Rover SD1 Efi System – Fuel Supply Components - Explanation and Testing of the Fuel Pump, Filter and Fuel Pressure Regulator

Introduction

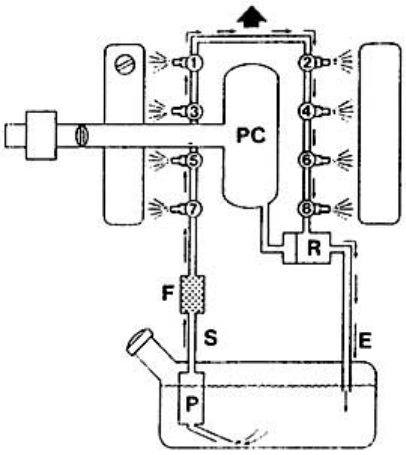
- Some of the notes here are repetitious in order to review the components from different viewpoints of their function and operation.

- The electric pump (P) draws fuel from the fuel tank (see fig.1). The pump passes the fuel along the fuel supply pipe (S), through a fine mesh (2 micron) in-line filter (F) to the injector rail and injectors (1 - 8). Fuel pressure is controlled by the regulator (R) and excess fuel returns to the fuel tank via the return pipe (E).

- Fuel enters the engine via eight injectors, one for each cylinder, and the fuel is injected indirectly. This means that fuel is not injected directly into the combustion chambers.

- The quantity of fuel supplied by the injectors is governed by the period of time they are open. The longer the "open time" the greater the amount of fuel delivered

- The injectors operate in two banks of four; each bank operates alternately, with both banks operating twice per working cycle.



- Fig.1 Fuel System
  - P Fuel pump not submerged on SD1 Efi
  - F Filter
  - S Fuel supply pipe
  - E Excess fuel return pipe
  - R Fuel pressure regulator
  - PC Plenum chamber
  - 1-8 Injectors

Location and Operation

Fuel Pump

- The electric fuel pump located in front of the fuel tank, partially protected by metal guards, is a roller type pump operated by a permanent magnet motor.

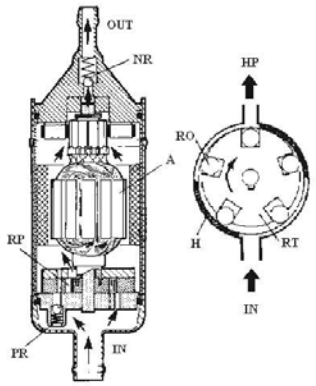
- The armature and bearings are cooled and lubricated by the fuel flowing through the pump with no risk of combustion because the pump never contains an ignitable mixture, even when the tank empties.

- Fig.2 shows an eccentric rotor (RT) mounted on the armature shaft with rollers (RO) in pockets rotating within the housing (H). When the motor is energised centrifugal force acting on the rollers forces them outwards, to act as seals.

- The fuel between the rollers is forced to the high pressure side of the system (HP). A pressure relief valve (PR) is located within the roller pump (RP) prior to the armature (A) and protects the pump from over-pressurizing.

- A non-return valve (NR) is located in the pump outlet to the filter and injectors; it prevents fuel draining from the injector supply pipe.

- Fig.2 Fuel Pump
  - RT Rotor
  - RO Roller
  - H Housing
  - HP High pressure side
  - RP Roller pump
  - PR Pressure relief valve
  - A Armature
  - NR Non-return valve



- Fuel gravitates through a filter in the tank to the pump inlet and into the roller pump ensuring that the system is primed. The roller pump generates the necessary fuel pressure to feed the injection system. Excess pressure opens the relief valve allowing fuel to re-circulate to the pump input.

Fuel Filter

- The filter is mounted on the N/S inner wing behind the suspension turret. Injectors are machined to close tolerances so thorough fuel filtering is essential to efficient operation and long life.

- It is a 2 micron, fine mesh unit that must be changed as recommended. The arrow on the filter body shows the direction of fuel flow.

Fuel Pressure Regulator

- The fuel pressure regulator, located on a bracket adjacent to the rear of the RH rocker cover, is required to control the pressure of fuel delivered at the injectors by sensing variations in manifold depression or vacuum.

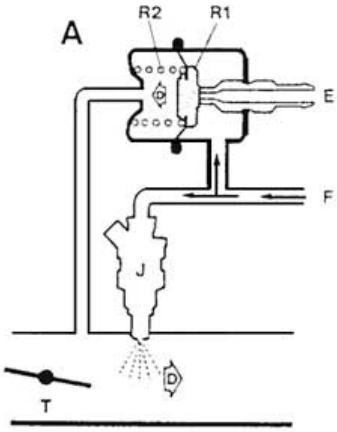
- This ensures the quantity of fuel released by the injectors is governed by one factor only - injector “open time”.

- Fitted in the excess fuel return pipe (E), close to the injector fuel rail with its fuel supply (F) as seen in Fig.2, it has two chambers separated by a diaphragm (R1).

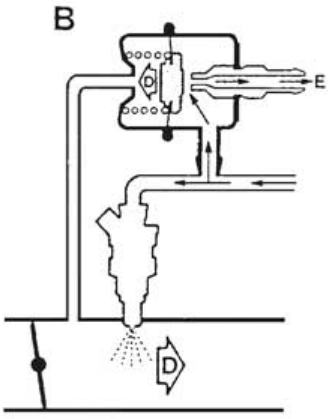
- One chamber contains fuel from the supply line (F). The other is linked by a pipe to the engine side of the throttle butterfly (T) to sense manifold depression (D).

- At rest, the spring (R2) holds the diaphragm valve against the fuel return pipe.

- Fig.3 Fuel Pressure Regulator
  - T Throttle butterfly
  - D Manifold depression (or vacuum)
  - E Excess fuel return
  - J Injector
  - R1 Regulator diaphragm valve
  - R2 Regulator spring
  - F Fuel Rail (pump supply)



- At full throttle (Fig.3A) manifold vacuum is low; the spring holds the diaphragm on its fuel return pipe seat so pump pressure must reach approx 36 psi to move the diaphragm valve against spring pressure allowing excess fuel to return to the tank.



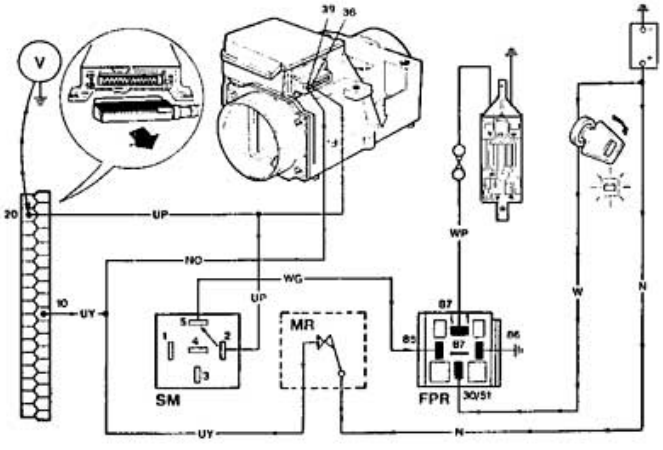
- At idle and overrun (Fig.3B), manifold depression is high. The fuel return is opened and pressure falls to 26 psi. Intermediate vacuums regulate fuel pressure between the minimum and maximum.

- Thus pressure varies between 26 and 36 psi according to manifold depression ensuring the amount of fuel delivered by injectors is governed only by injector "open time".

Testing the Electrical Components

- Fig.4 Electrical circuit
  - SM Steering module
  - FPR Fuel pump relay

- Conditions
  - ECU multiplug disconnected
  - Connect meter between ECU multiplug terminal 20 and earth
  - Ignition ON
  - Air flow meter flap closed



- Reading should be zero volts
  - If incorrect (reading a voltage) it means the fuel pump contacts of the air flow meter are closed indicating a fault which must be resolved before proceeding

- Manually open air flow meter flap
  - Listen for fuel pump relay and fuel pump operation
  - Voltmeter should read 11 to 12.5 volts

- If below 11 volts check
  - Battery voltage is not similarly low
  - All wiring and connections shown in diagram

- If still below 11 volts
  - Substitute steering module

- If voltmeter reads correctly but relay or pump are not heard to operate
  - Substitute steering module (SM) and then fuel pump relay (FPR)

- If pump still fails to operate, suspect faulty fuel pump or connections
  - Check wiring/connectors from relay to fuel pump via the fuel pump resistor
  - Check for debris preventing the pump from operating
  - If all OK replace the fuel pump

Fuel Pressure Checking

- **SAFETY WARNING: Under operating conditions the fuel injection system is pressurised by a high pressure pump operating at 26 to 36 psi. When the engine is stationary this pressure is maintained within the system.**

- **To prevent pressurised fuel escaping and to avoid personal injury it is necessary to depressurise the fuel injection system before connection of a test gauge or any servicing is carried out.**

Depressurising the Fuel System

- Remove the fuel pump relay located behind the passenger glove box to immobilise the fuel pump.

- Start and run the engine to use up the fuel in the fuel rail, the line pressure will drop and the engine will stall.

- Switch the ignition off and disconnect the battery.

- Fuel at low pressure will remain in the system which can be released by removing the cold start injector from the plenum chamber and placing it in a suitable container.

- Release the hose clip and carefully remove the hose from the injector to discharge the remaining fuel into the container.

Pressure gauge

- Connect a suitable pressure gauge to the injector hose.

- Refit the cold start injector to the plenum chamber, refit the fuel pump relay and re-connect the battery.

Testing the Fuel Pressure Regulator

- Remove the air filter from the airflow meter, switch on the ignition and operate the flap in the air flow meter by hand to energise the fuel pump.
  - The fuel pressure should be 35 - 37 psi.

- Switch off the ignition.
  - The fuel pressure should remain at 35 - 37 psi

- The fuel pressure may fall very slowly due to inconsequential weeping in either the fuel pressure regulator valve or the fuel pump non-return valve.
  - A slow steady fall is acceptable but a rapid fall must be investigated

- If the pressure test is unsatisfactory the most likely cause of the problem is the fuel pressure regulator.
  - Replace the fuel pressure regulator with a new or known good substitute unit

- If after fitting a known good regulator and re-testing the system, the pressure continues to fall rapidly check the following until the cause is found.
  - The fuel injectors
  - The fuel pump non-return valve
  - The fuel system pipe-work

- Depressurise the fuel system again before removing the test gauge.

- After final reconnection of the pipes check for fuel leaks at all the joints both before and after the fuel injection system is re-pressurised.

Conclusions

- So many problems can be attributed to the Rover SD1 Efi fuel system due to fuel flow and fuel pressure issues and because of the age of these cars the primary cause is liable to be fuel contamination due to a broken tank filter allowing crud into the fuel pump and beyond.

- If maintenance is neglected a blocked fuel filter is common as are damaged or malfunctioning injectors.

- If fuel contamination is not a problem or has been routinely prevented/cured, the fuel pump and fuel pressure regulator are very robust items and are less likely to fail as a result.

- Indeed, many of them are still operating after 25 years of service for maybe 150,000 miles or even more.

- Never-the-less, when they do start giving problems the actual cause will still be difficult to diagnose because either too high or too low fuel pressure will create a rich or weak mixture respectively and with these symptoms other components in the fuel injection system generally tend to come under suspicion first.

- For example, faults associated with the coolant temperature sensor, throttle pot, airflow meter, extra air valve, ECU and rogue air leaks might all affect mixture control in one way or another.

- Consequently the only way to be sure that the fuel system is working correctly is to perform the tests as described.

- It’s not rocket science and all it requires it a little time and careful observation of the safety guideline given above.

- In fact, it is a job worth doing on a routine basis even when problems are not suspected.

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