



## **SPARK IGNITION SYSTEMS**

Spark ignition systems began their evolution at the very beginning of internal combustion engine development, and yet still holds new challenges everyday. It's a subject I make no apology for revisiting, at ADS we are routinely rectifying ignition problems.

Some problems we encounter are as a direct result of the evolution process itself. The physical demands placed on ignition systems together with the local environment in which they operate are accelerating failure events. I am quite convinced from the exposure of problems we see that component quality and inappropriate servicing procedures are central to premature systems failure.

Ignition systems present some intriguing and potentially challenging problems, R F induction errors often causing failure or interference in other system parts, internal structural failure can be and is often discrete. We are increasingly being invited into the Serial diagnostic trap. Assurances from manufactures about the reliability and accuracy of Serial diagnostics leave me even more unconvinced.

Misfire defect, sounds reassuring but in practice is often flagged serially for lean fuelling faults rather than loss of spark energy at the plug. So what's our answer, and how do we approach ignition systems diagnostics.

**Three simple steps**, 1) Cleanliness, 2) Voltage, 3) Current.

### **Step 1**

Always examine the ignition system physically, especially the HT hardware, this often means removal of engine parts and covers. Remove the parts carefully, keep in sequential order and look for tell tail signs of tracking or corona effects. These often have an appearance of a grey plume around the coil casings, on ignition cables or extensions, and of course the inevitable brown staining around the spark plug base. Do not rush into cleaning until careful examination has been carried out, "we use a magnifying glass" and prefer natural daylight.

We find the more advanced coil on plug, and wasted spark, direct mounted coil systems much more prone to the corona effects. The decision to wash clean or replace coils must be an individual one, based on the condition. The fault symptoms and the results of a thorough diagnostic procedure involving voltage current and spark energy tests, (more later) and never costs. Your customer either wants the car to run right or not. Some people may feel my attitude a little arrogant, quite the opposite, I refuse to have confidence in a repair diminished by time wasters. Our aim is simple, perfection, the closer we come to it the happier our customers are.

Be careful washing HT hardware, use spray or splash method avoiding saturating parts in water; they are more porous than you imagine. Use a traffic film remover and thoroughly dry. Rubber coil extensions and HT leads are best replaced, this helps reduce unnecessary cost, without compromise to technical excellence.

Clean any relevant surrounding areas, this includes any conduits that carry HT leads or covers that often acts as conductors when dirty.

External power stages are mounted on heat sinks, replace the heat sink compound, this will help prolong module life by reducing operating temperatures.

Use quality spark plugs conforming to the O/E specifications; embody any relevant modifications on re-assembly for example Sagem for electrofil coils on Peugeot and Citroen vehicles.

Now you can wash your hands, make a brew and get your oscilloscope and current clamp out. I intend to focus on a couple of interesting problems we encountered both of which confirm the current clamp as a vital ingredient to an accurate assessment.

There are however six critical diagnostic measurements that confirm correct ignition system operation, all taken in the primary circuit.

(WAVEFORM)

- 1) Burntime
- 2) Primary current
- 3) Firing line
- 4) Coil Ringing
- 5) Peak Primary Voltage
- 6) Saturation time

The correct evaluation of these six key points, and often it takes only a couple, will direct you to a pin point diagnostic assessment.

Sometimes intermittent and premature component failure can be predicted.

The two problems I intend to focus on are current related and have totally opposite causes. I will support my explanations with the usual waveforms.

**Vehicle 1)** XJ6 Hybrid Zytec controller problem, weak spark, non-runner.

We carried a quick diagnostic assessment, attaching a spark plug gap tool, to confirm poor HT output. Connect Scope Ch 1 to pin 1 of coil ignition primary, connect current clamp Ch 2 around either pin 15 power supply, or pin 1 primary, crank vehicle, noting **Waveform 1** coil instability around the normally clear burn line, suggesting internal structure failure resulting in violent voltage transition

Normal current peak flow around 8 amps, however the current ramp is too aggressive suggesting the coil is not acting as a true inductor. A shorted primary is causing a low resistance; the coil is still capable of producing a weak spark. The coil if not replaced could lead to terminal failure of the driver circuit in the power module. Note the current control is working overtime already for the entire saturation period to limit the current @ 8 amps.

Now compare the circuit with a new coil, noting correct current ramping and clean burn line.

**Waveform 2**

**Vehicle 2** Mercedes 450 V8 Bosch EKZ external power stage control multiple inputs.

Vehicle fault intermittent cutting out, resulting in weak spark.

Apply same initial assessment as before with gap tool and Scope connections.

Run vehicle noting **Waveform 3** shorter than normal burn-time, coil ringing omitted suggesting coil secondary structure error, however normal current flow through primary at 10 amps, still looks like a coil secondary problem, but wait, note the way the current decays the end of the saturation period, instead of a prompt clean interruption as displayed on the good example. **Waveform 4**. A relative slow leakage of current due to driver stage error is resulting in low HT energy the cause EKZ module fault, not the coil

For a complete and comprehensive explanation of ignition and other diagnostic procedures training, and equipment choice Tel Jean 01772 201597

