# The Rover SD1 V8 Electronic Ignition System – Components and Testing.

**Prologue!** A holy trinity of Rover, Lucas, Bosch created the Rover SD1 V8 Electronic Ignition System but few pilgrims know it well. A saintly minority have it taped, including auto-bods who never tell anybody anything in fear of their secrets being usurped and a handful of enthusiasts who, even when trying to be helpful, display an incomplete gift of clarity to impart the joyous message to the congregation! Some of us only think we understand the gospel and as a result can further misinform those who don't. Consequently, numerous Rover SD1 V8 owners have very patchy knowledge of how their electronic ignition system really works. Yours truly, included!

**The Problem** today is aggravated since Rover first installed electronic ignition in the SD1, there have been several variants and over the last 20-30 years the various components have been "mixed n' matched" into many of the few remaining cars. Thus, confusion reigns and even if one has a grasp of the basics, dealing with hybrid systems means a problem can be hard to resolve. Knowing nothing, I resolved to do something about it and visited cyberspace to garner/study some interesting material and now, hopefully, set down a definitive understanding for laymen, of all the components that make up the Rover SD1 V8 Electronic Ignition, how it is supposed to work, how they interact, what to watch out for and how to test for the various fault conditions.

**The Reality** however, needs to be clarified. OurRV8 engines need two favourable conditions to make them growl; a combustible air/fuel mixture in the approximate ratio of 14.7 to 1 sucked or injected into cavernous combustion chambers plus a big fat spark occurring at exactly the right time to set off a controlled burn. Getting both these basic requirements right is an exhilarating driving experience resulting in the power and energy of nearly 200 horses being unleashed for everlasting pleasure. Getting them wrong can be a frustrating crawl of unfulfilled potential and kangaroo progress similar to the power of Hercules, Steptoe and Sons' carthorse, after he died! This treaty deals only with the ignition, perhaps rashly assuming that the fuel supply system – be it either by carburettor or by fuel injection – is actually working OK. And so it begins!

**The Individual Electronic Ignition Components and their Functions** as described below, from battery right through to the spark plug and beyond, are all involved and interacting together to generate a bright spark that ignites the awaiting air/fuel mixture. They must all work flawlessly for maximum engine efficiency.

**A Battery** in good condition, capable of lighting the blue touch paper of the ignition system even whilst churning a reluctant lump on a freezing cold day.

**An Alternator** with built in charging system to ensure the battery is always able to do its job.

**An Ignition Switch** with four key positions.

- Off.
- Accessories.
- Ignition On.
- Cranking.

The latter two positions both supply 12 volts to enliven the ignition circuit.

**A Distributor** with three tasks.

- Determine the eight exact moments during the four stroke cycle to generate a signal pulse to initiate the high voltage sparks.
- Route the resulting sparks to the right combustion chamber.
- Advance the ignition timing according to either inlet manifold vacuum or engine speed.

And inside the distributor:

**A Vacuum Advance Module** that senses manifold depression as soon as the throttle plate moves away from the idle position and advances the timing to capture maximum efficiency from the upcoming combustions at low engine speed before passing over ignition timing responsibility to:

**The Mechanical (Centrifugal) Advance Mechanism** that uses weights and springs to control the amount of ignition advance according to the engine speed.

**A Magnetic Rotor or Reluctor** with eight peaks to present a pulsing magnetic field adjacent to:

**A Pick-up Coil** that generates its own output (like an alternator, so not needing a voltage supply) to send a synchronised sine wave signal through its two electrical connections to:

**An Amplifier Module** mounted either on the side of the distributor or in a housing behind the coil, already connected between coil negative and earth that responds instantly to the incoming pick-up coil signal, switching on and then off, a path to earth for the negative side of:

**The Coil** like a transformer, using switched current from the battery to induce 10-20,000 volts in its secondary windings capable of bridging gaps up to10mm with a bright blue lightning strike.

**A Condenser (or Capacitor)** connected across the coil/amplifier combo to suppress RF signals otherwise destined to upset in-car entertainment and offend un-neighbourly TV soap addicts. It is also alleged to assist in rapidly collapsing coil primary voltage for sharper high voltage discharge

**A King Lead** connects the high voltage terminal of the coil to the centre turret terminal of:

**The Distributor Cap** that receives and transfers the high voltage discharges to the:

**The Rotor Arm** beneath the cap, which allocates the sparks to one of eight turrets connected to:

**The High Tension Leads** with particular RF suppression impedance terminating at the prickly:

**Spark Plugs** where a flash of highly charged electrons ignite the eager air/fuel mixture inside the combustion chambers, such that, under all engine conditions, the exact event is determined by:

**The Ignition Timing,** not in itself a component, but a critical function, often maladjusted.

**A Trigger Resistor** connects signals generated at coil negative to Pin 1 of an ECU on fuel injected cars informing it the engine is running and please keep injecting fuel until pulses cease.

**The Same Signals from Coil Negative** also go to the tachometer to indicate engine rpm and to the cruise control over-speed relay for engine protection if the cruise ECU tries to accelerate the engine when the transmission or gearbox is disengaged.

**Routine Maintenance and Preserving Component Lifetime** are essential for this diverse collection of parts to operate without missing a beat for years on end, up to an eye-watering 24000 high voltage discharges per minute making up to 20000 volts in the hostile under-bonnet environment of heat, damp, oil, grease and human interference normally found on our Rover SD1 V8. Plenty of scope for problems and faults, all the more so, if we unknowing enthusiasts neglect basic maintenance needs or component replacement schedules.

**Moisture** is by far the main problem yet so simple to neutralize with a monthly spray of damp inhibitor such as WD40 followed by a careful wipe over the external surfaces of all components using a clean rag. Consequently, leads, distributor cap and coil should last many tens of thousands of miles beyond normal life because the risk of high tension tracking across damp surfaces is eliminated. Plug leads last much longer without damp/grime contaminated surfaces.

**Commonly, Moisture Condenses inside the Distributor Cap,** so for the same reason, the rotor arm and the inside of the cap should also be routinely cleaned of deposits which may encourage high tension tracking. More recently there has been an increasing trend of component failure due to inferior manufacturing materials, so local cleanliness is very important. Like it or not, over-looking this simple task will invariably lead to premature component failure.

**The Ignition Switch** is a pain because normal failure mode is always intermittent. Few last for more than ten years, yet a single injection of Vaseline a.s.a.p. or when fitting a replacement will help it outlast any car. Manufacturers rely on un-lubricated switches to boost future spares sales.

**The Ignition Amplifier** has finite lifetime of 60-100000 miles which can be compromised if re-fitted or replaced without proper thermal paste to allow internal heat to escape as fast as possible.

**The Coil** lasts longer, typically 100-150000 miles. However failures elsewhere are often blamed on the coil which is then unnecessarily replaced more than any other component in the system.

**The Distributor** is a very accurate, yet hardy unit. Lifetime *should* exceed 150000 miles but neglect is the enemy so premature failure is easily sidestepped by cleanliness plus light routine oiling of the rotor spindle, bearing surfaces, springs and weights to keep corrosion at bay.

**The Condenser's** random failure is not easy to diagnose but newly heard RF interference is a good clue so if it comes under suspicion, considering how cheap they are, replacement as in earlier times when points and condensers were routinely changed together is an easy solution.

**Vacuum Advance** seems to suffer from random membrane failure at less than 100000 miles and need monitoring by 'mouth sucking' the vacuum pipe whilst observing the advance action.

**Mechanical Advance** benefits from internal lubrication as mentioned. Distributor strip-down for access requires a clean bench, care and good tools. Check out workshop manual before doing it.

**Spark plugs** must be routinely cleaned; gaps adjusted every 5-6000 miles and renewed every 10-12000 miles, but more frequently as the car gets older or if there are air/fuel mixture control issues that affect plug condition adversely. Even if the system seems to be operating normally there are other important considerations. If plug gaps are too small, the high voltage jumps the gap too easily, the spark is weak and cold, the burn is inefficient but plug life is extended. If the gaps are too large, the spark is stronger, hotter and longer so the burn is more efficient but plug life is reduced. Worse, extra voltage build-up can cause collateral damage elsewhere. As ever, the choice is between performance and cost. Not so obvious, if plugs have dissimilar gaps, then efficiency from each cylinder will be mismatched, engine performance will be rough and out of balance due to uneven power of combustion. A subtle issue worthy of more attention than it gets.

**High Tension Leads** can be public enemy number one, and like coils, habitually blamed for ignition failure elsewhere followed by premature replacement, often with high cost, snake oil, aftermarket versions, too thick to fit existing separators. All quite unjustified because, from the get-go, their very nature demands outstanding insulating properties for safety and fire hazard reasons so, really, even lower cost original specification items should last a very long time. Unfortunately this presumes no abuse, such as pulling directly on the lead instead of the rubber boot when disconnecting from coil, plug or distributor, unwanted contact with hot exhaust pipes, neglecting to ensure they are fixed securely in their separators and failure to keep them clean.

**Ignition Timing** is not a normal maintenance issue because it does not randomly vary unless there is malfunction, internal distributor wear or uninformed fiddling. Changing fuel grade and/or vendor, can make noticeable efficiency differences so it is best to stay with the same fuel if possible, but changing octane grade permanently really necessitates a timing change to optimise burn efficiency. Before making a change check the timing marks on the front pulley/damper are legible. If not, clean with solvent and fill the indentations with white wax crayon or Tippex. Rub off the excess. When Rover built these V8 engines the amount of ignition advance at idle was specified at about 6-8 degrees before top dead centre (BTDC). Nowadays, apart from cost issues, we have limited access to high octane, leaded fuel so if choosing to use a lower grade, ignition timing has to be adjusted for best burn efficiency. Typically it should be retarded by 4-6 degrees, so one might expect the timing at idle to be set around 2-4 degrees BTDC.

**Timing Procedure** can vary according to the equipment being used but basically, with a simple stroboscopic timing lamp, ensure the setting is made below normal idle speed (say 600 rpm) and with the vacuum advance tube disconnected from the ported vacuum outlet. Loosen the clamping bolt just enough to allow the distributor to rotate. Follow the manufacturer's instructions and set the timing to the recommended (or recalculated) figure. Reconnect the vacuum advance tube and readjust the idle speed to the normal setting. Secure the distributor clamping bolt, unless moving on to the next optional, but wholly appropriate empirical step.

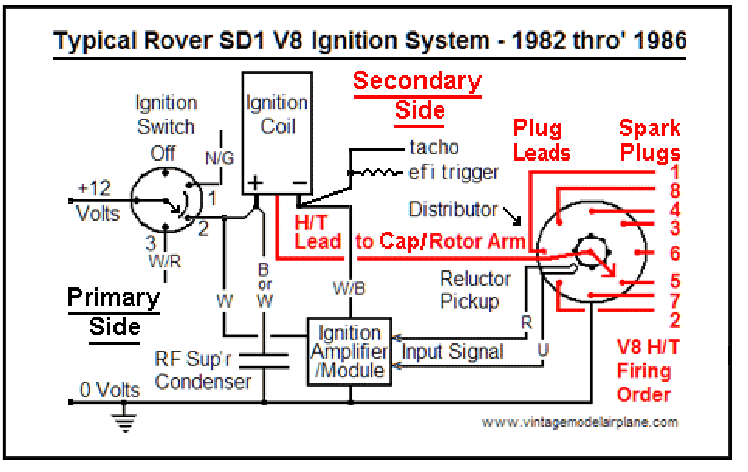
**Empirical Timing** is a dynamic process performed with the distributor clamp bolt loosened just enough for the unit to be rotated without undue force. Drive the car on a selected route where one can subject the engine to heavy uphill acceleration at low engine speed in a higher gear to listen for pinking, the high-pitched knocking noise, caused by premature detonation. If pinking is heard, stop the car and rotate the distributor very slightly to retard the ignition and test the car again under the same conditions. Use small adjustments each time until the pinking is eliminated.

**Conversely, Pinking may not be observed** at the start. To achieve optimum burn efficiency with a chosen fuel grade, advance the ignition under the same conditions until pinking begins then back off until it just disappears. Tighten the distributor clamp bolt and to finalize, back at the garage, re-measure the timing and note the actual setting for future reference. A good wheeze is to scratch a location mark on the distributor body to aid re-assembly after any future removal. As mentioned, this is not the whole story these days because fuel quality varies even between the same nominal grades and definitely between vendors who favour different additives, so decide upon the best grade and vendor to suit ones car, wallet and shopping habits, then stick to it.

**How it all Works** is best explained with the help of this **Ignition Circuit Diagram**.

**With Ignition Switch in the "OFF" Position** the main electrical systems are all off except memory feeds to radio, trip computer, alarm systems, some lighting functions such as sidelights, hazards, courtesy, and a live feed to central locking.

**In Position"1"** the Brown/ Green(N/G) circuit feeds power to accessories - radio, cigar lighters and some other functions including sunroof motor, window lift circuits.




**In Position "2"**the White (W) ignition circuit enlivens all electrical systems with the exception of the cranking circuit. 12volts is also fed to coil positive and the ignition amplifier/module.

**In Position "3"** the White/Red (W/R) cranking circuit activates the starter relay to engage the starter solenoid and motor and on Efi cars it also feeds part of the fuel system whilst cranking.

**When the Engine turns,** so does the distributor shaft and the pickup coil converts the varying magnetic field from the revolving reluctor into electrical input signals for the amplifier module.

**The Amplifier Module** switches the path to earth on and off for the coil negative terminal.

**As Current Flows through the Coil** a powerful magnetic field is built up awaiting the current to be switched off, triggering a very rapid collapse of magnetism which is transformed into a massive high voltage charge in the HT windings of the coil.

**The HT Discharge** is routed back to the distributor cap centre turret terminal by the king lead.

**The Rotor Arm,** depending upon its radial position re-directs the HT voltage out of the distributor cap turrets to each plug lead and spark plug in the correct firing order.

**At the Spark Plug**, the high voltage jumps the gap in a bright blue flash of ionisation to ignite the waiting air/fuel mixture already compressed inside the combustion chamber.

**An Orderly and Controlled Burning** of the air fuel mixture now occurs and the resulting rapid expansion of gasses generates the motive power.

**The Efficiency of the Burn** is wholly dependent on two main criteria.

- First, the correct fuel/air mixture called for by the engine depending up its temperature, speed and load as controlled by the fuel supply system.
- Second, the correct timing of the ignition sparks relative to the speed of the engine and its current load as sensed by a combination of, initially, inlet manifold vacuum advance and later by the mechanical advance systems.

**“My engine won’t run! Is it Fuel or Ignition? Let’s start with the Ignition!”** What follows is a personal collection of tests that, if carried out to the letter, will answer every eventuality. It is a structured program commencing with the secondary side, then moving upstream to the primary side. Whatever the starting point, the ignition has come under suspicion because the engine will not fire, or has a noticeable misfire. Being a home enthusiast, not an Auto Electrician, one does not have access to special equipment or intuitive knowledge enabling direct and/or magical identification of a faulty component, but it can help to have an assortment of good, second hand/used ignition parts, picked up or saved over the years, for the purpose of testing by substitution if the need arises. Something all owner enthusiasts might readily acquire.

**Testing the Rover SD1 V8 Electronic Ignition System** depends on motive but this program is highly effective for rapidly checking if the whole system is capable of making good high voltage spark or walking through each component individually in an efficient process of elimination.

**A Fully Charged Battery in Good Condition** is essential when performing any ignition test. It is pointless trying to diagnose ignition component faults with low voltage from a faulty battery.

**The Simple Ignition Test** commences by checking the secondary side as follows. Remove a spark plug lead from a convenient cylinder, usually No.1, on the front left hand bank of the engine. Connect a good spare spark plug to the plug lead and lay it safely on a metal part of the engine. Switch on the ignition and crank the engine whilst observing the spark plug.

**If there are Visible Bright Sparks,** juicy and fat, then apart from a possible timing issue, it’s likely the ignition system is working correctly. As back-up, by all means, repeat the above test with a plug lead from another cylinder and if the result is still good, for the time being at least; attention can be directed elsewhere to discover why the engine will not fire, or why it misfires.

**If there are No Sparks** or they appear to be pale yellow, very weak or intermittent, and then further investigation is called for. First of all though, eliminate the possibility of a single faulty plug lead by substituting it with one from elsewhere on the system.

**Refit the Plug Lead** and remove the king lead from the distributor centre terminal, connect it to the spare plug and repeat the last test, ignition on, crank and observe for sparks.

**If the King Lead gives Visible Bright Sparks** the fault is narrowed down to the distributor cap or rotor arm which must both be subjected to close visual internal and external inspection for the effects of carbon tracking, burned contacts, grime, moisture, whatever.

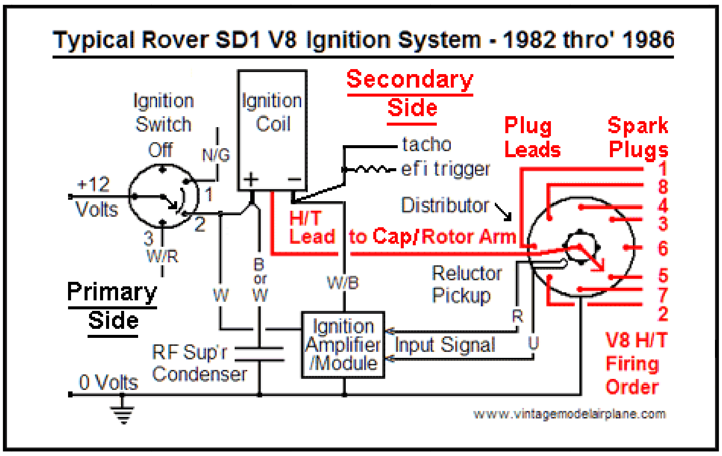
**Thoroughly Clean Cap and Rotor** with solvent spray (WD40 is good) plus a wiped-off smear of silicon grease takes care of most problems. Temporarily dress any burned contacts with fine wet and dry emery paper. If problems still exist, replacement of one or both items is on the agenda. Rotor arms are usually cheaper than caps so that might be first on the list.

**If the King Lead gives No Sparks,** temporarily swap if for a spare or a lead taken from another position on the system, and then repeat the test. If there are now sparks, the king lead is faulty.

**If the King Lead still gives No Sparks** the whole of the primary side, from the coil back to the ignition switch and beyond, are under suspicion, more of which, later.

**The Secondary Side Components** come under the most intense electrical stress and despite the frequency of coming under suspicion and unjustifiably replaced or upgraded; their misfortune is the most likely causes of problems are grime, moisture and neglect. Consequently, periodic cleaning with WD40and wiping away excess fluid will do wonders for maximizing their life.

**The Primary Side Components** benefit from cleaning too but because they deal with high electrical current, much more relevant is the need to check integrity of all the low tension connections all the way to the ignition switch and beyond to the battery.




**Review this Circuit Diagram** again, to assist identifying how parts may be disconnected/re-connected to perform some of the following tests. It denotes both versions, where the amplifier mounts inside aluminium housing behind the coil and, where it mounts on the side of the distributor. The electrics and their function are the same, just the physical location of parts differ.

**After Checking Integrity of Connections**, verify the earths and the wiring from the ignition switch through to the coil, distributor and amplifier module are pretty much the same as shown.

**The Reason for Testing Primary Side Components** as already discussed, is a proven loss of sparks at the king lead or weak/intermittent sparks thereabouts, causing misfiring.

**Test the Low Tension Side Voltage Feed** by switching the ignition to position 2 and use a voltmeter to verify battery voltage (12 to 13 volts) at coil positive. If no voltage appears, check the circuit between coil positive and the ignition switch, and if necessary, all the way back to the battery for corroded, loose or broken wires. Don't take it for granted if the voltage appears to be

OK. Waggle local wiring and toggle the ignition switch to ensure the reading is reliable because voltage can transcend poor contacts. Use a bright test lamp to check the wiring can supply a load.

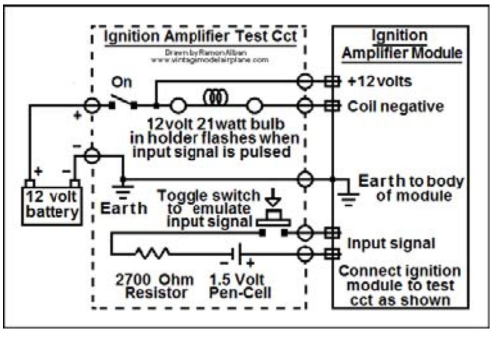
**To Test the Coil Independently,** remove king lead from the distributor, attach a spark plug as before, locate the White/Black (W/B) wire from coil negative to the amplifier and detach it from the coil. Connect a flying lead to coil negative, switch ignition on and briefly touch free end of the flying lead to earth. A good spark indicates the coil is working OK. Weak or absent sparks means the coil may be faulty to be exchanged or replaced. Repeat the test for a good spark.

**To Test the Amplifier and Distributor Pickup Coil Together,** remove the distributor cap. On Efi cars, disconnect the W/B trigger wire from the 6.8k ohm resistor to prevent spurious signals to the ECU, also detach W/B amplifier wire from coil negative. Connect a 12V 21W bulb from the same amplifier wire to coil positive (12 volt supply).The bulb acts as a substitute coil load. Turn ignition on and gently rotate distributor rotor arm back and forward against the mechanical advance springs. The toothed reluctor wheel triggers the pickup coil and the amplifier will flash the bulb. If flashing is positive and consistent the amplifier and pickup coil are working correctly together. If lamp does not flash or is inconsistent/weak either amplifier or pickup coil is faulty.

**To Test the Pickup Coil Independently,** remove the Red (R) and Blue (U) pickup coil connections at the amplifier itself and use an ohmmeter to measure the resistance of the distributor pickup coil for a steady value between 500 to 1500 ohms. Flex the wires at the same time testing their integrity. A result outside the specified range, short or open circuit indicates a duff pickup coil. By process of elimination, if pickup coil is OK, one might conclude the amplifier must be faulty but it is never that simple with electronic components, so to be sure:

**To Test the Amplifier Independently,** this elegant, simple test uses a 1.5 volt pen-cell joined in series with a (say) 2700 ohm resistor and two flying leads to simulate the pickup coil. With coil and amplifier connected normally, king lead connected to spark plug as before and the distributor pickup coil disconnected from the amplifier, connect one flying lead to one amplifier input terminal and touch the other intermittently to the other amplifier input terminal, emulating a pulsed input and activating the amplifier in sympathy to generate sparks. Pen-cell polarity is non-critical as neither lead is connecting to earth; the pulsing voltage from the pen-cell and resistor triggers the amplifier without causing stress or damage. The test can be performed with the 12 V 21 W bulb connected in place of the coil for the simulation flashes the bulb instead.

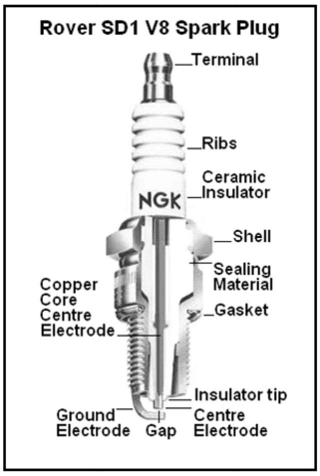
**Alternatively (for even more Elegance)**make a test box with two switches, a bulb holder for the 12 volt 21 watt bulb, 1.5 volt pen-cell, 2700 ohm resistor, 2 connections from a 12 volt car battery, 4small female spades to connect to the amplifier terminals and a clip to earth the module body. Connect up the battery and amplifier, switch on and toggle the test switch repeatedly to emulate the pulsed input from a pickup coil and observe the bulb flashing in sympathy. If it does, the amplifier (any amplifier) is working correctly.



**The Suppression Condenser** is an oft neglected item that fails by breaking down under the back-emf from the coil. Remove it from circuit to see if the problem disappears. If yes, replace it.

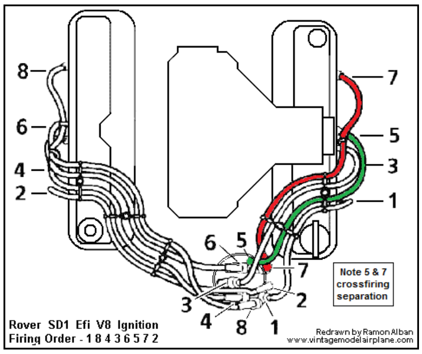
**Having tested all the Ignition Components,** first the secondary side and then the primary side, with any faulty parts replaced with good units, the ignition system should now be performing correctly so it’s an optional step to repeat the first test in this program (see below).

**The Simple Ignition Test (Repeated)** will check both sides of the system using a plug lead from (say) No.1 cylinder connected to the spare spark plug as before. Switch on the ignition and crank the engine whilst observing the spark plug. Still no sparks means something has been overlooked and the tests (in part) must be repeated. Beware, if the ignition is OK the engine will fire and run.

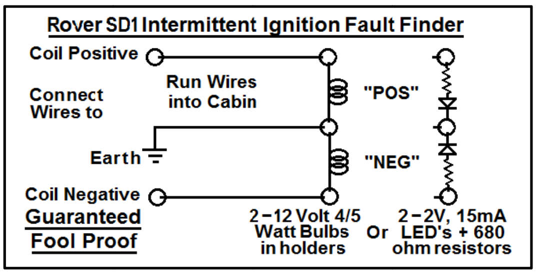



**With the Electronic Ignition System Working Correctly** there is still important tasks to perform. Remove the plugs and inspect for recommended type, insulator damage, carbon whiskers, soot or crud around the insulator tip and the gap between the central contact and the body. Clean the threads and electrodes using a traditional wire brush but be aware, it’s possible to leave metallic deposits on the insulator tip. Alternatively, sand-blast them using a kit available from tool suppliers. Adjust the gap to correct specification and clean to a shine. Remove and clean all the king/spark plug leads/boots, measure their suppression resistance with an ohmmeter, looking for about 5000 ohms per foot of ignition lead. A high reading indicates a broken or damaged conductor. Finally check ignition timing is correct as per the workshop manual, or suitably adjusted to suit low octane fuel, if used.

**Cross firing** may occur when plug leads No. 5 and 7 are adjacent to each other in their separators. As piston No 5 approaches TDC and receives its spark, piston No7 is 90 degrees behind, part way through its compression stroke. The high voltage in lead No 5 induces a discharge in No 7 by electromagnetic inductance. The resultant spark prematurely fires the partly compressed mixture in cylinder No 7 causing a partial burn, inefficiency overheating and likely collateral damage. To prevent this unique cross firing occurrence, those two plug leads must not be adjacent to each other.




**Intermittent Ignition Faults** are hard to find, often unseen in static tests, in which case try this dynamic test to view the primary side in action. Rig up two 4/5 watt, 12 volt bulbs (or better, two 2V, 15mA LED's + 680 ohm resistors) each connected between coil positive and coil negative to earth. Mark the bulbs “POS” and “NEG” and route the wires safely to the cabin. Keep them clear of hot/moving parts.



- Start the engine and observe that “POS”, sensing the ignition input voltage is permanently on, and “NEG”, sensing the pulsed voltage across the ignition amplifier flickers in sympathy with engine rpm, or is dimly lit (LED's flicker better). Now drive the car and have a helper note what happens when the engine misbehaves. If “POS” and “NEG” go out together there is an open circuit interruption of the 12 v feed such as a faulty wire/ignition switch, or a short on the same circuit due to burned insulation.

- If “NEG” comes on full, the amplifier or its associated wiring or earth contact has failed in open circuit mode or, the pulsed input from the pick-up coil to the amplifier from the dizzy has failed or the associated wiring is faulty/shorting to earth or (unlikely) the coil has failed in a short circuit mode.

- If “NEG” goes out, the amplifier has temporarily failed in short circuit mode due to excess internal heat or the local wiring is shorting to earth or the coil has failed in open circuit mode due to insulation breakdown or internal heat.

- If “POS” stays lit and “NEG” show signs of flickering instability, not sympathetic with engine rpm, then the amplifier or its connections are on the blink.

- If neither “POS” nor “NEG” change their behaviour, then the intermittency is not in the primary side so attention must revert to the secondary side high tension components.

**So does this Intermittent Test Process Help?** Well! It logically focuses on the probable erratic component as a prime candidate for replacement. It would be nice to more definitive but this is why a collection of good used parts is invaluable to confirm the diagnosis before buying new.

**The Conclusions** readers may draw from the above will be mixed. The wealthy may ignore it and replace everything anyway, yet sadly, still not find a faulty connection. The economically strapped may welcome the opportunity to test before shelling out for expensive parts. The technically disadvantaged may pale at the very thought of dealing with alien electronic stuff and the technically adept probably don’t need help anyway. As mentioned at the outset, though, the latter group are few and far between leaving everyone else needing help at some time or another.

**Epilogue!** Fear not the mighty dread, trying to fathom out the Rover SD1 V8 Electronic Ignition System. Read and re-read the article(s) until it starts to make sense and deal with the details and testing like the proverbial eating of the elephant. Take small pieces and chew well! As ever, because this is a work in progress, please advise of errors and omissions. Enjoy!

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