Labscopes / Oscilloscopes Part: II

By Maurice Donovan (the MD)

We have spoken before about Starting With The Basics. (here we go again)

It is very important for a technician to know where to start when diagnosing a problem vehicle.

I hear of so many technicians diving head first into a job changing ECUs, Air flow meters, TPS sensors etc, only to discover the engine is low on compression or the air fuel ratio is lean or some other very basic problem has occurred.

So this brings me to some very important facts. We first must always ensure the engine is producing at least 80% of its normal compression. If we have an engine that's worn out, we're not going to be able to perform proper diagnostics.

In the old days the first thing we always did before doing a tune up was a compression test. Why are we neglecting to do this today? Is it because spark plugs are often much harder to remove, so maybe we look for an easier ways?

USING A LABSCOPE TO CHECK COMPRESSION!

As the saying goes, 'there are more ways to skin a cat' so when it comes to checking compression there is a quicker and easier option, use your Labscope! Why are so many technicians not keeping up with the many versatile and ingenuous uses of the Labscope (oscilloscope)? Many may not know that you can carry out a relative compression test quickly and without the need to remove all the spark plugs.

Secondly, we need to make sure our air/fuel ratio is within the correct proportion, meaning we must have a vehicle that has good fuel control. Again this is not time consuming or hard to check.

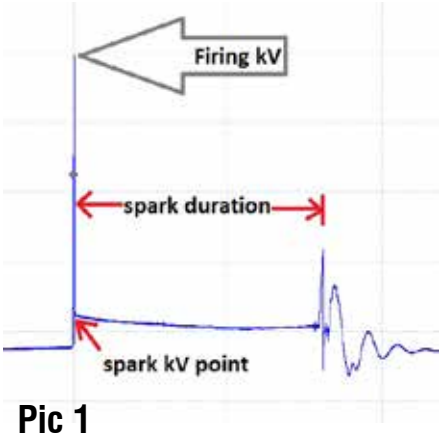
Thirdly, the intake and exhaust must be free from any abnormal restrictions. What is a normal restriction? Normal restrictions would be the exhaust system, the air filter or the throttle plate. An abnormal restriction would be a clogged or damaged catalytic converter or maybe a restriction of the intake system.

The forth basic check is our ignition secondary system which must also be in good condition and shouldn't be falling or leaking to ground. In short, we should have adequate spark. These are the foundations we need to check before proceeding.

Last edition we talked about checking the state of health of the ignition system. Let's continue as there is so much value in knowing how to read the primary and secondary ignition systems on our lab scopes (oscilloscope).

There are three critical points on a primary or secondary ignition spark pattern.

First is our Firing kV, Second is the spark kV point making sure its where it should be, (as you may remember this kv point was high when I had the wrong length plug lead ends fitted in my last story I shared). And, of course, the all-important spark duration period during idle or no load conditions. And then last but not least maybe if the misfiring occurs intermittently under a power brake loaded type condition or power brake testing the vehicle and we're going to watch those spark length characteristics to maybe find that intermittent lean density misfire, as you will see. **(pic 1)**



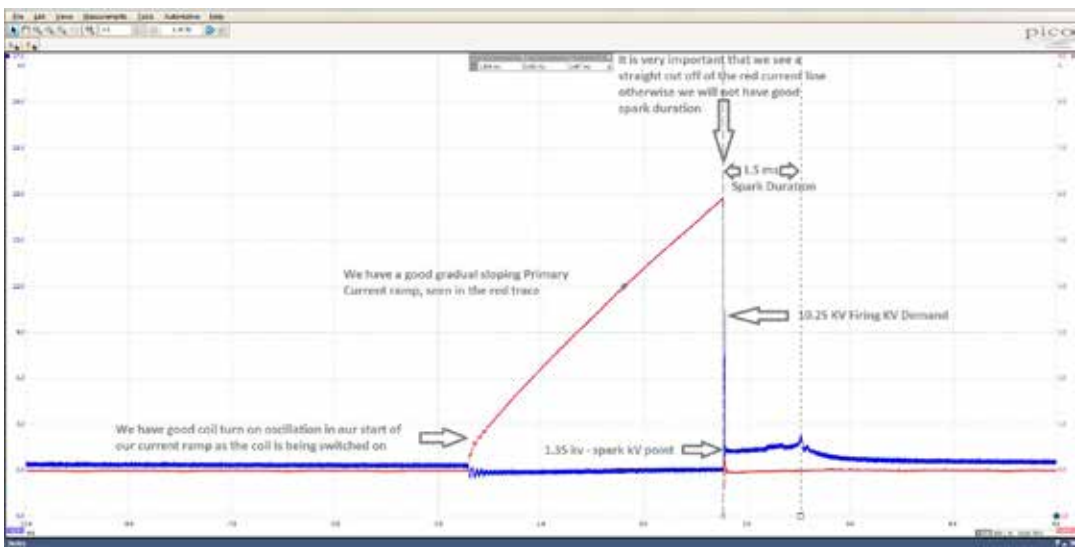
Pic 1

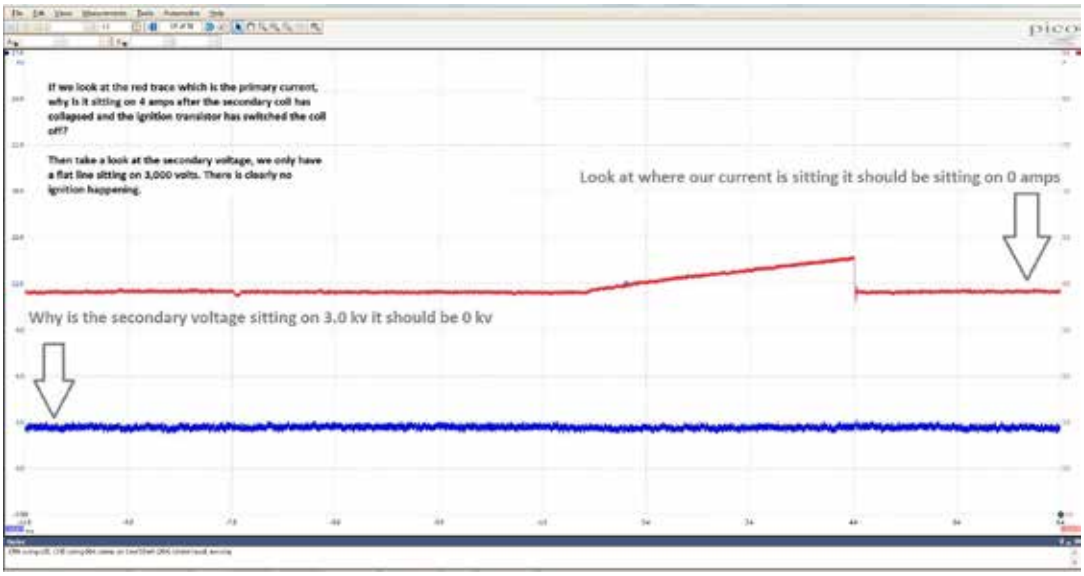
I want to share with you a story where I was helping a fellow tech understand what was happening to his customer's Mitsubishi Magna, which had an intermittent engine misfire and stalling problem. He went about this the right way, looking at the state of health of his ignition system etc.

He first sent me the images from his Pico lab scope when the misfire was not present. He captured the Secondary ignition seen with the blue trace, and the Primary current seen in the red trace. **(pic 2)**

When we are dealing with any intermittent problem it is important to have ways to reveal the problem, ie we may need to soak the ignition system with a good spray of water for example. We often need to apply the brakes loaded to load up the engine while in drive (This is knowing as a power brake type condition) to properly test the vehicle as we watch those spark length characteristics to maybe find that intermittent

Pic 2





Pic 3

misfire. There will be times when only a road-test may be the only way to catch this intermittent misfire.

And this Power Brake scenario is what I asked my fellow tech to do, and when he sent me the scope screen capture, it was no wonder his Mitsubishi was dying.

(pic 3) If we look at the red trace which is the primary current, why is it sitting on 4 amps after the secondary coil has collapsed and the ignition transistor has switched the coil off?

Then take a look at the secondary voltage, we only have a flat line sitting on 3,000 volts. There is clearly no ignition happening.

It is very important when checking for an ignition fault to look at either the primary voltage (nowadays on most late cars it is impossible to access the primary voltage) or secondary voltage and primary current. This way we can know for sure by seeing the voltage and the amps if we have a switching or triggering problem.

In the case of this Magna, we can see a trigger happening, even though the current is staying high there is still a rise and a fall in the amps when the trigger event takes place. So this tells us we do not have a crank or cam sensor problem.

But why do we have such high amps, and why is the secondary coil staying on? We understand we cannot have a spark event while the secondary coil remains ON. For a secondary event to take place, we have to drain the secondary voltage, so that the primary voltage can build up, and when the primary coil is switched OFF, then all that energy is induced into the secondary windings and due to the increase in windings we have our high voltage spark event.

The reason we are not seeing the secondary discharge is quite simple. We all know that the primary coil has a continuous power feed while the ignition is ON. The coil is controlled by the ground (earth) side and it switches to ground when the ignition module switches ON.

Let's say we have a coil that is partly switched to ground all the time. When I say partly switched to ground, I mean there is a path to ground but there is resistance causing a voltage drop in the return to the ground.

When the ignition transistor is turned ON we lose our voltage drop, and once the transistor turns OFF we have a voltage drop to ground. If we look at the primary current, the red trace, we can clearly see this happening, when the transistor is switched ON we see a slight rise in amps, when it switches OFF we see the amps fall away slightly. But we do not see the amps drop back to 0 amps as it should due to our continuous resisted leak to ground.

I would have dearly loved to have seen the primary voltage, but due the coil being built into the distributor, it is not possible. But we have enough evidence here telling us we have a faulty ignition module, and a heat stressed ignition coil. How do I know the ignition coil is heat stressed? Simple, our lab scope clearly identifies that the coil is not properly switching off so it has to be generating a lot of heat, and heat will stress out the coil.

So the solution for this vehicle was a new ignition module and a new ignition coil. The new parts were fitted and the problem solved.

Anyone can throw parts at a car, but it is only a good technician that will take the time and effort to scientifically prove beyond doubt the cause and reason why a part needs to be replaced. The lab scope (oscilloscope) is a tool that can improve your chances of proving and confirming electronic and mechanical faults in our modern vehicles.

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