Rover SD1 Efi System - Extra Air Valve - Explanation and Testing

Introduction

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

- A fundamental feature of the Rover SD1 Efi System is that, providing the volume of air entering the engine is accurately measured by the Air Flow Meter, the Electronic Control Unit will always calculate the correct amount of fuel needed to maintain the required air/fuel (stoichiometric) ratio, making minor adjustments according to coolant temperature, air temperature and battery voltage.

- When the engine starts from cold the ECU also has to overcome a temporary increase in friction caused by the viscosity of cold oil. There are no sensors measuring this but if ignored it will swamp normal idle speed and cause it to stall.

- To prevent such happening, the idle speed of the engine is artificially raised by introducing more metered air to the engine via the EAV. This metered air enters the system, not via the throttle discs, but directly into the rear of the plenum chamber. No changes in air/fuel ratio are caused by the function of the EAV.

- Basically, the EAV is temperature sensitive to two sources of heat, coolant temperature and an internal heating coil. The bimetallic lever within the valve must respond to both these heat sources before it can fully close the valve

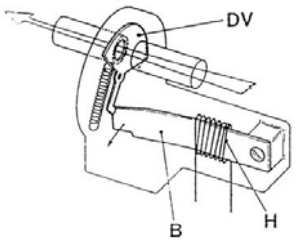
- Prior to cranking, with the engine cold, neither of these heat sources is present so the valve is fully open. From start-up, the internal coil is energised and heats the bimetal. At the same time the coolant temperature starts to rise also affecting the bimetal causing the EAV to close progressively.

- When the engine is sufficiently warmed and running normally, and with the heating coil still energised, the extra friction cause by the viscosity of cold oil has been eliminated the valve become fully closed and no air enters the engine via this route. Thereafter, the EAV does not figure in the normal running of the engine.

Location and Operation

- The EAV is mounted on the inlet manifold coolant gallery in front of and to the right of the plenum chamber, and is therefore sensitive to coolant temperature.

- Its design is simple and contains a disc valve (D) as seen in Fig.1A. When cold, an aperture in the disc and an aperture in the body of the valve are in alignment, allowing air to pass through. As temperature rises, the disc turns about its central spindle progressively eclipsing the aperture through which the air can pass.



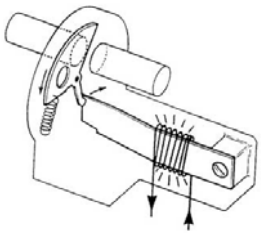


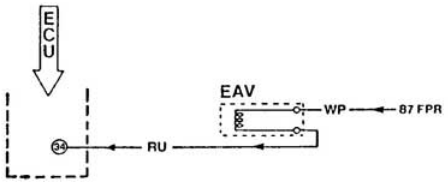
Fig.1A Extra air valve (cold) Fig.1B Extra air valve (hot)
DV Disc valve B Bi-metal H Heating wire

- The disc is turned by a bi-metal (B), which responds to both ambient (coolant) temperature and to the heating wire (H) coiled around it. The coil is connected to the fuel pump electrical circuit and therefore heats the bi-metal (Fig.1B) which begins to close the valve as soon as the engine cranks and runs. Once the engine is running, the combined effect of the heater coil and engine temperature closes the EAV fully between 60 - 70°C.

Electrical Operation

- The EAV contains a heating coil (Fig.2) which, when heated, causes a bi-metal to partially close off the air valve progressively.

Fig.2 Circuit diagram



- The heating coil is connected between terminal 87 of the fuel pump relay and pin 34 of the ECU where the circuit is grounded. Therefore when the fuel pump is operating, current is also passing through the heating coil and once the valve has closed after warm-up due to the combined effect of the heating coil and the coolant temperature being above 60 - 70°C the heat from the coil will continue to ensure that it does not open again until or unless the engine cools.

Testing the EAV for Air Leaks

- If the EAV or its connecting pipes lose their integrity, rogue air can be sucked into the plenum chamber and significantly upset the fuel/air mixture which, being un-metered, of course, cannot be corrected by the ECU. With the engine at normal operating temperature the following tests will confirm if there is a problem.

- Remove the rubber hose connecting the air rail to the metal pipe adjacent to the throttle area and seal the metal pipe with a patch of sticky tape (badge tape). Remove the “U” shaped rubber hose that connects the EAV to the plenum chamber and seal the open end of the pipe into the plenum likewise. The EAV and its connecting pipes are now completely removed from the system.

- Restart the engine and using the engine idle speed adjust screw, set the idle speed to about 850 rpm using an accurate tachometer (calibrated accordingly) connected to any injector or the negative side of the coil. Allow the idle speed to settle and note the exact reading. Stop the engine, remove the sticky patch from the plenum chamber and refit the "U" shaped hose connecting the EAV to the plenum.

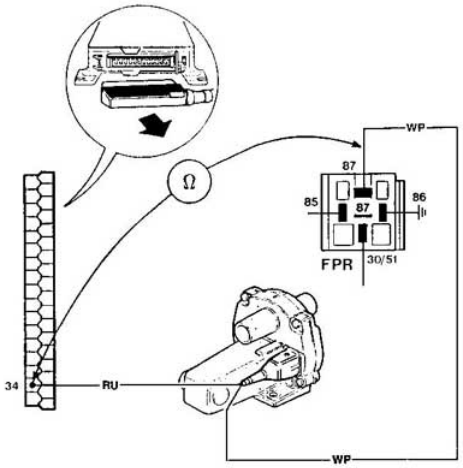
- Restart the engine, allow the idle speed to settle and check for a change in engine speed. Assuming the "U" shaped hose is sound and because the inlet hose is open at the throttle end, any change indicates that air is leaking through the EAV mechanism into the plenum chamber and therefore a fault exists in the EAV itself.

- A small change (of say 20 rpm) would not be considered a problem as there is likely to be a trace of air bypassing the disc inside the EAV but if the idle speed varies significantly (say up to 200 rpm), this is a strong indication that the bimetal heating coil is not functioning correctly leaving the valve partially open.

- It is also possible for the valve disc to be damaged or distorted such that the aperture in the EAV will not close off. Such damage would not occur naturally, probably being caused by injudicious poking with a metal object inside the valve. Any fault at this stage should be corrected before proceeding. Stop the engine, remove the other sticky patch, reconnect the hose adjacent to the throttle and repeat the process by restarting the engine, allow the idle speed to settle and re check the idle speed.

- Changes in idle speed at this stage indicate a problem with the rubber hose connecting to the air rail or the air rail itself or another component connected to the air rail such as the overrun valve or the air-conditioning anti-stall valve. If during the above checks no significant change in idle speed is detected then the EAV and all its connecting pipes are proved to be sound with respect to air leaks. Reset the idle speed to the desired value.

Testing the EAV and its Electrical Connections



- Test Conditions
  - ECU multiplug disconnected
  - Ignition OFF
  - Connect ohmmeter between terminal 87 on fuel pump relay and pin 34 on ECU multiplug.
- The resistance should be 30-40 ohms.
  - If outside these limits, renew EAV.
- If the ohmmeter shows open circuit, check for connection faults as follows
  - White/purple wiring (WP) and red/ blue wiring (RU) and connections
  - If necessary connect a substitute extra air valve and recheck reading

- It is easier to connect a substitute air valve than to attempt to connect the ohmmeter to the original valve in situ where terminal access is restricted.

- Correct any wiring or connection faults found at this stage.

Conclusions

- The EAV is a very robust component and because of its simplicity should rarely fail mechanically unless there has been interference with the internal components with a screwdriver or similar intrusion. It is however susceptible to electrical problems, as is any coil heating device but is much more likely to suffer from connection problems.

- This is particularly so, because the electrical socket is inaccessible when mounted on the Rover SD1 manifold and the plug can become dislodged or the connections can become corroded whilst its inaccessibility prevents easy fault diagnosis.

- The EAV's robustness also means it rarely fails with regard to air leaks within the component itself but the same cannot be said of the rubber hoses connecting it to the air rail and plenum chamber respectively. The under bonnet environment of the Rover SD1 Efi Engine is particularly harsh, regarding heat, so there is propensity to failure regarding rubber connecting hoses.

- Splits in hoses or hardening of the rubber can allow varying amounts of rogue air to be sucked into the plenum chamber depending upon under-bonnet temperature. Minor leaks often cause a hissing or whistling noise particularly on overrun.

- A way to prevent such air leaks is to ensure hoses are kept clean and free from contamination by oil or dirt and if a rubber to metal seal is faulty then the addition of a discrete hose clip will prolong joint life by many thousands of miles. Having said that, over-tightening of such clips can lead to early and unexpected failure.

- There are other "air system" functions and system components attached to the air rail and plenum chamber by various rubber hoses. If rogue air leaks into the plenum chamber are suspected of causing problems but the EAV checks out OK, similar checks can be made for the integrity of these other components.

- Finally, as with most components of the Rover SD1 Efi System, substitution of the EAV can be an alternative route to fault diagnosis. There are still plenty of inexpensive used items available through the second hand spares market or popular auction sites making it worthwhile picking up a spare item when the opportunity arises.

Ramon
Website: http://www.vintagemodelairplane.com
Blog: http://uk.blog.360.yahoo.com/maureen9235