

Training

1994 Volvo 940 2.3 L 4Cyl. No Start 148,447 Miles
by Peter Landry - Landry's Brookfield BP

I was called to a shop to see if I could lend a hand with a no start. At this point I'm told the car has spark, fuel, compression and wet spark plugs. Sounds like timing, right? They told me they pulled the timing cover and the marks are spot on.

My first test was confusing. I did a cranking current test with a sync probe hooked to number 1 spark plug wire. The results suggest the engine is in time or at least spark is being fired when A cyl. is at TDC. Figures 1 and 2

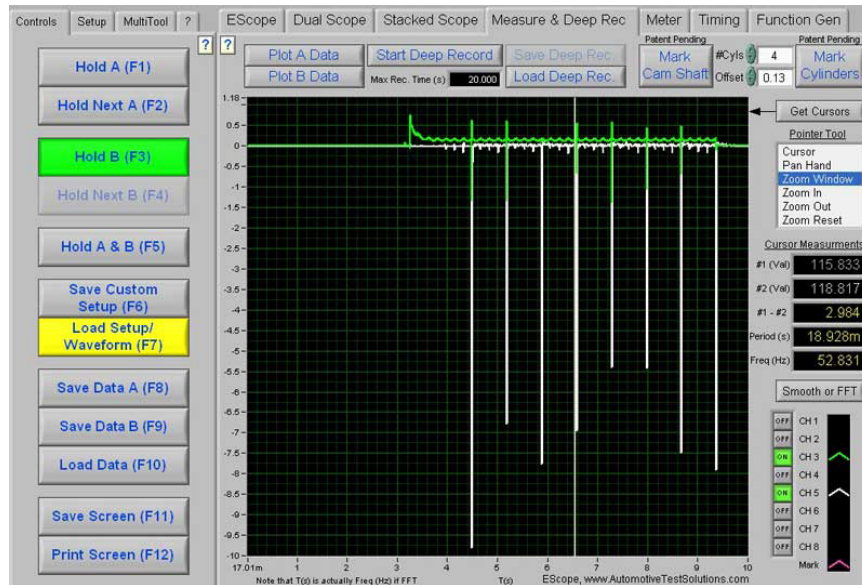


Fig 1

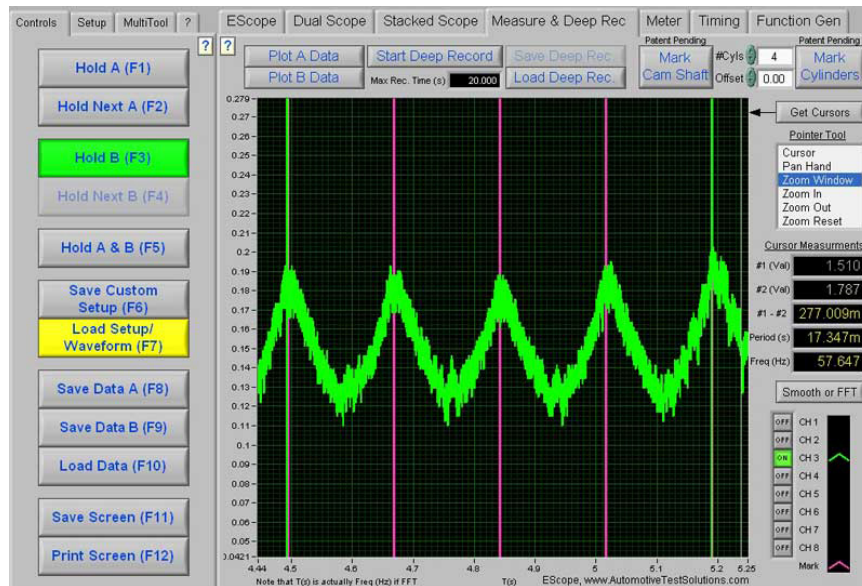


Fig 2

Second test, I hooked up my 5 gas analyzer and the readings shocked me. On one hand I have wet spark plugs, and on the other I have very little, less than 500ppm, HC out the tail pipe. What can possibly cause this issue???

I figure this engine is not breathing. At this time I recall being taught that an engine is just an air pump. The best test I'm aware of to test the engines ability to breathe or pump air is a cranking vacuum test using a vacuum transducer. Since ATS transducers along with the Escope does the conversion of voltage to inches of mercury for me there is no need to use a gauge here. Notice the pulses are even and the pattern is what I would expect to see. However note the scale. The pulses are going above and below zero inches of mercury. Figure 3

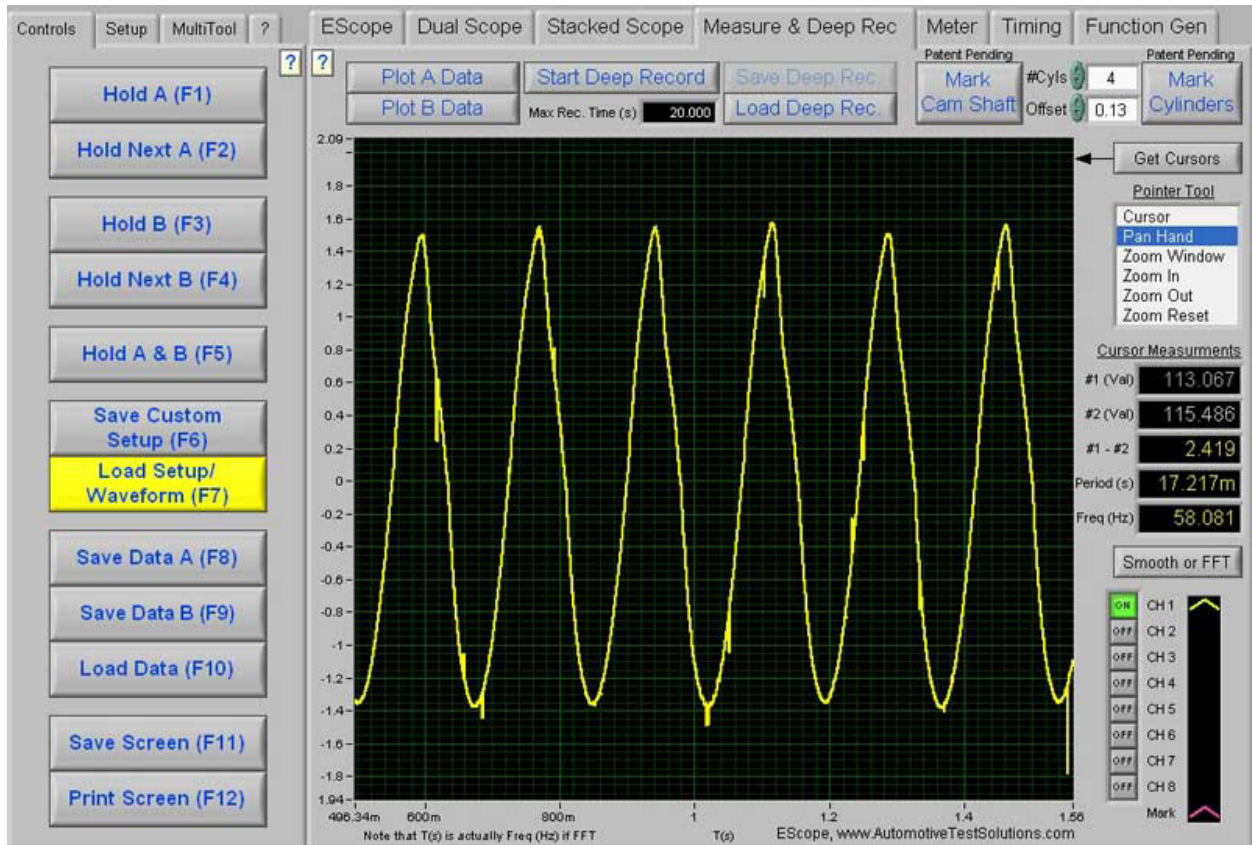


Fig 3

Now we're getting somewhere. My next test compares cranking compression and the firing of number 1 spark plug. As you can see there is a problem here. There are a few points in this waveform that stick out like a sore thumb.

Figure 4

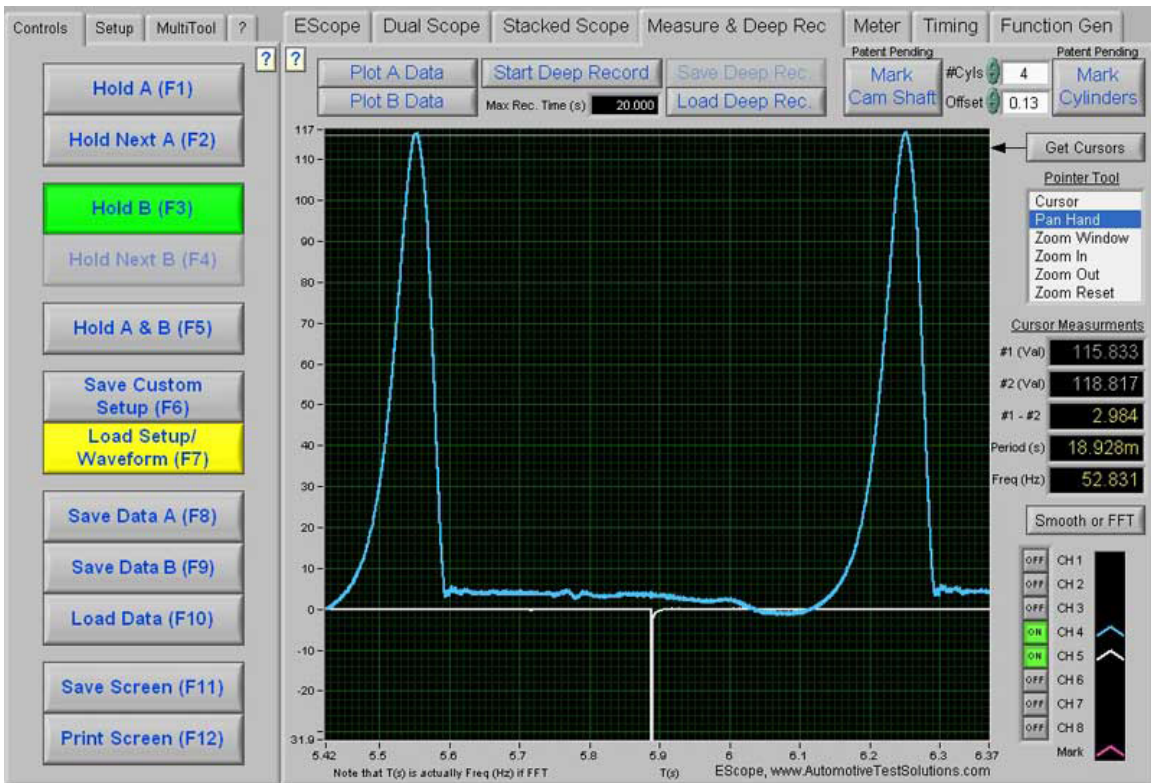


Fig 4

Let's take a closer look at the pressure waveform. Figure 5

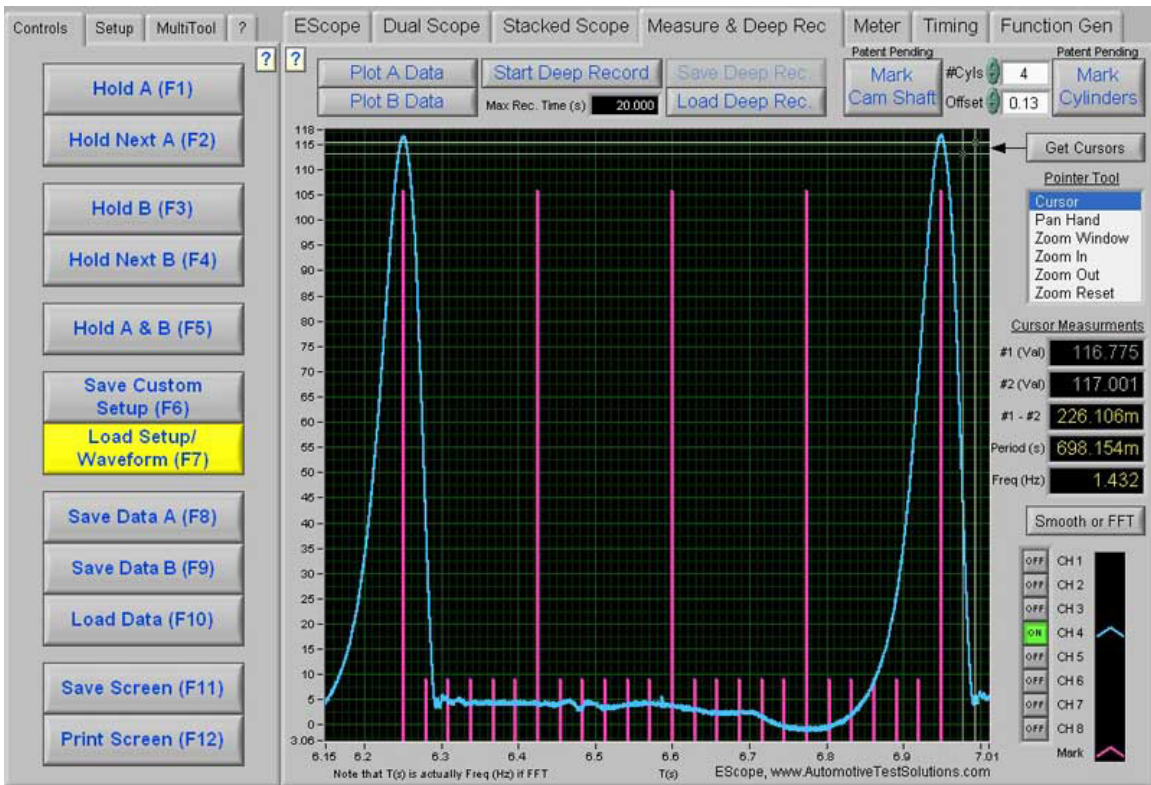


Fig 5

1. Spark should occur at or before TDC and it most certainly doesn't. Figure 4
2. The towers aren't even they are leaning to the right.
3. There is no exhaust ramp

Final diagnosis:

The cam sprocket locating pin was sheared, allowing the camshaft to turn roughly 90 degrees out of time.

On this car, the distributor is driven by a separate sprocket by the timing belt, which is why the ignition and crank timing was still a match in figure 1 and 2. Figure 6

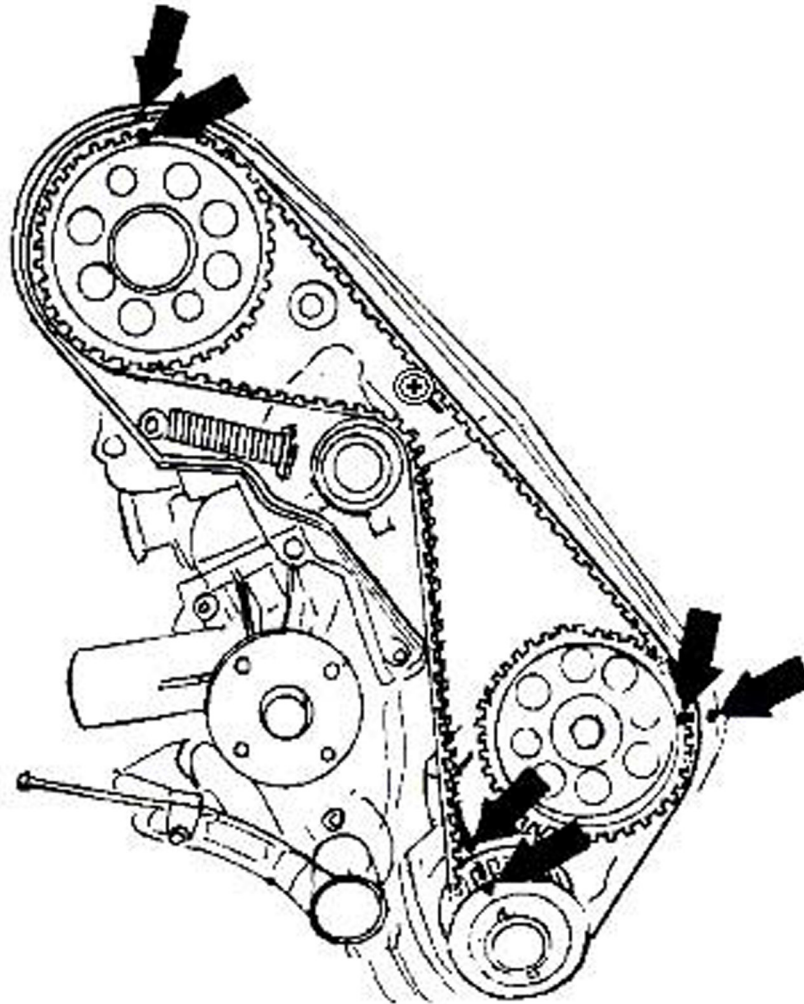


Fig 6

Looking at cylinder pressure dynamically is both a quick and accurate way to diagnose mechanical problems without engine disassembly. If you're like me, you're not going to take anything apart unless you're quite confident you have to.

Thanks Bernie and ATS gang for your great tools and support.