MISDIAGNOSING A DISTRIBUTORLESS IGNITION SYSTEM

The Distributorless Ignition System has been instrumental in helping the vehicle manufacturers comply with stringent emission mandates and fleet average fuel economy requirements. Compliance with these standards has resulted in many changes in the way the spark and fuel is delivered. With these changes have come some interesting and confusing problems for the service technician and that is the purpose of this information. As sophisticated as the system may be by design, some basic (not in the manual) problems can result in a no-start condition, thus leaving the technician in a holding pattern or replacing some expensive parts, needlessly. Such is the case for the service industry during extreme cold conditions. By the time you read this entire bulletin you will have a better understanding of the quirks which can elude the technician, frustrate the vehicle owner and leave them stranded, too.

The DIS System consists of 2 or 3 separate ignition coils, an ignition module, a crankshaft sensor, a network of wiring and the Electronic Spark Timing Circuit within the Electronic Control Module (see Fig. 1). Precise and consistent signal inputs are imperative or a no-start condition is inevitable. The DIS System must distinguish between crankshaft sensor signals and other signal noises such as Radio Frequency Interference. This requirement means the module waits for specific voltage signals before

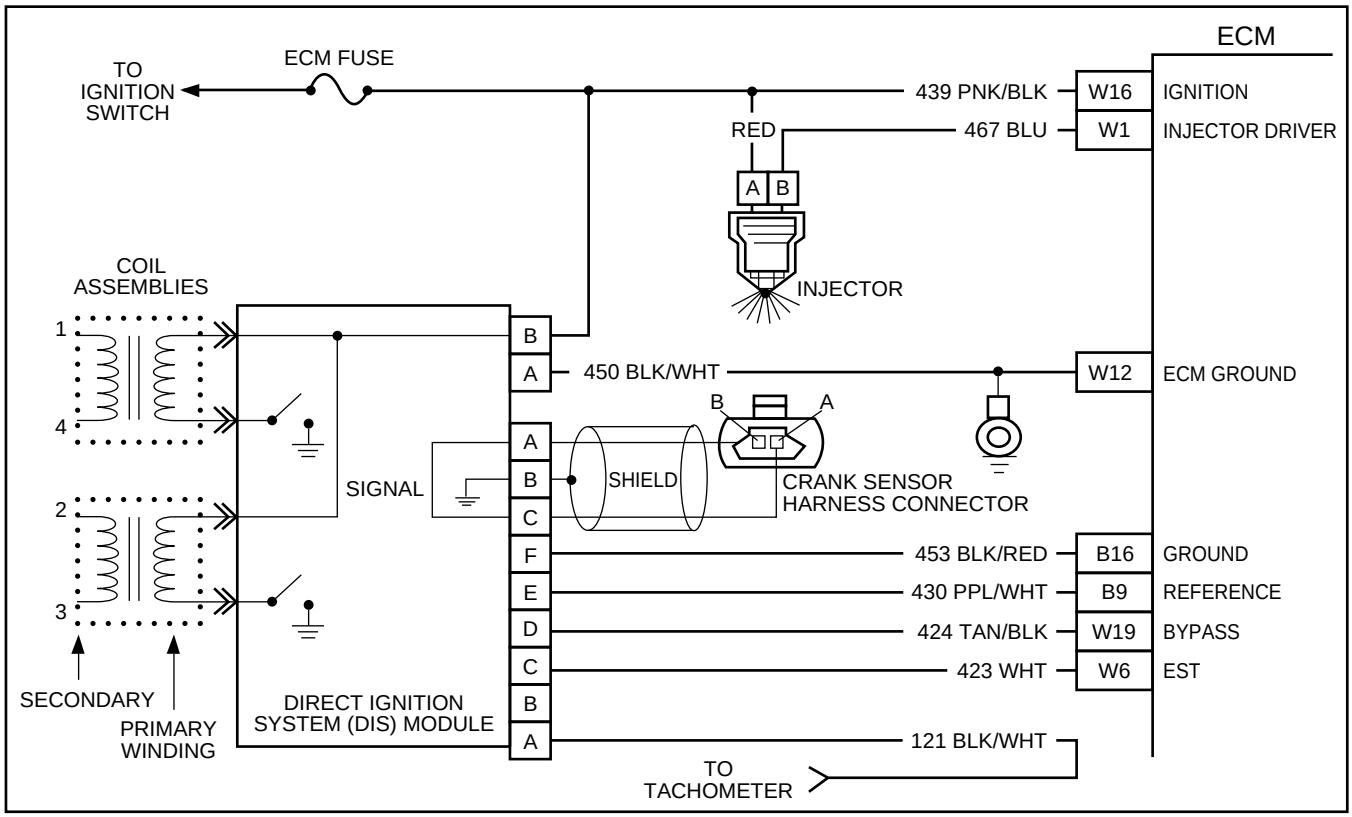

FIG. 1

identifying the fluctuating crankshaft sensor output voltage as the proper signal, to begin the firing sequence. The crankshaft sensor signal varies with engine speed and air gap spacing. The signal strength can vary from a positive 200 millivolts AC to a negative 200 millivolts AC, at very slow cranking speeds; to a positive 150 volts to a negative 120 volts, at high speeds. The voltage must rise above a certain positive threshold and then move through zero volts on the negative transition. At this point the module will trigger or count off the zero voltage crossing of the wave form. However, until the voltage reaches the threshold value, the module will not recognize the zero volt transitions and count the signals, thus a no-start.

A NARROW GAP

The crankshaft sensor is mounted on the bottom side of the DIS module and protrudes into the engine block. There is an approximate .050 inch air gap between the sensor and the crankshaft reluctor, when installed. The gap is critical, as the signal output is in relation to engine cranking speed and air gap spacing. Air gaps smaller than .030 inches will create higher than normal voltages and some high speed abnormalities with the threshold voltages, internally in the DIS module, and potential circuit damage. Air gaps larger than .070 inches will result in weaker voltage signals and some engine starting problems due to weak and erratic signals. The signals can be too weak for the module to count. When installing a crankshaft sensor and module, make certain it is properly torqued and never shimmed for any reason.

The reluctor is cast into the crankshaft. It has six evenly spaced slots cast into it, 60 degrees apart. A seventh slot is positioned 10 degrees from one of the other slots and functions as a "sync pulse." As the reluctor rotates past the sensor, the slots change the magnetic field of the sensor, creating induced voltage pulses. By comparing the time between pulses, the DIS module can recognize the pulse representing the seventh slot or "sync pulse," which starts the calculation of the ignition coil firing sequence. The second crank pulse following the "sync pulse" signals the DIS module to fire the #2/5 ignition coil, the fourth crank pulse signals the module to fire #3/6 coil and the sixth crank pulse signals the module to fire the #1/4 coil, on a 2.8L engine.

REVISED SPECIFICATIONS

Following is an updated DIS System specification chart from GM. These specs may vary from your service manual.

Ignition Coil Resistance

Primary Circuit:	0.35–1.5 ohms
Secondary Circuit:	5000–7000 ohms

Crankshaft Sensor Specifications

Engines: 2.0, 2.2, 2.8, 3.1, 3.4 liters
AC voltage signal output: Minimum 300 MV
Resistance: 900–1200* ohms at 70° F.
750–1100* ohms at 0° F.

Engine: 2.3 liters
AC voltage signal output: Minimum 200 MV
Resistance: 500–900* ohms at 70° F.
450–800* ohms at 0° F.

Engine: 2.5 liters
AC voltage signal output: Minimum 300 MV
Resistance: 800–900* ohms at 70° F.
650–800* ohms at 0° F.

Footnotes:

MV (millivolts)

* The resistance values will change with temperature. If heating or cooling a crankshaft sensor to the degree F. temperature listed is not convenient, then test the resistance of the sensor at room temperature. Further, place a flat steel tool against the tip of the crankshaft sensor and verify that the sensor is magnetized. It should be.

BY THE BOOK

The service procedures in the service manual direct

the technician to the following: When an intermittent no-start condition occurs and the usual diagnostic procedures do not identify a cause, replace the crankshaft sensor. The DIS module should be replaced only in instances where the previous replacement of the crankshaft sensor did not correct the intermittent no-start condition.

In service bulletin 88-58-6E, GM acknowledges that recent studies indicate a high percentage of returned alleged defective DIS modules and crankshaft sensors are not defective.

Prior to replacing the module, GM says the following should be reviewed:

1) If the customer comment is intermittent long crank time or an intermittent no-start, the problem is most likely not in the ignition system. Verify this by: a) testing for spark with the ST-125 spark tester while cranking, and b) testing for RPM reference signal to the Electronic Control Module by reading the RPM using a Scan Tool while cranking. This check verifies the correct operation of the ignition system. This can also be checked on Test Chart A-3 (Engine Cranks But Won't Run). ***Caution:*** In November 1988, GM updated the A-3 test charts, so make certain you are using the new chart. Also, remember that an inoperative fuel pump relay may lead to a long crank time when the engine is cold. PROM changes have also been made to circumvent this condition.

2) An intermittent miss, backfire, or hesitation may be caused by a defective coil.

3) When diagnosing an intermittent condition, the connector to the module should be inspected for proper connection. Inspection should include:
   a) Check the integrity of the weatherpack seal and replace if damaged.
   b) Check for proper terminal alignment in cavities. All terminals should be positioned at the same height. Seat any terminals which have backed out.
   c) Visually check the inside ramp of the terminals in the connector. If the inside ramp is bent or damaged, the terminal should be replaced.
   d) Make certain the connector locking arms lock over the ramp on the module when making the connection.

MAKING CONNECTIONS

The integrity of the connections should always be a concern when diagnosing an intermittent no-start condition. The connectors may be secured in their latches, but the terminals may not be making

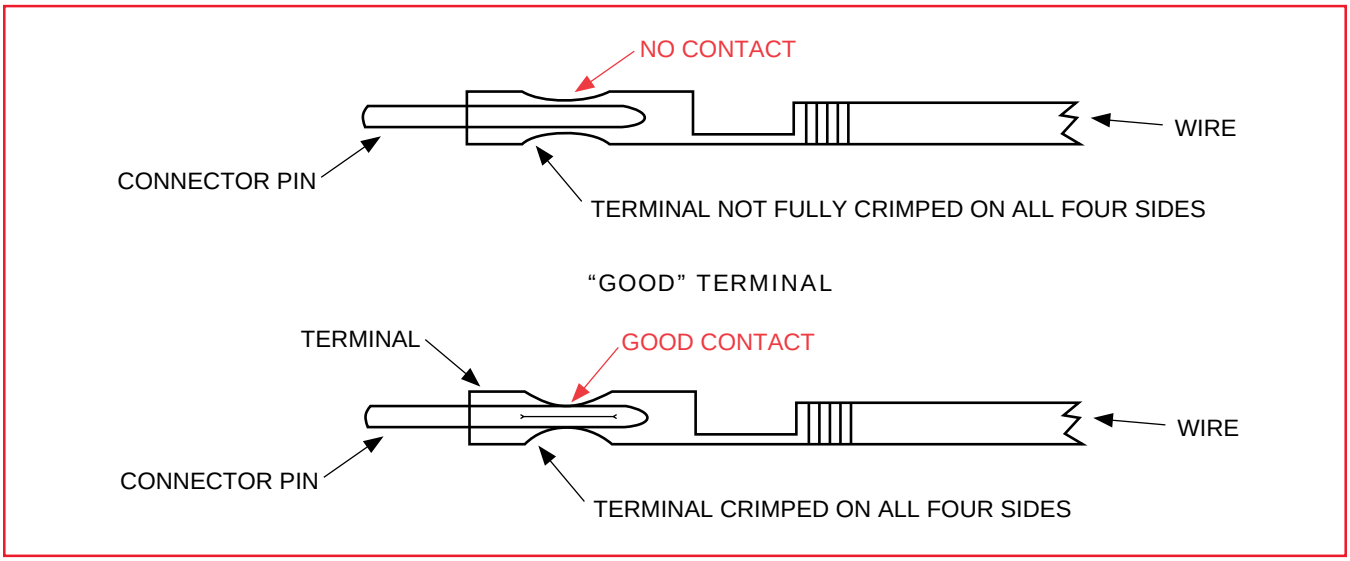

FIG. 2

electrical contact (see Fig. 2). Visually examine the connectors and test their integrity with the proper pin gauge or a mating terminal. Do not use a paper clip or similar object as terminal damage will occur. The gauge or terminal should not pass freely through the female terminal. If the female terminal does not grip properly, replace it. Bending or crimping the female terminal is usually a temporary fix.

GM addressed this concern in Service Bulletin 88-6E-18. Some vehicles may experience an intermittent no-start condition ("Cranks But Won't Run"), due to an intermittent electrical connection between DIS module and crankshaft sensor. The no-start is most likely to occur when the engine is cold.

Examination of their warranty material has shown that the connection problem was being improperly diagnosed as a DIS module condition, resulting in repeated come-backs and customer dissatisfaction. Because the integrity of the connection between the module and crankshaft sensor is provided by the terminal design, replacing the DIS module will not provide a lasting fix for the intermittent condition.

NO-STARTS DURING EXTREME COLD CONDITIONS

During the extreme cold weather the industry experienced a high return rate of DIS modules and crankshaft sensors. The typical scenario was a vehicle would encounter a no-start condition which required the vehicle to be towed to a repair facility. A spark test would lead to the replacement of the crankshaft sensor and the DIS module. In some cases the vehicle would experience the same no-start condition the next day. Actually, the new module and crankshaft sensor was not the cure for the condition. The technician would pull the vehicle into the shop and replace the two mentioned components and the engine would roar to life. Seemingly, the new parts fixed the problem, when the warm shop which increased the cranking speed was actually the cure. Extensive research has identified the cause of the no-start conditions as a slow engine cranking RPM, instead of defective electronic parts or connection related problems.

Thick oil, weak battery conditions and poor connections all slow the engine cranking RPM. The crankshaft sensor is nothing more than a signal generator. A slow engine cranking speed means a weak signal. The DIS module must receive six even pulses, which requires a minimum cranking speed of approximately 250 RPM. Any speed less than this results in erratic and weak signal strengths, causing the module to lose count. Remember: it must have six even pulses, evenly spaced and a seventh pulse ("sync pulse") or you get no juice to the plugs. Loose connections at the crankshaft sensor, module and ECM will result in weak signal strengths, just like a slow cranking RPM.

WARM CLIMATE NO CURE

Extreme heat conditions can result in the same no-start conditions. A weak battery or starter, corroded cables, loose connections, overheated engine, or any condition that deteriorates the cranking speed of the engine or weakens the signal strength may result in a no-start condition. The result can be the replacement of some expensive electronic parts which did not fix the customer's car.

WE HAVE THE CURE

Precise signals are imperative. By design, the module will not recognize weak and erratic signals.

So how did we fix the cold cranking problem? With an electronic adjustment. A circuitry change has been introduced into our current design DIS module, which makes the module forgiving. The circuit change reduces the threshold for detecting weak pulses and allows spark to occur with less than perfect crankshaft sensor signals.

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