Page
Return
Page 1
Page 2
Page 3
Page 4
Page 5
Page 6
Page 7
Page 8
Page 9
Page 10
Page 11
Page 12
Page 13
Page 14
Page 15
Page 16
Page 17
Page 18
Page 19
Page 20
Page 21
Page 22
Page 23
Page 24
Page 25
Page 26
Page 27
Page 28
Page 29
Page 30
Page 31
Page 32
Page 33
Page 34
Page 35
Page 36
Page 37
Page 38
Page 39
Page 40
Page 41
Page 42
Page 43
Page 44
Page 45
Page 46
Page 47
Page 48
Page 49
Page 50
Page 51
Page 52

GROUP 04

FUEL, AIR SUPPLY & EXHAUST SYSTEM

TABLE OF CONTENTS

GROUP 04

FUEL, AIR SUPPLY & EXHAUST SYSTEM

TABLE OF CONTENTS

IGNITION AND FUEL INJECTION SYSTEM BOSCH MOTRONIC ML 4 - 1

INTRODUCTION

The ignition and fuel injection system MOTRONIC ML 4-1, depending on appropriate signals detected by sensors located in the most critical points within the supply system, allows to maintain the best engine operation throughout all driving conditions reducing, at same moment, the emission of polluting matters.
The integrated Motronic system monitors together in an unique control unit, both ignition and injection, using for both operations signals coming from same sensors, thus reducing system complexity and costs.
The control unit is also equipped with a self-test feature that provides useful indications about anomalies or operation malfunctions.
For more details, refer to "**WIRING DIAGRAMS AND ELECTRICAL DIAGNOSIS**".

SYSTEM FUNCTIONS

The following are the most important functions performed by Motronic system:

- **Injection timing adjustment.**
  This function is performed in a very precise way using charts already memorized in the electronic unit depending on engine R.P.M. and load. The timing is optimized according to battery voltage and engine temperature. Further adjustments are made both to avoid knocking and to compensate for the decrease of inlet air quantity at altitudes higher than 2,000 mt. (6,600 feet).

- **Spark advance adjustment.**
  Spark advance is also gained from a chart memorized in the electronic unit depending on engine R.P.M. and load. The value in then optimized according to the inlet air and engine temperatures.

- **Cold start check.**
  During the cold start the unit monitors the spark advance (depending exclusively upon engine RPM and temperature) and the injection timing (recovered from a programmed value and corrected according to the inlet air temperature, to the engine temperature, to the battery voltage and to the engine R.P.M.). During the start phase the unit, until a stated R.P.M. (depending upon engine temperature), provides injection at each ignition pulse and so in four phases for each engine cycle.

- **Accelerator enrichment control.**
  At each accelerator demand, if the signal change of the air rate measurement device becomes greater than a predetermined one, the electronic unit not only adapts ignition to the new requirement but further increases it to rapidly reach the demanded R.P.M. At vicinity of predetermined R.P.M., the injection increase is progressively eliminated.

- **Fuel cut-off at deceleration.**
  The fuel cut-off is of adapted type.
  Fuel injection is deactivated when the throttle is closed and R.P.M. is greater than 1,080. Before reaching the idle condition the dynamic of R.P.M. decrease is checked: if it is higher than a predetermined value, the fuel feeding is partially resumed in order to obtain a soft decrease of engine R.P.M. until idle condition is reached.

- **Constant idle speed control.**
  The engine idle speed is controlled in every operational status by means of an appropriate actuator. During engine idling, the actuator works on a throttle by-pass in order to maintain the engine real R.P.M. at the predetermined value.

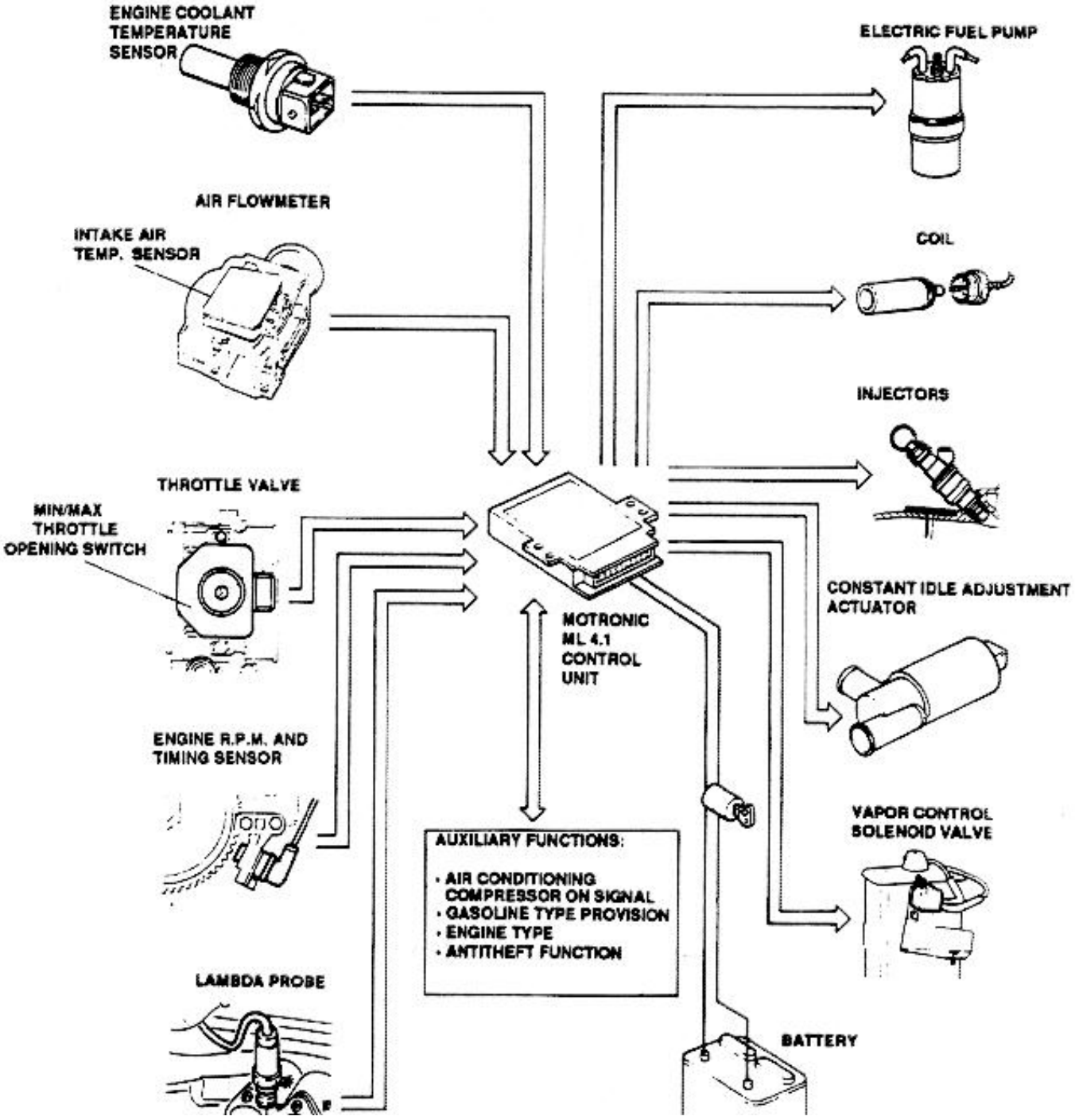
- **Maximum R.P.M. limitation.**
  Fuel injection is interrupted when the engine reaches 6,300 R.P.M. to avoid engine overloading.

- **Lambda probe check.**
  To get maximum efficiency from the catalytic exhaust

pipe it is mandatory that engine runs with a stoichiometric ratio as close as possible to the theoretical one. The "lambda" probe produces a signal, proportional to the presence of oxigen in the exhaust, that is sent to the electronic unit which corrects, in real time, the stoichiometric ratio.

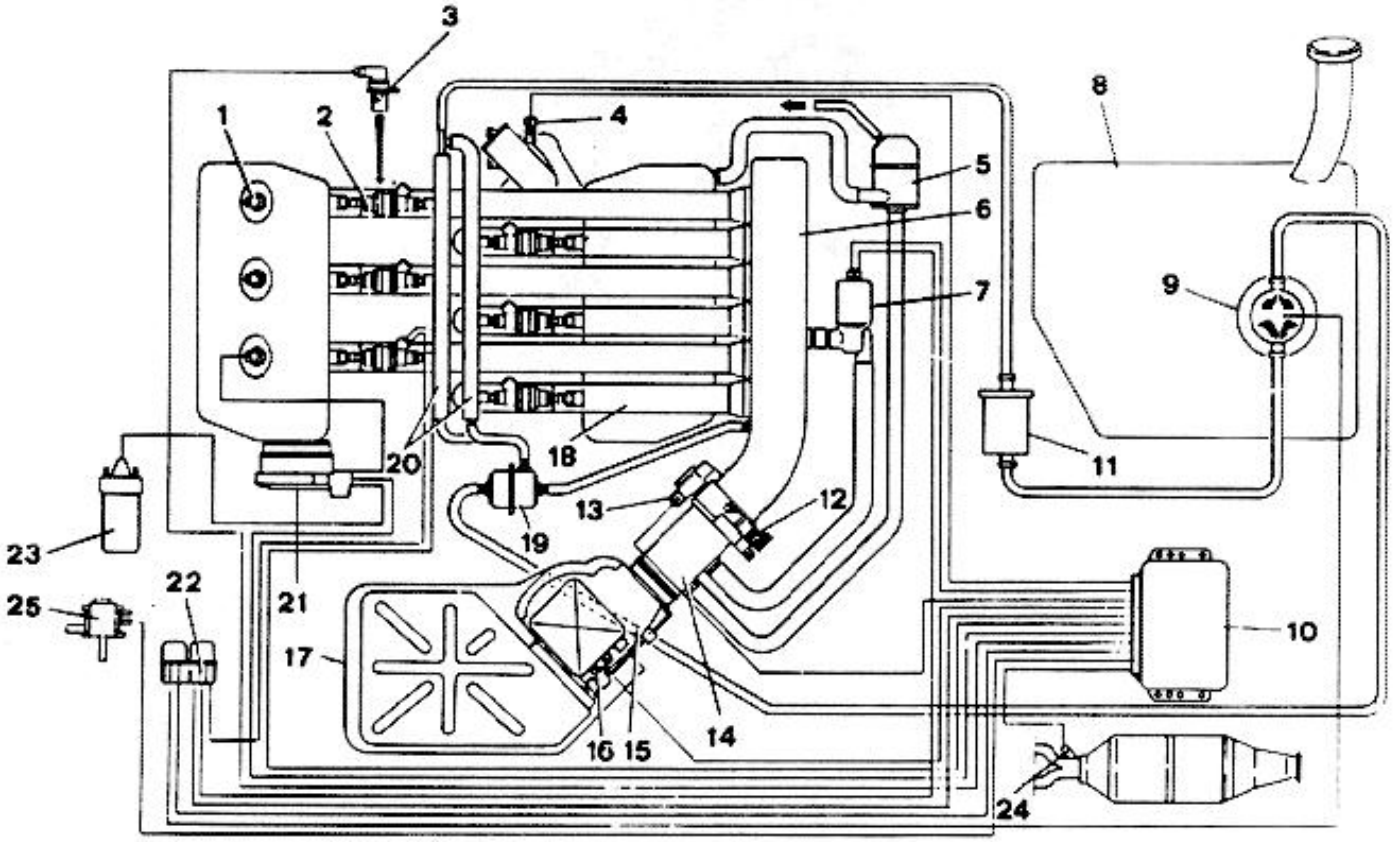
- **Evaporator emission solenoid valve control.** Fuel vapors are collected in the related filter. A solenoid valve controls the vapors flow toward engine, controlled by the unit when engine is hot and under load.

System functions and related sensors and actuators are graphically shown:



SYSTEM COMPONENTS

The Motronic system incorporates the following components with related connecting cables.



1. Spark plugs.
2. Injectors.
3. R.P.M. and timing sensor.
4. Engine coolant temperature sensor.
5. Oil fumes separator.
6. Air intake box.
7. Constant idle adjustment actuator.
8. Fuel tank.
9. Electric fuel pump.
10. Ignition and injection unit (Motronic ML 4-1).
11. Fuel filter.
12. Throttle valve.
14. Air intake duct.
15. Air flowmeter.
16. Inlet air temperature sensor.
17. Air cleaner.
18. Intake manifolds.
19. Fuel pressure regulator.
20. Fuel manifolds.
21. Ignition distributor.
22. Relays.
23. Ignition coil.
24. Lambda probe.
25. Evaporator emission solenoid valve.

13. Throttle valve min/max opening switch.

NOTE: **Each individual device will be illustrated in the paragraphs relevant to the systems in which they operate (Fuel supply, air supply etc.).**

CAUTION: IN CASE OF MAINTENANCE WORKS ON ELECTRONIC SYSTEM

- **Remove the electronic unit in case the car is oven painted at temperatures higher than 80°C (176°F) or when welding operations are performed on car body.**
- **If electrical accessories are installed on the car, it is always advisable to disconnect the electronic unit and check their operation with the unit disconnected. It is mandatory not to derive any connection from the unit wiring.**
- **Before attempting to work on any component of the system, ensure no disconnected connections, no loose clamps, no obstructed or cut pipes are evidenced.**
- **Never connect or disconnect the plug on the electric unit if ignition is powered.**
- **Do not short to ground, as a check, wires bearing high or low voltage.**
- **Do not start engine with battery disconnected.**

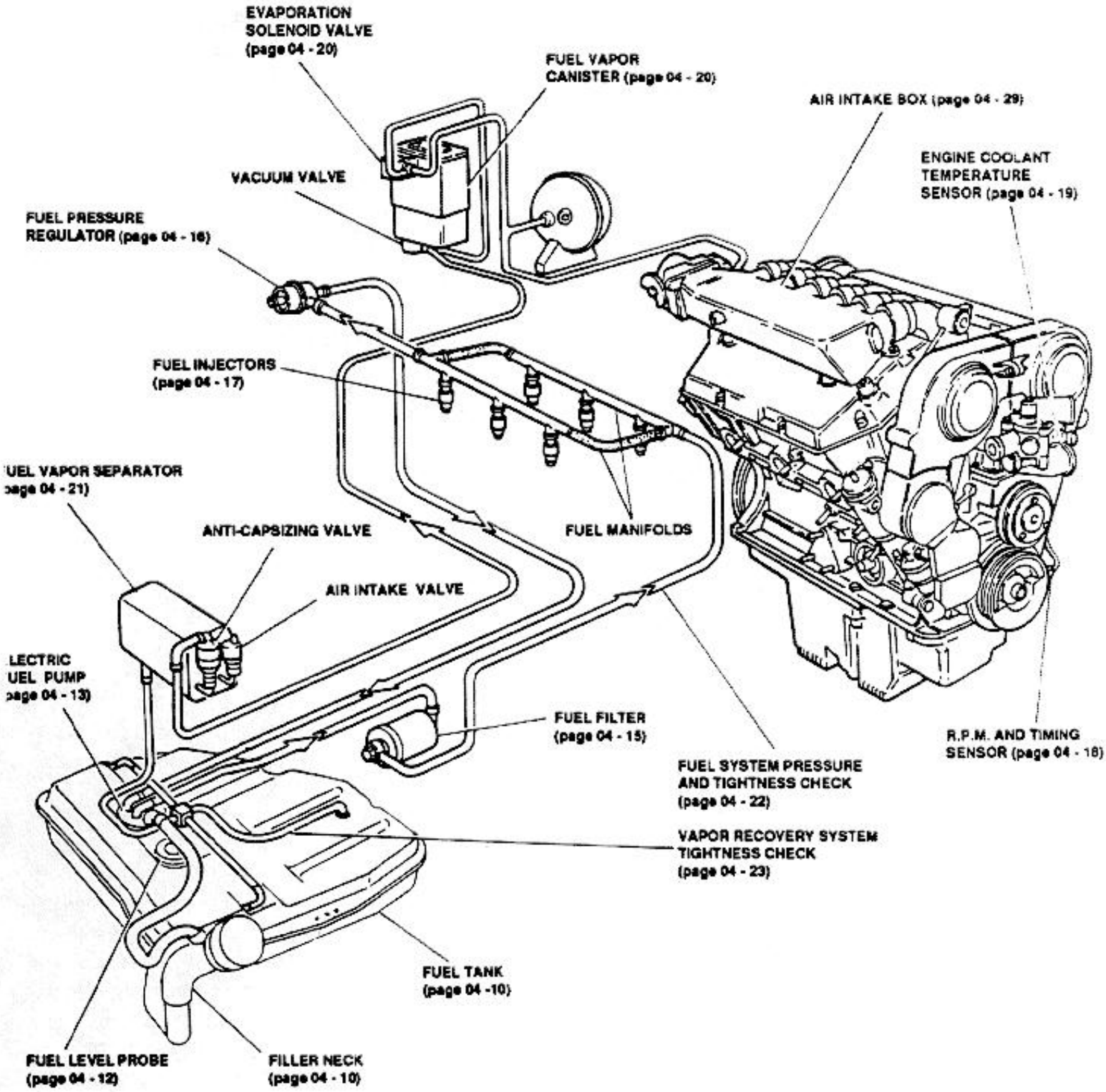
CHECKS AND TESTS

The electronic ignition and injection is provided with a "self test" function which allows a quick location of malfunctions, providing a very quick and precise remedy.
Refer to **WIRING DIAGRAMS AND ELECTRICAL DIAGNOSIS Book** for further details.

NOTE: **Before proceeding with test and troubleshooting shown in the WIRING DIAGRAMS AND ELECTRICAL DIAGNOSIS Book, it is advisable to carry out a visual inspection on main components and connections for integrity, correct position, good electrical connections, absence of leaks, etc.**

FUEL SUPPLY AND VAPOR RECOVERY SYSTEM

ILLUSTRATED INDEX



FUEL SUPPLY AND VAPOR RECOVERY SYSTEM

INTRODUCTION

General description

The system allows fuel contained in the tank to be sucked by a pump and, through a filter and a pressure regulator, sent under constant pressure to the fuel manifolds which feed the electroinjectors.

Notes on usable fuel grade: Octane Number.

The octane number defines gasoline resistance to detonation.The use of gasoline having the correct octane number is mandatory to avoid the detonation phenomenon that could be dangerous for the engine.

The antidetonating power increases along with octane number.Normal gasolines show an octane number that varies between 91 and 95 RON (Research Octane Number) or between 86 and 90 PON (Pump Octane Number).The PON octane number (declared at USA service stations) is determined as follows:

$$\frac{RON + MON^{*}}{2} = PON$$

* Motor Octane Number.

NOTE: PON octane number is normally 5 points less than RON octane number.

91 RON = 86 PON

95 RON = 90 PON

The engine requirements to operate correctly, are:

- use of unleaded gasoline because **lead presence rapidly wears out the catalytic converter of the exhaust system.**
- use of gasoline having PON octane number at least equal to 90. Upon request it is possible to use gasoline having PON octane number at least equal to 86 but it is necessary to change the device that looks like a relay colored YELLOW OCHRE located on the Motronic unit with a similar one but colored SKY BLUE.
  (For more details, refer to **WIRING DIAGRAMS AND ELECTRIC DIAGNOSIS Book, Motronic unit**).

NOTE: Avoid excessive use of detergent additives that, in the long run, might damage gaskets and other parts of the system.

EMISSION CHECK

"This vehicle conforms U.S.E.P.A. and California regulations applicable to 1991 M.Y. new light duty motor vehicles" (Refer to engine "tune up" label, located on coolant radiator).

FUEL VAPORS RECOVERY SYSTEM

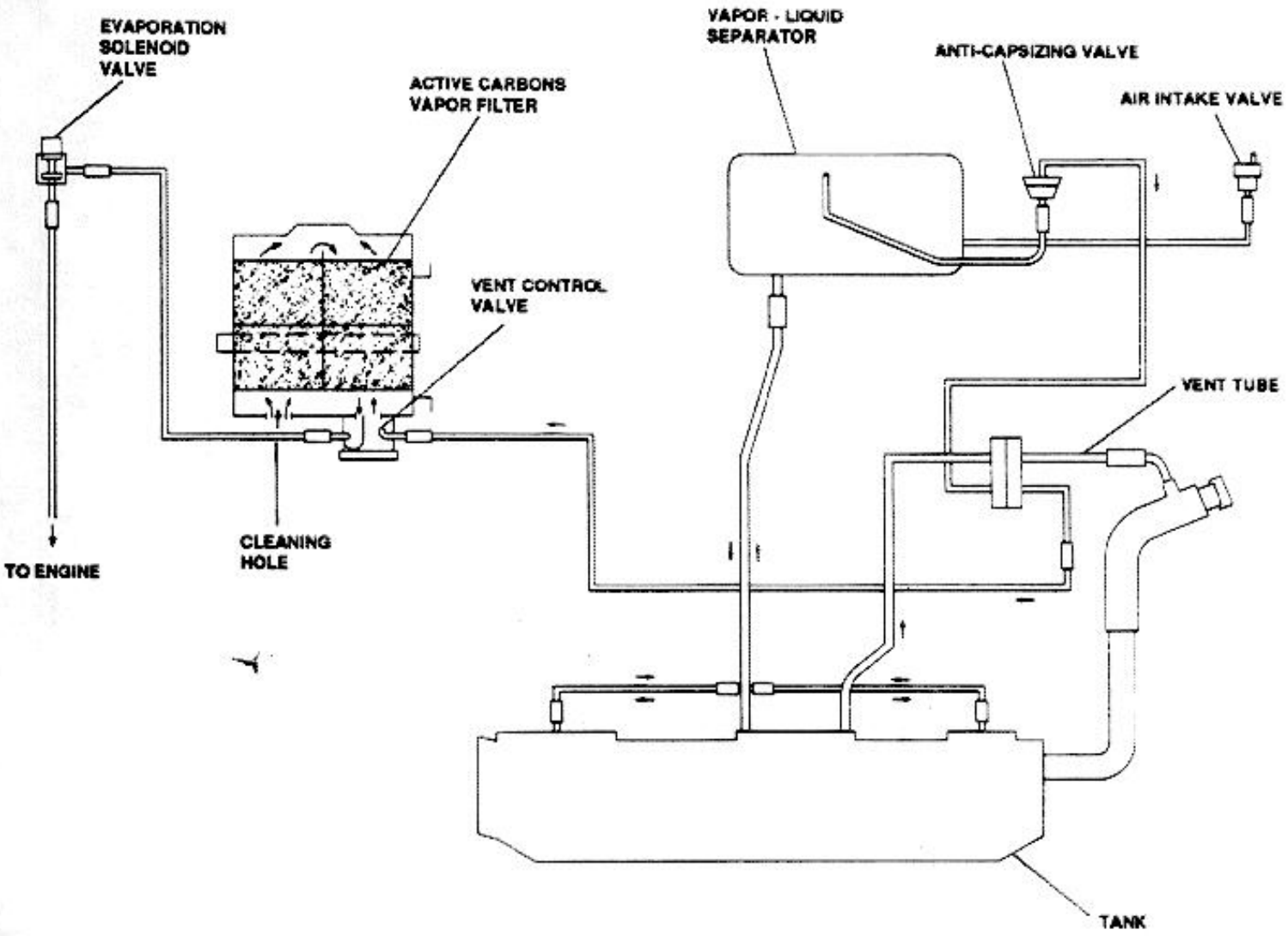
In case of high environmental temperatures and of drain pipes, fuel contained in the tank heats up producing a great quantity of vapors which, if released in open air, could have severe polluting effects.The vapors control system provides the possibility to recover those vapors and burn them out in the engine.Vapors coming from the tank are collected in vapors - liquid separator through three vent pipes.In the separator a portion of vapors are condensed and returned back as liquid to the tank through the three pipes. The remaining vapors coming out from the separator are sent to a depression valve (vent control) through an anti-capsizing valve that avoids gasoline to come out from the tank in case the vehicle turnsover. When the depression in the sucking manifold is lower than 4.5 kPa (0.65 p.s.i.) the valve stays closed and vapors are prevented to reach the fuel vapors filter. Above these limits, vapors are allowed to enter the fluid vapors filters, where they are absorbed and stored by active carbons.A solenoid valve is inserted between the manifold and the fuel vapors filter.When the solenoid valve is not energized, the sucking lines are closed, thus the fuel vapors are stored inside the fuel vapors separator, due to the active carbons.Should the solenoid valve become energized, due to pressure difference, fresh air is introduced through the hole cleaning out the carbons. Vapors directed into the engine intake system are

vapors, directed into the engine intake system, are

burned out in the combustion chambers. The solenoid valve, monitored by the injection control unit, is opened only with the engine under load, while with engine cold or idling the solenoid valve is closed and vapors are not burnt out. An air intake valve and a vent tube enable external air to enter and/or comeout from tank compensating for pressure variations.

The anti-capsizing valve avoids fuel to drain out from the circuit if the vehicle turnsover completely.

Vapors recovery system simplified schematic



NOTE: U.S. legislation on subject of atmos pheric pollution (Clean Air Act) prohibits, at Section 203 emended, from tampering with the anti pollution system components or from altering the relevant features.

"Tempering with" may be defined any operation able to produce alterations or modifications to characteristics outlined in this manual.

All Alfa Romeo vehicles are approved and, before leaving the company, have undergone to many tests to assure their conformity to those characteristics.

Vehicles not meeting the characteristics because they are not adjusted, not set or bearing modifications compared with the approved type, might not conform to law prescription on pollution, and also burn a great quantity of fuel.

The characteristics and data contained in this manual have been registered at U.S. entitled authorities.

Reference is made to above mentioned characteristics when checking the conformity to the approved type.

WARNING:

Before attempting to work on the engine supply components, carefully observe the following indications:

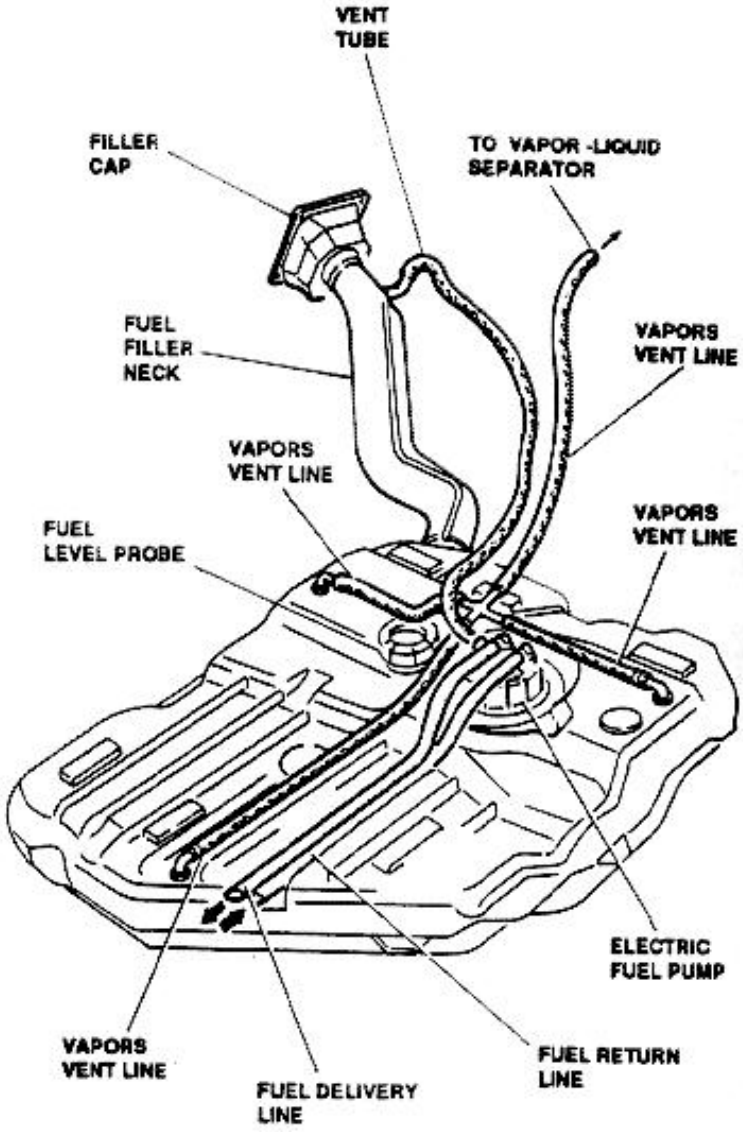
- Ensure shop is provided with equipments suitable to operate safely (fire extinguisher, etc.)
- Disconnect ground wire from the battery to avoid that an accidental contact of cables bearing power with the car body may cause spark and then fire.
- Put drained fuel into a suitable container equipped with safety cap.
- DO NOT SMOKE OR USE FREE FLAMES IN THE CLOSENESS.

FUEL TANK AND FILLER NECK

The tank is made of in metal sheet according to the fire prevention laws and is secured with bolts and brackets to car body in correspondance of vehicle rear axle.

On the upper surface it shows circular openings to give room for the pump assembly, the fuel level probe and three vents for gasoline vapors that are sent to the vapor/liquid separator.

The filler neck is connected to the filler by means of a rubber sleeve linked to gasoline vapors recovery system.

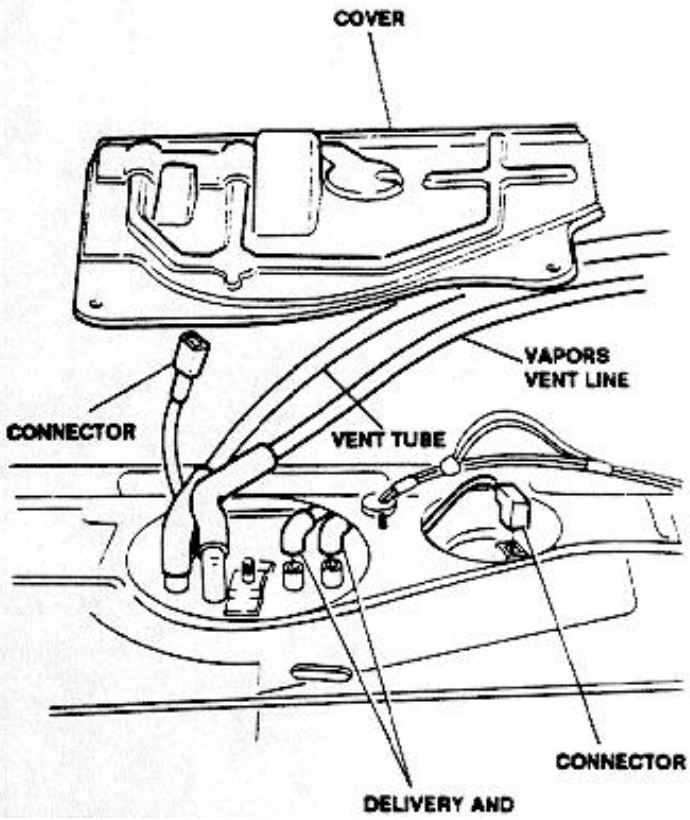


REMOVAL /INSTALLATION

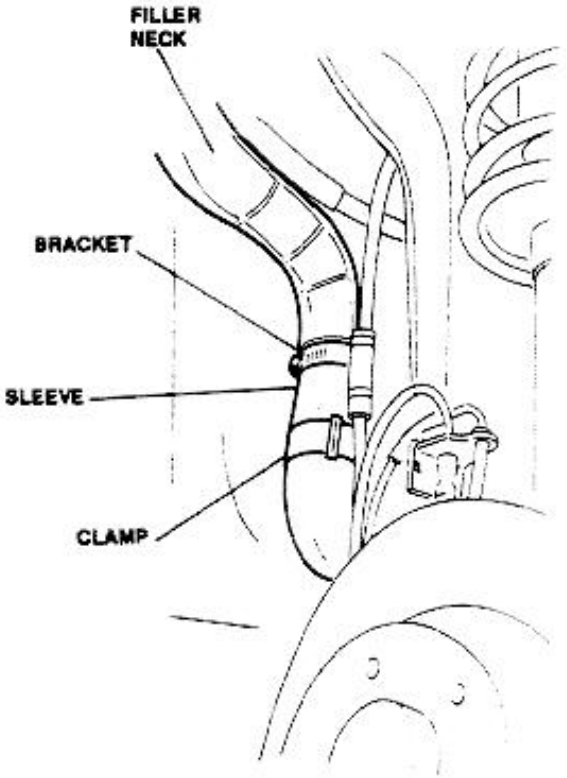
1. Position vehicle on lift platform.
2. Disconnect ground lead from the battery.
3. Discharge pressure in the tank by loosening the filler cap.
4. Empty tank sucking the fuel through the filler cap using an appropriate pump.

WARNING:
Put fuel drained from the tank in suitable containers.

5. Working from trunk, remove lower trim and remove the access cover to the pump and level probe assembly.
6. Disconnect all electrical connections from the pump and level probe.
7. Loosen clamps of fuel intake, return liner and vapors: vent and withdraw liner from the pump.

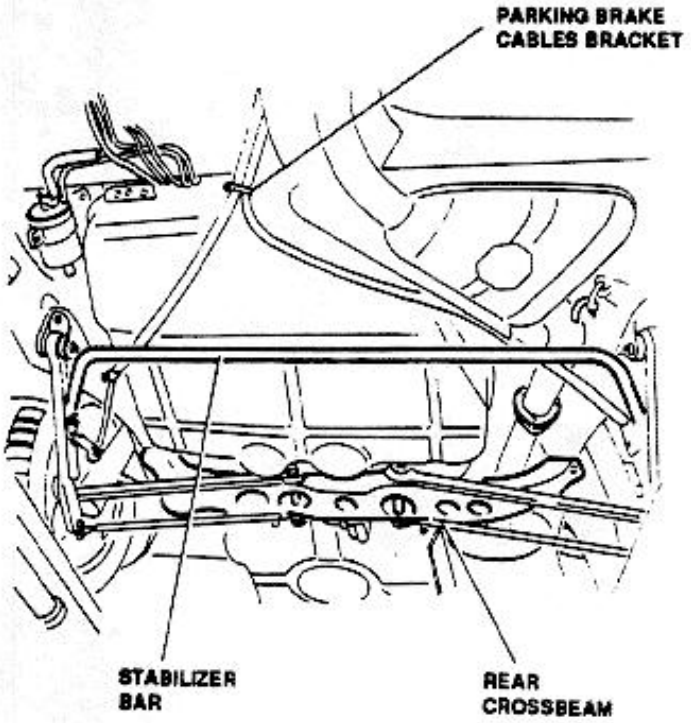


8. Remove rear right wheel.
9. Remove clamp connecting the sleeve to the filler neck.
10. Remove the filler neck bracket securing filler cap to fender and free the filler neck.



11. Lift the vehicle.
12. Remove rear stabilizer bar.
13. Loosen, without removing, rear crossbeam (loosen the four screws leaving it connected by means of suspension links).
14. Maintain in position the tank using an hydraulic jack
15. Loosen all tank securing screws, included those securing brackets sustaining the parking brake cables.
16. Remove the complete tank together with filler neck,

RETURN LINES | pump and fuel level probe.



INSPECTION AND CHECKS

Inspect tank for deformations or cuts.
Replace tank if necessary.

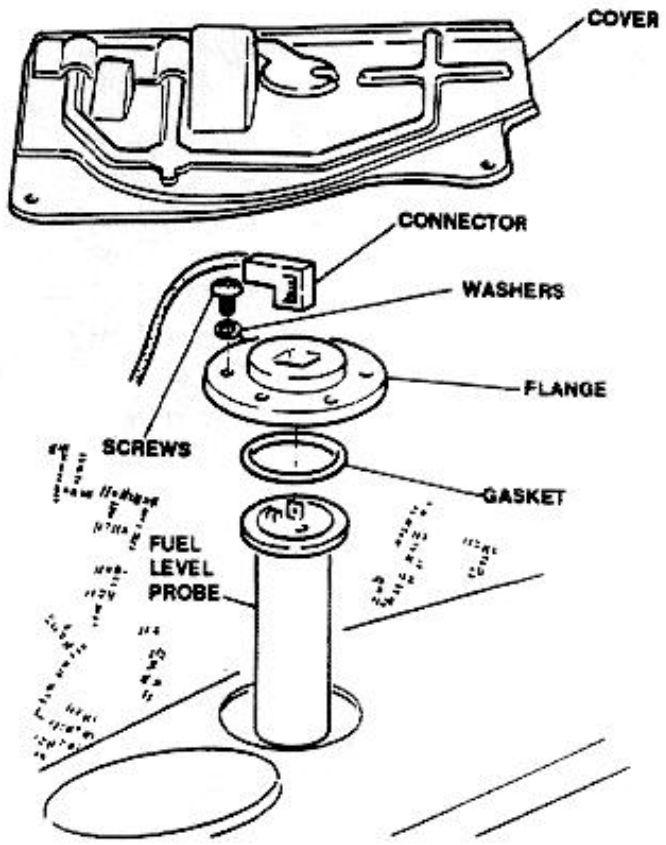
NOTE: Tank capacity 65 l 17.7 gals
Reserve 8 l 2.2 gals

FUEL LEVEL PROBE

Made of plastic material, it includes the float that provides signals to the instrument panel indicator. It is secured to tank by means of flange and screws.

REMOVAL /INSTALLATION

1. Disconnect the battery ground lead
2. Working from the trunk, remove trim and then the access cover to the pump and to the level probe.
3. Disconnect electrical connection from the probe.
4. Remove 8 screws securing the probe flange to tank.
5. Withdraw from tank the fuel level probe and related gasket.



INSPECTION AND CHECKS

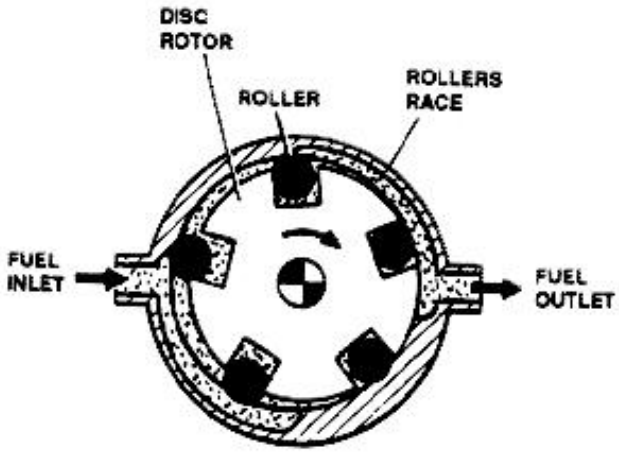
For a complete check, refer to the **WIRING DIAGRAMS AND ELECTRICAL DIAGNOSIS Book**; to check the probe adjustment, operate following the table below and using appropriate instruments.

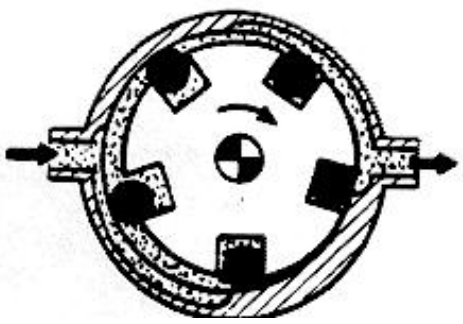
Level mm	Level In	Indicator reading	Resistance Ω
16	0.62	4/4	0 to 6
69	2.69	3/4	59 to 69
105	4.09	1/2	116 to126
149	5.81	1/4	186 to 201
172.5	6.73	Max reserve	-
178.5	6.96	Min reserve	-
198	7.72	0	295 to 315

ELECTRIC FUEL PUMP

The electric fuel pump is of the rotary cell and roller type.
The pump consists essentially of a cylindrical chamber with a disc rotor, eccentrically mounted.
The disc outer surface is provided with cells in which rolls are located. The centrifugal force due to disc rotation pushes rolls, working as rotating gaskets, toward the outside, generating alternatively an increase in chamber space corresponding to fuel inlet and then a decrease corresponding to fuel outlet.

NOTE: The fuel pump is powered only with ignition key inserted and engine running to avoid that, in case of accident , the fuel is spilt from lines, leaks or ruptures generating a fire.

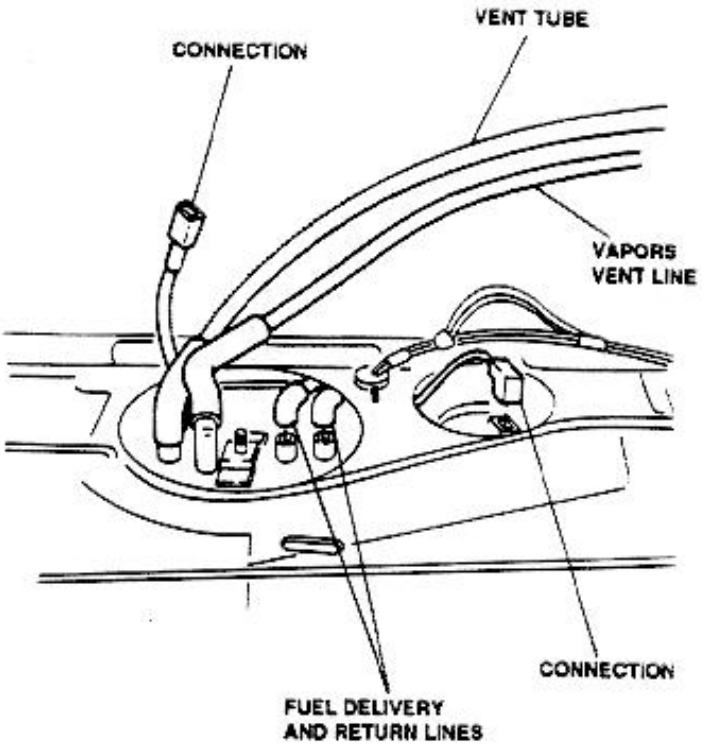




REMOVAL /INSTALLATION

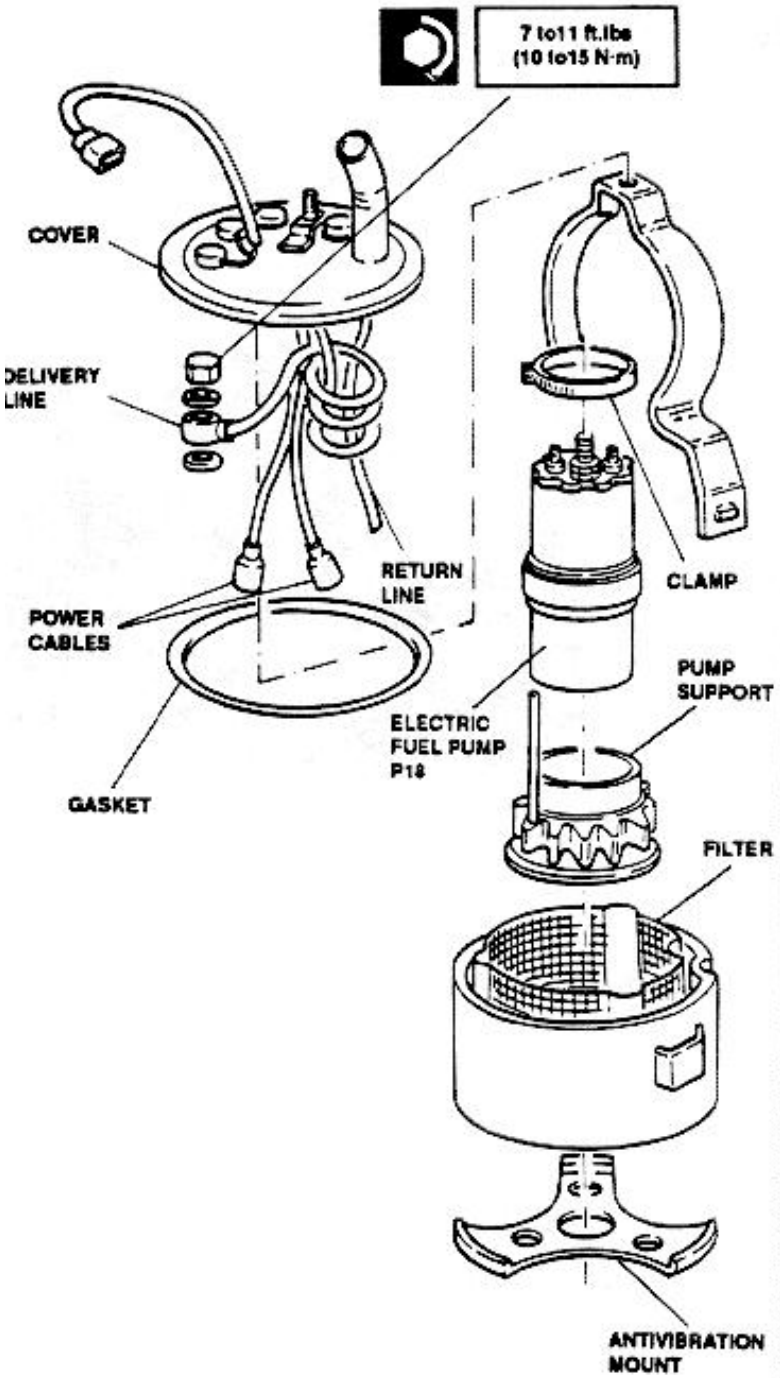
1. Remove trunk floor trim and access cover.
2. Loosen related clamps and withdraw pressure and return lines, anti-gurgle and vapors recovery lines.
3. Disconnect the pump electrical safety connection.
4. Remove 8 pump securing screws and withdraw pump from tank.

Install pump assy in the tank ensuring to insert a new gasket under cover; secure carefully the lines.



DISASSEMBLY /REASSEMBLY

1. Remove pump cover gasket.
2. Remove pump pressure line removing nut and washers.
3. Disconnect pump electrical connectors.
4. Remove nut that secures spring to cover and detach cover together with the lines.
5. Separate cover, pump body, gasket and sump filter.



INSPECTION AND CHECKS

Thoroughly clean net filter.

Water in the fuel is very dangerous for the pump because it generates internal oxidation.

Check carefully pump operation if water is present in the fuel. Check for efficiency of power contacts on the pump because, due to contacts oxidation, a voltage drop can reduce fuel pressure generating some air bubbles thus reducing the injected fuel quantity.

CAUTION:

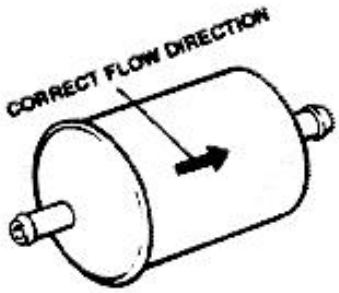
In case of replacement, remember that the pump is delivered filled with protective oil and with connections closed by appropriate plugs. When installing the new pump, it is not necessary to empty the pump because the oil is immediately burnt by the engine.

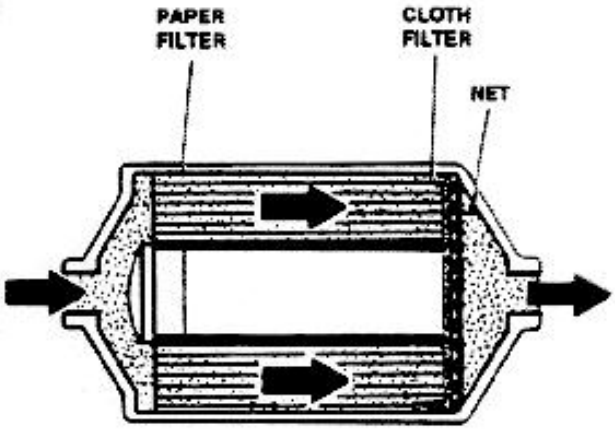
If pump is emptied of protective oil, it is necessary to put it in service within two weeks to avoid formation of a dry oil film on the motor collector which will put the motor out of order due to lack of electrical continuity.

FUEL FILTER AND LINES

FUEL FILTER

The filter provides a means to avoid fuel impurities from coming to the injectors.

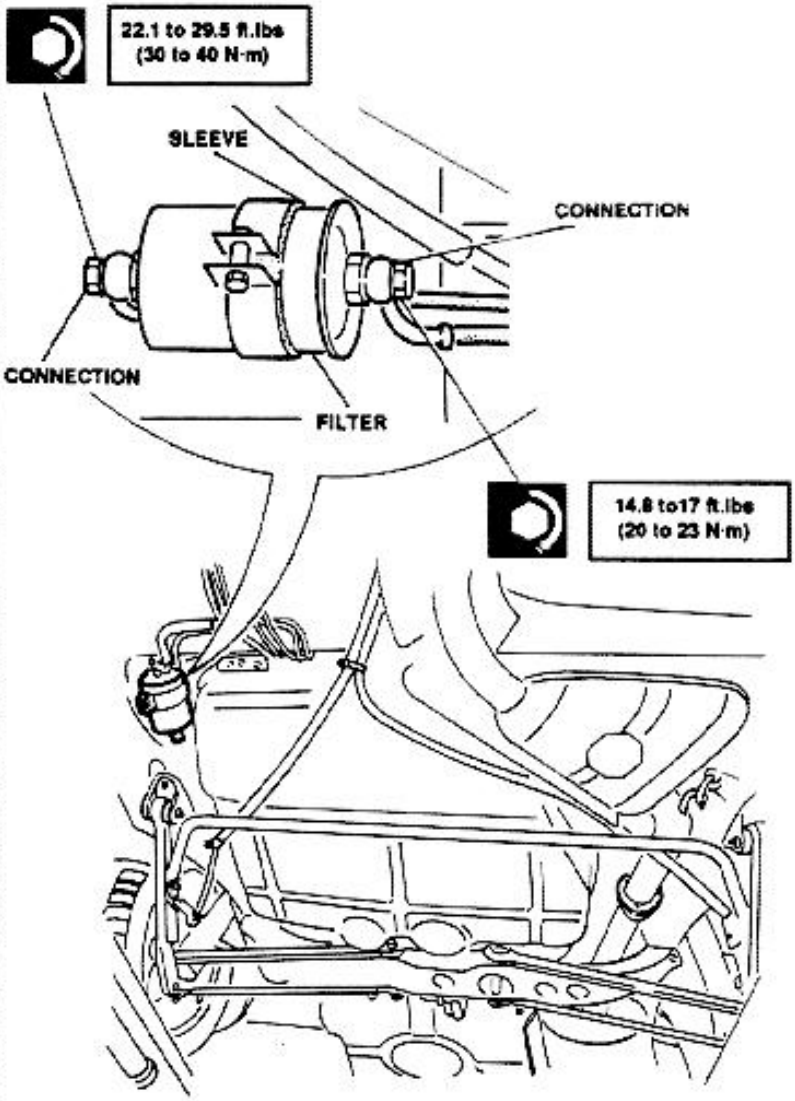




The filter is installed downstream of the pump, and is provided with a paper element having an average porosity of 10 micron, and with a cloth filter located after the paper filter.

FUEL FILTER REPLACEMENT

1. Place vehicle on a lift platform.
2. Start engine, disconnect fuel pump relay (see **Group 40**) and wait till the engine stops due to lack of fuel.
3. Lift vehicle.
4. Loosen the two filter connections.
5. Colect in a suitable container the fuel split during this operation: then close the connections without twisting or bending rigid lines.
6. Remove fuel filter by loosening bolt securing sleeve to the filter.
7. Install new filter replacing the connections directed toward fuel flow.



FUEL LINES

Note: Disconnect fuel supply system lines only when really needed.

1. Place vehicle on lift platform.
2. Start engine and disconnect fuel pump relay (see **Group 40**) and wait till the engine stops due to lack of fuel.
3. Loosen the securing clamps on the ends of lines to be removed.

CAUTION:
During removal plug flexible and rigid lines to avoid entry of dust and dirt.

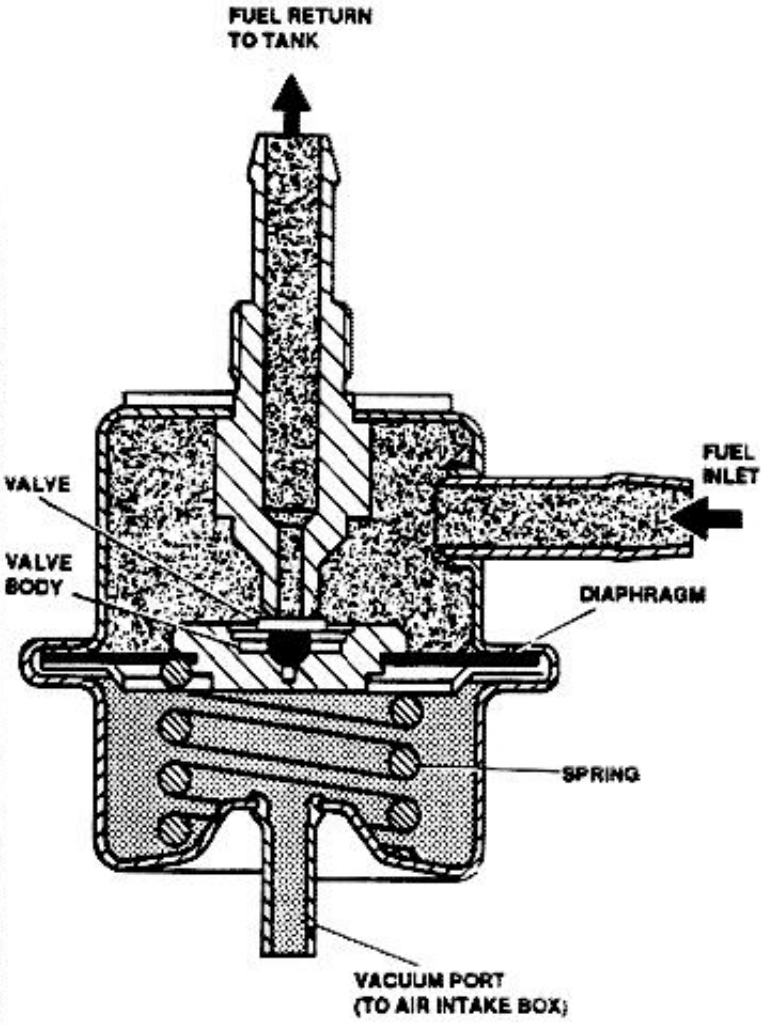
Install clamps accurately on system connections. Do not over torque clamps to avoid damage to the lines.
Do not bend or twist rigid lines during installation on the vehicle.
Start engine and check for absence of leaks from connections.

INSPECTIONS AND CHECKS OF PIPING

1. Check that hoses are not porous and do not show any damage; replace hoses if defective.
2. Check that rigid lines do not show signs of oxidation, blocking or denting.
3. Pay special attention to lines located near heat sources, since overheated material deforms and deteriorates very quickly.

FUEL PRESSURE REGULATOR

The main purpose fuel pressure regulator is to keep a constant difference between fuel pressure and pressure in the intake manifold.
In this way it is possible to meter fuel flow to the cylinders depending exclusively on the injectors opening time.
A diaphragm regulator limiter adjusted to **400 kPa (58 p.s.i.)**, when the fuel pressure overcomes this limit excess fuel comes back to tank. A small line connects the spring of the regulator chamber with the intake air box, in such a way that the pressure on the injectors input and output, when open, is always constant.

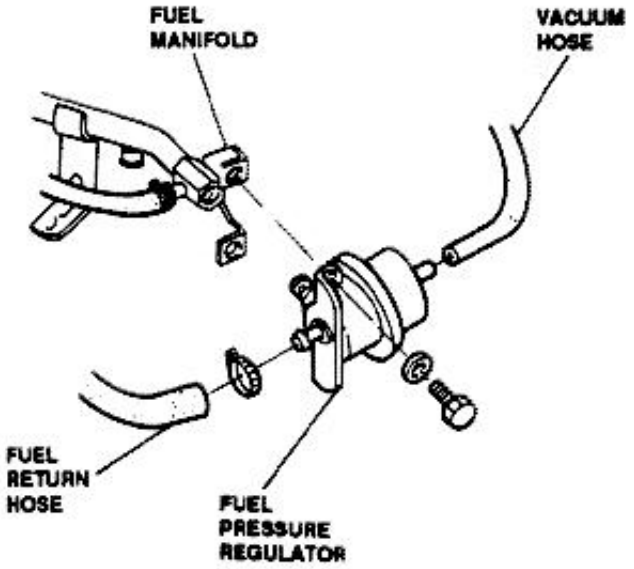


REPLACEMENT

WARNING:
Proceed with care: fuel system may be under pressure.

1. Disconnect the fuel depression and return hoses from the pressure regulator.
2. Unscrew bolt from fuel manifold and remove regu-

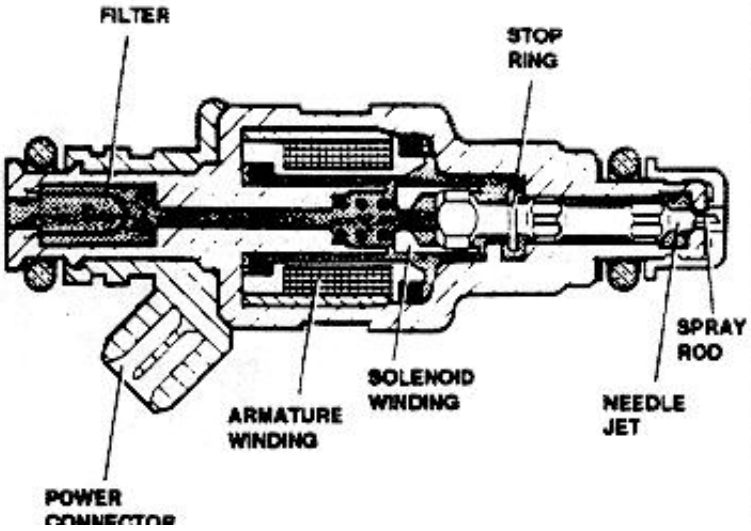
pushes on a valve that opens the return line; through it, lator.



FUEL INJECTORS

Each cylinder is supplied by one electromagnetically operated injector that is parallel connected with the others.

The injector mainly consists of a coil, magnetic core and a needle guide. The magnetic core moves the needle, which is pressed by a spring on the injector sealing seat. The injector needle is actuated by a magnetic field generated by the coil upon command from the MOTRONIC control unit.



INJECTOR OPENING CHECK

1. Note the carbon monoxide percentage at the exhaust.
2. Disconnect, one at the time, the injector connectors; note each time the carbon monoxide percentage on the exhaust and check that the value keeps constant for each check.
3. In the opposite, identify the faulty injector and replace it: in any case a visual check of the spark plugs electrodes can tell the correct operation of the injectors:
   - A **black color** corresponds to a very **rich mixture.**
   - A **clear color** corresponds to a very **poor mixture.**

INJECTOR TIGHTNESS CHECK

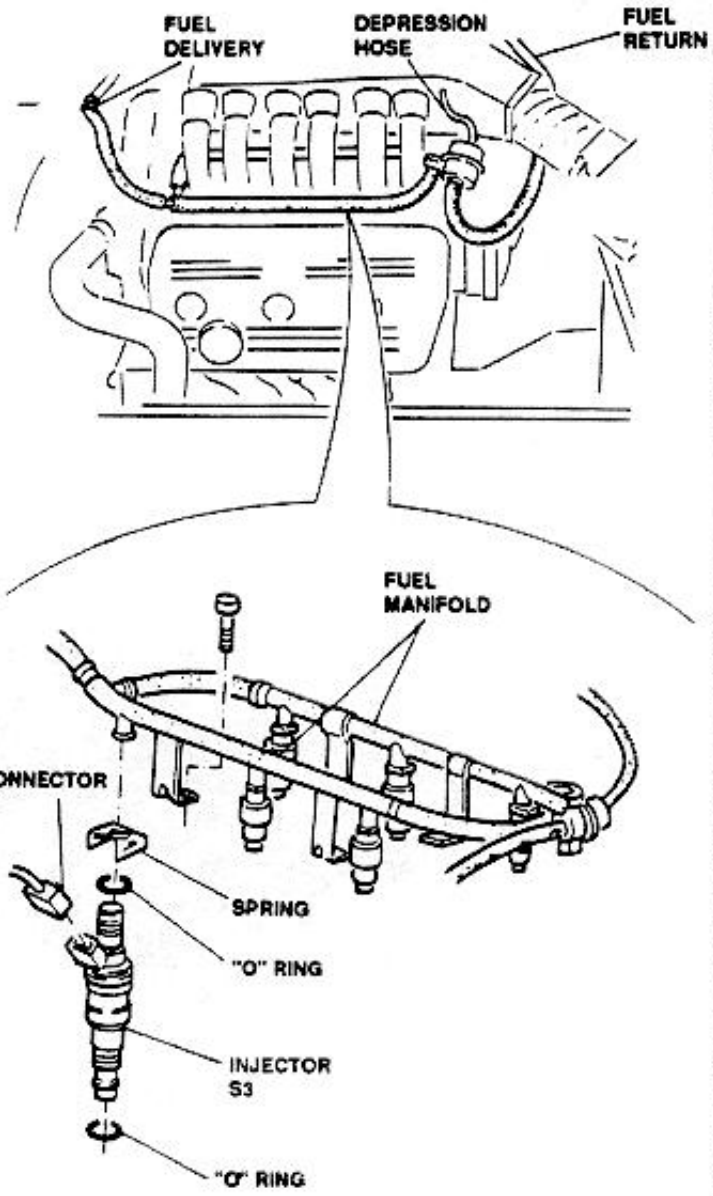
1. Remove the injectors group, together with fuel manifolds but keeping connected the fuel supply circuit.
2. Disconnect connectors from injectors.
3. Crank the engine and check for fuel leaks; if leaks occurs replace faulty injector.

REMOVAL /INSTALLATION

1. Disconnect ground wire from the battery.
2. Disconnect the depression hose.
3. Disconnect connections from the injectors.
4. Disconnect fuel delivery line.
5. Disconnect fuel return line.
6. Disconnect the stub pipes from the intake manifolds and tilt the intake box backward after removal of the securing screws.
7. Remove fuel manifold and injectors unscrewing 4

connector

7. Remove fuel manifold and injectors unscrewing 4 securing screws.



For each injector:

8. Withdraw the spring securing the injector to fuel manifold.
9. Remove injector.
10. Remove the "O" rings.

INJECTORS INSPECTIONS AND CHECKS

For the injector operational check, refer to **WIRING DIA-**

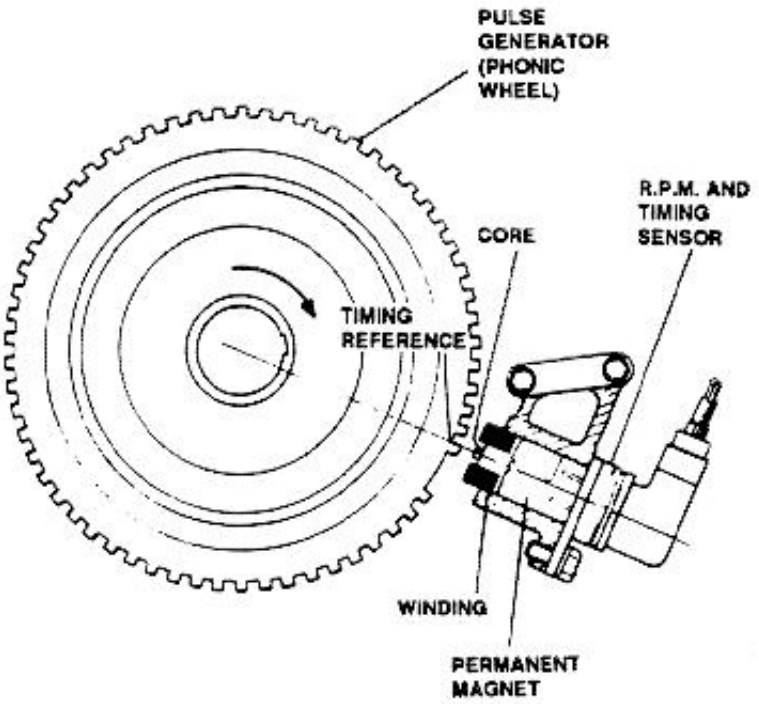
R.P.M. AND TIMING SENSOR

The sensor that detects the engine revolutions and timing is of inductive type.

Its operation depends on the magnetic field generated by a pulse generator (phonic wheel), connected to the crankshaft, passing in front of it.

The wheel teeth, passing in front of a magnetic field generating device, modifies the air gap between wheel and sensor thus the flux, which changes accordingly, induces in it an alternating current whose amplitude depends on the R.P.M.

On the phonic wheel there is a reference mark, obtained by cutting two teeth, used to check the engine timing.

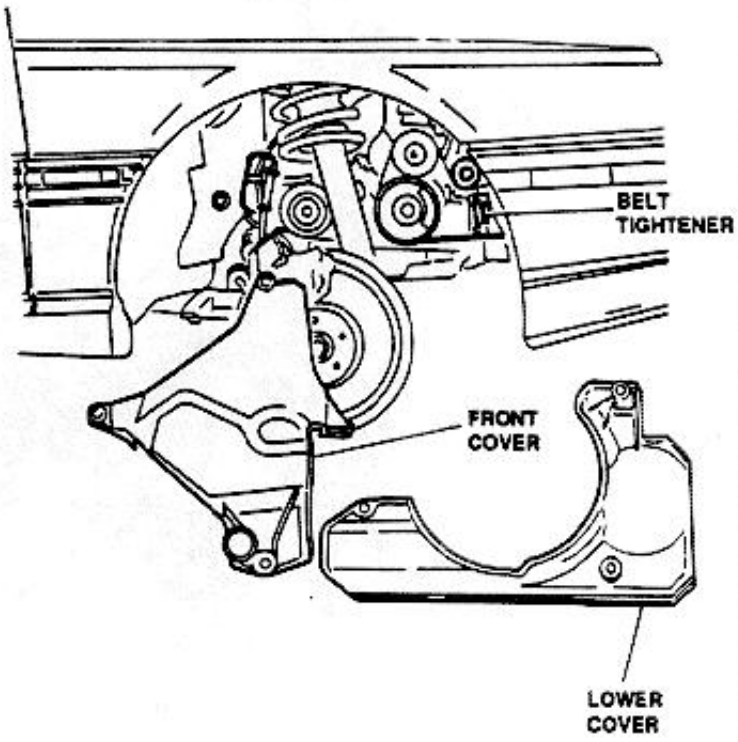


R.P.M. AND TIMING SENSOR GAP CHECK

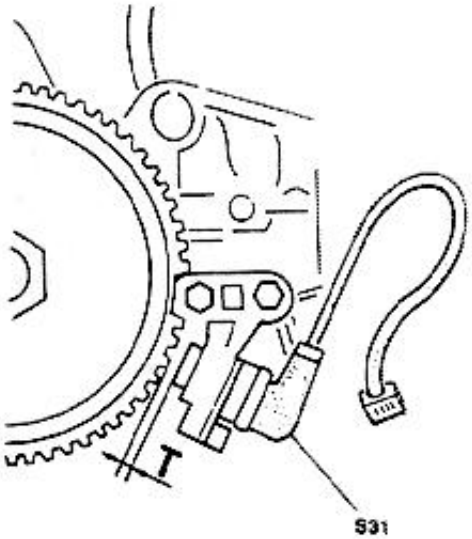
1. Remove front right wheel and front fender.
2. Remove front protective cover.
3. Remove lower protective cover by loosening the belt tightening pulley of water pump and air condi

GRAMS AND ELECTRICAL DIAGNOSIS Book.

tioning compressor belt.



4. Check, using a feeler gauge, the distance between phonic wheel (crankshaft pulley) and sensor is within prescribed limits.



Gap between the R.P.M. and timing sensor and crankshaft pulley
T = 0.5 to 1 mm 0.02 to 0.04 in

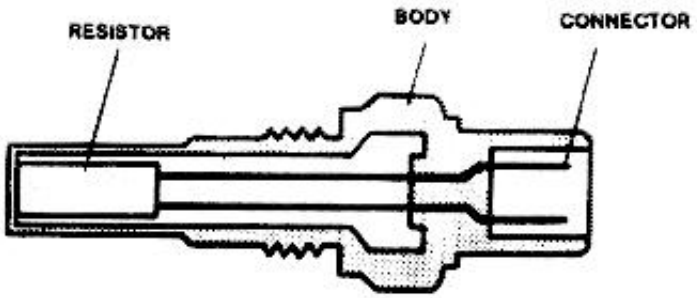
SENSOR INSPECTIONS AND CHECKS

For sensor operational check, refer to **WIRING DIAGRAMS AND ELECTRICAL DIAGNOSIS Book.**

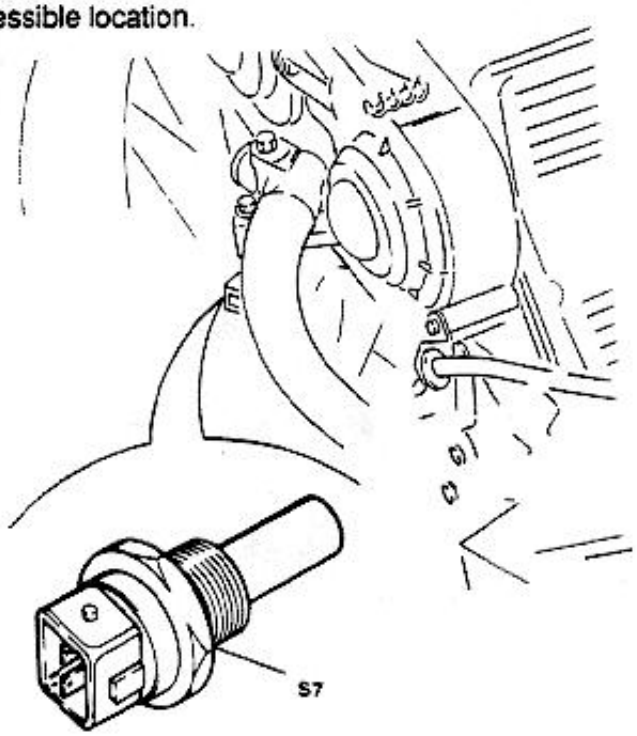
ENGINE COOLANT TEMPERATURE SENSOR

The engine coolant temperature sensor is of electronic type; the sensitive end is manufactured using a **NTC** resistor (Negative Temperature Coefficient), that decreases its resistance as temperature increases, powered by a constant voltage from the Motronic control unit.

The sensitive end of the sensor is in contact with the engine coolant; the current flowing through the resistor, monitored by the control unit, is proportional to the engine temperature.

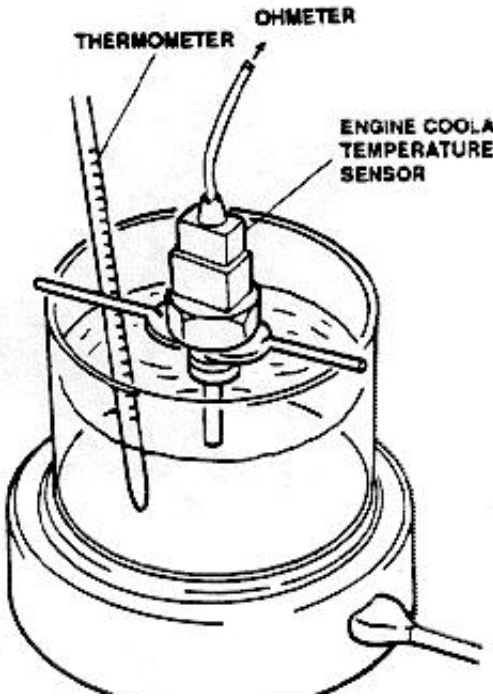


The sensor is located on the pump body, in an easily accessible location.



INSPECTION AND CHECKS

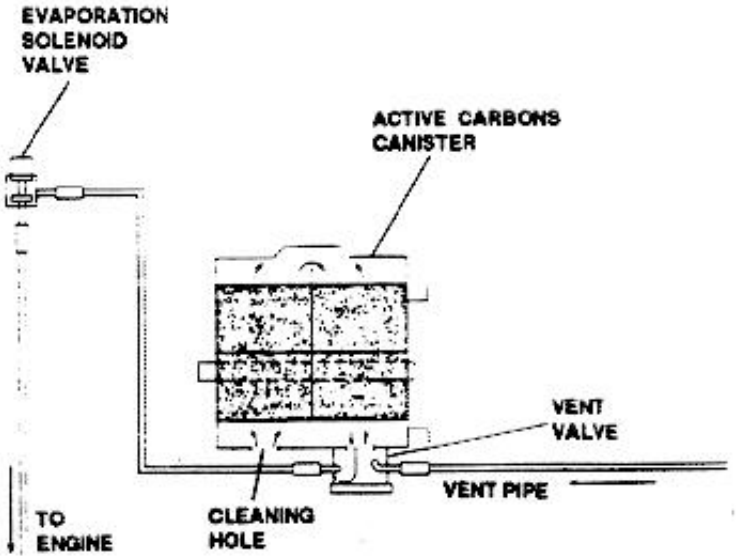
Plunging the sensor in a suitable container full of water, check, using a thermometer and an ohmeter, for correct adjustment values.
Replace sensor if correct values are not met.



TEMPERATURE °C	TEMPERATURE °F	RESISTANCE K Ω
0	32	~ 7.5
20	68	~ 4.5
100	212	~ 0.4

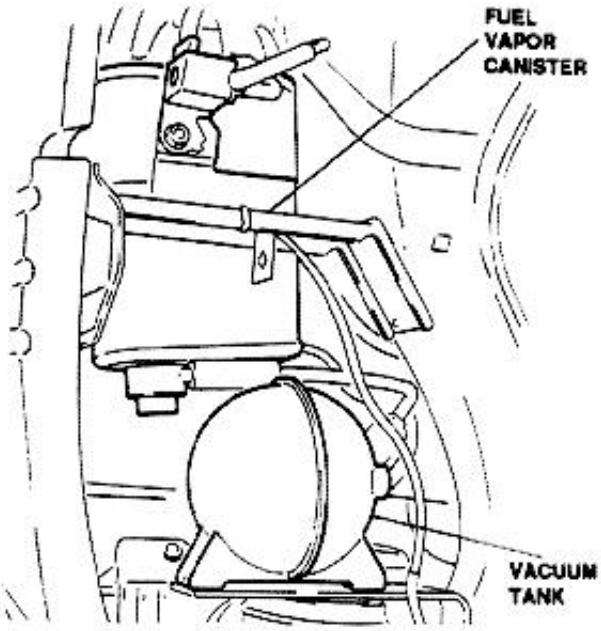
FUEL VAPOR CANISTER AND EVAPORATION SOLENOID VALVE

The canister uses active carbons which absorb fuel vapors from the recovery circuit.
A vent valve allows those vapors to enter the canister at a pressure higher than 4.5 kPa (0.65 p.s.i.)
A evaporation solenoid valve, controlled by MOTRONIC Control Unit, opens a depression that evacuates the filter and sends vapors to engine intake while enables canister cleaning recalling air through the related hole.

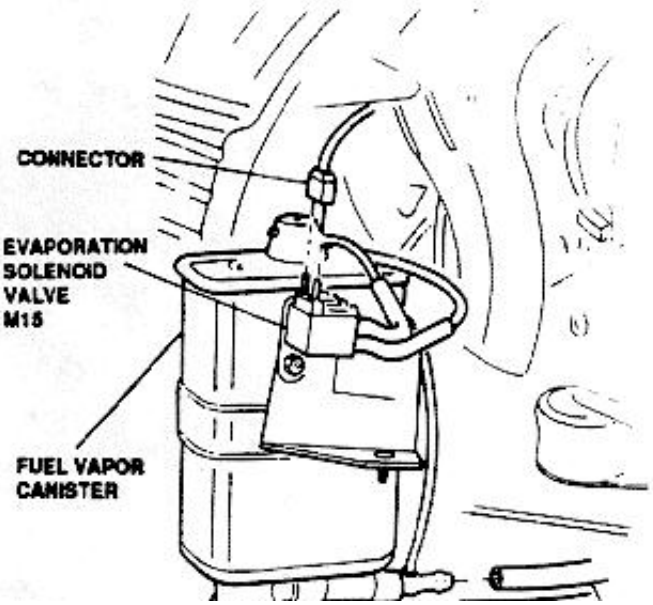


REMOVAL /INSTALLATION

1. Remove front left wheel and fender front section.
2. Remove vacuum tank of the Cruise Control System.



3. Disconnect electrical connections from evaporation solenoid valve and lines from canister.
4. Remove fuel vapor canister.



SOLENOID VALVE INSPECTIONS AND CHECKS

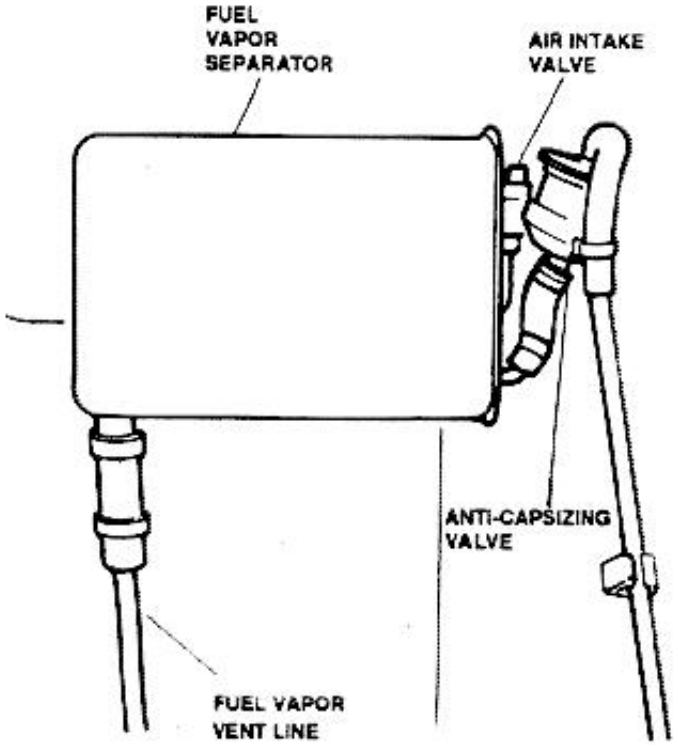
For the solenoid valve functional check, refer to **WIRING DIAGRAMS AND ELECTRICAL DIAGNOSIS Book.**

FUEL VAPOR SEPARATOR

The separator allows part of fuel vapors to condense, sending them back to the tank; the non-condensed part is sent to the canister and to the engine.

REMOVAL /INSTALLATION

1. Working from the trunk, remove floor and trim and gain access to fuel vapor separator.
2. Disconnect fuel vapor vent line.
3. Disconnect clamp securing the antisizing valve hose to separator.
4. Gain access to cabin and remove rear seat back.
5. Remove fuel vapor separator.

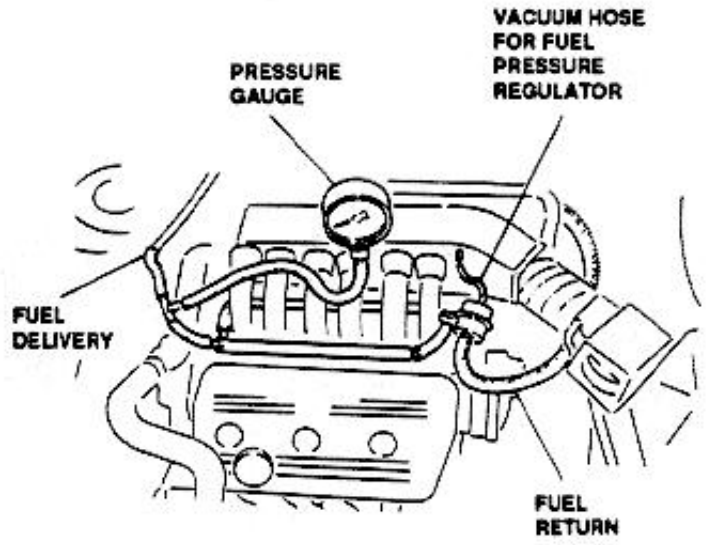



VENT
VALVE
HOSES

FUEL SYSTEM PRESSURE AND TIGHTNESS CHECK

Check fuel supply pressure as follows:

1. Disconnect fuel delivery hose from the injector inlet manifold.
2. Connect a pressure gauge, through a "Tee" union, at the ends of the inlet line previously disconnected.
3. Detach hose connecting pressure regulator to intake airbox in order to prevent that any uneveness in engine rotation speed can cause incorrect reading.



4. Start the engine and run at idle, then check the fuel pressure value is equal to the noted value.

Fuel pressure at idle
284 to 323 kPa (42 to 47 p.s.i.)

5. Reconnect hose to intake air box; when at idle, pressure should decrease by **50 kPa (7.3 p.s.i.)** and then increase when throttle valve opens.
   If values are incorrect check for leaks in the vacuum hose of the fuel pressure regulator.

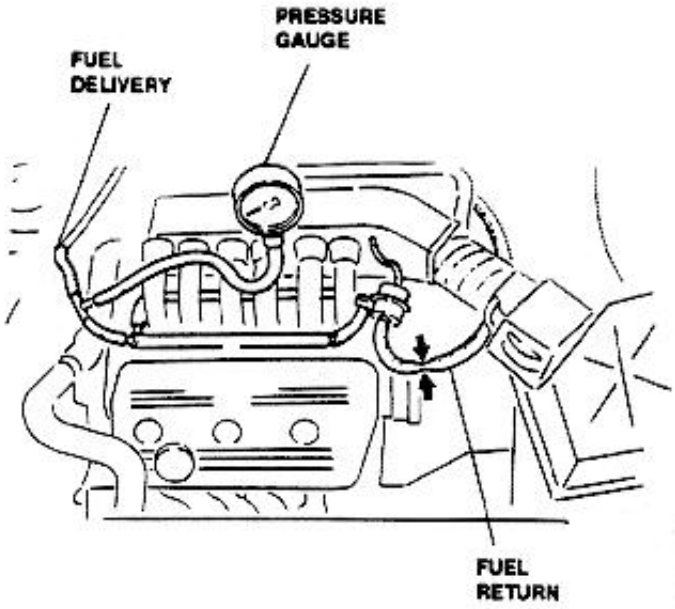
In presence of visible fuel leaks, or persistent fuel smell, perform the fuel system tightness check.

WARNING:
Keep a fire extinguisher within reach in case of fuel leaks.
DO NOT SMOKE.

SYSTEM TIGHTNESS CHECK

1. Keeping the pressure gauge connected and with engine idling, choke delivery hose immediately after pressure regulator and check that pressure rises up to about **400 kPa (58 p.s.i.)**.

Avoid pressure from exceeding this value!

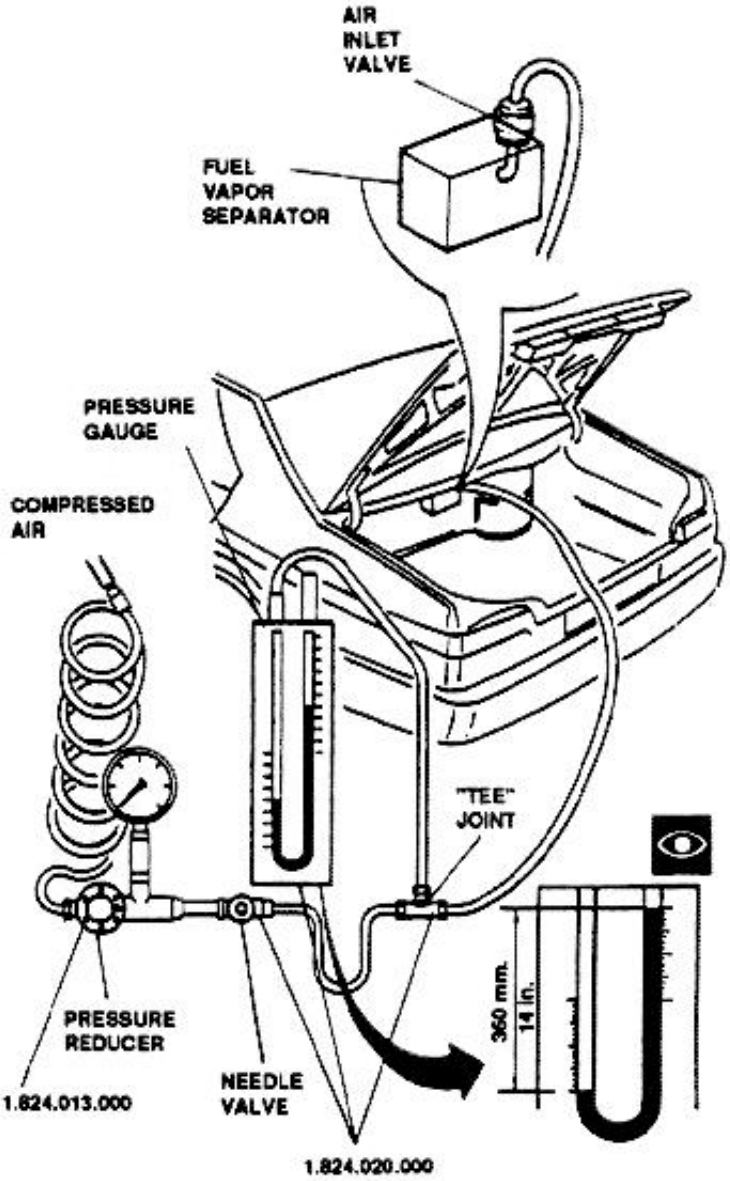


2. When the above pressure is reached, check for leaks in the fuel lines and connections.
3. If the pressure does not reach the above value, and no leaks are detected, check filter and/or pump operation.

VAPOR RECOVERY SYSTEM TIGHTNESS CHECK

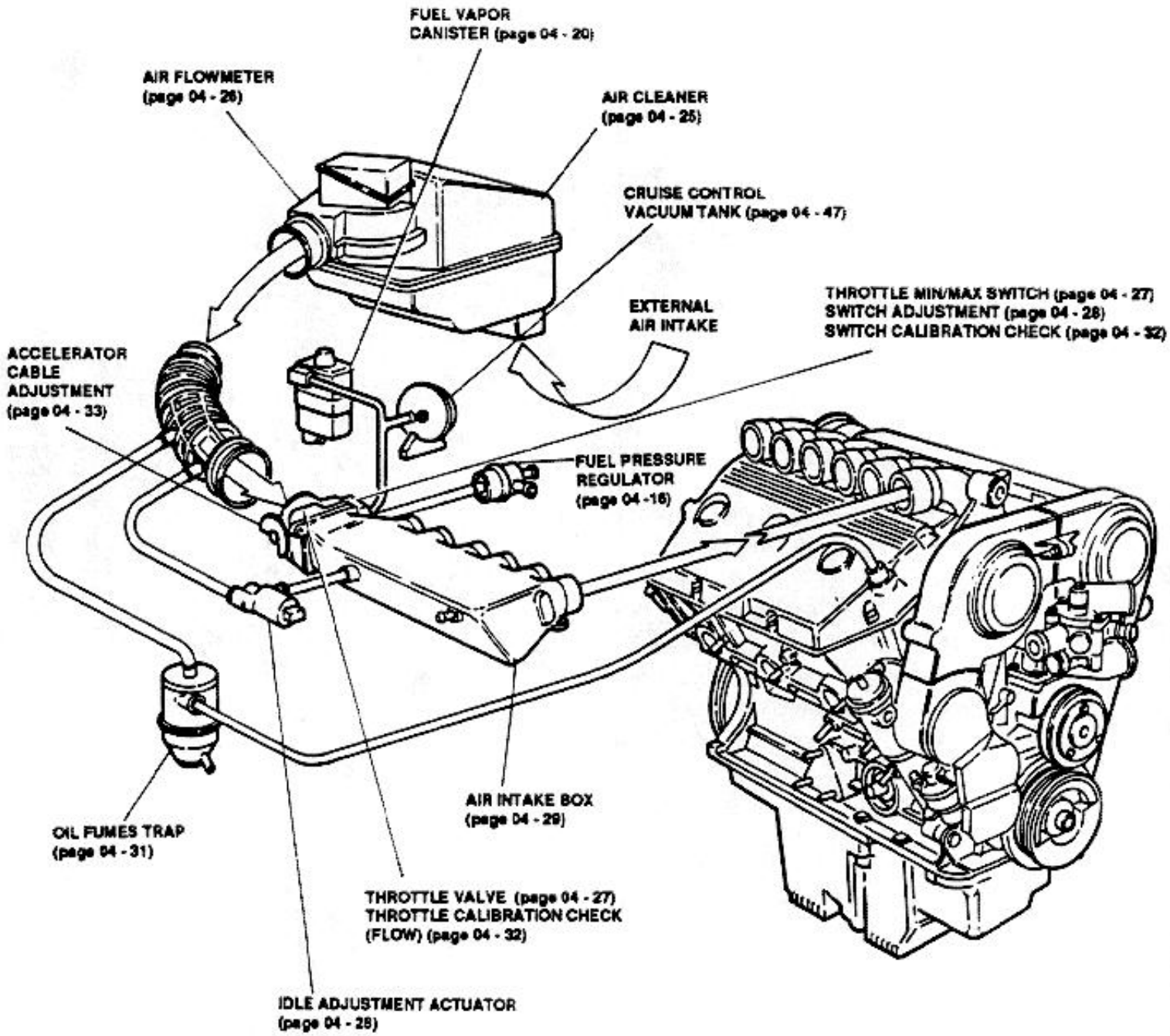
Check system tightness using the fixtures **1.824.013.000** and **1.824.020.000** (including a pressure gauge, needle regulation valve and lines with "Tee" connection).

1. Completely close valves of reduction **1.824.013.000** and of needle valve.
2. Connect the fixture connection to a source of compressed air.
3. Connect hose to the opposite end with the inlet air valve, located in the trunk, on the fuel vapor separator.
4. Operating on reduction **1.824.013.000**, reduce pressure to about **20 kPa (3 p.s.i.)**.
5. Slightly open the needle valve.
6. Operating on reduction, adjust pressure within the fuel circuit at **3.5 to 3.73 kPa (0.51 to 0.54 p.s.i.)** that corresponds to **360 mm (14 in)** on the pressure gauge.
7. Wait about 2 minutes and close valve, thus stabilizing pressure in the above mentioned circuit.
8. Measure the pressure drop in the system: it shall not exceed **0.5 kPa (0.07 p.s.i.)** within 5 minutes that corresponds to **50 mm (2 in)** on the pressure gauge.
9. If pressure drop exceeds the above value, locate leaks by spraying a soap solution on pipes and unions: soap bubbles will be present on the leak points.
10. If necessary, replace defective components and repeat the check.



AIR SUPPLY SYSTEM

ILLUSTRATED INDEX



AIR SUPPLY SYSTEM

INTRODUCTION

General description

The air supply system is composed of a dynamic intake, an air cleaner, an air flowmeter that senses the intake air quantity and temperature, a throttle valve and air intake manifold with idle by-pass.
The system also includes the vacuum input to the fuel pressure regulator, the line connecting the fuel vapor canister and the Cruise Control accumulator.
At last, the oil fumes recycling is connected with the intake manifold.

AIR CLEANER

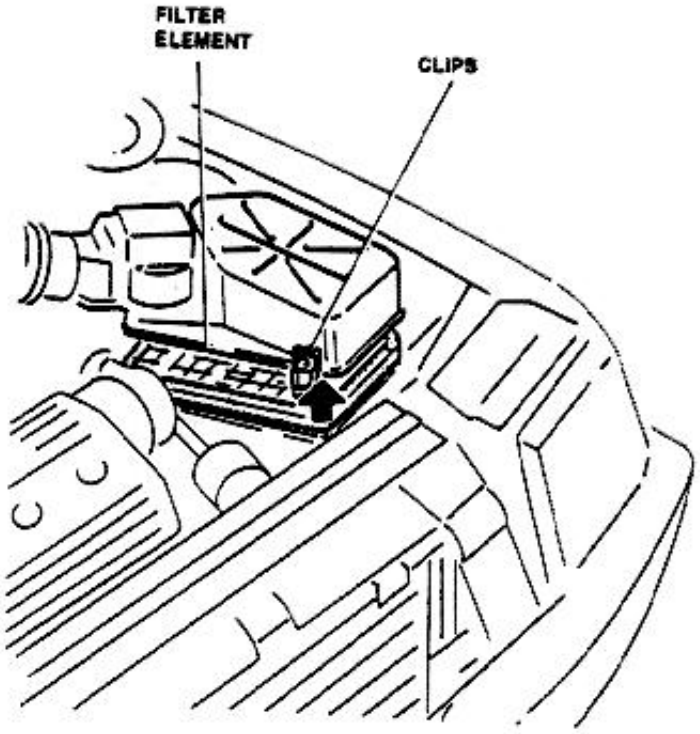
The cleaner, of the net type with filtering element easily replaceable, blocks particles and dust present in the engine intake air.
It operates also as an "intake silencer".

FILTER ELEMENT REPLACEMENT

1. Release securing clips.
2. Remove filtering element.
3. Thoroughly clean the filter element bowl.

CAUTION:
Any cleaning operation can damage the element, so compromising the correct operation of engine supply system.

4. Set new element, with net facing up.
5. Reinstall cover, taking care to correctly position it, then secure clips.

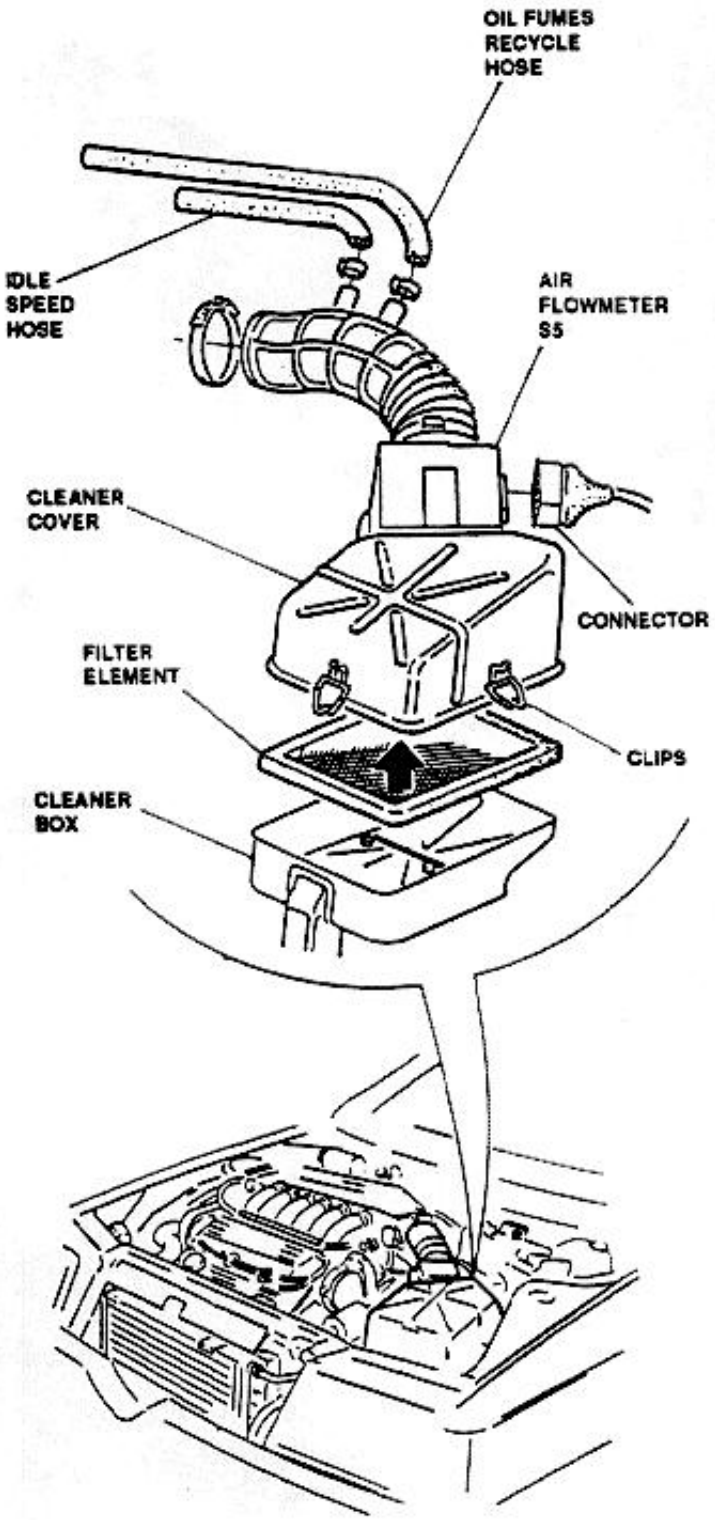


NOTE: If the cleaner shows traces of oil, check for possible infiltration in the whole air system.

REMOVAL /INSTALLATION

1. Disconnect battery ground lead.
2. Release cover clips.
3. Disconnect connector from the flowmeter.
4. Disconnect oil fumes recycle hose.
5. Disconnect idle adjustment hose.
6. Remove cover-flowmeter-intake manifold assembly.
7. Remove filter element.
8. Remove four nuts securing the air cleaner box to the

support.



AIR FLOWMETER

The air flowmeter measures the engine intake air quantity through a throttle valve controlled by the accelerator pedal, and sends to the MOTRONIC control unit a signal by which the unit determines the fuel injection timing.

The flowmeter operates according to the fluctuating throttle principle: a spring pushes over the throttle valve, that is a given air quantity corresponds to throttle valve precise angular position.

To compensate for the pressure functuation due to piston stroke a compensating throttle valve is used, strictly connected to the sensing throttle.

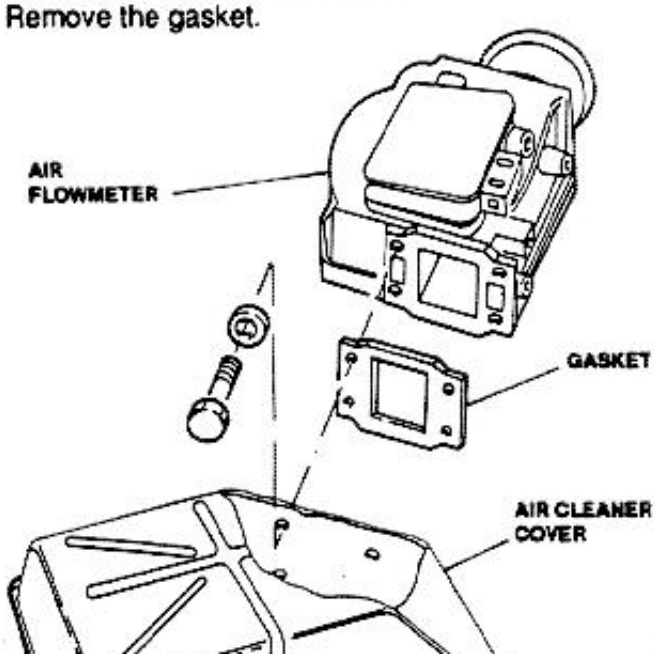
The electric signal is generated by a potentiometer whose shaft is connected to the functuating throttle valve.

Inside the flowmeter is located the intake air temperature sensor that is a NTC resistance connected to MOTRONIC control unit.

This sensor allows the control unit to monitor the fuel injection timing according to air density variations.

REMOVAL /INSTALLATION

1. Disconnect the battery negative lead.
2. Remove the air flowmeter cover assy.
3. Separate the air flowmeter from cleaner cover by unscrewing the four fixing screws.
4. Remove the gasket.

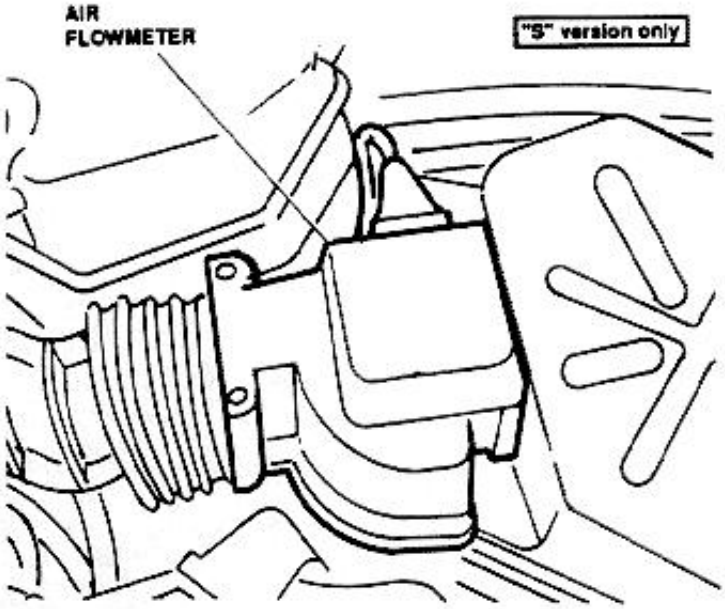


INSPECTION AND CHECKS

1. Push on the flowmeter flap and check it is free to rotate and there are no stops for its free rotation; also check for presence of dirt and scratches.
2. If necessary, clean the flowmeter interior using a dry clean cloth.
3. For a complete check of the electrical components (potentiometer, air sensor, etc.) refer **WIRING DIAGRAM AND ELECTRICAL DIAGNOSIS Book**.

NOTE: **Do not operate the flowmeter when disconnected from the control unit.**

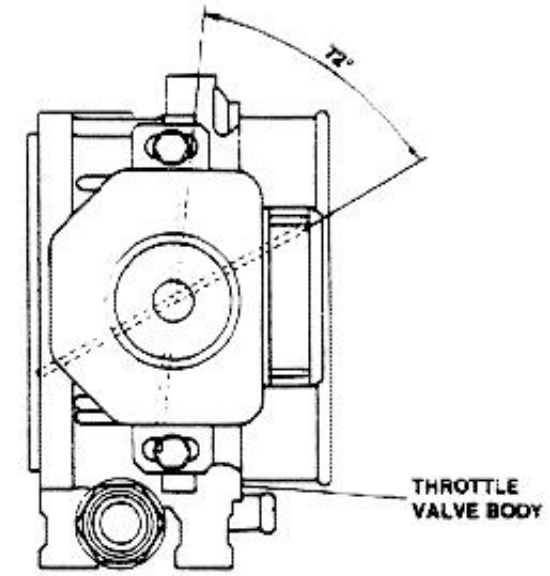
NOTE: The **"S" version** is equipped with a flowmeter that differs in characteristics and shape from the one installed on other versions.

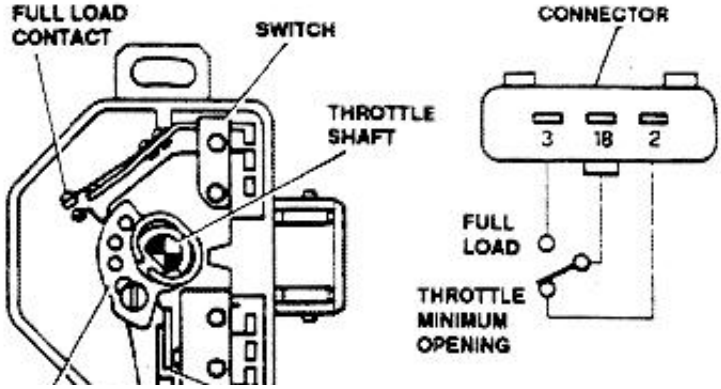


NOTE: The technical description and the maintenance procedure are identical to those described above.

THROTTLE VALVE BODY AND MIN / MAX OPENING SWITCH

The throttle body controls the quantity of air sent to manifold according to the accelerator pedal position.
The accelerator cable works on a pulley sector which is mechanically connected to the throttle valve. A spiral spring allows the throttle valve to return to close position.
On one side is located the opening switch that is fixed on the rotation shaft.
The switch assembly includes two microswitches, one **MIN** that sends to the control unit a signal proportional to throttle angle between **fully closed and 1 degree** openings, while the **MAX** provides a signal proportional to throttle angles higher than **72 degrees**.
Both microswitches provide a signal to block fuel during deceleration (cut-off) and increase fuel quantity at fully power requests (enrichment).

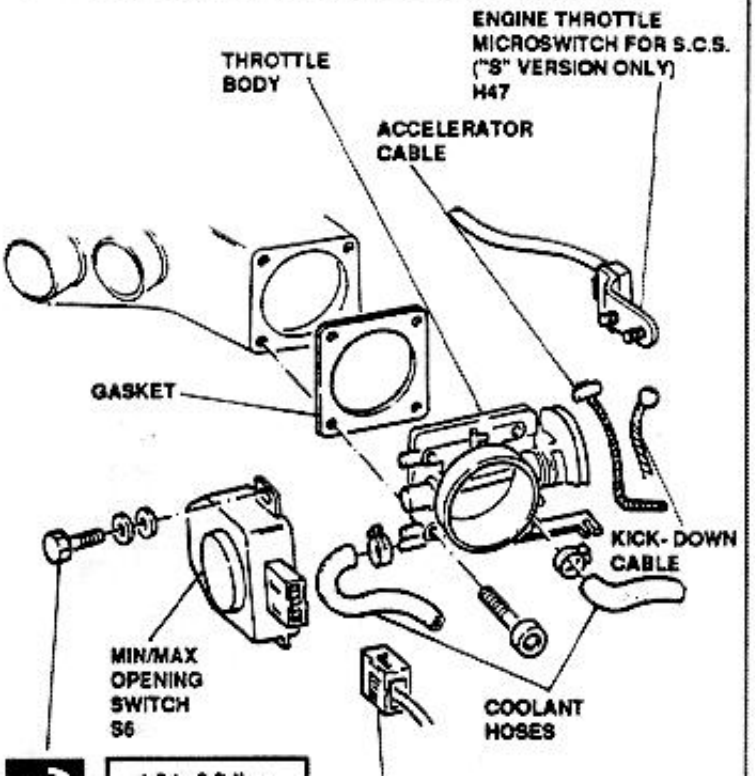




The throttle body of **vehicles equipped with automatic transmission** includes a kick-down cam (see **Group 16**) which engages lower gear when the accelerator pedal is fully pressed. The **"S" version** is equipped with controlled damping suspensions, which include a sensor on the throttle sensing throttle openings higher than 20 degrees (see **Group 21**).

REMOVAL /INSTALLATION

1. Disconnect the battery negative lead.
2. Remove the air flowmeter-cover-intake manifold assembly.
3. Unplug connector from min/max opening switch.
4. **"S" version only:** remove engine throttle microswitch for S.C.S..
5. Disconnect accelerator cable.
6. **Versions equipped with automatic transmission only:** disconnect kick-down cable.
7. Disconnect the coolant outlet and inlet hoses from the throttle valve body.
8. Remove throttle valve body.
9. Remove gasket.
10. If necessary, remove min/max opening switch.



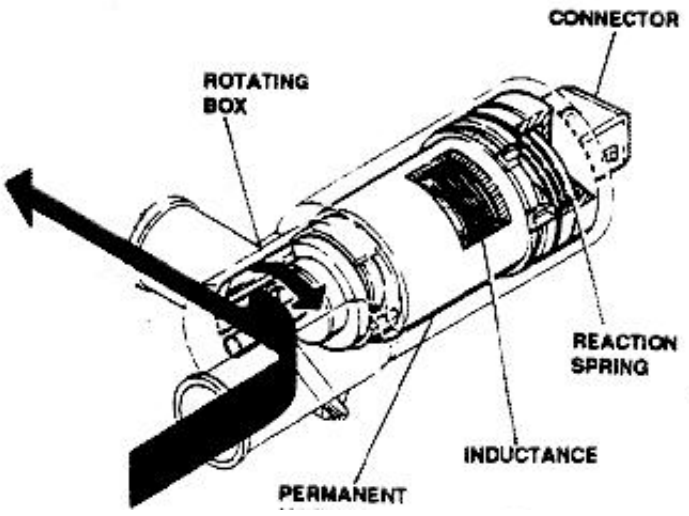
ADJUSTMENT OF THROTTLE VALVE MIN/ MAX OPENING SWITCH

1. Connect the switch joint on the throttle shaft and install the two attaching screws without completely tightening them.
2. With the valve fully against the minimum limit stop, slowly rotate switch clockwise until the switch trips. Secure in this position tightening screws to the specified torque.

MIN angle opening contact	**1°**
MIN angle closing contact	**0.2°**
MAX angle closing contact	**72°**

IDLE ADJUSTMENT ACTUATOR

The actuator to control constant idle adjustment allows to exactly determine the quantity of air during start and to maintain the engine at idle in any condition.
The actuator is located on throttle body by pass line: the actuator flow through section provides, in case of throttle closed or at minimum opening, an air flow controlled by the accelerator and by the MOTRONIC control unit.
The actuator is realized by a monowind rotating regulator: upon command from the control unit it opens a rotating manifold. The closing rotation is accomplished by an antagonist spring.



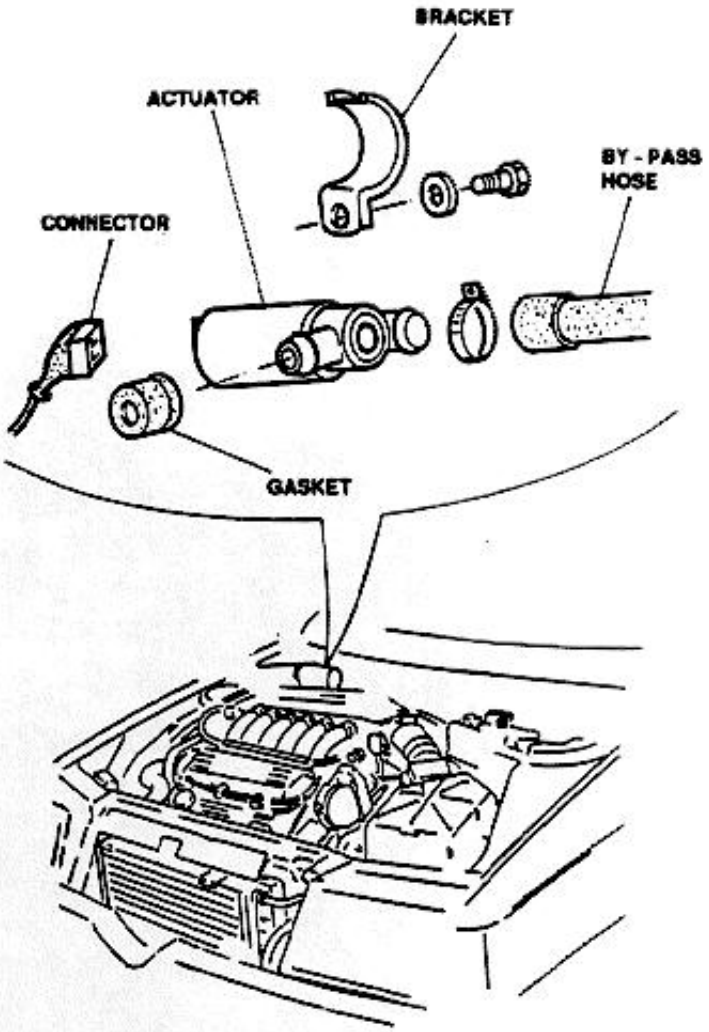
1.8 to 3 ft.lbs
(2.5 to 4 N·m)

CONNECTOR

MAGNET

REMOVAL /INSTALLATION

1. Disconnect battery negative lead.
2. Unplug connector.
3. Disconnect the by pass hose for the idle speed adjustment.
4. Remove the idle speed actuator from the air intake manifold removing bolt securing bracket.
5. Remove gasket.



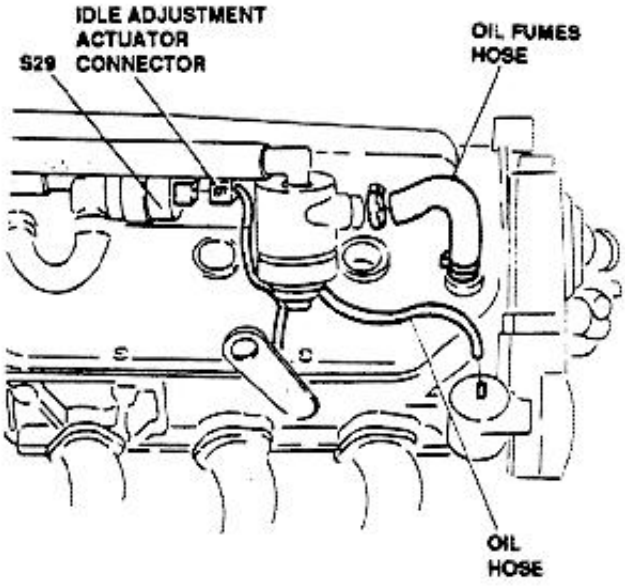
INSPECTION AND CHECKS

For the operational check of the electromagnetic components, refer to the WIRING DIAGRAMS AND ELECTRI-

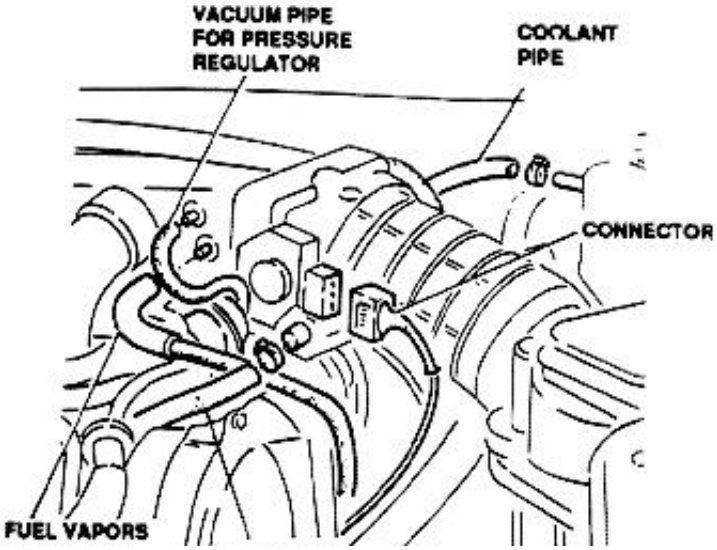
AIR INTAKE BOX

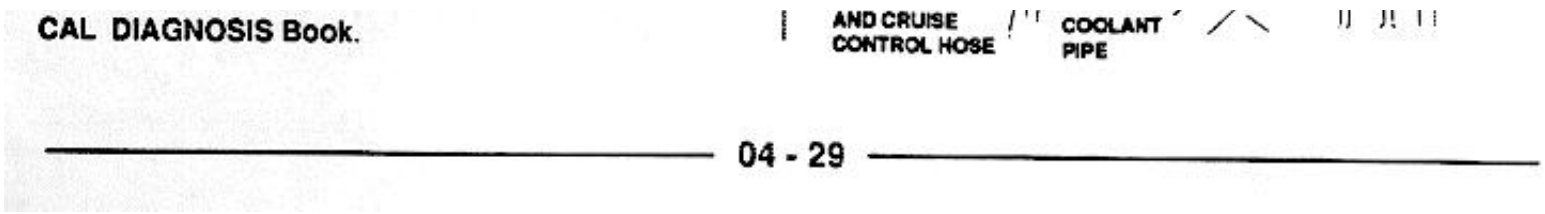
REMOVAL /INSTALLATION

1. Disconnect battery negative lead.
2. Unplug adjustment speed actuator connector.
3. Disconnect oil fumes recovery hose.
4. Disconnect oil recovery hose.

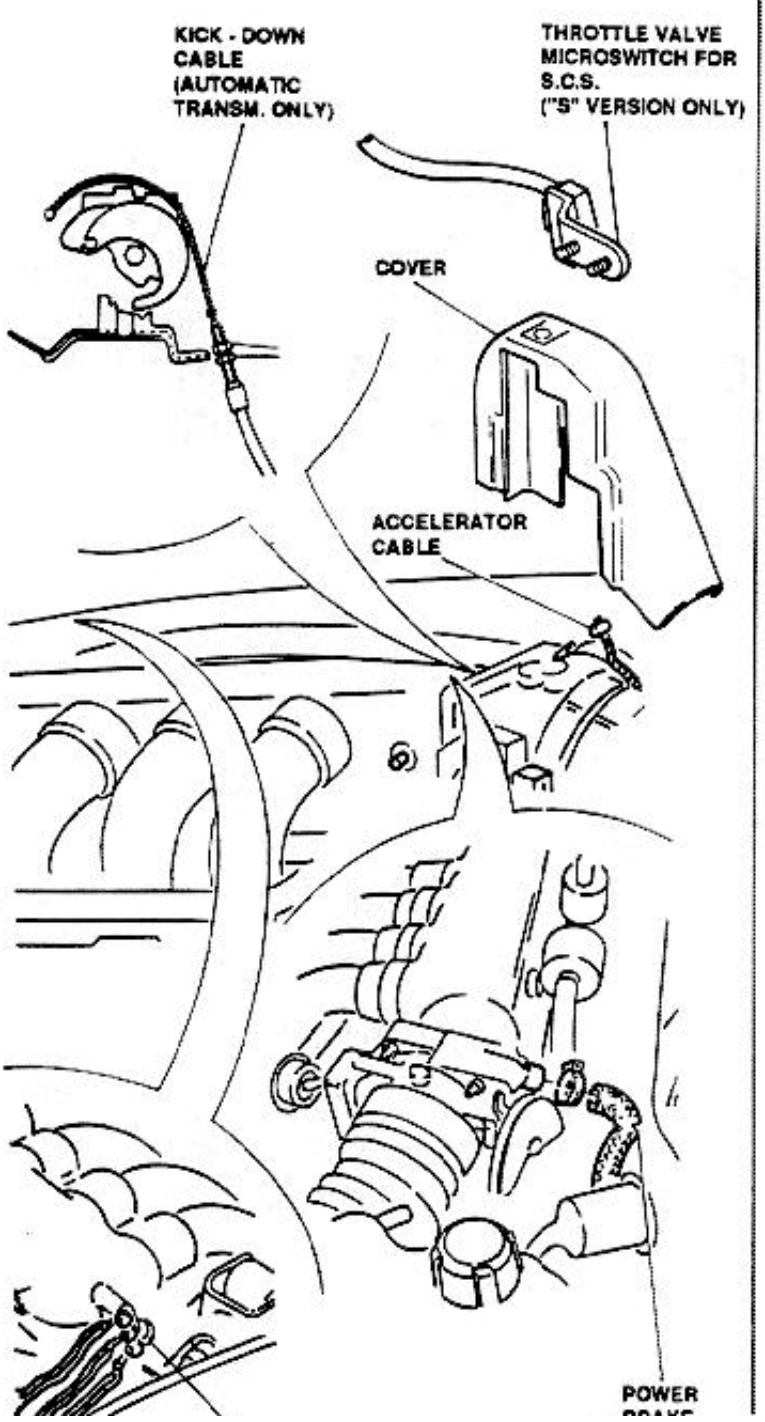


5. Unplug throttle valve min/max opening switch connector.
6. Disconnect vacuum pipe for the fuel pressure regulator and the fuel vapors and Cruise Control hose.
7. Disconnect throttle body inlet and outlet coolant pipes.

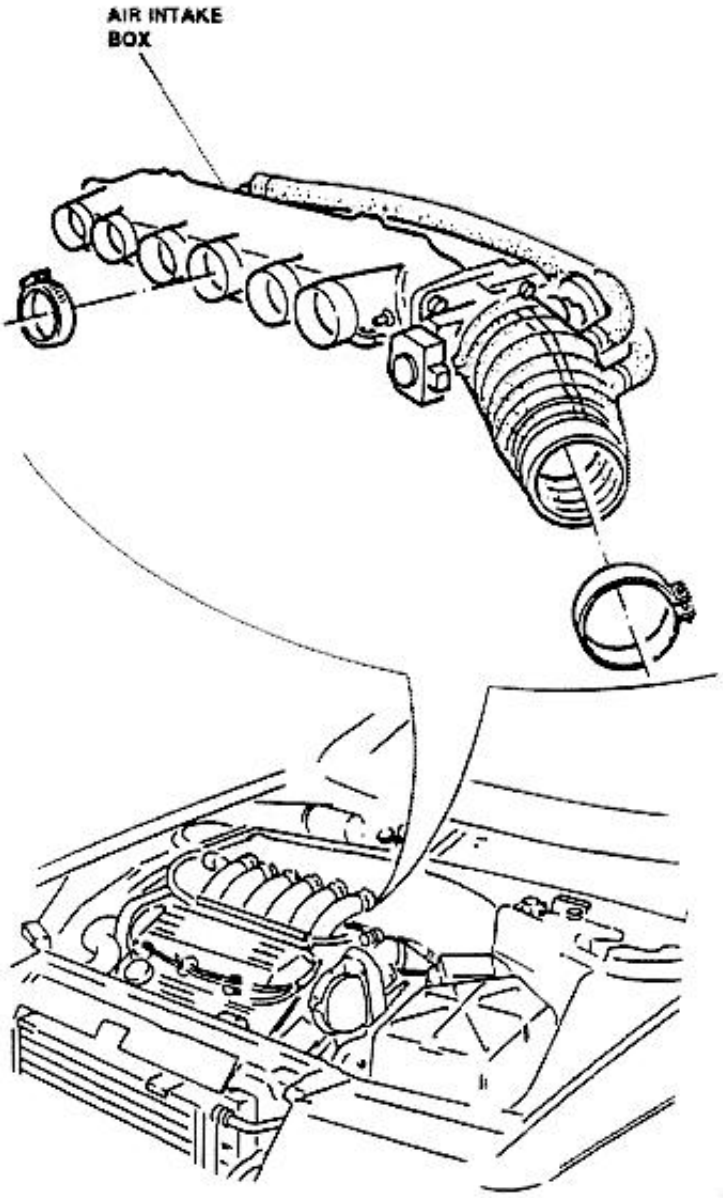


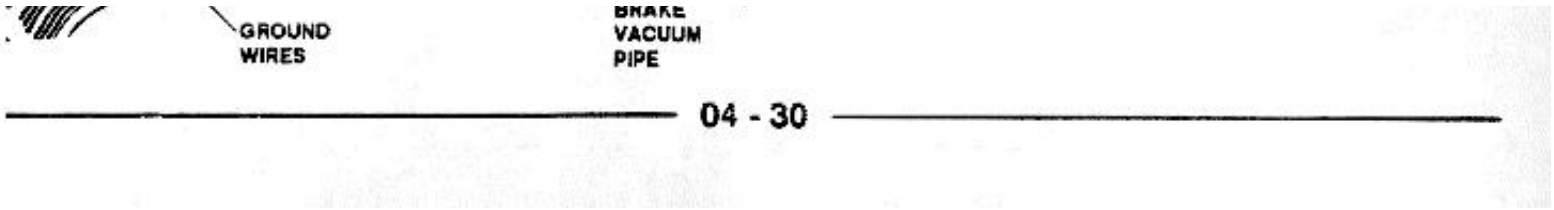


8. Remove throttle body cover.
9. **"S" version only:** remove throttle valve microswitch for S.C.S..
10. Release accelerator cable.
11. **Automatic transmission version only:** disconnect kick-down cable.
12. Unplug ground wires.
13. Disconnect the vacuum intake pipe from the power brake.



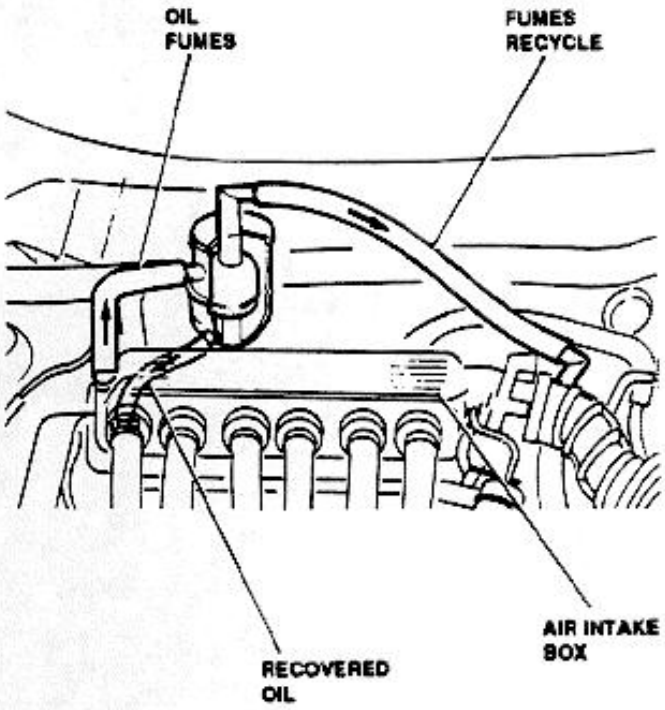
14. Remove air intake box after unscrewing the tree fixing screws and loosening the clamps on the stub pipes and intake duct.

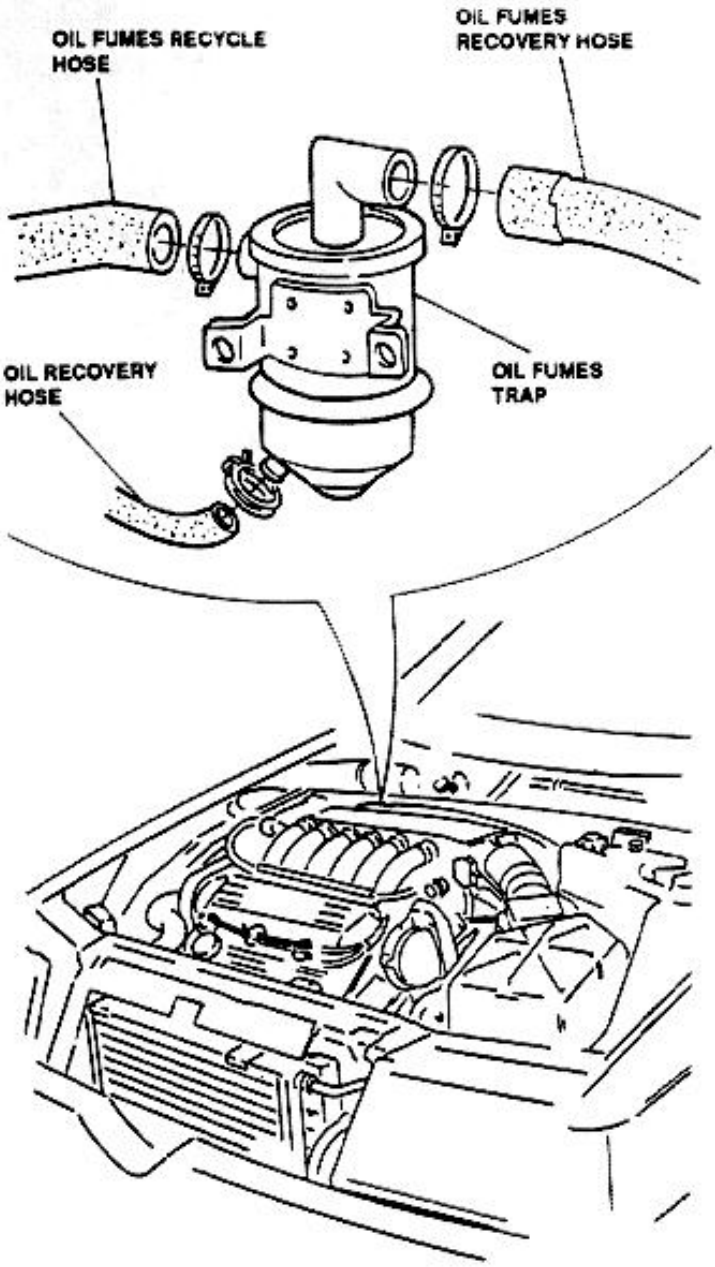



GROUND
WIRES
BRAKE
VACUUM
PIPE

CRANKCASE EMISSION CONTROL SYSTEM

The oil fumes control is accomplished by a trap that collects the oil fumes generated within the cylinders head and operates,being it at a lower temperature, a gradual condensation.
The liquid is introduced in the oil sump, while fumes are introduced in the air intake system and burnt in the engine.



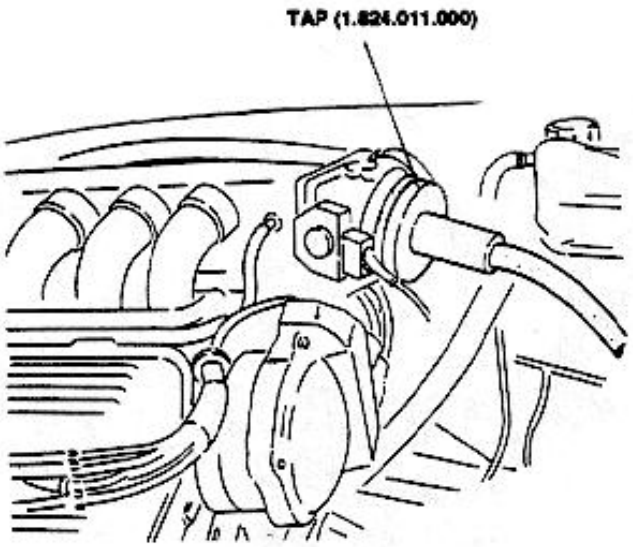


OIL FUMES TRAP REMOVAL AND INSTALLATION

1. Disconnect oil fumes recycle hose.
2. Disconnect oil fumes recovery hose.
3. Disconnect oil recovery hose.
4. Remove the oil fumes trap from the air intake box.

THROTTLE CALIBRATION CHECK (FLOW)

1. Remove air flowmeter-cover-intake manifold assembly.
2. Make sure throttle valve is in closed position; lay flowmeter tap **1.824.011.000** on the valve body inlet and check that the air flow through the valve ranges within the specifiedvalues.
3. If the flow does not meet specified value, operate the adjusting screw till the correct value is obtained.



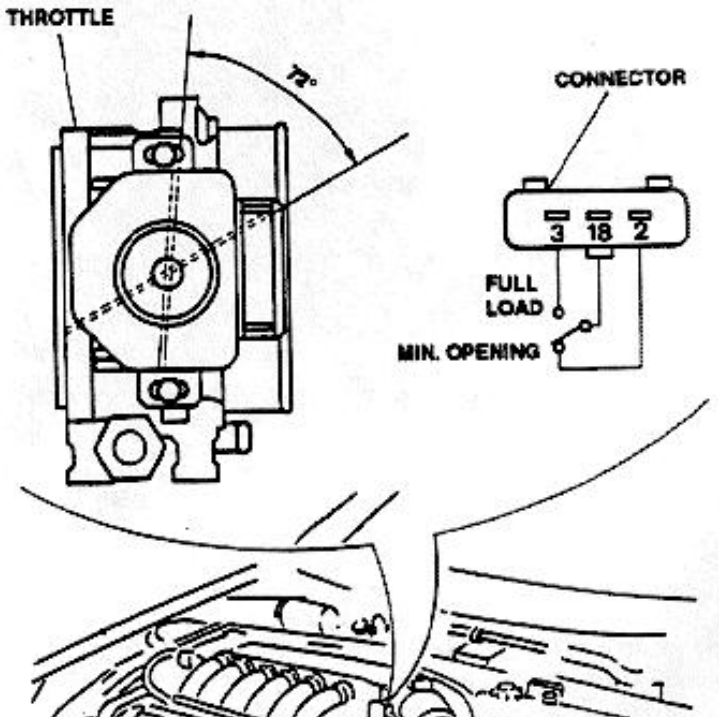
Air flow through throttle valve in closed position (SOLEX flowmeter)
290 to 310 on N scale

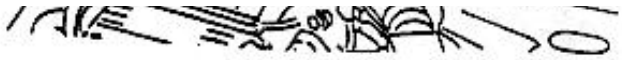
164 "S" version : 270 to 290 on N scale

THROTTLE VALVE MIN/MAX OPENING SWITCH CALIBRATION CHECK

NOTE: Before carrying out this adjustment, make sure the throttle calibration is correct.

1. Unplug connector from the throttle valve min/max opening switch and check with an ohmmeter for the following resistance values:
   a. With valve **fully closed**, between **terminals 2 and 18** the resistance should read **0 ohm**.
   b. Slowly **rotate valve**: With meter connected to **terminals 2 and 18** the resistance should read **infinite** before valve has rotated for less than 1 degree from its previous closed position.
2. If this condition is not met, loosen screws and rotate switch till contact is closed (resistance = 0 ohm) between terminals 2 and 18 with valve fully closed. Tighten screws.
3. Connect meter between **terminals 3 and 18**, set valve to **fully open** position and check for a resistance reading of **0 ohm**.
4. Check accelerator control or replace switch, if the previous conditions are not met.



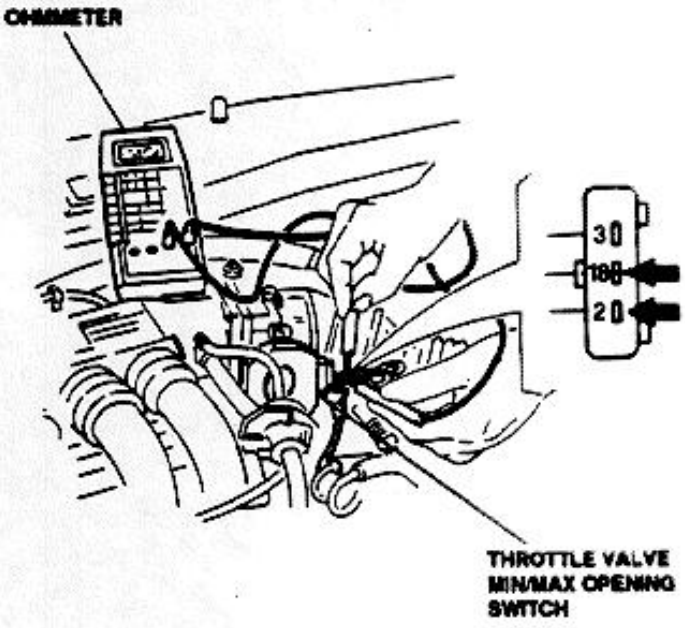


ACCELERATOR CABLE ADJUSTMENT

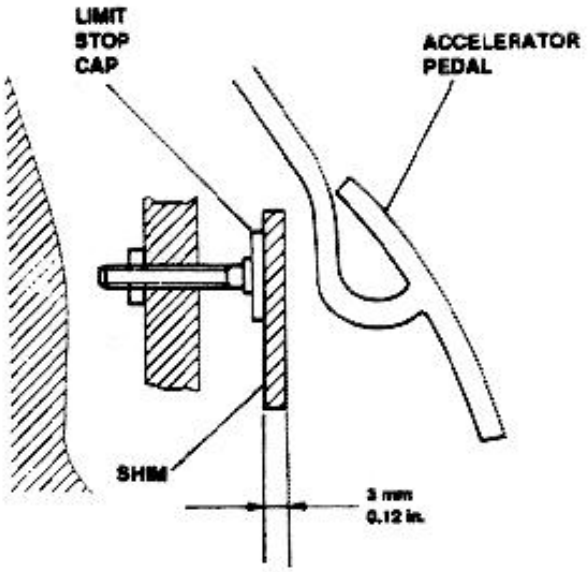
WARNING:
The accelerator cable system has been accurately designed so as to minimize pedal effort and provide a sure and quick return under any circumstance.
THE ACCELERATOR CABLE SHALL BE EN ANY CASE WELL CALIBRATED.

1. Connect an ohmmeter to **terminals 18 and 2** of throttle valve min/max opening switch.

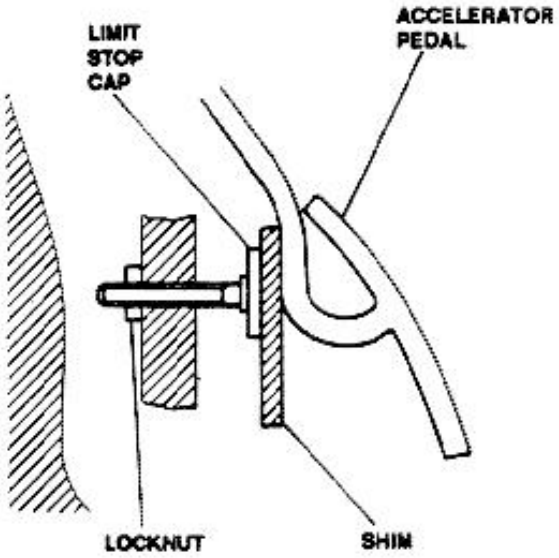
NOTE: The meter connection is needed to operate **without unplugging** the normal connector: use needles or similar features.



2. Check for a resistance reading of infinite (insulation). Unscrew the limit stop cap under the accelerator pedal until the above value is reached.
3. Insert a **3 mm (0.12 in) shim** between limit stop cap and pedal.

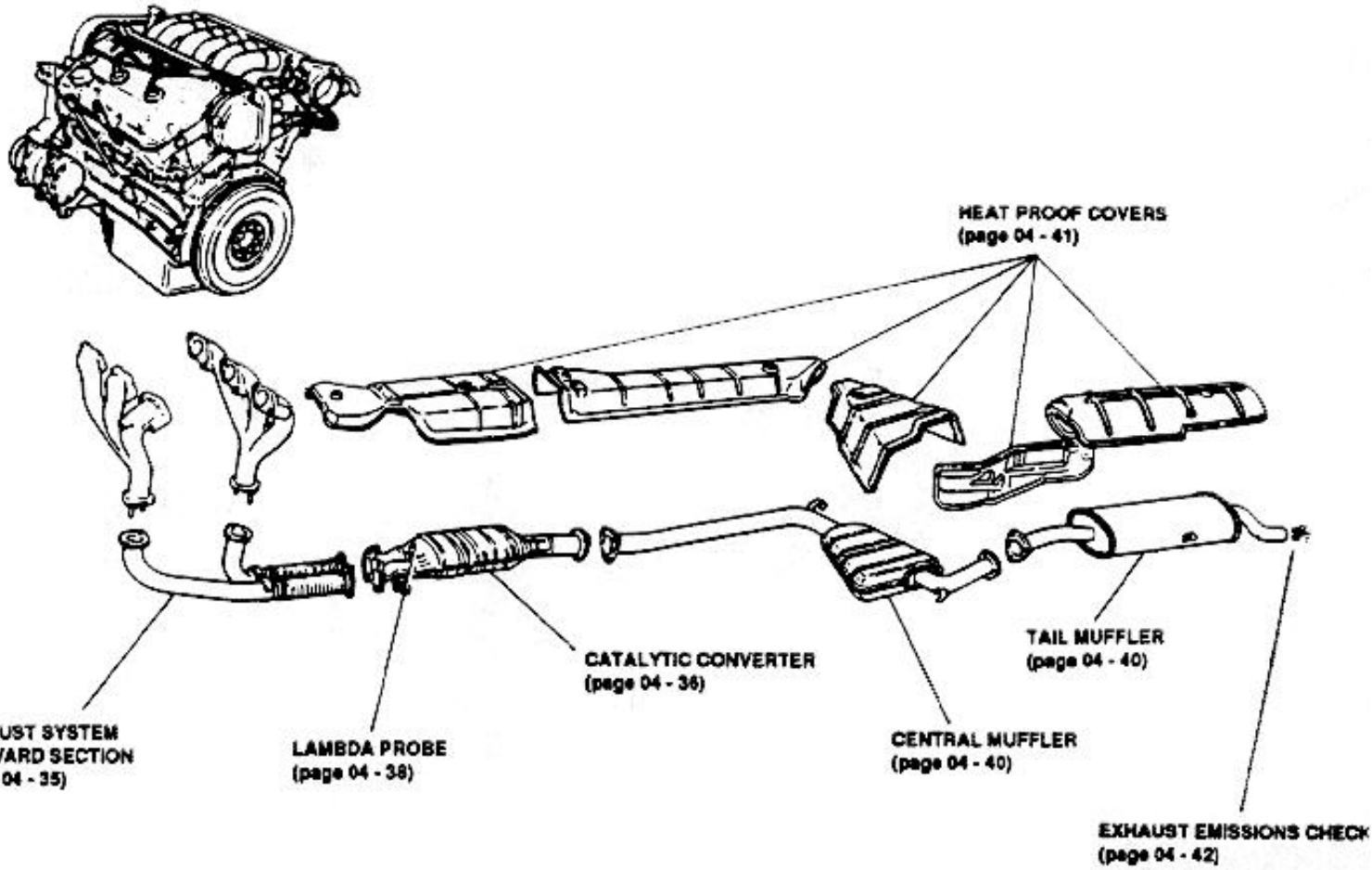


4. Push the pedal against the cap and check for a reading of 0 ohm (continuity). Screw the limit shop cap until the above value is reached. Tightly screw the cap locknut.



NOTE: Upon accelerator cable adjustment, also adjust the kick-down cable - see **Group 16** (Vehicles equipped with automatic transmission only), and Cruise Control cable - see **"CRUISE CONTROL CABLE: ADJUSTMENT"**.

EXHAUST SYSTEM
ILLUSTRATED INDEX



EXHAUST SYSTEM

INTRODUCTION

General description.

The engine exhaust gases flow into two triple manifolds (one each head) and then, through two exhaust pipes, into the three way catalytic converter where most of the polluting matters are removed.On the catalytic converter input is positioned the lambda probe that sends a signal, proportional to oxigen quantity in the exhaust gases, to MOTRONIC control unit.
This unit monitors the fuel injection timing so as to maintain a correct air to fuel ratio.
The exhaust gases come out from the converter going toward two mufflers.
Heat dissipation toward car body, very high because of the catalytic converter, is limited by a thermal isolation accomplished by means of covers made of low heat conducting materials.

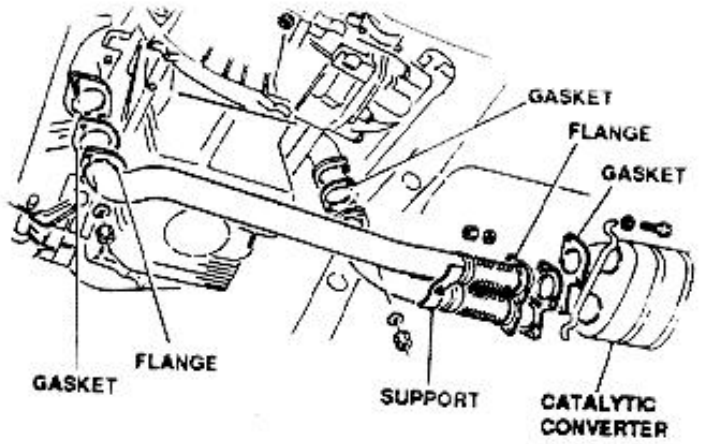
WARNING:
During engine operation all exhaust pipes, and particularly the catalytic converter, heat up considerably. Before any work allow system to cool down with the engine shut down.
DO NOT EVER TOUCH THE CATALYTIC CONVERTER WITHOUT APPROPRIATE PRECAUTIONS SUCH AS GLOVES, ETC.
DO NOT ALLOW EASILY FLAMMABLE MATERIAL TO COME IN CONTACT WITH THE CATALYTIC CONVERTER.

EXHAUST SYSTEM: FORWARD SECTION

From both exhaust manifolds - one for each cylinder head (see **Group 01**) - a pipe collects exhaust gases and flow them into the catalytic converter.
Connection with the manifolds and with the catalytic converter is accomplished by means of bolted flanges with gaskets.
An appropriate support keeps both pipes parallel at the input of catalytic converter connection flanges, allowing to minimize the possibility of converter damage due to heat deformation of the pipes.

REMOVAL /INSTALLATION

1. Place car on a lift platform.
2. Disconnect pipe from both exhaust manifolds and remove the related gaskets.
3. Disconnect pipe from the catalytic converter and remove the related gasket.
4. Remove pipe.



CATALYTIC CONVERTER

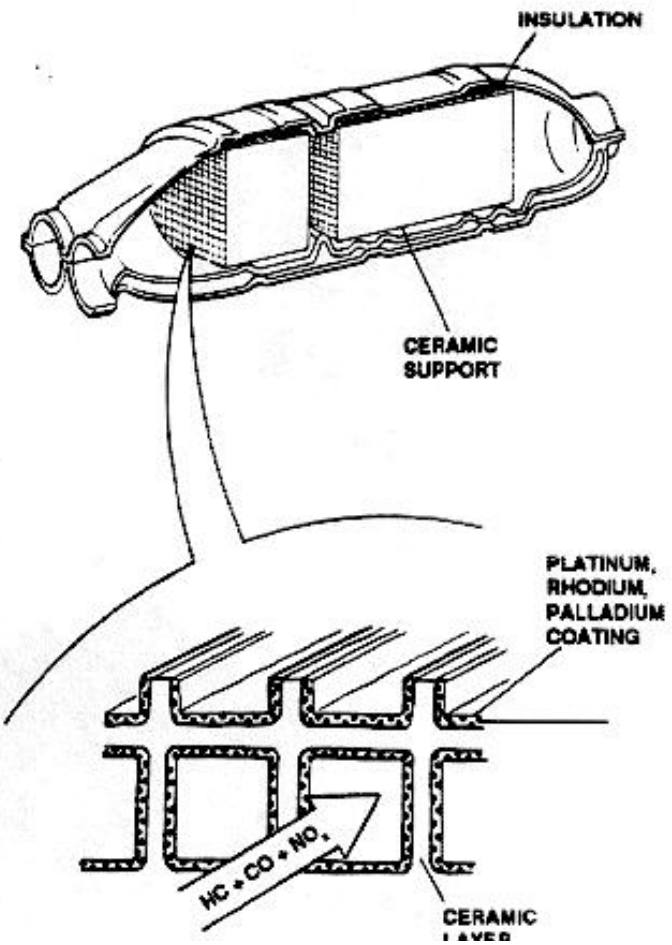
The fuel combustion generates harmful gases such as:

- carbon monoxides (CO)
- unburnt hydrocarbons (HC)
- nitrogen oxides (N0x)

These matters are changed, by means of chemical reactions within the converter, into non-polluting matters normally present in the atmosphere:

- carbon dioxide (C02)
- water vapor (H2O)
- inert nitrogen (N2)

The catalytic converter is internally composed of a support made of heat resistant ceramics through which, following appropriate channels, flow the exhaust gases. The channels are internally coated with small quantities of rare metals, such as platinum, rhodium and palladium that allow the starting at acceleration of the changing chemical process of the polluting matters.



CAUTION:
The case metals contained in the converter, due also to the internal high temperature, are chemically attached by the presence of lead. FOR THIS REASON, THE USE OF LEADED GASOLINES MUST BE AVOIDED, OTHERWISE A RAPID AND IRREVERSIBLE DAMAGE TO THE CONVERTER WILL OCCUR.
NEVER USE, EVEN IN EMERGENCY OR FOR A VERY SHORT TIME, GASOLINE CONTAINING LEAD!

The converter performance is greatly depending upon:

- **exhaust gases temperature**: the chemical reactions occuring within the converter are of oxigen reducing type, occuring normally in nature at temperatures ranging between 1000 to 1200 °C (1830 to 2190°F). The presence of rare metals allows those reactions to occur at lower temperatures 250 to 300°C (480 to 540°F). Those temperatures are reached by the exhaust gases with engine running at normal speed.

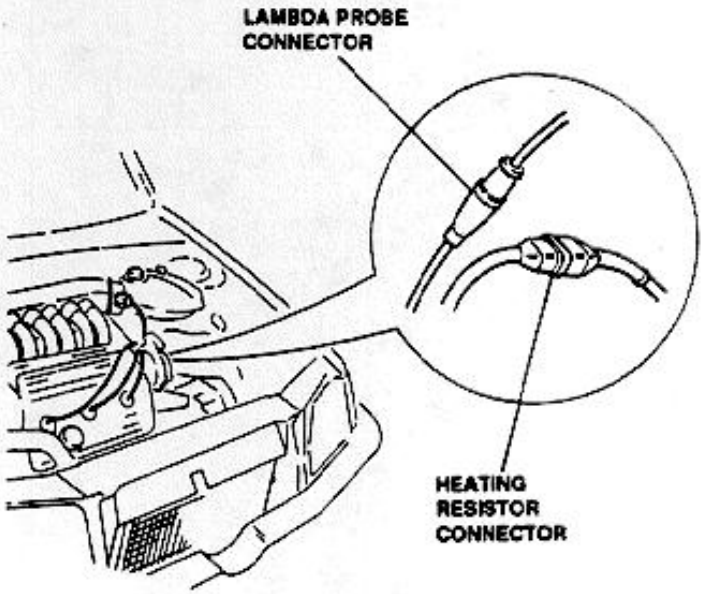
- **engine air - fuel ratio**: the contents of polluting matters in the exhaust gases is minimum when the air - fuel ratio of the burnt mixture is almost equal to the theoretical stoichiometric ratio (14.7:1). In this condition the converter is able to decrease the concentration of polluting matters in the exhaust gases by 80%. That is why a lambda probe is used, see next paragraph.

LATER

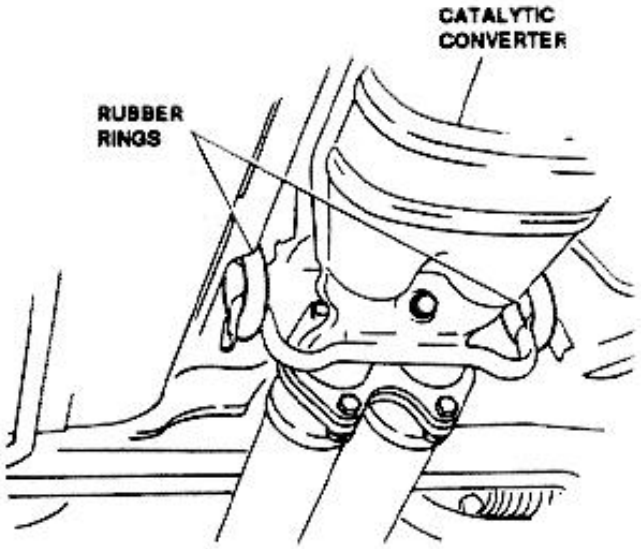
REMOVAL /INSTALLATION

WARNING:
During engine run the catalytic converter heats up considerably.
Before attempting any work, allow an appropriate period of time after engine shut down.
NEVER TOUCH THE CATALYTIC CONVERTER, EVEN IF WEARING APPROPRIATE PROTECTIONS SUCH AS GLOVES, ETC.
DO NOT ALLOW EASILY FLAMMABLE MATERIALS TO COME IN CONTACT WITH THE CATALYTIC CONVERTER.

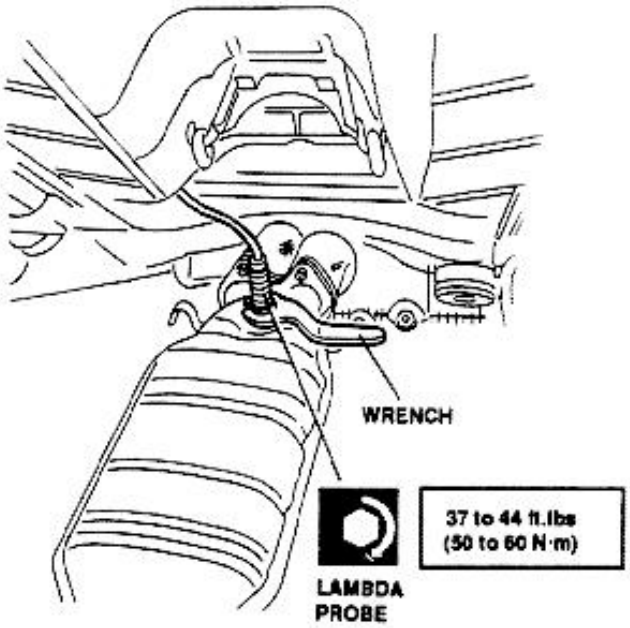
1. Place the car on a lift platform.
2. Disconnect battery negative lead.
3. Remove air filter cover - flowmeter assembly.
4. Unplug lambda probe connector.
5. Unplug connector of lambda probe heating resistor.



6. Lift car.



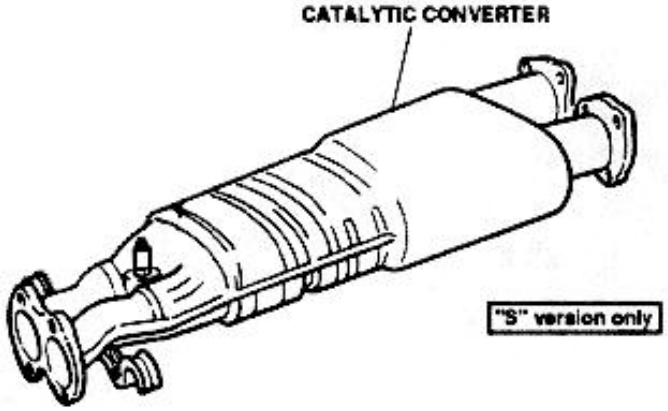
8. Disconnect catalytic converter from exhaust pipe that connects it to mufflers, remove gaskets.
9. Remove lambda probe using an appropriate wrench.
10. Remove catalytic converter, remove gaskets.



WARNING:
The removed converter, also if externally cold, might be very hot internally. That is why YOU MUST NOT THROW THE REPLACED CONVERTER ON FLAMMABLE

7. Remove rubber rings securing the catalytic converter.	RUBBISH.

NOTE: The catalytic converter installed on the "164" version has a single output pipe toward central muffler; the **"164 S" version** has a two-split pipe.



The technical descriptions and the maintenance procedures remain essentially the same.

CAUTION:
HIGH CONVERTER TEMPERATURE.
If, during engine operation, a high converter temperature is indicated, it is advisable to immediately troubleshoot it in order to avoid damage to converter components.
Follow the troubleshooting procedures at the end of this Group.

LAMBDA PROBE (O^2 SENSOR)

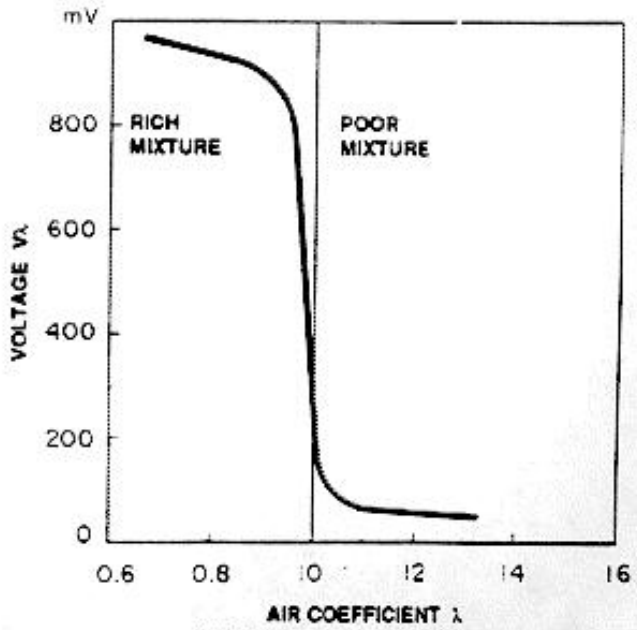
The lambda probe informs the Motronic system about the state of air-fuel mixture combustion, and allows the system to maintain the mixture stoichiometric ratio as close as possible to the theoretical value.
To get a very god mixture it is necessary that the engine intake air is equal to the theoretical one needed to burn all the injected fuel. In this case it is said that lambda (λ) factor is equal to 1, in fact:

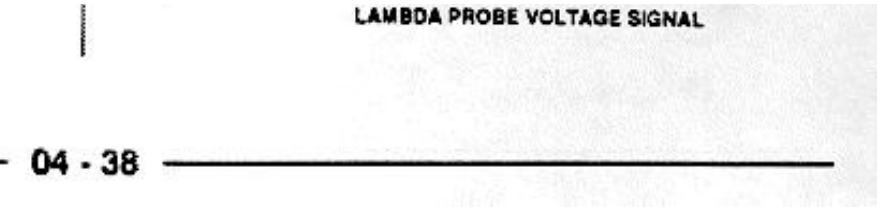
$$\lambda = \frac{\text{AIR INTAKE QUANTITY}}{\text{THEORETICAL AIR QUANTITY NEEDED TO BURN ALL THE INJECTED FUEL}}$$

Therefore:

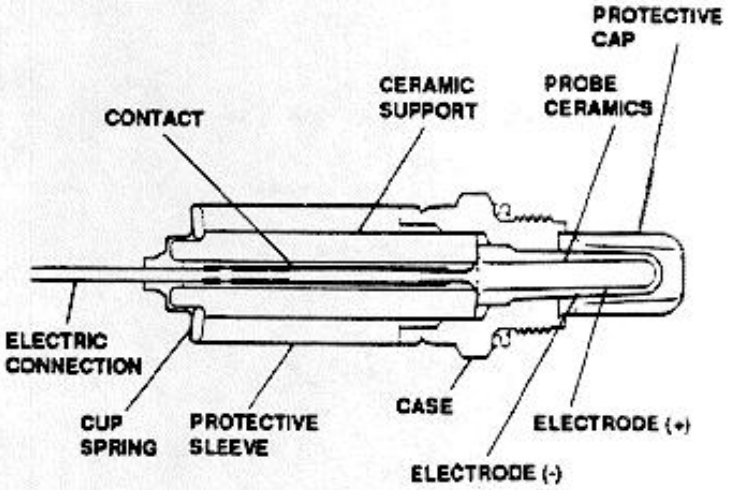
- $\lambda = 1$ **IDEAL MIXTURE**
- $\lambda < 1$ **RICH MIXTURE**
- $\lambda > 1$ **POOR MIXTURE**

The lambda probe, in contact with exhaust gases, generates an electric signal whose voltage depends upon oxygen concentration in the exhaust gases.
This voltage has a sudden variation when the mixture composition moves far from $\lambda = 1$.





The lambda probe is made of a ceramic capsule that supports two platinum electrodes, one in contact with the exhaust gas and the other with the atmosphere. To avoid corrosion due to exhaust gases, platinum is covered by a porous ceramic layer and by a metallic capsule which protects the electrode from collision with solid particles present in the exhaust gases. One electrode is directly connected to ground, while the other is connected to the unit. At very high temperatures (over 300°C - 570°F) the ceramic becomes porous and allows passage of oxigen ions contained in the exhaust gases, ions that lay on the platinum electrode. On the electrode in contact with atmosphere lay, on the contrary, oxygen ions present in it, generating a voltage of same hundreds of mV., voltage that indicates if mixture is poor or rich. To allow probe to reach quite soon the temperature of 300°C - 570°F needed for the probe correct operation, in its interior there is a heating resistor which is powered when the engine is cold.

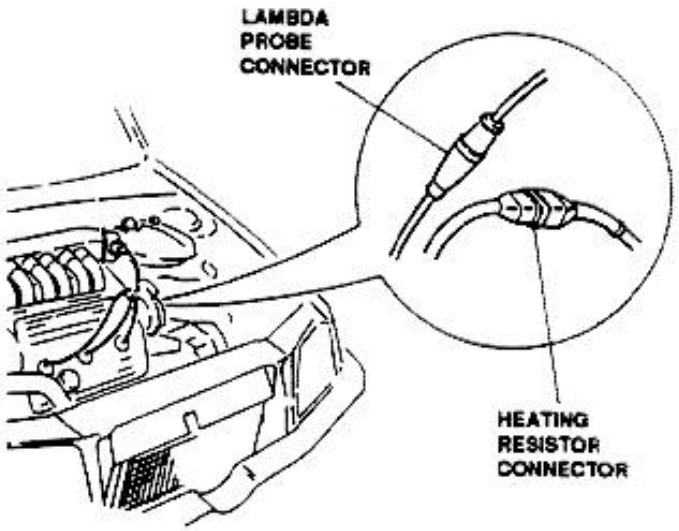


CAUTION:
The internal platinum electrodes are chemically attacked by the lead present in the exhaust gases.
FOR THIS REASON DO NOT USE LEADED GASOLINES, OTHERWISE A QUICK AND IRREVERSIBLE DAMAGE TO THE PROBE WILL OCCUR. NEVER USE, EVEN IN EMERGENCY AND FOR SHORT TIME, GASOLINES CONTAINING LEAD.

LAMBDA PROBE REPLACEMENT

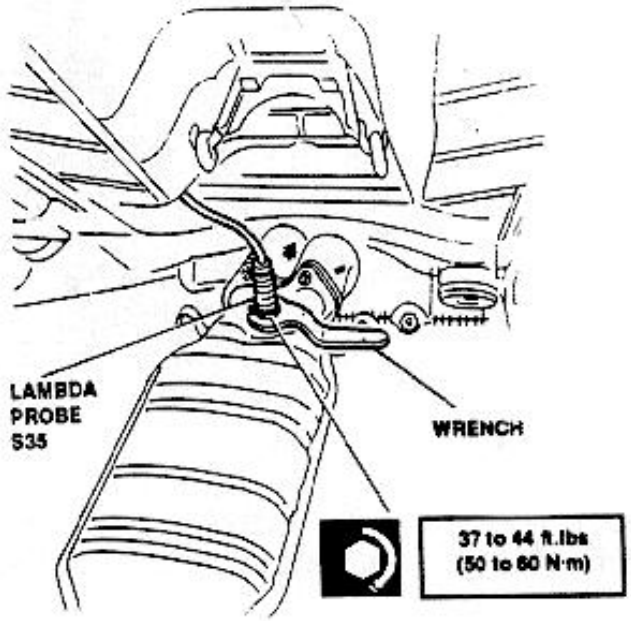
WARNING:
During engine operation the catalytic converter heats up considerably.
Before working on it, allow an appropriate period of time after engine shut down.
NEVER TOUCH THE CATALYTIC CONVERTER EVEN WITH APPROPRIATE PROTECTIONS SUCH AS GLOVES, ETC.
DO NOT ALLOW EASILY FLAMMABLE MATERIALS TO COME IN CONTACT WITH THE CATALYTIC CONVERTER.

1. Place car on a lift platform.
2. Disconnect battery negative lead.
3. Remove air filter cover - flowmeter assembly.
4. Unplug lambda probe connector.
5. Unplug lambda probe heating resistor connector.
6. Lift the car.



7. Release supports securing the catalytic converter.
8. Disconnect converter from exhaust pipe center section.
9. Remove lambda probe using an appropriate wrench.
10. Install lambda probe, making sure to smear threads with an antiseizing compound (R. GORI Never Seez.).

11. Torque probe to correct value.



12. Reinstall all parts previously removed.

INSPECTIONS AND CHECKS

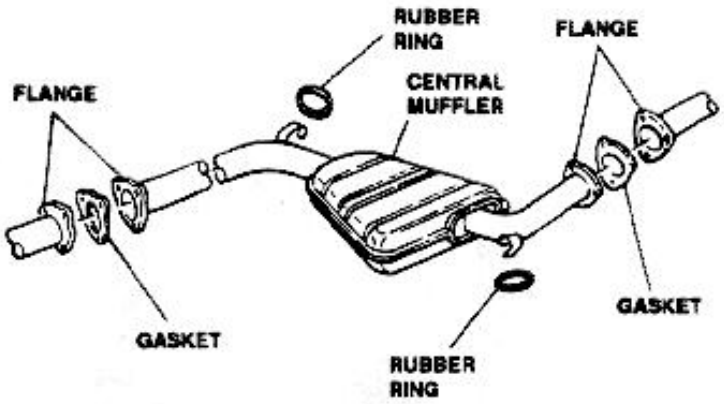
For the functional check of the lambda probe and of the heating resistor, refer to **WIRING DIAGRAMS AND ELECTRICAL DIAGNOSIS Book**.

CENTRAL AND TAIL MUFFLERS

Both mufflers provide an effective decrease in engine noise to levels approved by the current laws.The central muffler has a triangular shape to better fit the room under car; the tail muffler has a cylindrical shape.
The exhaust to atmosphere is accomplished through a single pipe.Both mufflers are attached to car body by means of rubber rings and are interconnected by means of bolted flanges with tightening gaskets.

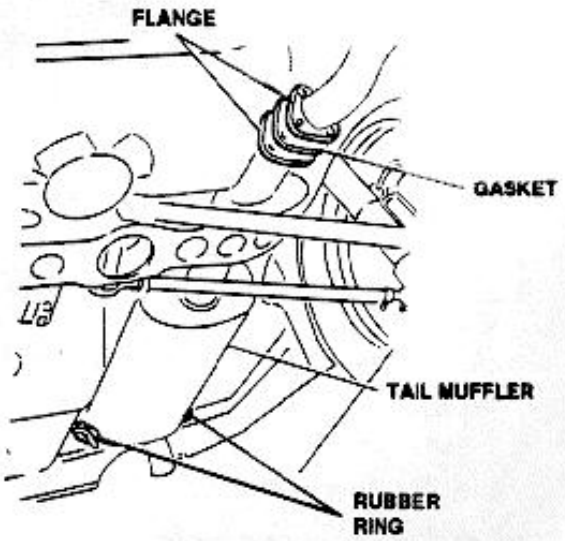
CENTRAL MUFFLER REMOVAL AND INSTALLATION

1. Place car on a lift platform.
2. Disconnect the forward attaching flange, remove gaskets.
3. Remove supporting rubber rings.
4. Remove central muffler disconnecting it from the aft attaching flange.

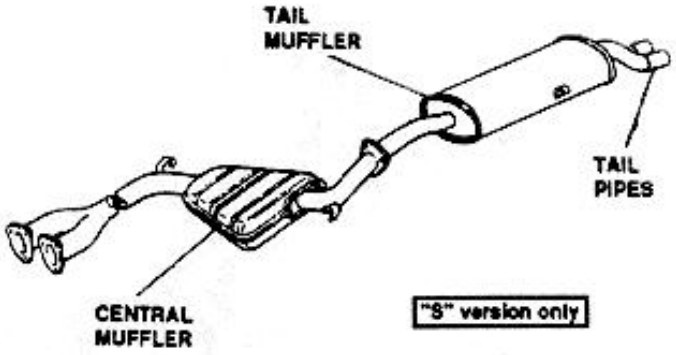


TAIL MUFFLER REMOVAL AND INSTALLATION

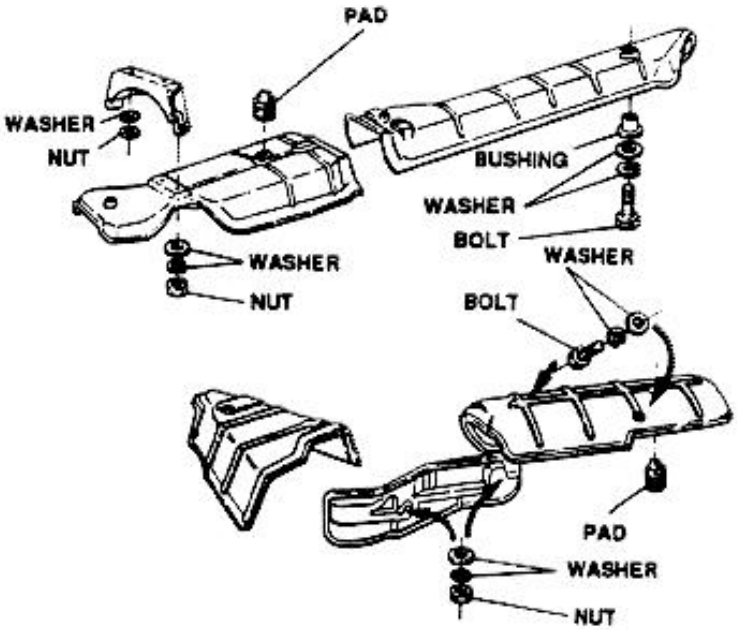
1. Place car on a lift platform.
2. Disconnect the forward attaching flange, remove gasket.
3. Remove supporting rubber ring.
4. Remove tail muffler.



NOTE: On **"S" version**, both components are identical to those of other versions; the only difference is that the exhaust pipe is split in two. The exhaust pipe end is made of stainless steel.



The technical description and maintenance operations are in any case identical.



HEAT PROOF COVERS

The covers are made of heat proof material and are used to protect car body from considerable heat radiated by the exhaust pipes, particularly by the catalytic converter.

CAUTION:
Avoid application of rust prevention compounds or undercoating materials to exhaust system heat proof covers.
Light spray of the edges is permitted. Application of coating greatly reduces the covers efficiency resulting in excessive floor temperature.

REMOVAL /INSTALLATION

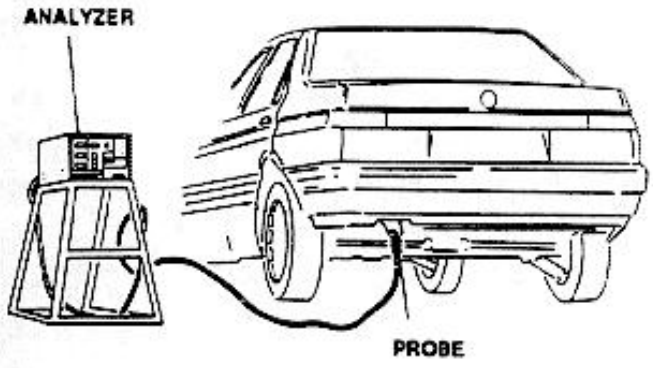
1. Remove exhaust system components that are protected by the cover to be removed.
2. Remove cover unscrewing bolts connecting it to car body: save washers and bushings. At any time, replace attaching rubber rings.

EXHAUST EMISSIONS CHECK

WARNING:
The exhaust emissions check must be carried out in open air or, in any case, in a suitable place equipped according to the given requirements.

NOTE: The check must be carried out with engine at normal running temperature (after the electric fan has turned on and then off) and while running at idle speed. If idle speed is not within the indicated values, first check the idle-speed actuator.

1. Make sure engine oil level is correct and air filter element is clean.
2. Start and idle engine.
3. Insert the tester probe in the tail pipe and check that CO and HC percentages are lower than limit values.

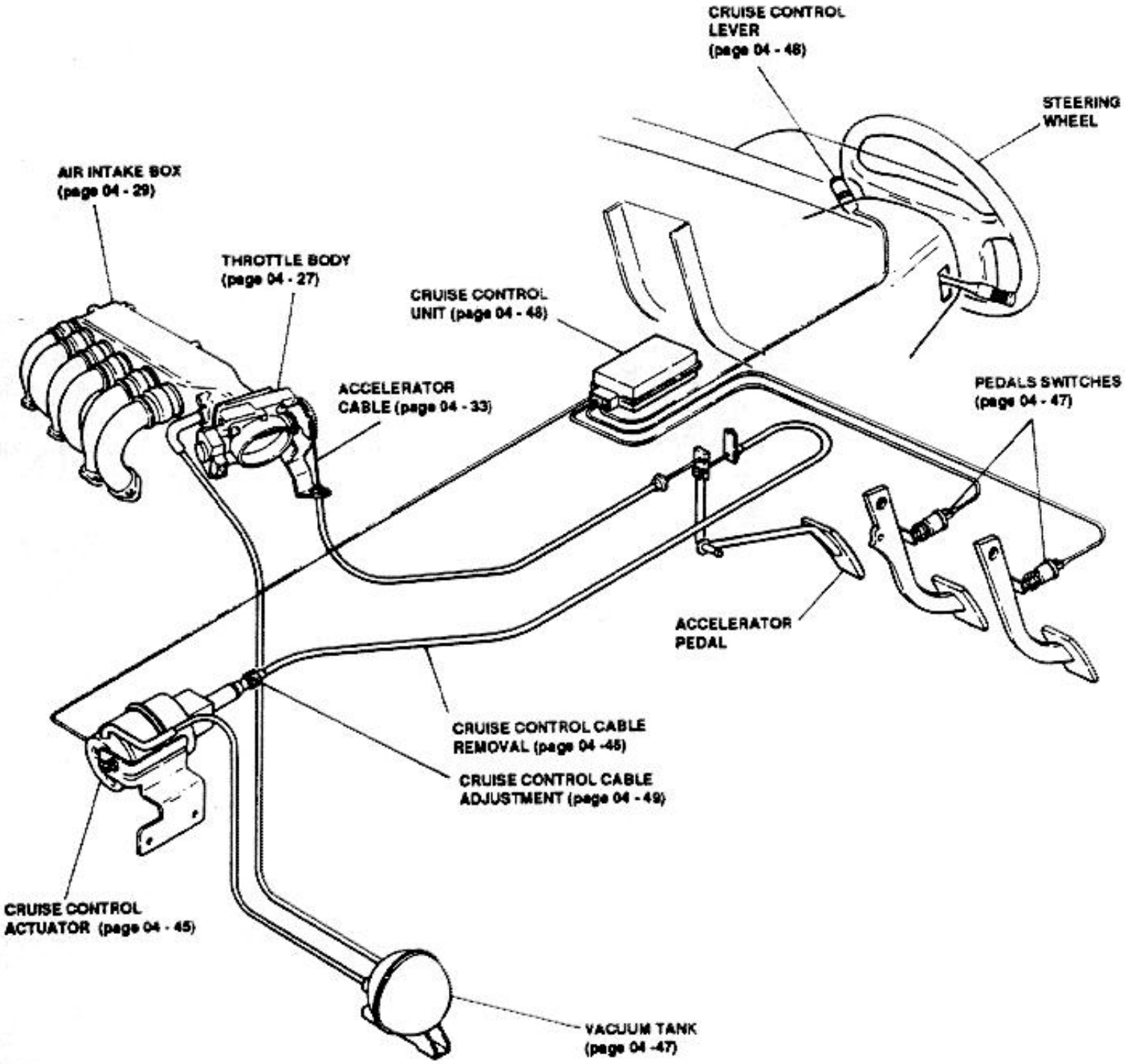


	164 -164 L	164 "S"
Idle (R.P.M.)	650 to 800	700 to 800
CO Percentage	≤ 0.2%	≤ 0.2%
HC Percentage	≤ 70 p.p.m.	≤ 70 p.p.m.

4. If check gives values not within the specified range, apply to troubleshooting procedures at the end of this Group and see the diagnostic procedure outlined in the **WIRING DIAGRAMS AND ELECTRICAL DIAGNOSIS Book**.

NOTE: DO NOT ATTEMPT TO ADJUST THE CO PERCENTAGE. It is necessary to work on defective components that cause the CO to increase.

CRUISE CONTROL SYSTEM
ILLUSTRATED INDEX



CRUISE CONTROL SYSTEM

INTRODUCTION

The Cruise Control is an electromagnetic device controlled by an electronic control unit that **allows the vehicle to run at constant speed without any action by the driver.**
Speeds, over 30 m.p.h., chosen and memorized are kept constant also if the driving conditions are changed (uphill, downhill, wind, etc.).
The system can be easily disengaged stepping on the brake or clutch pedal or placing gear lever to neutral.

WARNING:
THE USE OF CRUISE CONTROL IS NOT RECOMMENDED WHEN DRIVING CONDITIONS DO NOT PERMIT TO MAINTAIN A CONSTANT SPEED, SUCH AS IN HEAVY TRAFFIC OR ON WINDY, ICY, SNOW COVERED OR SLIPPERY ROADS.

OPERATION

- **Engage:** with the switch set to "ON", when the desired speed is reached, press and release the **SET/COAST** pushbutton. That speed will be maintained. The system memorizes speeds over 30 m.p.h.

- **Disengage:** pressing the brake pedal (or clutch pedal on cars equipped with manual transmission) the Cruise Control is disengaged, but keeps in memory the speed value.
  Setting switch to "OFF" or pulling out the ignition key, the memory is completely erased.

- **Recovery after braking:** pressing and releasing the **RESUME/ACCEL** the car foils back to the previously memorized value.
  For cars equipped with manual transmission: the gear must be the same at which the speed was memorized.

- **Overtaking:** accelerate to normally overtake, then release pedal: the car automatically reverts to the memorized speed.

- **Increasing the memorized speed:** accelerate till the desired value is reached, then press and release the **SET/COAST** pushbutton, or actuate again and again the **RESUME/ACCEL:** at any stroke speed increases by 1 m.p.h. Holding pressed the control, speed increases constantly and is memorized the value at which the button is released.

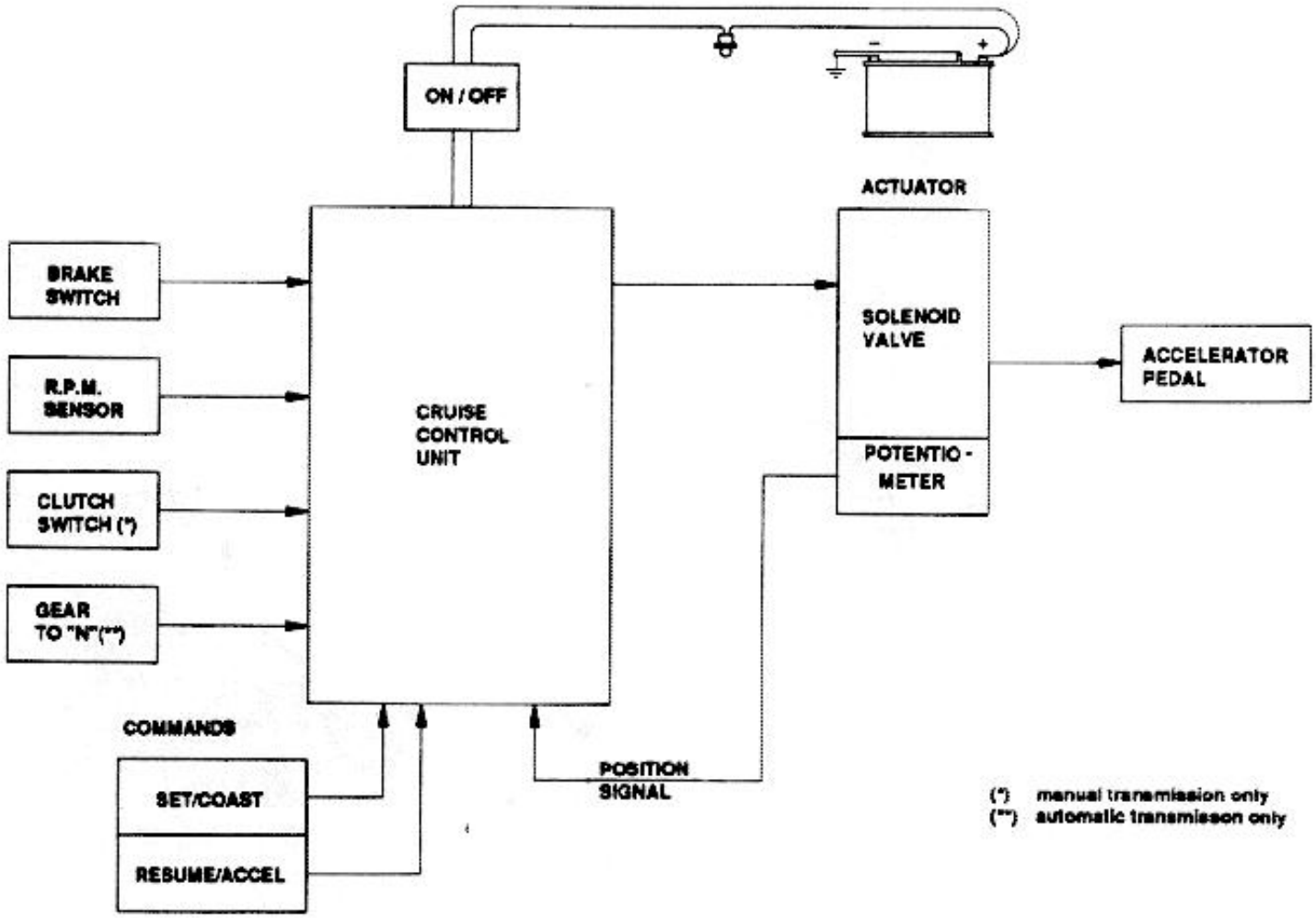
- **Decreasing the memorized speed:** Press and hold the **SET/COAST** pushbutton until the desired speed is reached, then release it.

- It is advisable to engage the Cruise Control only when the road and traffic conditions allow to use it in complete safety such as: dry, ice and snow free roads, on autoroutes or, in any case, on highways or freeways having limited and smooth running traffic with good pavement.
- The Cruise Control is a device to be used on long distances and on freeways, and then it shall never be used in town traffic or in any case in heavy traffic or stop-and-go tipical of the town streets.
- Engage the Cruise Control only when thespeed is within the specified limits (30 to 90 MPH).
- On vehicles equipped with automatic transmission it is advisable to engage the Cruise Control with gear selector set to "D". Do not change gear manually having the Cruise Control engaged.
- On vehicles equipped with manual transmission engage Cruise Control only when transmission is at 4th or 5th gear, depending on the vehicle speed.

SYSTEM DESCRIPTION

The most important equipment of the system is the electronic control unit that monitors all the signals received by the sensors, and controls the actuator. The signal are coming from a switch located on the brake pedal, from one located on the clutch pedal (for vehicles equipped with manual transmission), from the automatic transmission - N position - and from the R.P.M. sensor. The actuator works directly on the accelerator pedal, then sends a feed back signal to the control unit to indicate the pedal position. A vacuum tank and a hose connected to the air intake box power and control the actuator pneumatically.

CRUISE CONTROL FUNCTIONAL SCHEMATIC



CRUISE CONTROL ACTUATOR

The actuator is an electro-pneumatic device that, upon command received by the control unit, works on the accelerator pedal by means of an appropriate cable.

Three solenoid valves (one discharge, one charge and one damper) adjust the accelerator pedal position, thus maintaining the memorized speed also if the engine is subject to a load variation.

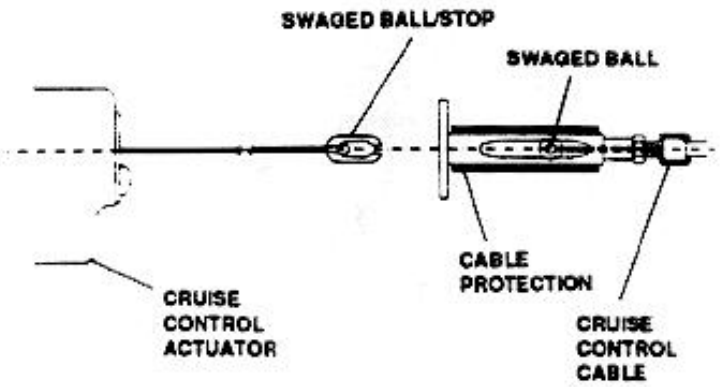
A potentiometer generates the cable position feed back

accelerator pedal by means of an appropriate cable, maintaining the speed set by the automatic system.

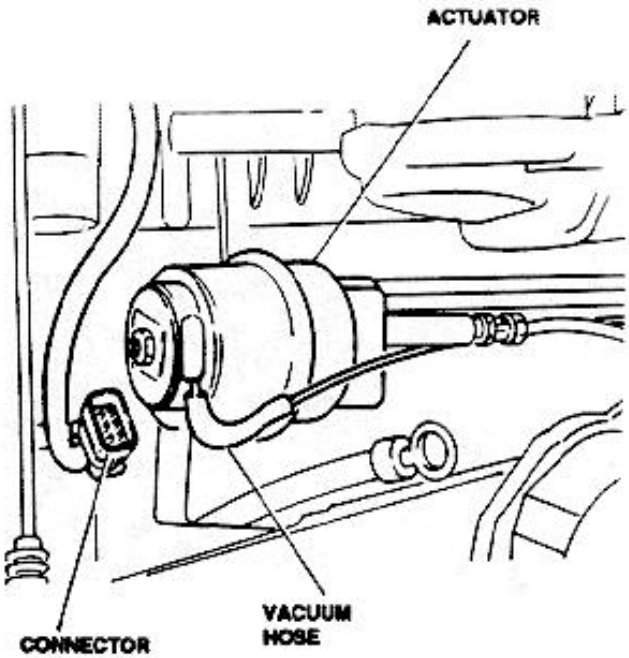
A potentiometer generates the cable position feed back signal applied to the control unit.

REMOVAL /INSTALLATION

1. Remove Cruise Control cable protection.
2. Gain access to the swaged ball/stop and disconnect one end, separating cable from actuator.

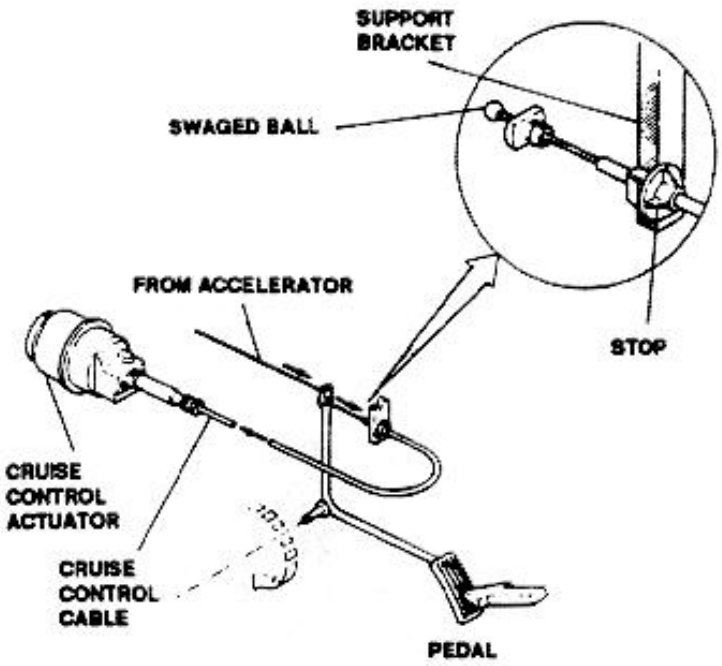


3. Disconnect vacuum hose.
4. Unplug electric connector.
5. Remove actuator.



CRUISE CONTROL CABLE REMOVAL

1. After cable is disconnect from the actuator, connect a string to cable end for cable recovery.
2. Working from the cabin, disconnect swaged ball attaching cable to accelerator pedal and to the support bracket.
3. Lower the knee stop and remove cable leaving string along the way between engine compartment and cabin: this will ease the correct positioning of new cable.

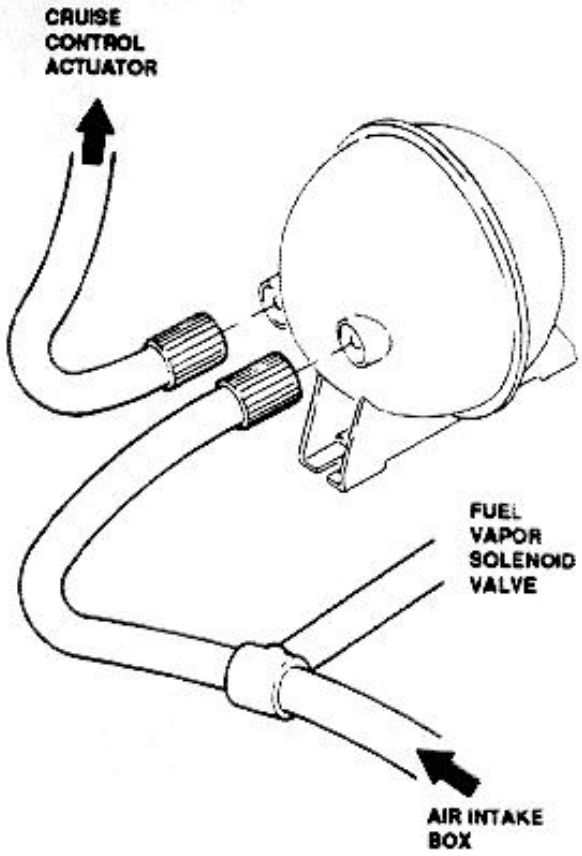


INSPECTIONS AND CHECK

To electrically check the Cruise Control for correct operation, refer to **WIRING DIAGRAMS AND ELECTRICAL DIAGNOSIS Book**.

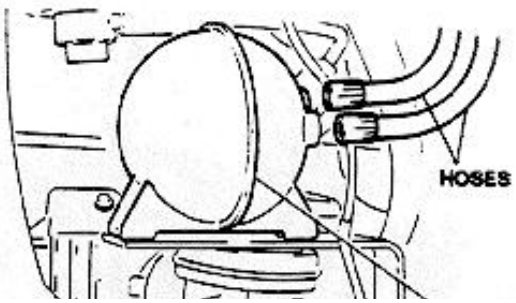
VACUUM TANK

The tank provides the actuator pneumatic solenoid valves with vacuum that is needed for their operation. This vacuum is taken, through a check valve, from the air intake box in such a way to control the actuator according the engine load changes.



REMOVAL /INSTALLATION

1. Place car on a lift platform, remove front left wheel and fender forward section.
2. Remove vacuum tank, disconnecting two hoses.

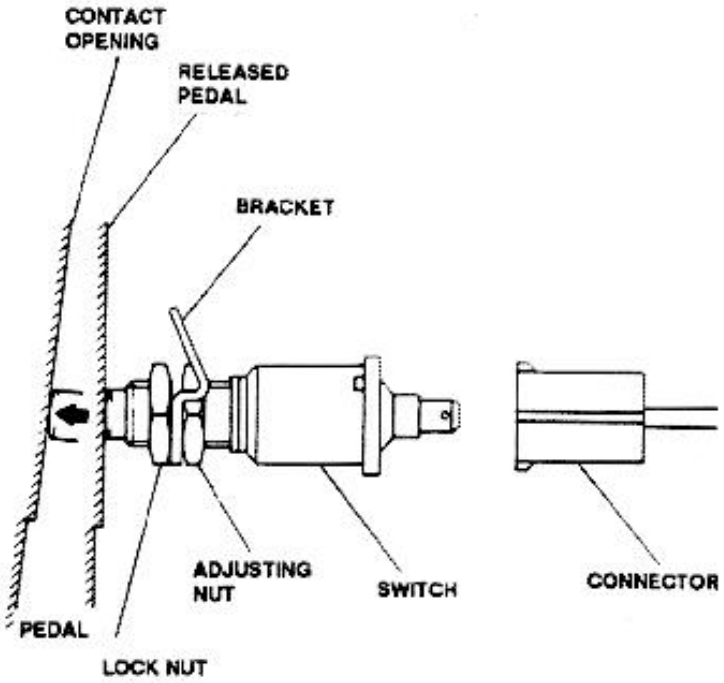


PEDALS SWITCHES

A switch is located on the brake pedal while a second one, equal to the other, is located on the clutch pedal (for vehicles equipped with manual transmission).

INSPECTIONS AND CHECKS

The switch is closed when the pedal is released; check, using an appropriate tester, that it opens as the pedal starts to send a command to the brakes.
If an adjustment shall be made, work on the fixing nuts and on the lock nut.



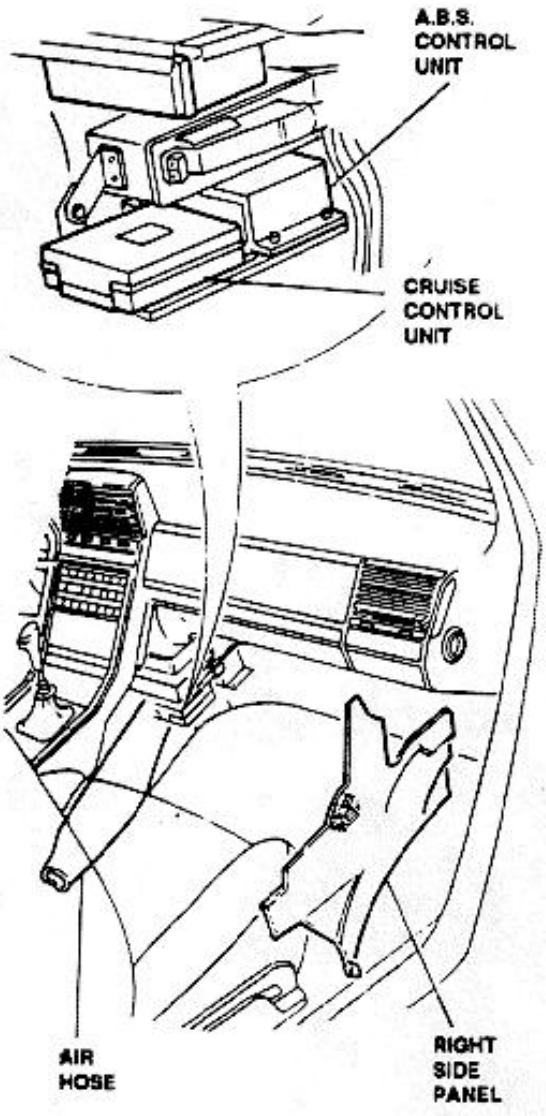

VACUUM
TANK

CRUISE CONTROL UNIT

The unit is located under the center console, below the A.B.S. control unit.
For technical features, inspections, check etc. refer to **WIRING DIAGRAMS AND ELECTRICAL DIAGNOSIS Book**.

REMOVAL /INSTALLATION

1. Remove right side panel.
2. Remove air hose to rear seats.
3. Unplug A.B.S. unit connector.
4. Remove Cruise Control unit and unplug connector.



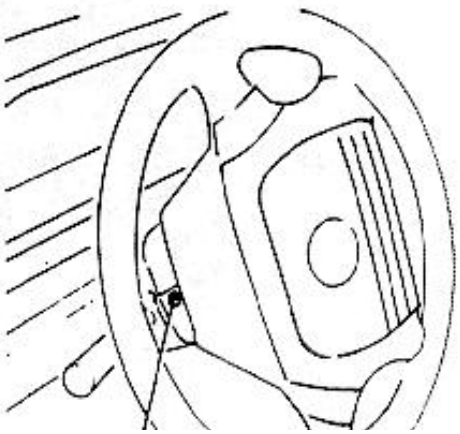
CRUISE CONTROL OFF/RESUME SWITCH

The switch is located on the steering wheel column, on the right side, and it is easily accessible and operated.

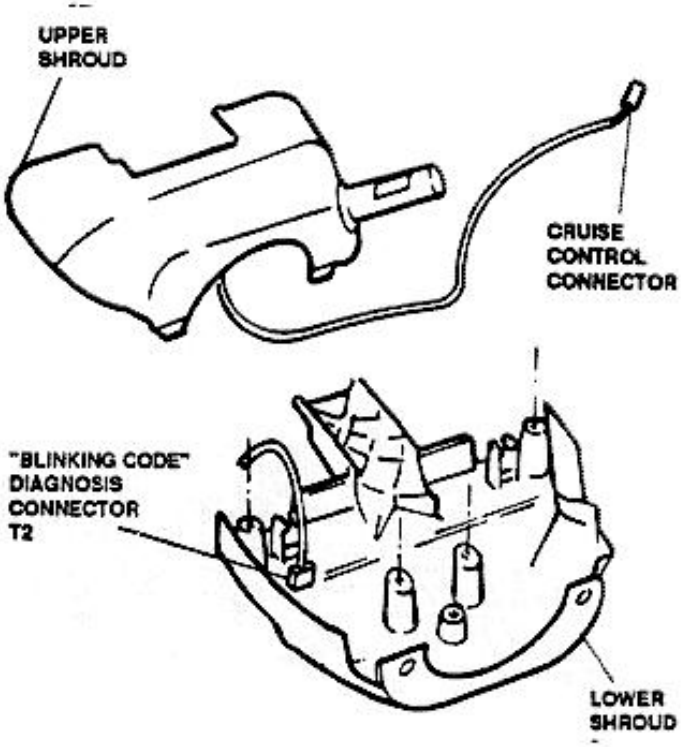
REMOVAL /INSTALLATION

WARNING:
Use all possible precautions since you are working in the proximity of the "Air Bag", see Group 00, and particularly:
- **disconnect battery**
- **isolate battery negative lead**

1. Rotate steering wheel to right and to left, remove screws fixing both upper and lower of shrouds.



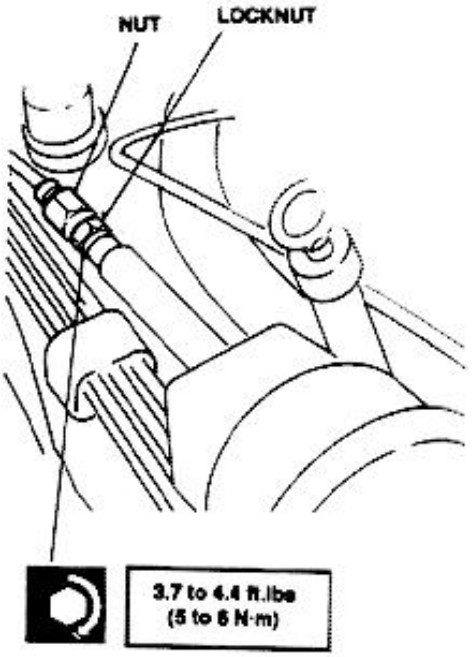
2. Remove screws fixing shrouds from the bottom.
3. Unplug "blinking code" diagnosis connector.
4. Unplug Cruise Control connector.
5. Remove upper and lower shrouds.



6. Separate Cruise Control off/resume switch from the half upper shroud.

CRUISE CONTROL CABLE ADJUSTMENT

1. Check for correct air flow - see **AIR SUPPLY SYSTEM - THROTTLE CALIBRATION CHECK**.
2. Check throttle valve switch - see **AIR SUPPLY SYSTEM -THROTTLE MIN/MAX SWITCH CALIBRATION CHECK**.
3. Adjust accelerator pedal cable - see **AIR SUPPLY SYSTEM - CABLE ADJUSTMENT**.
4. Connect Cruise Control cable and pull it, working on the related nut, until the throttle valve switch actuates.



NOTE: 3.5 turns correspond to an end play of 0.06 in (1.5 mm) between the Cruise Control cable swaged ball and accelerator pedal bracket.

5. Loosen nut by 3.5 turns backwards and lock the locknut tightening it at correct value.

TECHNICAL CHARACTERISTICS AND SPECIFICATIONS

GENERAL SPECIFICATIONS

FUEL

Gasoline with Octane number	RON PON	95 91 90 86

FUEL TANK

Total capacity	65 l	17.5 gals
Reserve	8 l	2.2 gals

CHECKS AND ADJUSTMENTS

FUEL SUPPLY PRESSURE CHECK

Operating pressure at idle speed	284 to 323 kPa	42 to 47 p.s.i.
Max pressure (pressure regulator engaged)	400 kPa	58 p.s.i.

THROTTLE VALVE MIN/MAX OPENING SWITCH CHECK

Contact opening minimum angle	1°
Contact closing minimum angle	0.2°
Contact closing maximum angle	72°
Resistance with opening angle of 0° to 1°	0 Ω on terminals 2-18
Resistance with opening angle exceeding 1°	infinite on terminals 2-18
Resistance with open throttle (72°)	0 Ω on terminals 3-18

THROTTLE VALVE BODY ADJUSTMENT (FLOWMETER)

Air flow through throttle valve in closed position (with Solex flowmeter)	290 to 310 on scale N

NOTE: For 164 "S" version : 270 to 290 on scale N

PHASE AND R.P.M. SENSOR GAP

Gap between sensor and crankshaft pulley	0.5 to 1 mm	0.02 to 0.04 in

TIGHTNESS CHECK ON VAPOR RECOVERY SYSTEM

Reference value (on pressure gauge column) Max pressure drop in 5 minutes (on pressure gauge column)	3.5 to 3.73 kPa (360 mm) 0.5 kPa (50 mm)	0.51 to 0.54 p.s.i. (14.2 in) 0.07 p.s.i. (2 in)

CRUISE CONTROL CABLE CHECK

End play between Cruise Control cable swaged ball and accelerator pedal bracket	1.5 mm *	0.06 in *

* **corresponding to 3.5 turns backwards of the adjusting nut of cruise control cable**

ENGINE IDLE SPEED AND EXHAUST EMISSIONS

Idle speed	650 to 800 R.P.M. *
Exhaust CO percentage at idle speed	< 0.2%
Exhaust HC percentage at idle speed	< 70 p.p.m.

* **164 "S" versions only : 700 to 800 R.P.M.**

TIGHTENING TORQUES

Fuel pump to cover attachments	7 to 11 ft. lbs	10 to 15 Nm
Fuel filter joint attachments	22.1 to 29.5 ft.lbs	30 to 40 Nm
Fuel filter joint attachments	14.8 to 17 ft.lbs	20 to 23 Nm
Throttle valve switch screws	1.8 to 3 ft.lbs	2.5 to 4 Nm
Lambda probe attachments	36.9 to 44.3 ft.lbs	50 to 60 Nm
Cruise Control cable locknut	3.7 to 4.4 ft.lbs	5 to 6 Nm

SPECIAL TOOLS

TOOL NUMBER	DESCRIPTION
1.824.011.000	Tap for throttle valve flowmeter check
1.824.013.000	Pressure reducer (with pressure gauge)
1.824.020.000	Pressure measurement fixture

TROUBLESHOOTING PROCEDURE

PRELIMINARY CHECKS

To troubleshooting of malfunctions related to supply and ignition becomes easier since it is available, inside MOTRONIC system, the self diagnosis function (**On Board Diagnosis: O.B.D.**) that memorizes and displays malfunctions occurred in some system components.
It is advisable, therefore, to carry-out immediately this automatic check using the related pushbutton and "CHECK ENGINE" indicator lamp (see **WIRING DIAGRAMS AND ELECTRICAL DIAGNOSIS Book - MOTRONIC IGNITION AND INJECTION - ON BOARD DIAGNOSIS**): this can provide a simple and quick solution of the problems.

NOTE: Do not disconnect battery before to carry-out the O.B.D. test.

Following, however, it is provided a troubleshooting procedure related to the most important malfunctions of the ignition and injection systems.
This procedure outlines the test to check all the components that can be involved, addressing to the above automatic troubleshooting for the components checked by the self diagnosis function.

The ON BOARD DIAGNOSIS provides information about:	TEST *
BATTERY VOLTAGE	A
THROTTLE VALVE MIN/MAX OPENING SWITCH	B and C
ENGINE TEMPERATURE SENSOR	D
AIR FLOW METER (including AIR TEMPERATURE SENSOR)	E and I
CONSTANT IDLE ADJUSTMENT ACTUATOR	F
LAMBDA PROBE	G and H
VAPORS RECOVERY SOLENOID VALVE	M
FUEL PUMP (RELAY)	L
CONTROL UNIT	N

* See **WIRING DIAGRAMS AND ELECTRICAL DIAGNOSIS Book - MOTRONIC IGNITION AND INJECTION - ON BOARD DIAGNOSIS**: the letters indicated herein do not refer to this manual.

Malfunctions relevant to these components are immediately and easily displayed by the "CHECK ENGINE" indicator lamp; for further details see **WIRING DIAGRAMS AND ELECTRICAL DIAGNOSIS Book - MOTRONIC IGNITION AND**

TROUBLESHOOTING PROCEDURE

TROUBLES AND SYMPTOMS	FAULT ISOLATION	TEST REFERENCE
ENGINE DOES NOT START (UNDER ANY CIRCUMSTANCES)	- Turning the ignition key, nothing happens. It is then necessary to investigate for possible problems to the IGNITION SWITCH	See **WIRING DIAGRAMS AND ELECTRICAL DIAGNOSIS Book**: STARTING AND CHARGING
	- Turning the ignition key, the instrument panel lights illuminate normally, but no noise from the STARTER MOTOR is heard. It is then necessary to investigate for malfunctions of the STARTING MOTOR	See **WIRING DIAGRAMS AND ELECTRICAL DIAGNOSIS Book** STARTING AND CHARGING
	- Turning the ignition key, the instrument panel lights illuminate, the starting motor runs normally but the engine does not start	**A** (ignition) and then **B** (supply)
ENGINE DOES NOT START WHEN COLD	- Turning the ignition key, the instrument panel lights illuminate, the starting motor runs normally but - WITH COLD ENGINE ONLY - the engine does not start **NOTE**: When hot, the engine starts normally	**C**
ENGINE DOES NOT START WHEN WARM	- Turning the ignition key, the instrument panel lights illuminate, the starting motor runs normally, but the engine JUST TURNED OFF, OR ANY WAY WARM, does not start	**D**
ENGINE IS DIFFICULT TO START, AND REQUIRES MANY ATTEMPTS	- Turning the ignition key, the instrument panel lights illuminate, the starting motor runs normally but the engine starts AFTER MANY ATTEMPTS only	**E**

(Cont.d)

TROUBLESHOOTING PROCEDURE

TROUBLES AND SYMPTOMS	FAULT ISOLATION	TEST REFERENCE
ENGINE STARTS, BUT STOPS IMMEDIATELY	- Turning the ignition key, the engine starts immediately (or almost immediately) but after short time IT STOPS SUDDENLY	**F**
ENGINE IDLE SPEED NOT REGULAR **NOTE:** If the trouble is present with warm engine, see test **D**	- The idle speed does not meet the required values, or it does not remain constant and regular Correct values: 164 - 164 L: 650 to 800 R.P.M.; 164 S: 700 to 800 R.P.M.	**G** If this test is not succesful, it is possible to carry-out test **A**
ENGINE SURGES (in any driving condition) **NOTE:** Examples of driveability conditions that are not accepted by Alfa Romeo, in accordance with requirements of driveability and performance characteristics requested for vehicles sold in the States.	- In any driving condition (at any speed and/or load) the engine surges and has some hesitations **Surge:** Condition of leaness, resulting in short and sharp fluctuations. These can be cyclic or irregular and can occur at any speed or load conditions, generally on steady speeds. **Hesitation:** Temporary lack of initial response in acceleration rate (initiated with a flat spot)	**H**
ENGINE STUMBLES **NOTE:** Examples of driveability conditions that are not accepted by Alfa Romeo, in accordance with requirements of driveability and performance characteristics requested for vehicles sold in the States.	- The engine surges or stumbles, the acceleration is not smooth. **Stumble:** Short, sharp reduction in acceleration rate	**I**
ENGINE DOES NOT REACH MAXIMUM PERFORMANCES	- The vehicle runs normally at medium/low speeds, but does not reach maximum performances (in terms of speed and thrust)	**J**

(Cont.d)

TROUBLESHOOTING PROCEDURE

TROUBLES AND SYMPTOMS	FAULT ISOLATION	TEST REFERENCE
EXCESSIVE FUEL CONSUMPTION **NOTE:** it is obvious that fuel consumption increases considerably with wrong driving conditions: incorrect gears use, accelerations in neutral position, etc.	- Check if the consumption is excessive compared with the values given by Alfa Romeo or with data noted during to vehicle life	**K**
HIGH EXHAUST CO AND HC PERCENTAGE	- Check the CO and HC percentage at idle speed Correct values: CO ≤ 0.2%; HC ≤ 70 p.p.m.	**L**
LOW CO PERCENTAGE (high NO_x Value)	- Check the CO percentage: a value too low * gives surely high NO_x value (NO_x = nitrogen oxide) (*) value to low: if the analyzer reads 00.00. Take samples of exhaust gas upstream of converter: - if CO read is about 0.7%, analyzer is defective and emission values are correct. - if CO read is lower, CO percentage is actually too low.	**M**

WARNING:
The IGNITION system operates with dan gerous voltages (high or low).
Take maximum care and disconnect always the system before to work on it.

Do not smoke while working on the SUPPLY SYSTEM, and ensure that all safety equipment are within reach (fire extinguisher, etc).

NOTE: THE ON BOARD DIAGNOSIS IS TURNED OFF WHEN THE BATTERY IS DISCONNECTED: THE MEMORY IS ERASED!

THE ENGINE DOES NOT START - IGNITION MALFUNCTION	TEST A

TEST STEPS	RESULTS	REMEDY
A1 BATTERY SUPPLY CHECK - Check for ignition malfunction caused by the battery - See **WIRING DIAGRAMS AND ELECTRICAL DIAGNOSIS Book - MOTRONIC O.B.D. - TEST A**	OK ▶ ~~OK~~ ▶	Carry-out **step A2** Follow the indication of the **WIRING DIAGRAMS AND ELECTRICAL DIAGNOSIS Book**
A2 ANTI-THEFT CHECK - Check for correct operation of antitheft system - See **WIRING DIAGRAMS AND ELECTRICAL DIAGNOSIS Book - ANTI-THEFT**	OK ▶ ~~OK~~ ▶	Carry-out **step A3** Follow the indicator on the **WIRING DIAGRAMS AND ELECTRICAL DIAGNOSIS Book**

WARNING:
The ignition system operates with dangerous voltages (high or low). Therefore, take maximum care and always disconnect the system before working on it.

A3 SPARK PLUGS CHECK - Check that: • spark plugs are not dirty and do not show signs of burns • sparks shoot normally: remove plug, connect it to ground and check the spark **NOTE: Never disconnect the spark plug cable**	OK ▶ ~~OK~~ ▶	Carry-out **step A4** Clean and replace affected spark plugs

(Cont.d)

THE ENGINE DOES NOT START - IGNITION MALFUNCTION	TEST A

TEST STEPS	RESULTS	REMEDY
A4 HIGH VOLTAGE AND GROUND CABLES CHECK		
- Check: • that high voltage cables (from coil to distributor and from distributor to the spark plugs) do not show signs of damage • the electric resistance ensuring non dissipation is present H.V. CABLE RESISTANCE ≡ 2.5 k Ω • that ground plaits are correctly torqued and do not show signs of oxidation	OK ▶ ~~OK~~ ▶	Carry-out **step A5** Replace affected H.V. cables or ground plaits. Torque correctly the grounds plaits
A5 DISTRIBUTOR CHECK		
- Check: • that distributor cap is internally free from dirt and signs of burns • that cover is not cracked or damaged • brush resistance DISTRIBUTOR BRUSH RESISTANCE ≡ 1.1 k Ω	OK ▶ ~~OK~~ ▶	Carry-out **step A6** Clean or replace the affected components

(Cont.d)

THE ENGINE DOES NOT START - IGNITION MALFUNCTION	TEST A

TEST STEPS	RESULTS	REMEDY
A6 IGNITION COIL CHECK		
- Check: • ignition coil power supply • coil primary resistance and secondary resistance COIL RESISTANCE PRIMARY = 0.4 to 0.5 Ω SECONDARY = 5.4 to 6.6 Ω	OK ▶ ~~OK~~ ▶	Carry-out **step A7** Restore correct power supply or replace faulty coil
A7 R.P.M. AND TIMING SENSOR CHECK		
- Check: • connection between sensor and control unit (pins 23 and 25) • air gap between sensor and pulley - see **Group 04 - RPM AND TIMING SENSOR** GAP BETWEEN SENSOR AND PULLEY: 0.02 to 0.04 in / 0.5 to 1 mm	~~OK~~ ▶	Restore connection or set sensor to the correct position

End of test A

ENGINE DOES NOT START - INJECTION MALFUNCTION	TEST B

TEST STEPS	RESULTS	REMEDY
WARNING: **When working on the fuel supply system, do not smoke and ensure all safety equipment is available.**		
B1 FUEL CHECK - Check for presence of gasoline in the tank (low level light and level indicator might be defective), that gasoline is not mixed with water or other improper fluid, and for absence of dirt in the tank	OK ▶ ~~OK~~ ▶	Carry-out **step B2** Clean tank, if necessary. Fill the system with prescribed gasoline grade
B2 O.B.D. CHECK - Check for correct operation of fuel pump relay - **See WIRING DIAGRAMS AND ELECTRICAL DIAGNOSIS Book - MOTRONIC O.B.D. - TEST L**, engine temperature sensor - **TEST D**, air flowmeter - **TEST E**, electroinjectors - **PROCEDURE B** **NOTE: Do not disconnect battery before carrying out O.B.D. function**	OK ▶ ~~OK~~ ▶	Carry-out **step B5** Carry-out procedure indicated in the **WIRING DIAGRAMS AND ELECTRICAL DIAGNOSIS Book** - then carry-out **steps B3 and B4**
B3 AIR FLOW METER CHECK - Check that flap moves freely without binding. Check that the interior is free from dirt and shows no signs of rubbing.	OK ▶ ~~OK~~ ▶	Carry-out **step B4** Replace (or clean) air flow meter

(Cont.d)

THE ENGINE DOES NOT START - INJECTION MALFUNCTION	TEST B

TEST STEPS	RESULTS	REMEDY
B4 INJECTORS CHECK - By touching the injectors it is possible to feel needles movement, then check injector resistance (1.7 Ω)	OK ▶ ~~OK~~ ▶	Carry-out **step B5** Replace defective injectors
B5 FUEL PRESSURE CHECK - Carry-out tightness and pressure check of fuel supply system - See **Group 04 - FUEL SYSTEM PRESSURE AND TIGHTNESS CHECK**	OK ▶ ~~OK~~ ▶	Carry-out **step B6** Check for correct operation of fuel filter, pump, pressure regulator and replace as needed
B6 CONTROL UNIT CHECK - Check for correct operation of MOTRONIC control unit (simply checking the vehicle using another control unit).	OK ▶ ~~OK~~ ▶	Replace control unit Connect old unit, then carry-out **step B7**
B7 DISTRIBUTION TIMING CHECK - Check for correct distribution timing - See **Group 01 - DISTRIBUTION TIMING CHECK**	~~OK~~ ▶	Restore correct timing

End of test B

ENGINE DOES NOT START WHEN COLD	TEST C

TEST STEPS	RESULTS	REMEDY
C1 BATTERY MALFUNCTION - Check for proper battery voltage MIN. VOLTAGE:12V. A Voltage enough for the starting motor could not be enough for the Motronic control unit	OK ▶ ~~OK~~ ▶	Carry-out **step C2** Charge or replace battery
C2 O.B.D. CHECK - Check for correct operation of engine temperature sensor - **See WIRING DIAGRAMS AND ELECTRICAL DIAGNOSIS Book - MOTRONIC O.B.D. - TEST D**, air temperature sensor - **TEST I** **NOTE: Do not disconnect battery before carrying-out O.B.D. function**	OK ▶ ~~OK~~ ▶	Carry-out **step C3** Carry-out procedure indicated in the **WIRING DIAGRAMS AND ELECTRICAL DIAGNOSIS Book**
C3 FUEL PRESSURE CHECK - Carry-out tightness and pressure check of fuel supply system - See **Group 04 - FUEL SYSTEM PRESSURE AND TIGHTNESS CHECK**	OK ▶ ~~OK~~ ▶	Carry-out **step C4** Check for correct operation of fuel filter, pump, pressure regulator and replace as needed
C4 CONTROL UNIT CHECK - Check for correct operation of MOTRONIC control unit (simply checking the vehicle using another control unit) since the air enrichment at cold function can be faulty.	OK ▶	Replace control unit

End of test C

ENGINE DOES NOT START WHEN WARM	TEST D

TEST STEPS	RESULTS	REMEDY
D1 O.B.D. CHECK - Check for correct operation of engine temperature sensor - **See WIRING DIAGRAMS AND ELECTRICAL DIAGNOSIS Book - MOTRONIC O.B.D. - TEST D**, air temperature sensor - **TEST I**, air flowmeter - **TEST E** **NOTE: Do not disconnect battery before carrying out O.B.D. function**	OK ▶ ~~OK~~ ▶	Carry-out **step D3** Carry-out procedure indicated in the **WIRING DIAGAMS AND ELECTRICAL DIAGNOSIS Book** - then carry-out **step D2**
D2 AIR FLOW METER CHECK - Check that flap moves freely without binding. Check that the interior is free from dirt and shows no signs of rubbing	OK ▶ ~~OK~~ ▶	Carry-out **step D3** Replace (or clean) air flow meter
D3 FUEL PRESSURE CHECK - Carry-out tightness and pressure check of fuel supply system - See **Group 04 - FUEL SYSTEM PRESSURE AND TIGHTNESS CHECK**	OK ▶ ~~OK~~ ▶	Carry-out **step D4** Check for correct operation, of fuel filter, pump, pressure regulator and replace as needed

(Cont.d)

ENGINE DOES NOT START WHEN WARM	TEST D

TEST STEPS		RESULTS	REMEDY
D4	VAPOR LOCK CHECK		
- Check for absence of vapor lock phenomenon in the fuel supply system. Carry-out starting operation for long time, without stopping: in this way the fuel pump can purge the system by recycling the fuel. **NOTE: The phenomenon disappears if engine is allowed to coal off.**		OK ▶	Replace faulty components

End of test D

ENGINE IS DIFFICULT TO START	TEST E

TEST STEPS	RESULTS	REMEDY
E1 O.B.D. CHECK		
- Check for correct operation of engine idle actuator - **See WIRING DIAGRAMS AND ELECTRICAL DIAGNOSIS Book - MOTRONIC O.B.D. - TEST F and PROCEDURE B**, - air temperature sensor - **TEST I**, engine temperature sensor - **TEST D**, - electroinjectors - **PROCEDURE B** **NOTE: Do not disconnect battery before carrying out O.B.D. function**	OK ▶ ~~OK~~ ▶	Carry-out **step E2** Carry-out procedure indicated in the **WIRING DIAGRAMS AND ELECTRICAL DIAGNOSIS Book**
E2 AIR LEAKAGE CHECKS		
- Check for: • absence of air leaks in the related system: brush soap solution on the connections of lines down stream the flow meter; with engine at idle speed, check that soap solution is not sucked by the engine • correct flow setting - SEE **Group 04 - THROTTLE CALIBRATION CHECK**	OK ▶ ~~OK~~ ▶	Carry-out **step E3** Replace defective components
E3 FUEL PRESSURE CHECK		
- Carry-out tightness and pressure check of fuel supply system - See **Group 04 - FUEL SYSTEM PRESSURE AND TIGHTNESS CHECK**	OK ▶ ~~OK~~ ▶	Carry-out **step E4** Check for correct operation, of fuel filter, pump, pressure regulator and replace as needed

(Cont.d)

ENGINE IS DIFFICULT TO START	TEST E

TEST STEPS		RESULTS	REMEDY
E4	CYLINDERS HEAD GASKETS CHECK		
- Check for absence of water leaks from head gaskets - See **Group 01 - CYLINDER HEADS**		OK ▶	Carry-out **step E5**
		~~OK~~ ▶	Replace cylinder head gaskets
E5	THROTTLE AND IDLE ADJUSTMENT ACTUATOR CHECK		
- Disassembly throttle body and check for absence of dirt and traces of oil. Carry-out same check on the idle adjustment actuator		OK ▶	Carry-out **step E6**
		~~OK~~ ▶	Clean affected components
E6	CONTROL UNIT CHECK		
- Check for correct operation of MOTRONIC control unit (simply checking the vehicle using another control unit)		OK ▶	Replace control unit

End of test E

ENGINE STARTS, BUT STOPS IMMEDIATELY	TEST F

TEST STEPS	RESULTS	REMEDY
F1 O.B.D. CHECK		
- Check for correct operation of idle speed actuator - **See WIRING DIAGRAMS AND ELECTRICAL DIAGNOSIS Book - MOTRONIC O.B.D - TEST L and PROCEDURE B**, engine temperature sensor - **TEST D**, air flowmeter - **TEST E** **NOTE: Do not disconnect battery before carrying-out the O.B.D. function**	OK ▶ ~~OK~~ ▶	Carry-out **step F3** Carry-out procedure indicated in the **WIRING DIAGRAMS AND ELECTRICAL DIAGNOSIS Book** - then carry-out **stepF2**
F2 AIR FLOW METER CHECK		
- Check that flap moves freely without binding. Check that the interior is free from dirt and shows no signs of rubbing	OK ▶ ~~OK~~ ▶	Carry-out **step F3** Replace (or clean) flow meter
F3 FUEL PRESSURE CHECK		
- Carry-out tightness and pressure check of fuel supply system - See **Group 04 - FUEL SYSTEM PRESSURE AND TIGHTNESS CHECK**	OK ▶ ~~OK~~ ▶	Carry-out **stepF4** Check for correct operation of fuel filter, pump, pressure regulator and replace as needed
F4 ALTERNATOR CHECK		
- Check for correct operation of alternator and, particularly, of voltage regulator: the alternator should not overcharge. **See WIRING DIAGRAMS AND ELECTRICAL DIAGNOSIS Book - STARTING AND CHARGING - ALTERNATOR**	~~OK~~ ▶	Replace voltage regulator or alternator, if defective

End of test F

ENGINE IDLE SPEED NOT REGULAR	TEST G

TEST STEPS	RESULTS	REMEDY
G1 O.B.D. CHECK - Check for correct operation of idle speed actuator - **See WIRING DIAGRAMS AND ELECTRICAL DIAGNOSIS Book - MOTRONIC O.B.D - TEST F and PROCEDURE B**, throttle minimum opening switch - **TEST B** **NOTE: Do not disconnect battery before carrying-out the O.B.D. function**	OK ▶ ~~OK~~ ▶	Carry-out **step G4** Carry-out procedure indicated in the **WIRING DIAGRAMS AND ELECTRICAL DIAGNOSIS Book** - then carry-out **steps G2 and G3**
G2 THROTTLE SWITCH CHECK - Check for correct adjustment of switch - See **Group 04 - THROTTLE MIN/MAX SWITCH**	OK ▶ ~~OK~~ ▶	Carry-out **step G3** Replace switch, if faulty
G3 AIR FLOW METER CHECK - Check that flap moves freely without binding. Check that the interior is free from dirt and shows no signs of rubbing	OK ▶ ~~OK~~ ▶	Carry-out **step G4** Replace (or clean) flow meter
G4 FUEL PRESSURE CHECK - Carry-out tightness and pressure check of fuel supply system - See **Group 04 - FUEL SYSTEM PRESSURE AND TIGHTNESS CHECK**	OK ▶ ~~OK~~ ▶	Carry-out **step G5** Check for correct operation of fuel filter, pump, pressure regulator and replace as

		needed

(Cont.d)

ENGINE IDLE SPEED NOT REGULAR	TEST G

TEST STEPS	RESULTS	REMEDY
G5 AIR LEAKAGE CHECK		
- Check for: • absence of air leaks in the related system: brush with soap solution connections and lines down stream of flowmeter and check, with engine at idle, that soap solution is not sucked by the engine • correct flow - See **Group 04 - THROTTLE CALIBRATION CHECK**	OK ▶ ~~OK~~ ▶	Carry-out **step G6** Replace defective components
G6 CYLINDERS COMPRESSION CHECK		
- Carry-out cylinders compression check - See **Group 01 - CYLINDERS COMPRESSION CHECK**	OK ▶ ~~OK~~ ▶	Carry-out **step G7** Return cylinders to correct compression
G7 CONTROL UNIT CHECK		
- Check for correct operation of MOTRONIC control unit (simply checking the vehicle using another control unit) since the idle speed control logic could be defective	OK ▶	Replace control unit

End of test G

ENGINE SURGES	TEST H

TEST STEPS	RESULTS	REMEDY
H1 FUEL CHECK - Check for presence of gasoline in the tank (low level light and level indicator might be defective), check that gasoline is not mixed with water or other improper fluid, and for absence of dirt in the tank	OK ▶ ~~OK~~ ▶	Carry-out **step H2** Clean tank, if necessary. Fill the system with prescribed gasoline grade
H2 SPARK PLUGS CHECK - Check that: • spark plugs are not dirty and do not show signs of burns. • sparks shoot normally: remove plug, connect it to ground and check the spark. **NOTE: Never disconnect spark plug cable with the engine running**	OK ▶ ~~OK~~ ▶	Carry-out **step H3** Clean and replace the affected spark plugs
H3 HIGH VOLTAGE AND GROUND CABLES CHECK - Check that : • high voltage cables (from coil to distributor and from distributor to spark plugs) do not show signs of damage • the electric resistance ensuring non dissipation is present H.V. CABLE RESISTANCE ≅ 2.5 k Ω • that ground plaits are correctly torqued and do not show signs of oxidation	OK ▶ ~~OK~~ ▶	Carry-out **step H4** Replace affected H.V. cables or ground plaits. Torque correctly the ground plaits.

(Cont.d)

ENGINE SURGES	TEST H

TEST STEPS	RESULTS	REMEDY
H4 ALTERNATOR CHECK		
- Check for correct operation of alternator and, particularly, of voltage regulator: the alternator should not overcharge. **See WIRING DIAGRAMS AND ELECTRICAL DIAGNOSIS Book - STARTING AND CHARGING - ALTERNATOR**	OK ▶	Carry-out **step H5**
	~~OK~~ ▶	Replace voltage regulator or alternator, if damaged
H5 AIR LEAKAGE CHECK		
- Check for: • absence of air leaks in the related system: brush with soap solution connections and lines downstream of flowmeter and check, with engine at idle, that soap solution is not sucked by the engine • correct flow - See **Group 04 - THROTTLE CALIBRATION CHECK**	OK ▶	Carry-out **step H6**
	~~OK~~ ▶	Replace defective components
H6 AIR FLOW METER CHECK		
- Check that flap moves freely without binding. Check that the interior is free from dirt and shows no signs of rubbing	OK ▶	Carry-out **step H7**
	~~OK~~ ▶	Replace (or clean) flow meter
H7 FUEL PRESSURE CHECK		
- Carry-out tightness and pressure check of fuel supply system - See **Group 04 - FUEL SYSTEM PRESSURE AND TIGHTNESS CHECK**	OK ▶	Carry-out **step H8**
	~~OK~~ ▶	Check for correct operation of fuel filter, pump, pressure regulator and replace as needed

		needed

(Cont.d)

ENGINE SURGES	TEST H

TEST STEPS	RESULTS	REMEDY
H8 CYLINDERS COMPRESSION CHECK		
- Check cylinders compression - See **Group 01 - CYLINDERS COMPRESSION CHECK**	OK ▶	Carry-out **step H9**
	~~OK~~ ▶	Restore cylinders correct compression
H9 CRANKSHAFT PULLEY CHECK		
- Check for correct torque of crankshaft pulley 173 Ft lbs (235 Nm) (An incorrect torque " makes mad " the RPM and stroke sensor)	OK ▶	Carry-out **step H10**
	~~OK~~ ▶	Torque to correct value
H10 CONTROL UNIT CHECK		
- Check for correct operation of MOTRONIC control unit (simply checking the vehicle using another control unit)	OK ▶	Replace control unit

End of test H

ENGINE STUMBLES	TEST I

TEST STEPS	RESULTS	REMEDY
I1 O.B.D. CHECK		
- Check for correct operation of air flow meter - **See WIRING DIAGRAMS AND ELECTRICAL DIAGNOSIS Book - MOTRONIC O.B.D -TEST E,** throttle MAX opening switch - **TEST C** **NOTE: Do not disconnect battery before carrying-out the O.B.D. function**	OK ▶ ~~OK~~ ▶	Carry-out **step I3** Carry-out procedur indicated in the **WIR ING DIAGRAMS AN ELECTRICAL DIAG NOSIS Book** - then carry-out **step I**
I2 THROTTLE SWITCH CHECK		
- Check for correct adjustment of switch - See **Group 04 - THROTTLE MIN/MAX SWITCH**	OK ▶ ~~OK~~ ▶	Carry-out **step I3** Replace switch if fault
I3 AIR LEAKAGE CHECK		
- Check for: • absence of air leaks in the related system: brush with soap solution connection and lines downstream of flowmeter and check, with engine at idle, that soap solution is not sucked by the engine • correct flow - See **Group 04 - THROTTLE CALIBRATION CHECK**	OK ▶ ~~OK~~ ▶	Carry-out **step I4** Replace defectiv components

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ENGINE STUMBLES	TEST I

TEST STEPS	RESULTS	REMEDY
I4 HIGH VOLTAGE AND GROUNDS CHECK		
- Check: • that high voltage cables (from ignition coil to distributor and from distributor to spark plugs) do not show signs of damage • the electric resistance checking for absence of dissipation. HIGH VOLTAGE CABLE RESISTANCE HV ≅ 2.5 k Ω • that grounds are correctly torqued and do not show signs of oxidation	OK ▶ ~~OK~~ ▶	Carry-out **step I5** Replace affected H.V. cables or ground. Torque correctly the grounds
I5 ACCELERATOR CABLES CHECK		
- Check for smooth movement and correct play of accelerator and Cruise Control cables - See **Group 04 - ACCELERATOR CABLE ADJUSTMENT - CRUISE CONTROL CABLE ADJUSTMENT**	OK ▶ ~~OK~~ ▶	Carry-out **step I6** Adjust cables
I6 CONTROL UNIT CHECK		
- Check for correct operation of MOTRONIC control unit (simply checking the vehicle using another control unit) since the air enrichment at full load function can be faulty	OK ▶	Replace control unit

End of test I

ENGINE DOES NOT REACH MAXIMUM PERFORMANCES	TEST J

TEST STEPS	RESULTS	REMEDY
J1 O.B.D. CHECK - Check for correct operation of air flowmeter - **See WIRING DIAGRAMS AND ELECTRICAL DIAGNOSIS Book - MOTRONIC O.B.D - TEST E**, throttle MAX opening switch - **TEST C**, injectors - **PROCEDURE B** **NOTE: Do not disconnect battery before carrying-out the O.B.D. function**	OK ▶ ~~OK~~ ▶	Carry-out **step J5** Carry-out procedure indicated in the **WIRING DIAGRAMS AND ELECTRICAL DIAGNOSIS Book** - then carry-out **steps J2, J3, J4**
J2 THROTTLE SWITCH CHECK - Check for correct adjustment of switch - See **Group 04 - THROTTLE MIN/MAX SWITCH**	OK ▶ ~~OK~~ ▶	Carry-out **step J3** Replace switch if faulty
J3 AIR FLOW METER CHECK - Check that flap moves freely without binding. Check that the interior is free from dirt and shows no signs of rubbing	OK ▶ ~~OK~~ ▶	Carry-out **step J4** Replace (or clean) flow meter
J4 INJECTORS CHECK - By touching the injectors it is possible to feel needles movement, then check injectors resistance (1.7 Ω)	OK ▶ ~~OK~~ ▶	Carry-out **stepJ5** Replace defective injectors

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ENGINE DOES NOT REACH MAXIMUM PERFORMANCES	TEST J

TEST STEPS	RESULTS	REMEDY
J5 SPARK PLUGS CHECK - Check that: • spark plugs are not dirty and do not show signs of burns. • sparks shoot normally: remove plug, connect it to ground and check the spark. **NOTE: Never disconnect the spark plug cable**	OK ▶ ~~OK~~ ▶	Carry-out **step J6** Clean and replace the affected spark plugs
J6 HIGH VOLTAGE AND GROUND CABLES CHECK - Check that: • high voltage cables (from coil to distributor and from distributor to spark plugs) do not show signs of damage • electric resistance ensuring non dissipation is present H.V. CABLE RESISTANCE ≅ 2.5 k Ω • ground plaits are correctly torqued and do not show signs of oxidation	OK ▶ ~~OK~~ ▶	Carry-out **step J7** Replace affected HV cables or ground plaits. Torque correctly the ground plaits
J7 THROTTLE CHECK - Check throttle for free movement without binding or irregularities: particularly, it should open, at maximum, till the limit stop	OK ▶ ~~OK~~ ▶	Carry-out **step J8** Replace throttle

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ENGINE DOES NOT REACH MAXIMUM PERFORMANCES	TEST J

TEST STEPS	RESULTS	REMEDY
J8 FUEL PRESSURE CHECK - Carry-out tightness and pressure check of fuel supply system - See **Group 04 - FUEL SYSTEM PRESSURE AND TIGHTNESS CHECK**	OK ▶ ~~OK~~ ▶	Carry-out **step J9** Check for correct operation of fuel filter, pump, pressure regulator and replace as needed
J9 VALVES CLEARANCE CHECK - Check for correct valves clearance value - See **Group 01 - VALVES CLEARANCE CHECK AND ADJUSTMENT** (and **Group 00** too) intake: 0.0187 to 0.0197 in / 0.475 to 0.500 mm exhaust: 0.0088 to 0.0098 in / 0.225 to 0.250 mm	OK ▶ ~~OK~~ ▶	Carry-out **step J10** Adjust valves clearance according to procedure in **Group 01**
J10 CYLINDERS COMPRESSION CHECK - Carry-out cylinder compression check - See **Group 01 - CYLINDERS COMPRESSION CHECK**	OK ▶ ~~OK~~ ▶	Carry-out **step J11** Return cylinders to correct compression
J11 CONTROL UNIT CHECK - Check for correct operation of MOTRONIC control unit (simply checking the vehicle using another control unit)	OK ▶	Replace control unit

End of test J

EXCESSIVE FUEL CONSUMPTION	TEST K

TEST STEPS	RESULTS	REMEDY
K1 TIRES CHECK - Check tires pressure and wear (see also **Group 28**)	OK ▶ ~~OK~~ ▶	Carry-out **step K2** Inflate or replace tires
K2 AIR FILTER CHECK - Check for cleanliness of air filter element (see also **Group 04 - AIR FILTER**)	OK ▶ ~~OK~~ ▶	Carry-out **step K3** Replace filter element
K3 O.B.D. CHECK - Check for correct operation of throttle MIN. switch - **See WIRING DIAGRAMS AND ELECTRICAL DIAGNOSIS Book - MOTRONIC O.B.D. - TEST B,** engine temperature sensor - **TEST D,** air flow meter - **TEST E,** injector - **PROCEDURE B** **NOTE: Do not disconnect battery before carrying-out the O.B.D. function**	OK ▶ ~~OK~~ ▶	Carry-out **step K7** Carry-out procedure indicated in the **WIRING DIAGRAMS AND ELECTRICAL DIAGNOSIS Book** - then carry-out **steps K4, K5 and K6**
K4 THROTTLE SWITCH CHECK - Check for correct adjustment of switch - See **Group 04 - THROTTLE MIN/MAX SWITCH**	OK ▶ ~~OK~~ ▶	Carry-out **step K5** Replace switch if faulty

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EXCESSIVE FUEL CONSUMPTION	TEST K

TEST STEPS	RESULTS	REMEDY
K5 AIR FLOW METER CHECK - Check that flap moves freely without binding. Check that the interior is free from dirt and shows no signs of rubbing	OK ▶ ~~OK~~ ▶	Carry-out **step K6** Replace (or clean) flow meter
K6 INJECTORS CHECK - By touching the injectors it is possible to feel needles movement; then check injectors resistance (1.7 Ω)	OK ▶ ~~OK~~ ▶	Carry-out **step K7** Replace defective injectors
K7 FUEL PRESSURE CHECK - Carry-out tightness and pressure check of fuel supply system - See **Group 04 - FUEL SYSTEM PRESSURE AND TIGHTNESS CHECK**	OK ▶ ~~OK~~ ▶	Carry-out **step K8** Check for correct operation of fuel filter, pump, pressure regulator and replace as needed
K8 CONTROL UNIT CHECK - Check for correct operation of MOTRONIC control unit (simply checking the vehicle using another control unit)	OK ▶	Replace control unit

End of test K

HIGH EXHAUST CO AND HC PERCENTAGE	TEST L

TEST STEPS	RESULTS	REMEDY
L1 AIR FILTER CHECK - Check filtering element for cleanliness (see also **Group 04 - AIR FILTER**)	OK ▶ ~~OK~~ ▶	Carry-out **step L2** Replace filter element
L2 O.B.D. CHECK - Check for correct operation of lambda probe - **See WIRING DIAGRAMS AND ELECTRICAL DIAGNOSIS Book - MOTRONIC O.B.D. TEST G and H**, engine temperature sensor - **TEST D**, flow meter - **TEST E**, injectors - **PROCEDURE B** **NOTE: Do not disconnect battery before to carrying-out the O.B.D. function**	OK ▶ ~~OK~~ ▶	Carry-out **step L4** Carry-out procedure indicated in the **WIRING DIAGRAMS AND ELECTRICAL DIAGNOSIS Book** - then carry-out **step L3**
L3 AIR FLOW METER CHECK - Check that flap moves freely without binding. Check that the interior is free from dirt and shows no signs of rubbing	OK ▶ ~~OK~~ ▶	Carry-out **step L4** Replace (or clean) flow meter
L4 CATALYTIC CONVERTER CHECK - Check for correct operation of catalytic converter. Take samples of exhaust gas up and downstream of converter and analyze it; the catalytic converter correct operation is indicated by lowering of CO and HC values. (See also **Group 04 - CATALYTIC CONVERTER**)	OK ▶ ~~OK~~ ▶	Carry-out **step L5** Replace catalytic converter

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HIGH EXHAUST CO AND HC PERCENTAGE	TEST L

TEST STEPS	RESULTS	REMEDY
L5 INJECTORS CHECK		
- Check: • injectors operation: by touching the injectors it is possible to feel needles movement • injectors resistance (1.7 Ω) • injectors for tightness: no fuel leakage is allowed	OK ▶ ~~OK~~ ▶	Carry-out **step L6** Replace defective injectors
L6 FUEL PRESSURE CHECK		
- Carry-out tightness and pressure check of fuel supply system - See **Group 04 - FUEL SYSTEM PRESSURE AND TIGHTNESS CHECK**	OK ▶ ~~OK~~ ▶	Carry-out **step L7** Check for correct operation of fuel filter, pump, pressure regulator and replace as needed
L7 CONTROL UNIT CHECK		
- Check for correct operation of MOTRONIC control unit (simply checking the vehicle using another control unit) since the CO control logic could be defective	OK ▶	Replace control unit

End of test L

LOW EXHAUST CO PERCENTAGE	TEST M

TEST STEPS	RESULTS	REMEDY
M1 O.B.D. CHECK - Check for correct operation of flowmeter - **See WIRING DIAGRAMS AND ELECTRICAL DIAGNOSIS Book - MOTRONIC O.B.D. - TEST E**, engine temperature sensor - **TEST D**, lambda probe - **TEST G and H**, injectors - **PROCEDURE B** **NOTE: Do not disconnect battery before carrying-out the O.B.D. function**	OK ▶ ~~OK~~ ▶	Carry-out **step M4** Carry-out procedure indicated in the **WIRING DIAGRAMS AND ELECTRICAL DIAGNOSIS Book** - then carry-out **steps M2 and M3**
M2 AIR FLOW METER CHECK - Check that flap moves freely without binding. Check that the interior is free from dirt and shows no signs of rubbing	OK ▶ ~~OK~~ ▶	Carry-out **step M3** Replace (or clean) flow meter
M3 INJECTORS CHECK - By touching the injectors it is possible to feel needles movement, then check injectors resistance (1.7 Ω)	OK ▶ ~~OK~~ ▶	Carry-out **step M4** Replace defective injectors

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LOW EXHAUST CO PERCENTAGE	TEST M

TEST STEPS	RESULTS	REMEDY
M4 AIR LEAKAGE CHECKS - Check for: • absence of air leaks in the related system: brush soap solution on the connections of lines downstream the flowmeter; check with engine at idle speed that soap solution is not sucked by the engine • correct flow setting - SEE **Group 04 - THROTTLE CALIBRATION CHECK**	OK ▶ ~~OK~~ ▶	Carry-out **step M5** Replace defective components
M5 FUEL PRESSURE CHECK - Carry-out tightness and pressure check of fuel supply system - See **Group 04 - FUEL SYSTEM PRESSURE AND TIGHTNESS CHECK**	OK ▶ ~~OK~~ ▶	Carry-out **step M6** Check for correct operation of fuel filter, pump, pressure regulator and replace as needed
M6 CONTROL UNIT CHECK - Check for correct operation of MOTRONIC control unit (simply checking the vehicle using another control unit) since the CO control function could be defective	OK ▶	Replace control unit

End of test M