

Check for loose pulleys on water pump, alternator, power steering pump or air conditioner compressor.

Loud knock and is worse with increased RPM

If the noise comes from within the engine it could be a bearing that is in the process of failing, this could be a connecting rod bearing or crankshaft bearing. The engine should be pulled down and all bearings and journals inspected. Inspect for wear and clearance.

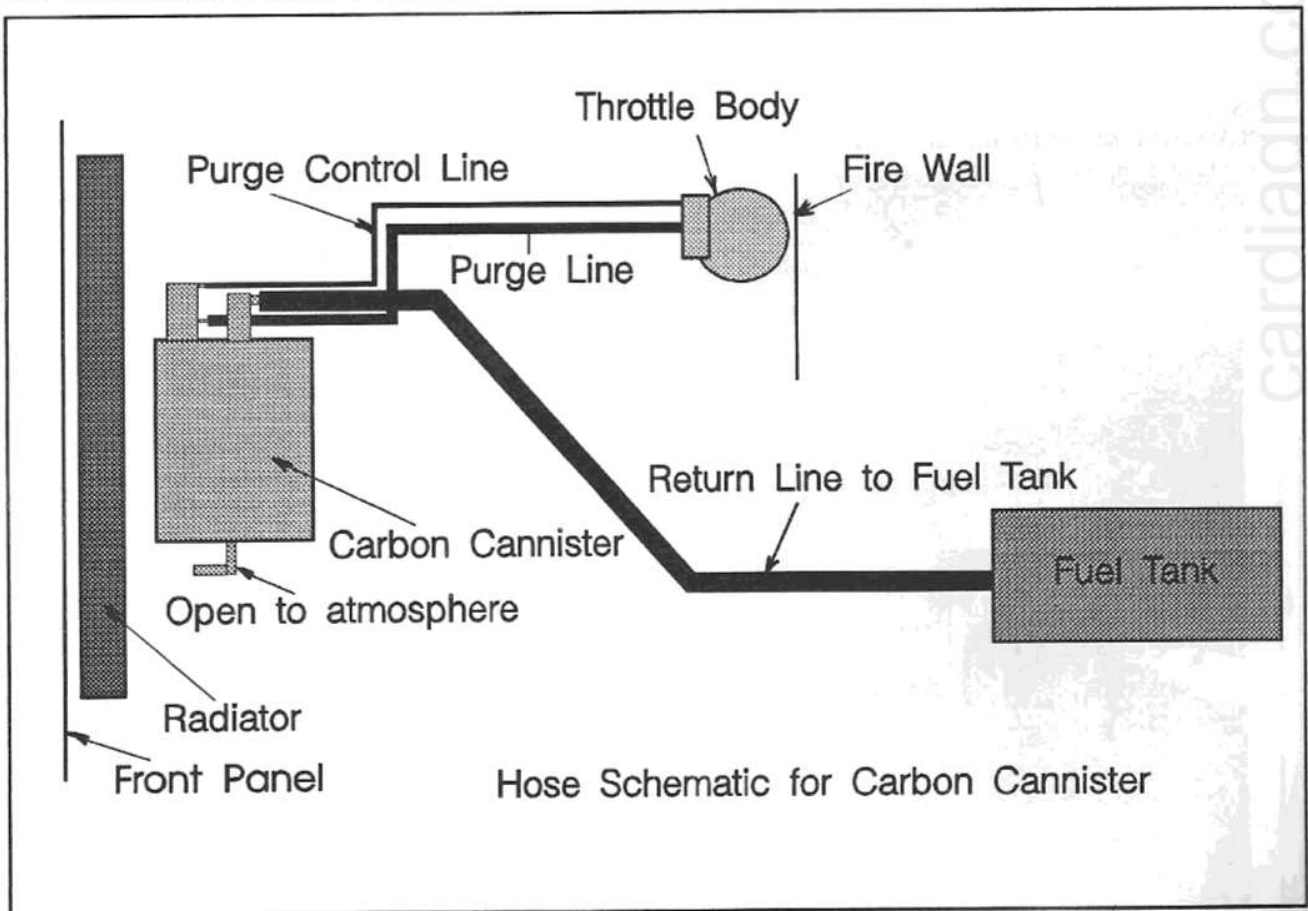
Check for loose or cracked flexplate/flywheel bolts. Also check for broken or loose pulleys at the front of the engine.

EMISSION CONTROL SYSTEMS.

SYSTEM PURPOSE.

Name of System	Abbreviation	Purpose
Positive Crankcase Ventilation	PCV Valve	Reduces blow-by fumes (HC)
Fuel Evaporative Emission Control (Carbon Cannister System)	EVAP system	Reduces evaporative HC
Oxygen Sensor System	Oxygen monitor	Monitors oxygen to reduce NOx
Spark Control System	EST System (electronic spark timing)	Reduces NOx and HC
Idle Air Control Valve	IAC Valve	Reduces HC and CO
Exhaust and Catalytic Converter	Catalytic converter	Reduces HC and CO

HOSE SCHEMATIC LAYOUT DRAWING



POSITIVE CRANKCASE VENTILATION (PCV) SYSTEM.

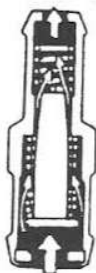
INSPECTION OF PCV VALVE

1. Remove PCV valve from rocker cover.

Engine not operating
or backfire while operating.



Engine running
under normal conditions.



2. Attach clean hose to PCV valve.

3. Blow from cylinder head side.

Check that air passes through easily.

WARNING: Do not suck air through the valve.

Petroleum substances inside the valve are harmful.

4. Blow from intake manifold side.

Check that air passes through with difficulty.

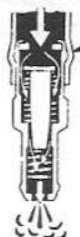
If the PCV valve fails either of these checks, replace it.

5. Reinstall PCV valve into rocker cover.

INSPECTION OF PCV HOSES AND CONNECTIONS.

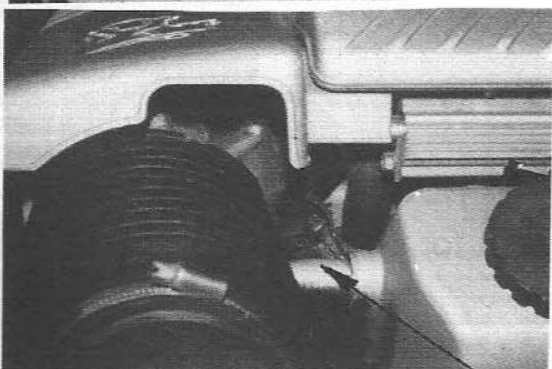
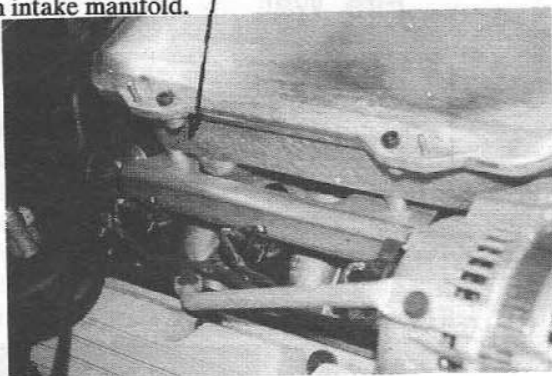
Visually inspect hoses, connections and gaskets.
Check for cracks, leaks or damage.

Air should blow through one only



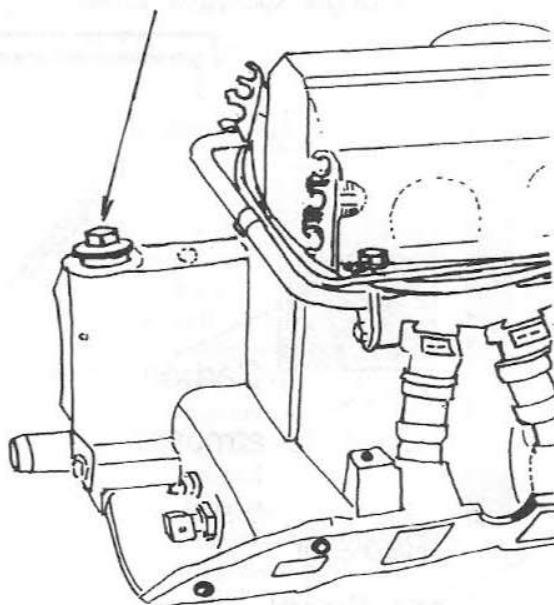
VS V6

PCV valve is situated under air intake chamber in intake manifold.



VR V6

PCV Valve



V8 PCV Valve

FUEL EVAPORATIVE EMISSION CONTROL SYSTEM.

INSPECTION OF FUEL VAPOR LINES, FUEL TANK AND TANK CAP.

1. Visually Inspect Lines And Connections.
Look for loose connection, kinks or damage.

2. Visually Inspect Fuel Tank.

Look for deformation, cracks or fuel leakage.

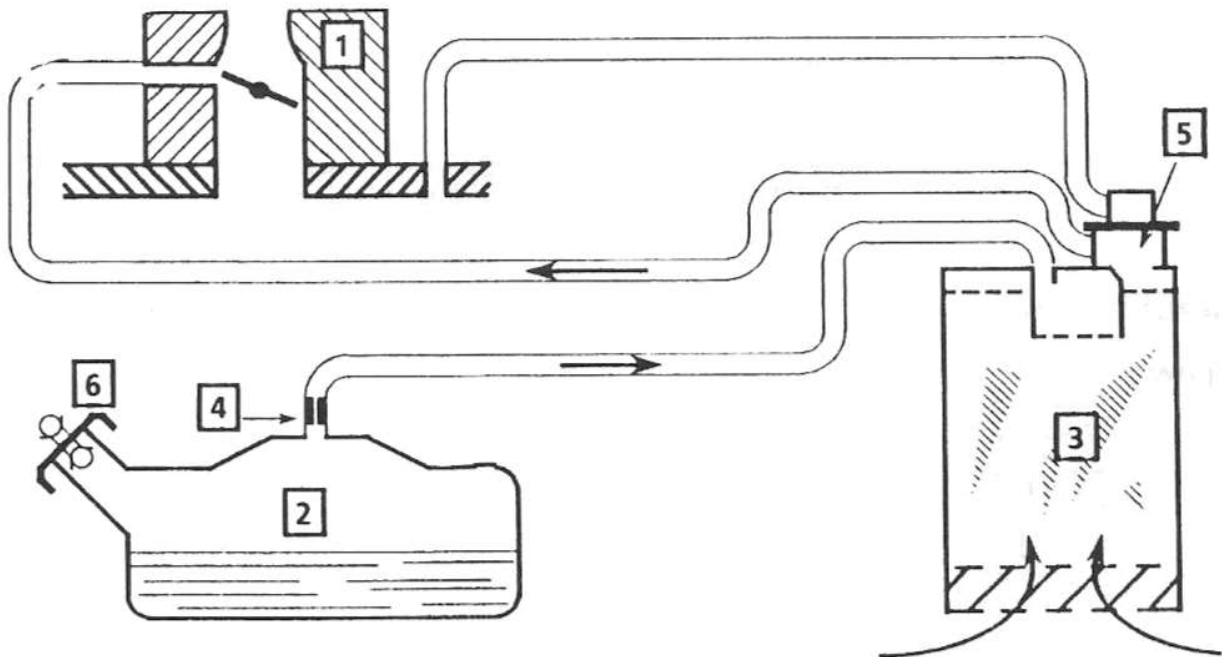
3. Visually Inspect Fuel Filler Cap.

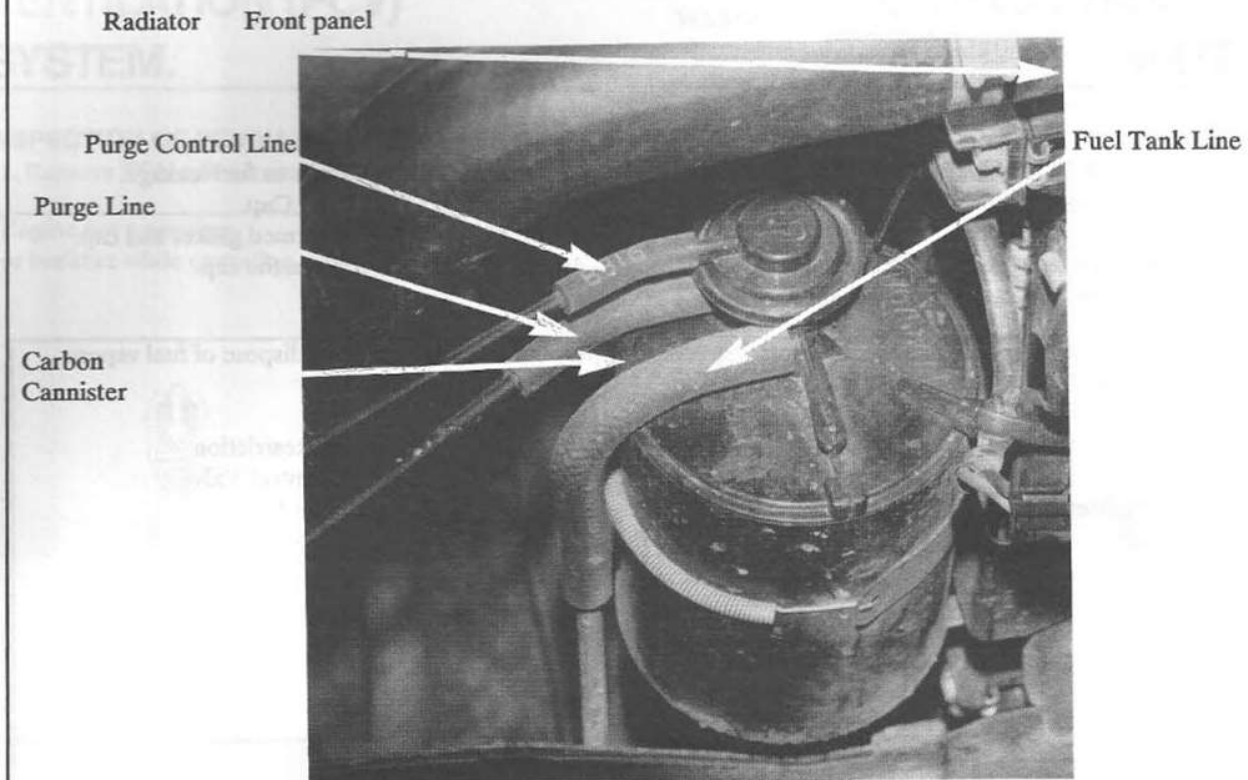
Look for a damaged or deformed gasket and cap.
If necessary, repair or replace the cap.

Typical layout of fuel evaporative emission control system. The purpose of this system is to dispose of fuel vapour from the fuel tank into the intake throttle body.

1. Throttle body
2. Fuel Tank
3. Carbon Cannister

4. Vapour Restriction
5. Purge Control Valve
6. Fuel Filler Cap



**INSPECTION OF CARBON CANISTER.**

1. Remove Carbon Canister.
2. Visually Inspect Carbon Canister.
Look for cracks or damage.
3. Check for clogged filter and stuck check valve.

(a) Using low-pressure compressed air, blow into the tank pipe and check that the air flows without resistance from the other pipes

(b) If a problem is found, replace the charcoal canister.

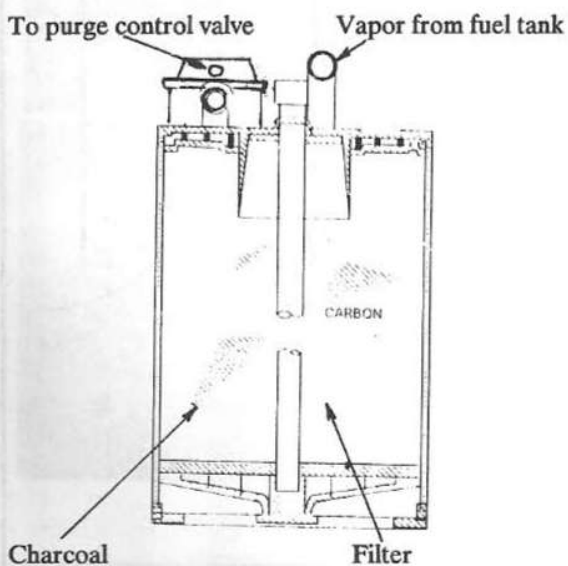
4. Clean Filter In Canister

Clean the filter by blowing 3 kg/cm sq. (43 psi, 294kPa) of compressed air into the pipe to the outer vent control valve while holding the other upper canister pipes closed.

NOTE:

Do not attempt to wash the canister.

No activated carbon should come out.

5. Install Carbon Canister.**CARBON CANISTER****INSPECTION OF PURGE CONTROL VALVE**

Check Purge Control Valve Operation.

(a) Disconnect the hoses from the valve.

(b) Check that the valve is open when a vacuum is applied to the vacuum control connection.

(c) Check that the valve is closed when there is no vacuum present.

(d) Reconnect the hoses to the proper locations.

If the valve does not operate, replace the valve.

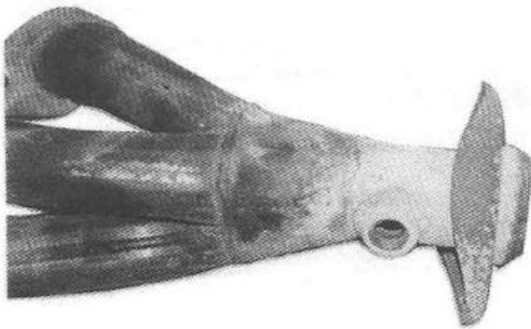
OXYGEN SENSOR

SYSTEM.

Removal

1. Disconnect the battery earth cable.
2. Remove the sensor from the left side manifold or exhaust pipe. Care must be used while unscrewing sensor, as the sensor will not operate if damaged.

Location of sensor in V8 manifold



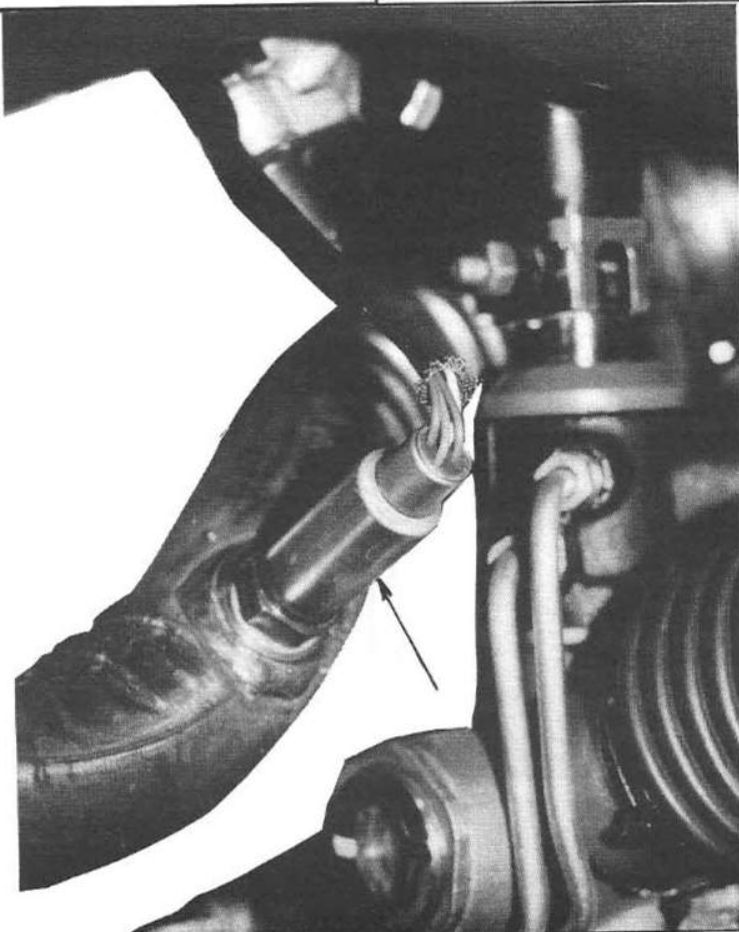
Inspection of Oxygen Sensor.

1. Check and clean Oxygen Sensor.
 - (a) Check for contamination or damage, the end must be kept free of grease, dirt or other contaminants.
2. (a) Cold test with a volt metre should read 0.35 - 0.45 of a volt.
 - (b) Hot test.
Engine running and engine at operating temperature the voltage should vary between 0.010 - 1.000 of a volt.
3. Check seating of oxygen sensor.
4. Check wiring loom for damage.

Installation

1. If replacing a unit coat threads with a suitable anti-seize compound. Do not apply anti-seize to the end of the sensor.
New sensors should have the threads coated with anti-seize from the manufacture, if not apply anti-seize as above.
2. Install sensor and tighten to specification.
Oxygen Sensor tighten specification: 40-60Nm
3. Reconnect the earth cable to the battery.

Location of sensor



SPARK CONTROL SYSTEM.

INSPECTION OF SPARK PLUGS. V6 & V8

1. Clean and Inspect Spark Plugs.

(a) Clean the spark plugs using a spark plug cleaner or wire brush.

(b) Examine the spark plugs for electrode wear, thread damage and insulator damage. Replace the plugs if a problem is found.

2. Adjust Electrode Gap.

Bend the outer electrode carefully to obtain the correct electrode gap.

V6 Correct electrode gap: 1.5 mm

V8 Correct electrode gap: 1.0 mm

3. Spark plug type.

V6 Specified Spark Plug: R44LTS6

V8 Specified Spark Plug: R42LTS

4. Torque plug to correct specification.

Spark Plug Torque specification: 14-20Nm

FIRING ORDER

The firing order for the 6 cylinder engines is 1-6-5-4-3-2 and the firing order for V8 engines is 1-2-7-8-4-5-6-3.

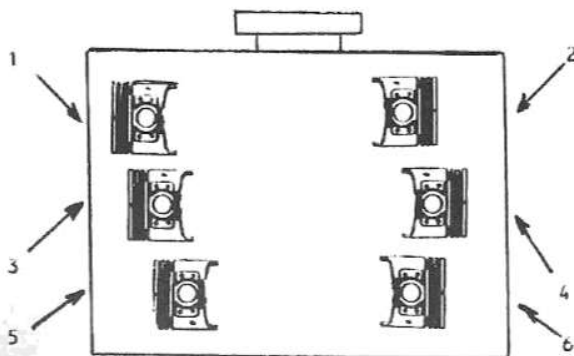
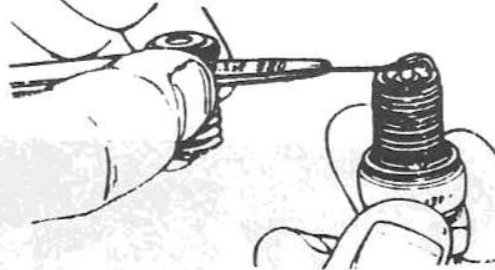
IGNITION TIMING

The ignition timing for both V6 and V8 is preset and can not be adjusted. However the timing is monitored and automatically adjusted via the ECU.

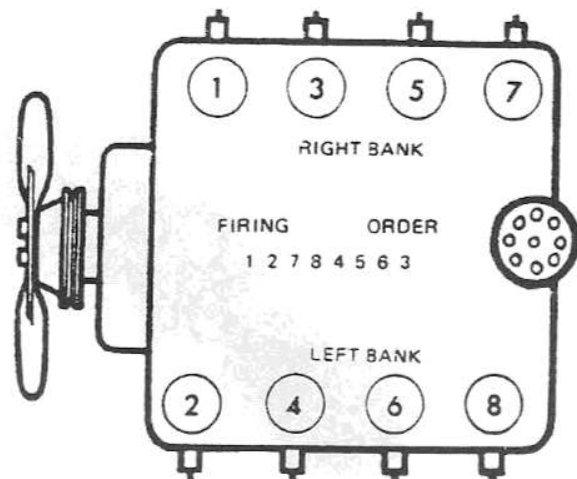
Ignition Timing: 10° Before Top Dead Centre B.T.D.C.

Spark plug gap should be checked with a feeler gauge or spark plug gap feeler gauge.

Spark Plug Gap : - V6 1.5mm - V8 1.0mm



V6



V8

The firing order for the 6 cylinder engines is 1-6-5-4-3-2 and the firing order for V8 engines is 1-2-7-8-4-5-6-3.

EMISSION SYSTEM

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IDLE AIR CONTROL VALVE.

Idle air control valve is found at the rear of the motor, on the side of the throttle body.

Removal

1. Remove the throttle body as described in the fuel chapter.
2. Remove the IAC wiring connector.
3. Remove the IAC valve attaching screws, using a torx screw remover.
4. Remove the IAC valve.

Inspect

1. Check that valve spring is not broken, and that the spring moves freely.
2. Check that the distance between the base of the IAC valve to the end of the pintle valve extension is within specification.

Valve specified maximum length: 28mm

If not within specification, push down on the valve to shorten spring.

3. Replace "O" ring if damaged.

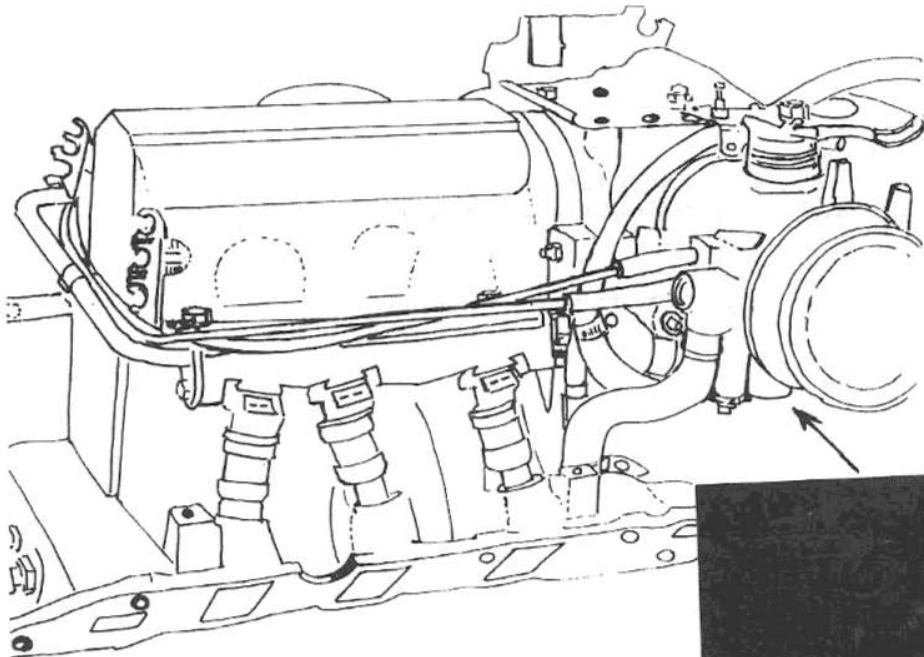
Installation

1. Install the IAC valve and attaching screws. Tighten to specification.

IAC Attaching screws specification: 1-1.5Nm

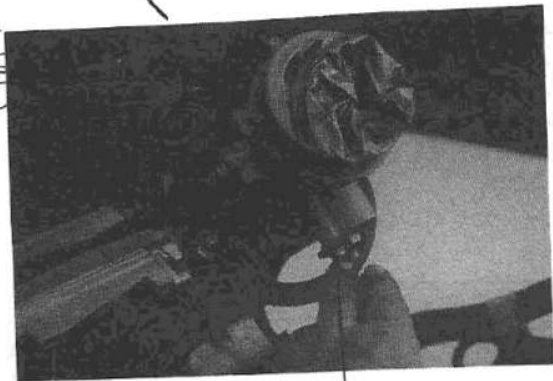
2. Replace the throttle body if removed.
3. Replace IAC wiring connector and loom.
4. Start engine and test drive.

Idle air control valve is found at the rear of the motor, on the side of the throttle body.



Throttle Body

IAC Valve



Exhaust & Catalytic Converter

INSPECTION OF EXHAUST PIPE ASSEMBLY.

1. Check Connection For Looseness or Damage.
2. Check Clamps For Weakness, Cracks, or Damage.

INSPECTION OF CATALYTIC CONVERTER.

Check For Dents or Damage.

If any part of protector is damaged or dented to the extent that it contacts the catalyst, repair it or replace it.

INSPECTION OF HEAT INSULATOR.

1. Check Heat Insulator For Damage.
2. Check For Adequate Clearance Between Catalytic Converter And Heat Insulator.

REPLACEMENT OF CATALYTIC CONVERTER.

1. Remove Catalytic Converter.
 - (a) Jack up the vehicle.
 - (b) Check that the converter is cool.
 - (c) Remove the bolts at the front and rear of the converter.
 - (d) Remove the converter and gaskets.
 2. Install Catalytic Converter.
 - (a) Place new gaskets on the converter front and rear pipes, and connect the converter to the exhaust pipes.
 - (b) Tighten the bolts.
- Torque: Catalyst - Exhaust Pipe 45 N.m**
- (c) Reinstall the bracket bolts and tighten them.

