ASTON MARTIN AND LAGONDA

Fuel Injection Supplement

to the

OWNERS HANDBOOK

ASTON MARTIN

and

LAGONDA

Fuel Injection Supplement

to the

OWNER'S HANDBOOK

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INTRODUCTION

Fundamental changes have been made in connection with the fuel system of the Aston Martin V8 Saloon, Volante, certain Vantage models and Lagonda cars. These models are now equipped with a fuel-injection system.

This system is electronically controlled. It monitors information which is fed into it from strategically placed sensors in the engine and fuel systems. It analyses the conditions, determines the requirements and automatically adjusts the fuel settings to give optimum performance.

Those owners whose cars are fitted with this system are advised not to make any adjustments to the fuel injection components. Certain associated components, however, may require attention and relevant details are given in the Servicing Section.

Any variations to the specification of the car are given in the section headed 'Specification'. This lists only those items which have been changed.

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SPECIFICATION

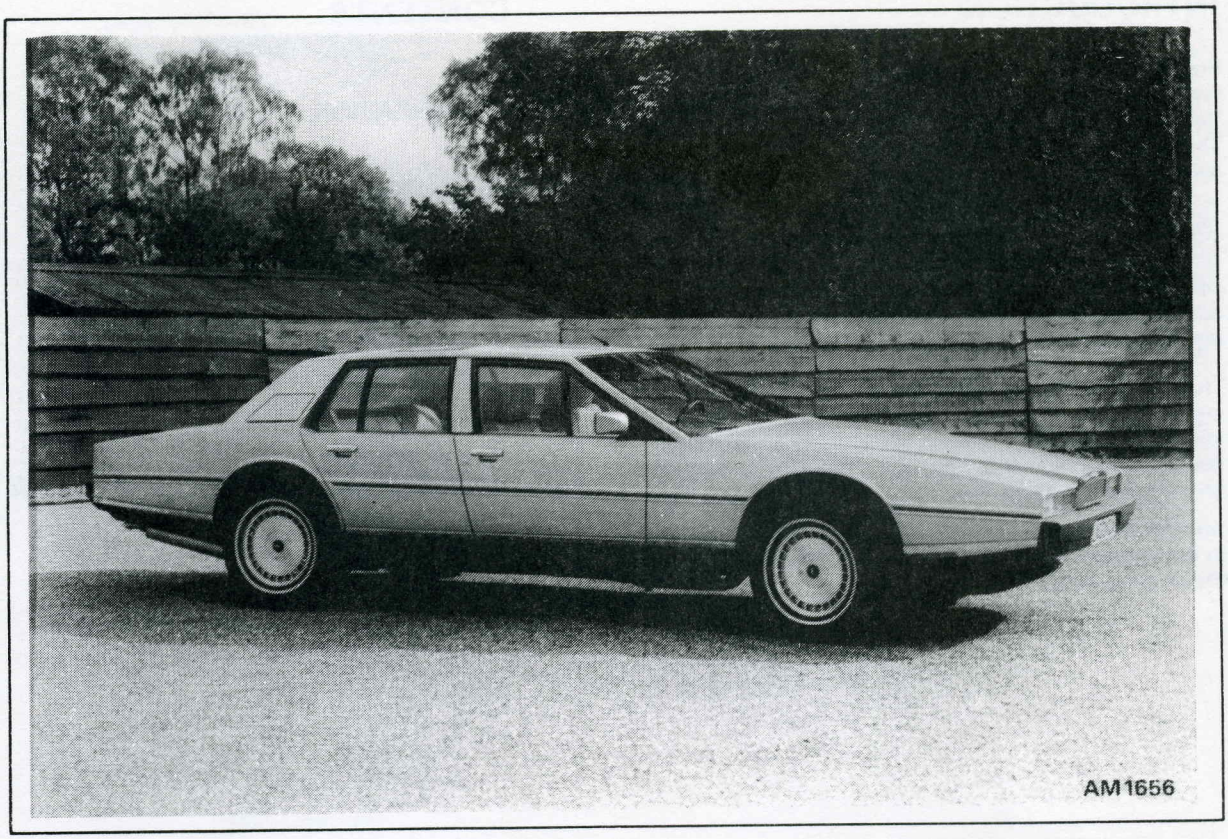
PRINCIPLES OF OPERATION

THE FUEL SYSTEM

THE AIR SYSTEM

THE ELECTRICAL SYSTEM

SERVICING



Lagonda

Aston Martin Volante

ENGINE

Compression Ratio		8.0:1 - '585' Series Engine
Maximum rpm		
Sustained		5750 rpm
Intermittent		6000/6200 - restricted by rev limiter
Distributor		2 off - See 'Electrical System' Section
Ignition Coils		2 off - See 'Electrical System' Section
Sparking Plugs	Type:	Non-USA cars - NGK BPR 6EY USA Cars - NGK BPR 5EV
	Gap:	0.76mm (0.030in.)
Ignition Timing		Automatic through Electronic Control Unit. (See 'Electrical System' section).
Alternator		100 amp - mounted below L.H. cylinder bank.

FUEL SYSTEM AND EMISSIONS

Fuel Pump and Fuel Filter - See 'Fuel Systems' Section.

Carburettors: Certain Vantage models only, otherwise deleted in favour of the Fuel Injection System described in this supplement.

Fuel Evaporative System

Emission Control Cars.

The system consists of a fuel tank with an integral roll-over valve, vapour liquid separator and one carbon canister, connected to the fuel tank.

The fuel filler caps are of the non-vented type. A permanently-open pipe from the fuel tank collects vapour which is then stored in the canister. When the engine is running, air is blown through the canister and out of the top via a purge valve which is operated by manifold vacuum. The majority of purging therefore takes place when the engine vacuum is high.

Exhaust Emission System

Description

Emission reduction is achieved initally by the electronic engine control system fitted to the car. Further reduction is achieved by an air injection system which completes the burning of the fuel mixture before the exhaust gases are emitted.

Air Injection System

The air injection system comprises an air pump which supplies air, under pressure to the exhaust ports in order to complete the burning of the exhaust gases leaving the combustion chambers.

The air pump is mounted on the left hand side of the engine and belt-driven from the water pump pulley. Air is pumped to both cylinder banks. A check valve prevents exhaust gases being directed back to the pumps.

Emission control engines have a second pump which feeds air to the second pair of catalysts.

GENERAL DESCRIPTION

The system produces a very precise air/fuel mixture and by optimising the ignition advance/retard setting, extracts an increased horsepower rating from the engine, reduces the fuel consumption and lowers the amount of unburnt exhaust gas.
It operates on the 'Speed/Density' principle. The engine rpm and the air density are used to measure the air intake quantity and once this is known, the required fuel quantity is determined. Further sensing devices in the system correct the mixture proportions and compute the required ignition setting to match the driving conditions.
The quantity of air induced into each cylinder per cycle depends on the density of air in the inlet manifold, on the cylinder displacement and on the volumetric efficiency. The air density is calculated as a function of the pressure and the temperature of the air in the inlet manifold. The volumetric efficiency is determined by the full operational range of the engine - in terms of rpm and load - and is then stored in the memory of the electronic control unit.
Three inter-related sub-systems combine together to form the complete system, viz:-

1. Fuel — The fuel is injected into the inlet manifold before the inlet valve opens.
2. Air. — The requisite quantity of air is induced into the inlet manifold through a throttle valve which is controlled by monitoring devices during warm up.
3. Electrical — The various engine conditions are relayed to the electronic control unit which computes the fuel mixture and ignition advance/retard requirements.

METHOD OF CONTROL

Starting

As soon as the starter motor turns, the control unit activates the fuel pump. At the same time it receives signals from the sensors which indicate the atmospheric pressure and engine temperature. When the engine starts, the required injection and ignition conditions are determined by the main control unit as a result of rpm and phase signals.
During cold starting, a rich fuel mixture is provided and an optimised ignition setting. When the engine is running the control unit will vary the ignition advance angle.
An additional feature for emission control cars is an automatic, twelve-second fast idle. During warm up, the enrichment and idle speed are progressively reduced.

Normal Running

When the normal running temperature of the coolant has been reached, the control unit calculates the phase angle, injection time and ignition advance in relation to the manifold air density and engine speed.
From these values, the exact quantity of fuel which is required is determined and this quantity is injected into each cylinder at the precise instant in relation to the engine speed for maximum economy and power.

Acceleration.

During accelaration, the air pressure in the inlet manifold varies and, as a result of a signal from the relevant sensor, together with a signal from the water temperature sensor, the control unit computes the increase in the amount of fuel which will be required to give the desired acceleration.

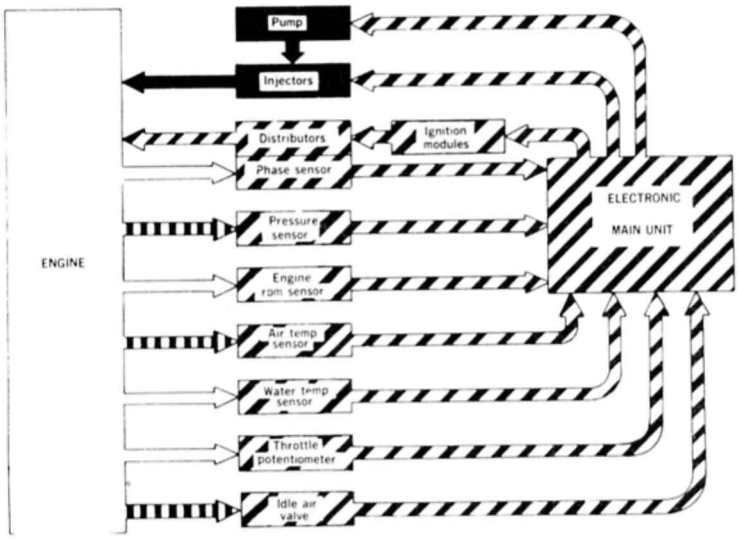
Deceleration

The control unit recognises this condition by means of the throttle position sensor, the pressure in the inlet manifold and the engine rpm.
It then regulates the amount of fuel which is injected into the cylinders. This increases the braking effect of the engine and reduces the fuel consumption.

Full Load Conditions

Under full load conditions, it is necessary to provide a richer mixture in order to maintain maximum engine performance. This is because the basic mixture value aimed at providing a low fuel consumption figure.

This is automatically determined by the control unit which recognises this full load condition by signals from the throttle position sensor, the inlet manifold pressure sensor and the engine rpm sensor.



Block Diagram of System

AM 1673

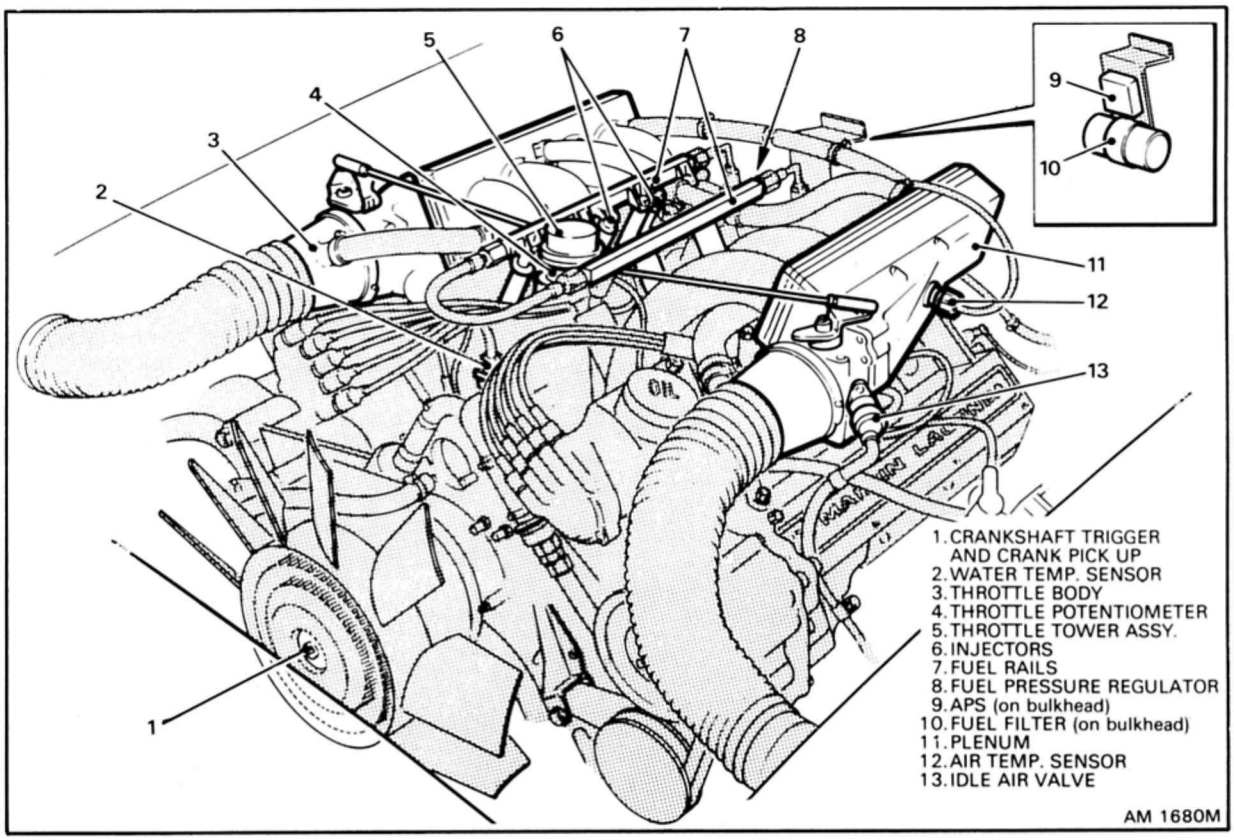


Fig. 1 Layout of Components on Engine

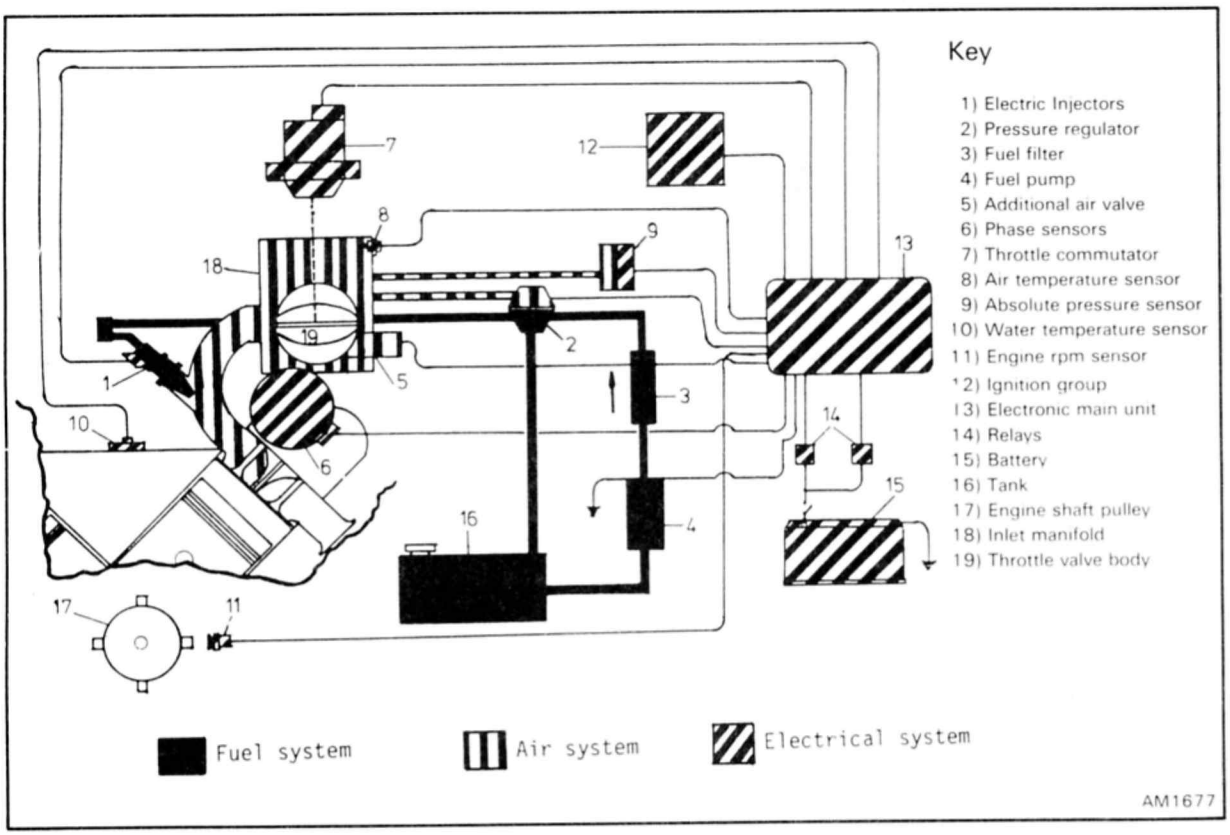


Fig. 2 Schematic Layout of Components

GENERAL DESCRIPTION

The electric pump draws fuel from the tank and pumps it through a filter to the fuel rail, which is made up of several branches. Each branch contains an injector. The pressure in the system is kept constant in relation to the inlet manifold by a pressure regulator which ensures that any excess fuel is returned to the tank.

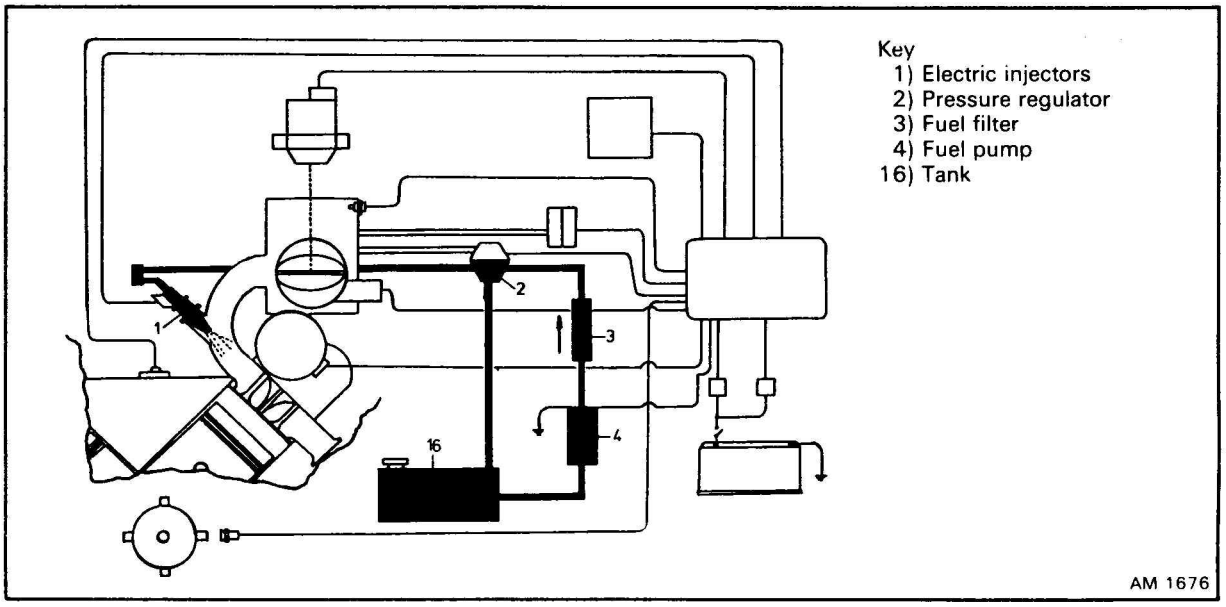


Fig. 3 Schematic Layout of Fuel System Components

COMPONENTS

Injectors

The injector controls the quantity of fuel which is delivered into the cylinder. It has two alternative positions - ON or OFF.

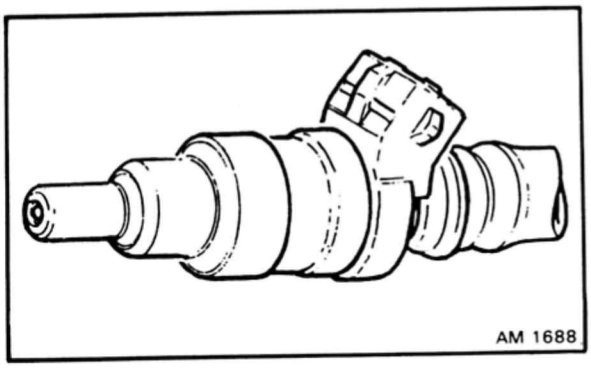


Fig. 4 Injector

Fuel Filter

This is fitted between the pump and the pressure regulator. The arrow shows the direction of the flow of the fuel. It contains a paper filter.There is also an additional filter in the fuel tank.

Pressure Regulator

This prevents sudden changes of pressure being applied to the injectors. It is of the differential diaphragm type and it is calibrated to operate at 2.5 bar (36.5 lb/in²)

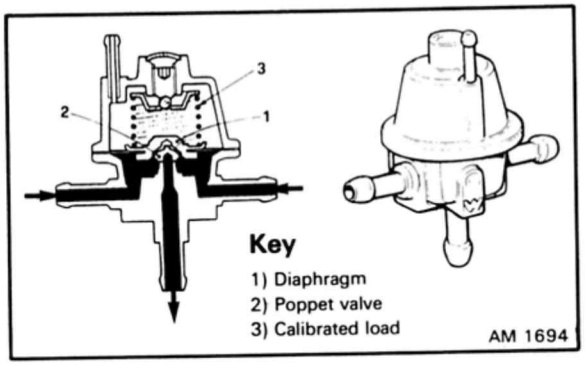


Fig. 5 Pressure Regulator

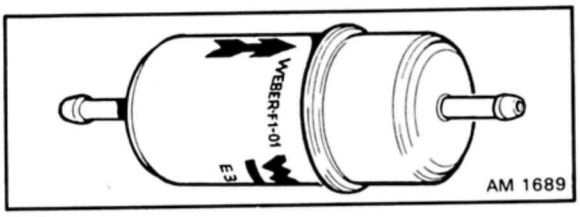


Fig. 6 Fuel Filter.

The Fuel Pump

This is a motor-driven, volumetric, roller pump, the motor being immersed in the fuel. The volume of the fuel is limited by rollers which are pressed against the outer ring when the motor is rotating. A non-return valve is provided to prevent the fuel system from emptying the pump when it is not operating.
An over-pressure valve short circuits the delivery if the pressure reaches ≃ 5 bar. (72lb/in^2).
This prevents the motor from overheating and sustaining possible damage.

Note: DO NOT OPERATE THE FUEL PUMP DRY.
The system must be de-pressuried **before** any fuel connected is disturbed.

The system must be primed **after** any fuel connection has been disturbed.
This includes the draining and refilling of the fuel tank.

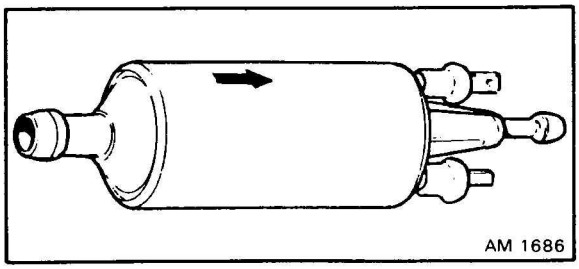


Fig. 7 Fuel Pump

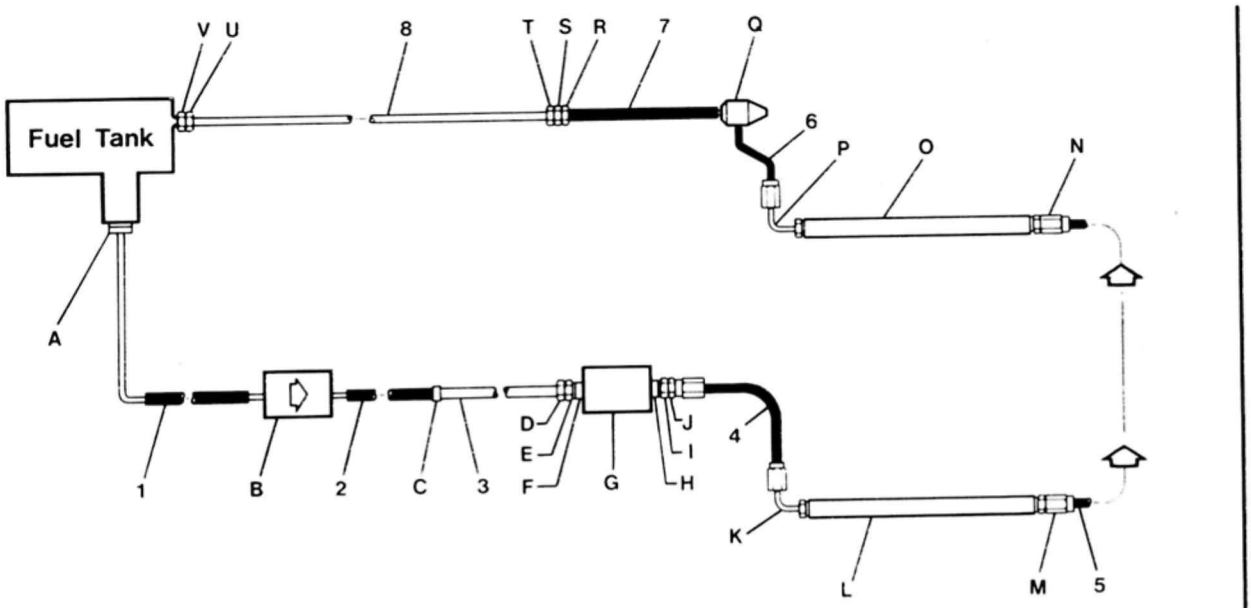


Fig. 8 Diagram of Fuel System Components - V8 (Saloon and Volante)

AM 1681M

Key

A. Fuel pick-up assembly.
B. Fuel Pump.
C. Reducing connector.
D. Main feed hose connection.
E. Adaptor.
F. Copper washer.
G. Fuel filter assembly.
H. Copper washer.
I. Male/male connector.
J. Female Swivel.
K. 90° Female swivel.
L. Fuel rail assembly, L.H.
M. Female swivel.
N. Female swivel.
O. Fuel rail assembly, R.H.
P. 90° Female swivel.
Q. Pressure regulator assembly.
R. Return line connector.
S. Double-ended union.
T. Return hose connection.
U. Return hose connection.
V. Double-ended union.

1. Rubber hose.
2. Rubber hose.
3. Clear PVC sleeve.
4. Rubber hose.
5. Rubber hose.
6. Rubber hose.
7. Rubber hose.
8. Clear PVC sleeve.

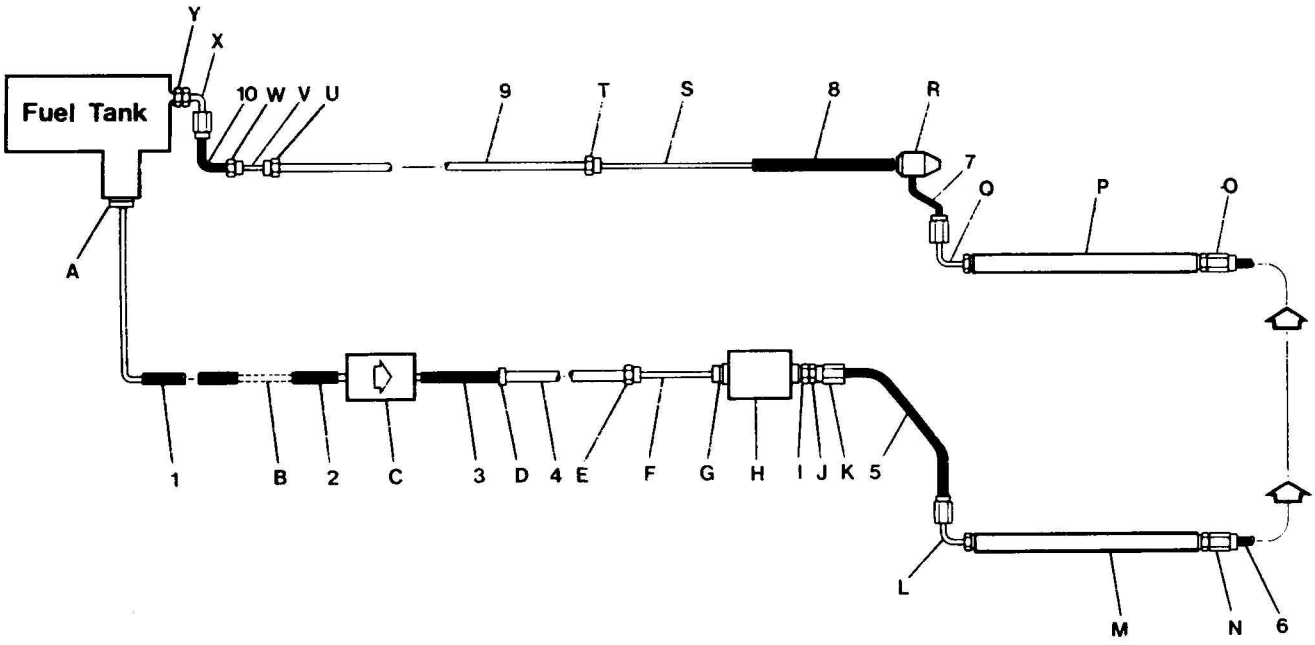


Fig. 9 Schematic Diagram of Fuel System Components - Lagonda

AM 1682M

Key

A Fuel pick-up assembly.
B. Feed pipe, over axle.
C. Fuel pump.
D. Reducing connector.
E. Main feed hose connection.
F. Fuel feed line, forward (assembly).
G. Copper washer.
H. Fuel filter.
I. Copper washer.
J. Male/male connector
K. Female swivel.
L. 90° Female swivel.
M. Fuel rail assembly, LH.
N. Female swivel.
O. Female swivel.
P. Fuel rail assembly, RH.
Q. 90° Female swivel.
R. Pressure regulator assembly.
S. Return line pipe, forward (assembly).
T. Return hose connection.
U. Return hose connection.
V. Over-axle return pipe assembly.
W. Return hose connection.
X. 90° Elbow assembly, fuel tank return.
Y. Adaptor

1. Rubber hose
2. Rubber hose.
3. Rubber hose.
4. Clear PVC sleeve
5. Rubber hose.
6. Rubber hose.
7. Rubber hose.
8. Rubber hose.
9. Clear PVC sleeve.
10. Rubber hose.

GENERAL DESCRIPTION

This consists of two throttle body assemblies, (which include the idle air control valves), inlet manifolds, absolute pressure and air temperature sensors.

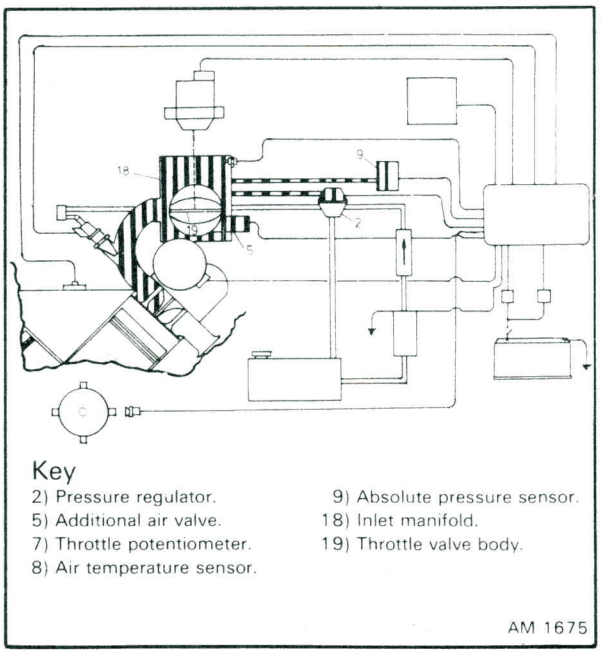


Fig. 10 Schematic Layout of Air System Components.

COMPONENTS

Throttle body Assembly (see Fig. 11).

The quantity of air taken in is regulated by the throttle plate which is part of the throttle body assembly, located in the inlet manifolds. The throttle plate closing position is limited by a screw (4) but this screw must not be used for adjusting the idling characteristics. Under running conditions, when the engine coolant has reached its normal temperature, the mixture is regulated by an output signal from the electronic control unit. This output signal is determined by input data from the pressure and temperature sensors. The throttle pedal controls the throttle plate and the resultant air flow is detected by sensors which send signals to the electronic control unit.

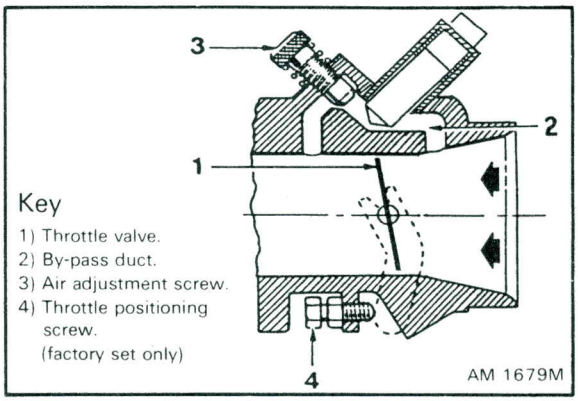


Fig. 11 Throttle Body Assembly.

Idle Air Control Valves (see Fig. 11)

Each valve is fitted into a throttle body assembly and has a variable-sized orifice, through which air flows, by-passing the throttle plate. The valves are controlled by the electronic control unit and maintain a suitable engine idling speed during the warm-up period.

When the coolant temperature rises above 78°C, the feature becomes inoperative but it will be momentarily re-activated if the idling speed falls to below 500 rpm.

The Absolute Pressure Sensor

The Air Temperature Sensor

These devices provide information to the control unit on their respective conditions in the inlet manifold.

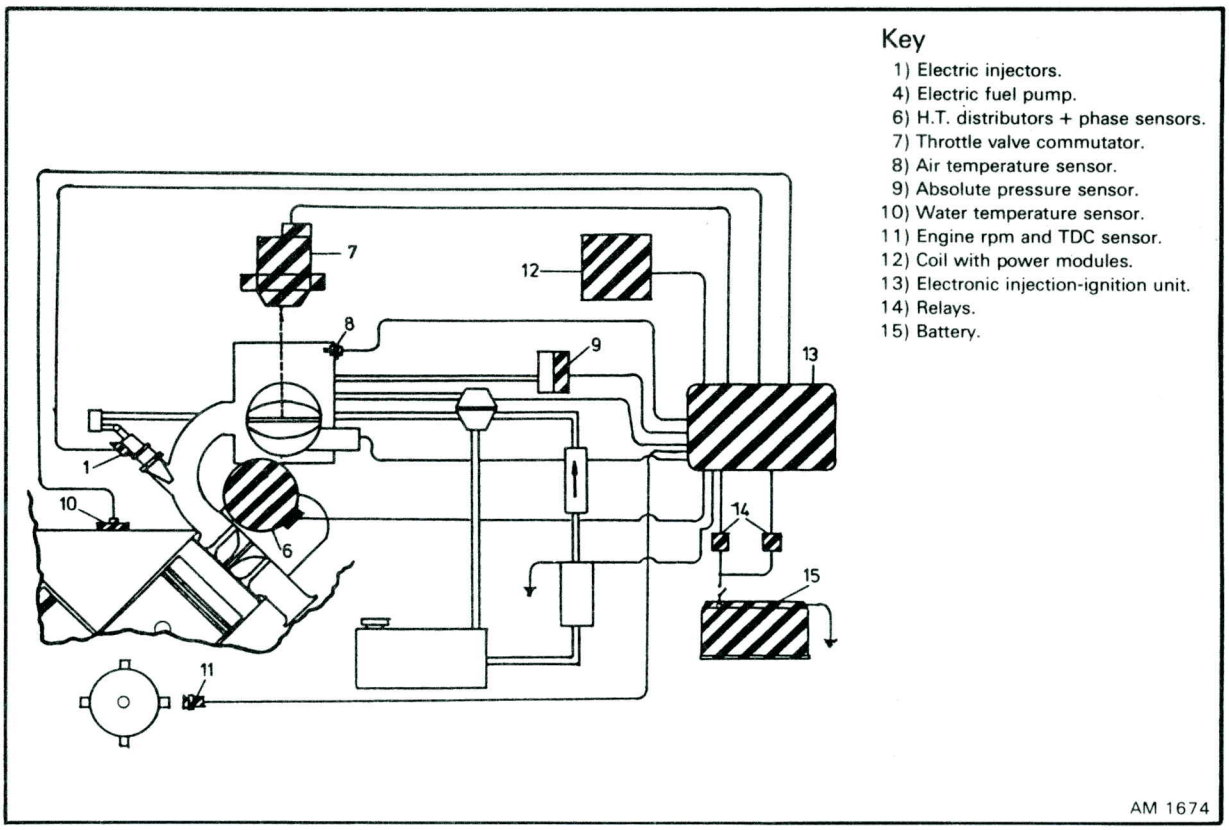


Fig. 12 Schematic Layout of Electrical Components

COMPONENTS

Electronic Control Unit

This is the main elctrical unit of the system, It receives the following information from the various sensors within the system:

1. The absolute pressure inside the inlet manifold.
2. The air intake temperature.
3. The coolant temperature.
4. The rpm and the position of each cylinder as related to the TDC.
5. The battery voltage.
6. The throttle position.
7. Idle air valve status.

The unit computes the relevant details and determines the following conditions which control the operation of the fuel and air circuits.

1. The quantity of fuel to be delivered to each cylinder in the correct sequence.
2. The timing of the fuel input related to the stroke of the cylinder.
3. The required ignition advance/retard.
4. The opening of the idle air valve.

Relays

Two standard automotive relays are used:

1. For the fuel pump and idle air valve control.
2. For the injectors and main unit control.

Absolute Pressure Sensor

This detects the pressure of the air in the inlet manifold and delivers a voltage signal, the value of which is directly proportional to the air pressure, to the electronic control unit.

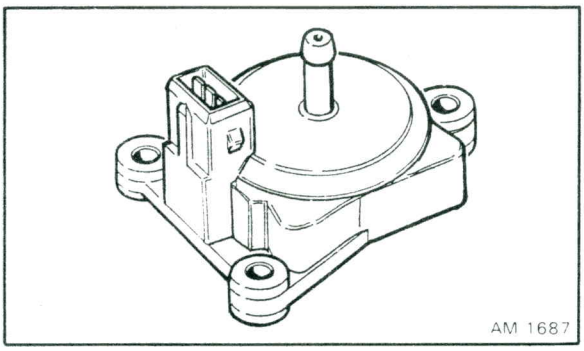


Fig. 13 The Absolute Pressure Sensor

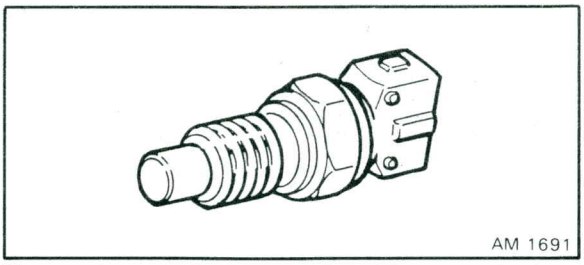


Fig. 14. Air Temperature Sensor

Air Temperature Sensor

This detects the temperature of the air in the inlet manifold and delivers a signal to the electronic control unit. This signal is combined with that received from the absolute pressure sensor to calculate the air density.

Coolant Temperature Sensor

This detects the temperature of the engine coolant. The signal is delivered to the electronic control unit and is used to achieve corrections to the basic fuel mixture, and the idle speed control.

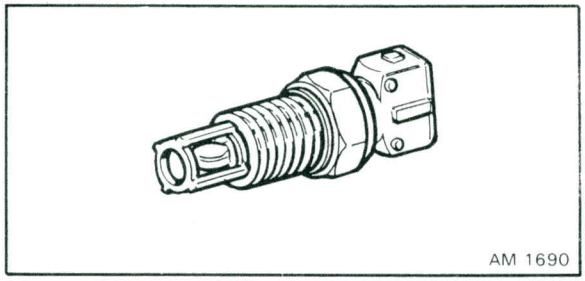


Fig. 15 Coolant Temperature Sensor

Engine rpm and TDC Sensor

This sensor is of the variable reluctance type. It is located opposite the engine crankshaft pulley which has four protruding teeth, around the periphery, at 90° to each other. As each tooth passes the sensor, an alternate electric signal is delivered to the distributor. The frequency of this signal enables the information relating to the rpm, combined with the signals delivered by the phase sensor (inside the distrubutor) to be diagnosed by the control unit and interpreted to recognise the position of the different cylinders as related to their compression TDC.

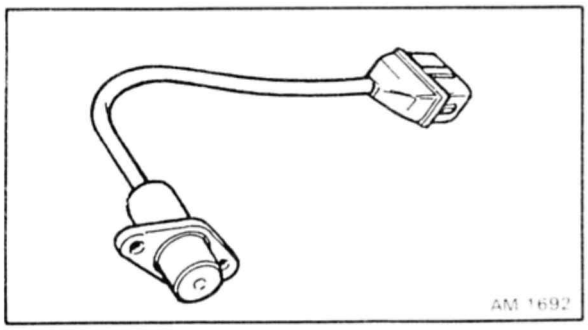


Fig. 16 Engine rpm and TDC Sensor

Phase sensor

Another inductive sensor is fitted inside the R.H. distributor. It is located opposite a cam which has two teeth at 90° to each other. As each tooth passes the sensor, alternate signals of the same type as generated by the rpm sensor are delivered to the electronic control unit.
These signals, together with that of the rpm sensor, identify the phase of each cylinder.

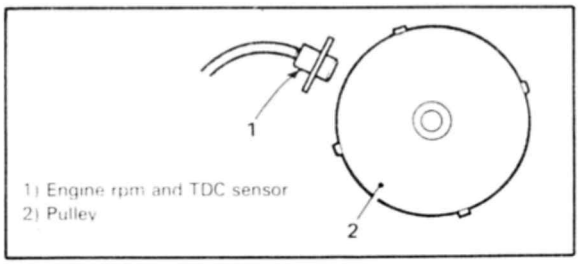


Fig. 17 Location of Sensor and Pulley

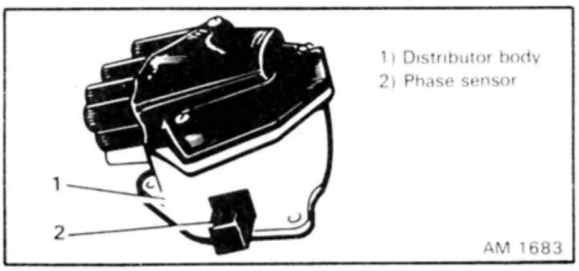


Fig. 18 Phase Sensor

Throttle Potentiometer

This sends a signal to the control unit identifying different throttle positions:

closed - partially closed - fully open

this information is used to correct the basic mixture control and for the cut-off function. The potentiometer is fitted at the top of the throttle tower assembly in the centre of the "V".

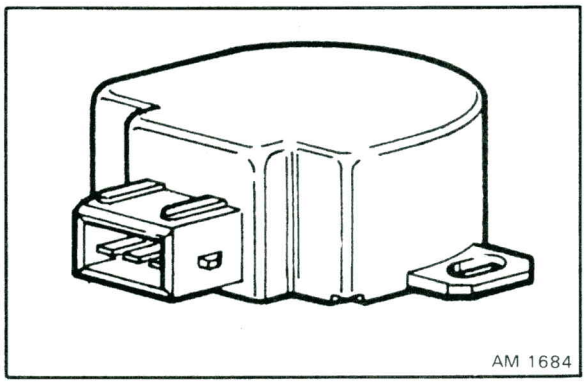


Fig. 19 Throttle Potentiometer

Coil with Power Module

Two coils are fitted. Each unit is of the type which has an inductive discharge. It receives a signal from the control unit which determines the ignition advance. The power module ensures a constant energisation of the coil.
Each coil and its module is fitted into a specially-designed heat dissipator.

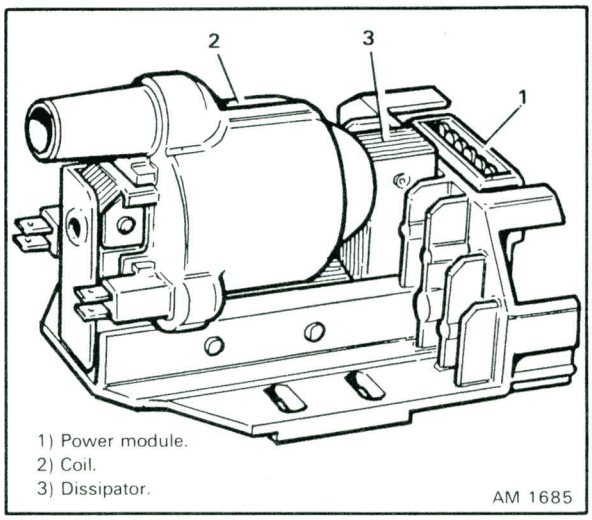


Fig. 20 Coil with Power Module

The Electronic Fuel Injection system has been tailored to suit the particular needs of the Aston Martin and Lagonda cars. It requires special equipment and test facilities to set it up and maintain it so that the car will give maximum performance, coupled with economy and reliability.

The owner is therefore strongly advised not to interfere with the system in any way. If it is felt that it is not functioning correctly, the car should be returned to an authorised Aston Martin Lagonda dealer or distributor who will be equipped with the necessary specialised equipment and knowledge.

Some maintenance work, however, such as is possible on a carburettor car, can be undertaken.

Where this is thought to be advisable, and where the items differ from those in the main handbook, the necessary information is given below.

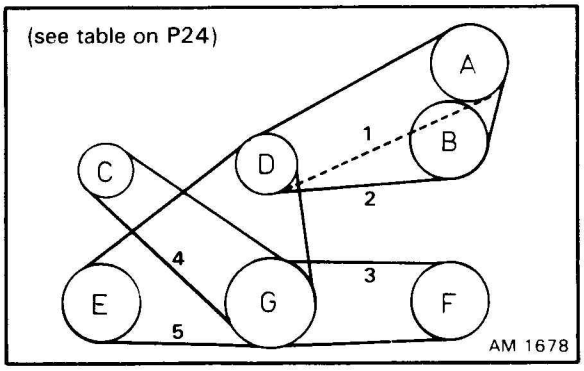


Fig. 21. Diagram of Auxiliary Drive Belts

Ignition Leads

If these are disturbed or renewed, special attention must be paid to the following:-

1. Ensure that the plug lead terminals make good contact with the distributor, coil and spark terminals.
2. Check that the insulator covers are correctly fitted.
3. The leads should be bound together using 'Spirap' to prevent them from chafing against the throttle linkage and to make a neater appearance.

'Spirap' ½" OD. Outdoor, Nylon, Black.
2 off:- 178mm (7")
1 off:- 51mm (2")

Lead Lengths:	Nos. 1 and 5:	584mm (23in.)
	Nos. 2 and 6:	699mm (27½in.)
	Nos. 3 and 7:	864mm (34in.)
	Nos. 4 and 8:	838mm (33in.)
	Coil:	813mm (32in.)

Spark Plugs

European cars:	NGK BPR 6EY
USA cars:	NGK BPR 5EV
Gap:	0.76mm (0.030in.)

The plugs should have 'Copa Slip' applied to the threads and should be tightened to a torque of 16-19Nm (12-14lbf.ft).

Auxiliary Drive Belts

No.	TO	FROM	VARIANT	SIZE (mm)	AML No.	TENSION (daN) INSTAL	TENSION (daN) AFTER RUN
1.	AIR PUMP	WATER PUMP	EUROPEAN	9.5 x 1050	07 -21020	15.4 - 18.5	12.4 - 15.4
2.	AIR PUMPS	WATER PUMP	FEDERAL	9.5 x 1138	07 - 21021	28.6 - 34.3	22.9 - 28.6
3.	ALTERNATOR	CRANKSHAFT	ALL	763 x 4 Grooves	09 - 21024	38.8 - 46.6	31.2 - 38.8
4.	POWER STEERING PUMP	CRANKSHAFT	ALL	12.5 x 1200	24 - 21026	41.2 - 49.4	33.0 - 41.2
5.	WATER PUMP AND AIR CONDITIONING	CRANKSHAFT	ALL	12.5 x 1125	05 - 21030	36.7 - 44.1	29.4 - 36.7

FUEL SYSTEM

WARNING

IF A LEAK OCCURS IN THE FUEL SYSTEM MAKE SURE THE PUMP IS NOT DRY. IF IT IS NOT PUMPING FUEL WHEN RUNNING IT WILL BE DESTROYED.