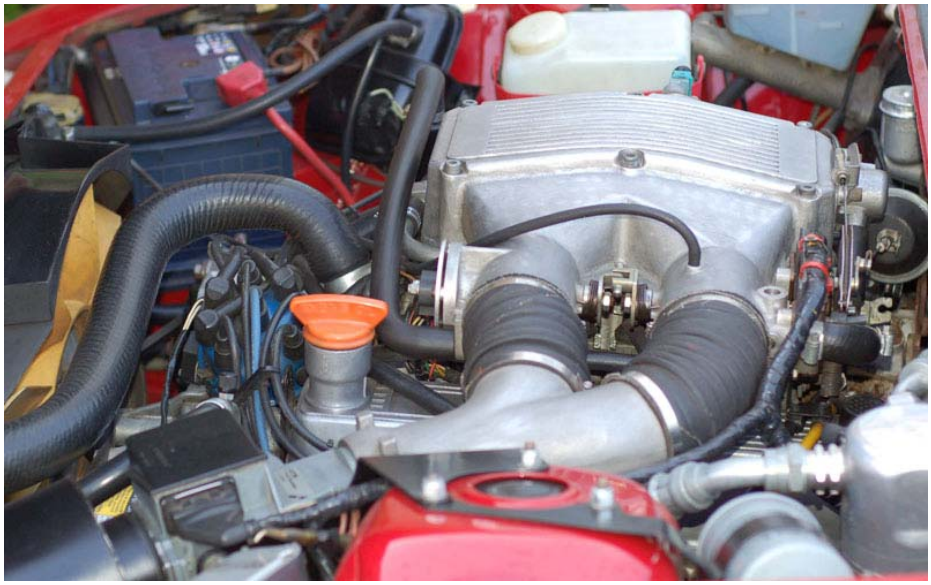
Rover SD1 Efi System - Testing and Adjustment.



Here is a methodical program to test and adjust the Rover SD1 Efi System that has gained an undeserved reputation for unreliability. On the majority of cars, this is wholly due to long term neglect, lack of cleanliness and poor maintenance. Do not assume that poor engine performance is caused by a faulty Efi system without first ensuring that the ignition components are in good order, ignition and cam timing is correctly set, distributor cap, rotor arm, spark plugs, coil and leads are all clean and dry, and that air and fuel filters are OK. If the engine actually runs, even if a little rough, so much the better, but even on a dead engine, many of the following checks can still be carried out.

Although there are many potential problems with the Rover SD1 Efi system the two most common causes are uncontrolled air leaks into the plenum chamber and electrical wiring/connector faults. In addition, most faults are detectable passively or at idle by using this “easy to follow” schedule. Diagnosis, adjustment and correction are carried out using simple equipment and test techniques.

This, then, is the agenda of key points that must be checked or corrected to ensure the Efi system behaves itself under idle conditions. If all the checks are completed and faults, where found, are put right, then there is a high probability that the system will also behave correctly under normal driving conditions. It is possible to use a scattergun approach to testing but the chances of hitting the right solution are significantly reduced. The sequence recommended offers the best chance of solving problems. Also, bear in mind that there may be more than one fault present, thus, completing the whole program offers a good probability of curing them all.

1. Check for blocked breather including flame trap, main breather pipe and gallery at the front of the plenum chamber. There is a usually a lot of crystallized carbon gum around here and the narrow gallery must be clear right through to the plenum interior. The breather inlet on the rear of the left hand rocker cover has a small hole that must also be clear. If fitted, the small filter here needs to be free of contamination. Also make sure the main breather pipe is not split.

2. Check for a blocked idle air gallery which runs directly away from the rear left hand side of the plenum from the bottom of the idle adjust screw hole and is about 2" long. It must be clear and clean. This and the breather gallery are easier to clean with the plenum removed. Removal offers an excellent opportunity to clean and service the throttle assembly also - see later item 8. It's amazing how much sticky gum collects inside this part of the system and if badly contaminated it is a sure sign of neglect.

3. Check for obvious air leaks at all plenum hoses and vacuum lines, but particularly the main inlet air hose(s) which can split, delaminate or be poorly fitted by its large but delicate jubilee clips. A systematic check is described later from item 9 onwards.

4. Because the "CO2" mixture adjust screw on the air flow meter can get seriously maladjusted by well meaning enthusiasts or dumb garage mechanics, wind in the allen headed screw and count the number of turns it takes to go fully home. Make a note of this number in case it becomes necessary to revert to this setting in order to make the engine run again. If it is close to 2 ½ turns from fully home, that is OK, otherwise set it to that figure. By and large the Rover Efi system tends to run on the weak side and in any case, CO2 levels depend on more than just this factor and subsequently, by all means get it measured using professional equipment, but for the time being the recommendation is close enough to get the system working.

5. Switch on the ignition but do not run the engine. Use a basic digital voltmeter to measure the voltage between the red and green wires of the throttle potentiometer and make a written note of the reading, again, in case it is necessary to revert. It should be 325 millivolts (0.325 volts) plus/minus 25 mv. If required, slacken the three retaining screws slightly and rotate the assembly until 325 mv is obtained. Tighten the screws and recheck the reading.

6. Slowly operate the throttle mechanism by hand and watch the voltage reading go smoothly to a maximum of 4.3 volts. Some set-ups may fall slightly short, say 3.7 to 4.1 volts, but it does not affect the system operation very much. If the reading is erratic or unstable then the throttle potentiometer is probably faulty and will need to be replaced. It is possible to prolong the life of this item, as described elsewhere, as is the substitution of the original component with a readily available alternative. Providing the voltage change is slow and smooth the injectors may be heard firing/clicking just once as the assembly approaches full throttle. When it is opened rapidly, the injectors fire much sooner during the rotation. This simulation of fast acceleration emulates the supplementary injector firing needed to provide the extra fuel needed as soon as possible during real conditions. If it proves impossible to get anywhere near the maximum voltage with the throttle fully open then inspect the throttle quadrant/assembly, cruise control quadrant - especially because it can foul it’s own mounting bracket, accelerator pedal, driver’s side floor carpet and automatic transmission kick down cable. Faults here can prevent full throttle opening. If the voltage rise is erratic it is very likely that the injectors will be heard firing randomly or in sympathy. This faulty signal from the potentiometer fools the ECU into thinking the throttle is moving swiftly when it isn’t, and under casual driving conditions results in a rich mixture and lumpy running with gross adverse affect on fuel consumption caused by the random injection of extra fuel. Contrary to item 5, erratic voltage readings are observed more readily with an analogue voltmeter.

7. Run the engine until hot and set the idle speed to about 800 rpm. If a stable and reliable idle speed cannot be obtained, there are more air rail and/or vacuum checks to make (From 9 below).

8. Firstly however, does the idle speed reset to the same level every time the throttle closes? If not the mechanism must be mechanically checked for “idle speed hang-up". Un-wanted friction anywhere in the assembly is the killing factor. This will necessitate disassembling the throttle shaft(s) and disc(s) to clean up all the external and internal components, bearings, disc and tunnel, and thoroughly inspecting each component for misalignment and wear. Cellulose thinner makes an excellent solvent for cleaning the internal metal parts but do not allow the fluid anywhere near paintwork. Judge which parts, if any, to replace and whilst sourcing spares from after-market suppliers is possible it can be expensive, do fit inexpensive new throttle shaft rubber seals if the originals are hardened or split. Range Rover dealers have them as do carburettor suppliers. All this is much simpler with the plenum chamber removed to the

workbench. When re-assembling, take special care to ensure the disc(s) is (are) absolutely central within the tunnel(s) and be sure that the whole throttle mechanism operates smoothly from fully closed to fully open. On the SD1 system the throttle disc(s) should leave no gap in the tunnel when closed. This is a contentious issue as some other system descriptions tell it differently and it might well depend upon whether there is a throttle stop screw adjustment on the mechanism. Either way, when the throttle assembly is properly adjusted, idle speed should be smoothly controlled by the idle air adjustment screw from a stalling level up to about 1400 rpm and “hang-up” should be hardly noticeable. Some twin plenum owners have resorted to adding an extra return spring to the central shaft connections to overcome this fault but if the twin disc throttle is scrupulously clean and correctly adjusted this spring should not be needed. More so, because a supplementary spring adds considerable resistance to the rotating forces which in turn accelerates any potential wear suffered by the delicate rearward throttle shaft.

9. Air leaks are a major source of problems and can be checked out systematically as follows:- With the exception of the fuel pressure regulator vacuum pipe, disconnect all other air and vacuum pipes from the plenum, degrease the ends of the pipes/fittings and seal all the open pipes and plenum connection points with patches of sticky tape. Badge tape is ideal. For cars fitted with air conditioning, set the heater controls to "off".

10. Run the engine as in "7" ensuring that it holds a steady idle speed around 800 rpm. It may be necessary to pump the throttle to get the engine started with the extra air valve detached. Use an accurate external tachometer to monitor the engine speed (**). Re-attach one function at a time in the following order and watch for an idle speed change. If it does then a rogue source of air has been introduced into the plenum, either due to a damaged pipe or a faulty ancillary item.

    - Extra air valve - see 12 below
    - Over-run valve - see 13
    - Brake servo - see 14
    - Automatic transmission modulator valve - see 15
    - Aircon idle boost valve, if fitted - see 16
    - Idle speed boost valve, if fitted - see 16
    - Air rail - see 17
    - Vacuum advance - see 18
    - Aircon heater control mechanisms - see 19
    - Fuel pressure regulator and pipe - see 20
    - Plenum - see 21
    - ** Many multi-meters have a reasonable tacho function as do some ignition timing lamps. Either way, the instrument tachometer is not accurate enough to measure changes of rpm.

11. Checking only one function at a time, re-attach the air or vacuum pipe(s) and rectify any faulty hoses and/or ancillaries discovered. Significant changes (say) 30-100 rpm must be dealt with. Smaller changes (say 10 to 20 rpm) may not be a problem. Make methodical notes as the tests progress and remember, at idle speed on a warmed up engine, the only fresh air allowed to enter the plenum must pass through the airflow meter, then around the around the closed throttle disc or through the idle speed air gallery controlled by the idle adjust screw. Any other source of air is un-metered, must be considered “rogue”, and will affect idle speed and therefore normal driving. Forgiveness, please, for re-stating the obvious, but any if air entering the plenum chamber is un-metered then the ECU cannot be aware of it and cannot calculate and supply the correct amount of fuel to make the engine run properly. To repeat, be sure to check the rubber pipes connecting all the following ancillaries, for damage.

12. If rogue air enters the plenum via the extra air valve which is only supposed to supply air during warm-up, then this may be faulty as follows. The valve is an aperture in a rotating disc turned by a bimetal strip which is heated from two sources: - (i) a 12 volt supply to the heating coil under control of the ECU. & (ii) the hot inlet manifold at about 60-70C. Note that one heat source alone provides insufficient rotation to the disc to shut off the extra air, so check the electrical connections to the valve and that the coil resistance is 30-40 ohms. Its awkward, but the valve can be tested off the car in a shallow pan of very hot water whilst applying a 12V battery to the coil and observe that the aperture rotates completely out of sight of the airway, visible through the output pipe connection.

13. The over-run valve on the rear of the plenum is supposed to pass air only at high manifold depression, i.e.: - high vacuum. However, it may be maladjusted or even jammed open by debris allowing a continuous flow of air. The mechanism consists of a spring, a plate and an adjustment nut. The correct setting is not clearly defined in any of the workshop manuals but it will not be far out if the adjustment nut is 6 turns out from fully home. When refitting the valve, ensure that the mating faces of the housing/plenum are sealed sparingly with suitable sealant.

14. The brake servo must hold a vacuum. There is a non-return valve and seal on the servo and a fault here or in the servo itself will also almost certainly affect braking system efficiency.

15. The automatic transmission modulator valve may go faulty. If it does then manifold depression sucks ATF into the engine causing lots of smoke. It is common for the rubber elbows at each end of the metal pipe, one is under the car at the very rear of the transmission, to split or simply detach because the pipe is misaligned. When that happens, rogue air enters the plenum. A split elbow can be easily fixed with superglue. Degrease it first.

16. The air conditioning idle boost valve is most unlikely to leak but the pipes can deteriorate and thus leak air into the plenum. It is also worth checking the valve is not blocked (it happens) as this allows aircon "cut-in" to adversely affect idle speed without the compensating air to hold up the rpm. The same checks are valid for the idle boost valve compensating for gearbox load. This item was not fitted to new auto cars but was retro-fitted to some cars on a technical recall basis.

17. The metal air rail delivers metered air to other components and it is partially hidden below the plenum intake. Because it has one or two braised/soldered take-off points, check it for leaks.

18. The membrane inside the distributor vacuum advance often fails and can be checked by sucking on the open pipe for a holding vacuum. Obviously this will adversely affect distributor performance and should be corrected, but it will not affect idle speed as the closed throttle disc occludes the hole into the plenum intake area.

19. The heater controls on an aircon car can leak vacuum via the operating quadrant, flap control, pipes and water shut off valve adjacent to the right hand rocker cover. Operate the various heater/aircon controls to see if they affect idle speed. If they do the associated pipes and quadrant are located below the central console which has to be removed along with the glove boxes, radio and trip computer keyboard.

20. It is necessary to check the integrity of the fuel pressure regulator and its vacuum pipe by sucking on the pipe to ensure it holds a vacuum. Unfortunately it is not possible to carry out a dynamic test as previously described with the pipe disconnected as this would upset the fuel pressure control, which itself would upset idle speed. A suspect fuel pressure regulator may be checked out with a pressure gauge fitted to the fuel rail at the cold start injector feed pipe and looking for the correct fuel pressures described in the workshop manual, usually 26 to 36 psi.

21. The plenum itself may also leak air via its seal with the trumpet housing. Squirt some "WD40" or "Cold Start" all around and along the seal and watch or listen for unwanted suction or observe for changes in idle speed. Apparently the ingress of fluid can cause a noticeable exhaust smoke but not always. Removing the plenum provides ideal opportunity to address the upper assembly jobs previously mentioned, and when refitted, smear the seal edges sparingly but effectively with instant gasket. There is about 30" of metal-to-metal seal no wider than 3/16" so it's very vulnerable to leaking. If after completing all the above tests there is still an idle speed problem, its time to check other components as follows:-

22. The Efi temperature sensor should measure about 200-300 ohms when engine is hot. Short lived hunting or rhythmic idle speed changes when cold, is an occasional design characteristic of this system and can be improved by connecting a 10Kohm resistor across this sensor. Later versions of "Haynes Workshop Manual" shows how this is done. Interestingly, whilst a 100% correctly set-up system does not hunt, quite small system errors can introduce this phenomenon. Consequently, hunting is an indicator that something is not quite correct.

23. A faulty thermotime switch will disrupt the cold start process and could even fire the cold start injector continuously but under the condition being tested the mixture would be so rich the engine would hardly run. Eliminate any affect from a faulty switch by pulling off the injector plug to test for changing idle speed. The cold start injector gasket/seal must be checked for integrity. Also check for a leaky injector by removing it to observe for weeping petrol whilst the fuel rail is pressurised.

24. Because it operates in a very hostile environment, the Efi wiring loom and its connections are notorious sources of intermittent problems so check all the electrical terminations to system components for damaged joints, terminals, etc. In particular clean the earth connections at the rear of the engine block just below the left hand rocker cover. The main braided engine earth strap(s) terminals must also be checked as should the earth and connections to the distributor amplifier module on early Efi models. A common problem. Methods of checking out wiring looms for such problems are described elsewhere.

As yet, there is no mention of the Airflow Meter, ECU, and Injector Resistors. All can be checked using workshop manual guidance and testing by substitution is often the only practical option but this needs a cooperative Efi owner, friend or club colleague willing to loan the appropriate item. Alternatively, these items are often available in online auctions for reasonable prices.

The Airflow Meter has an adjustable spring position beneath the sealed plastic cover and whilst adjustment is possible such action is not within the scope of this procedure. Bear in mind that for the standard system then the original settings on the airflow meter are most likely to be the correct ones and that any maladjustment will only lead to problems. If the meter is suspected of being maladjusted, try to obtain one that is known to be good.

If they are suspect, Injectors can be professionally checked at some expense. Alternatively, buy a full set of replacement pintle caps and filter baskets for only a small outlay from Burlen Fuel Systems or a local Injection Factor and with confidence, care and cleanliness, repair is not particularly difficult. Cut off the swaged hose collar at a sharp angle using suitable snips or a small metal saw. Discard the old fuel hose. Extract the filter with a small "easy-out" or a suitable sized wood screw. Cut off the pintle caps and wash everything with Panel Wipe. Blow-dry and clean with an airline. Press new caps and filters in place in a vice using hardwood protectors with a small hole preventing pintle damage. Test each injector on a hose containing an ounce or two of Panel Wipe at 30 psi from an airline, pulsing the coil with a 3 volt (not 12 volt) power supply and observe, against

a back-light, an orderly conical spray pattern with no dribbling. Couple new hose lengths to the injectors using neat fuel hose clips from Burlen and upon re-assembly, connect the new injector hoses to the fuel rail along with any other new hoses as required using the same type clips.

The fuel supply system also needs checking, by the book, but is unlikely to be a source of idle speed errors. Never-the-less check for blocked filter, fuel pump performance, damaged pump resistor and petrol tank ventilation.

If after all the above checks the idle speed problems persist or there are other problems manifesting when driving then a more serious review of the components must be undertaken. In this case it will be necessary to seek professional assistance or perhaps try to obtain one of the specific manuals available for this system.

However, hopefully the above test process will have enlightened the reader that the Rover SD1 Efi system isn’t rocket science and that by performing these few simple, orderly tests, anyone might rectify the performance of an afflicted Efi system.

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