Volume 13, Issue 1

March 2016

Technicians Service Training

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Editor

" G" Jerry Truglia

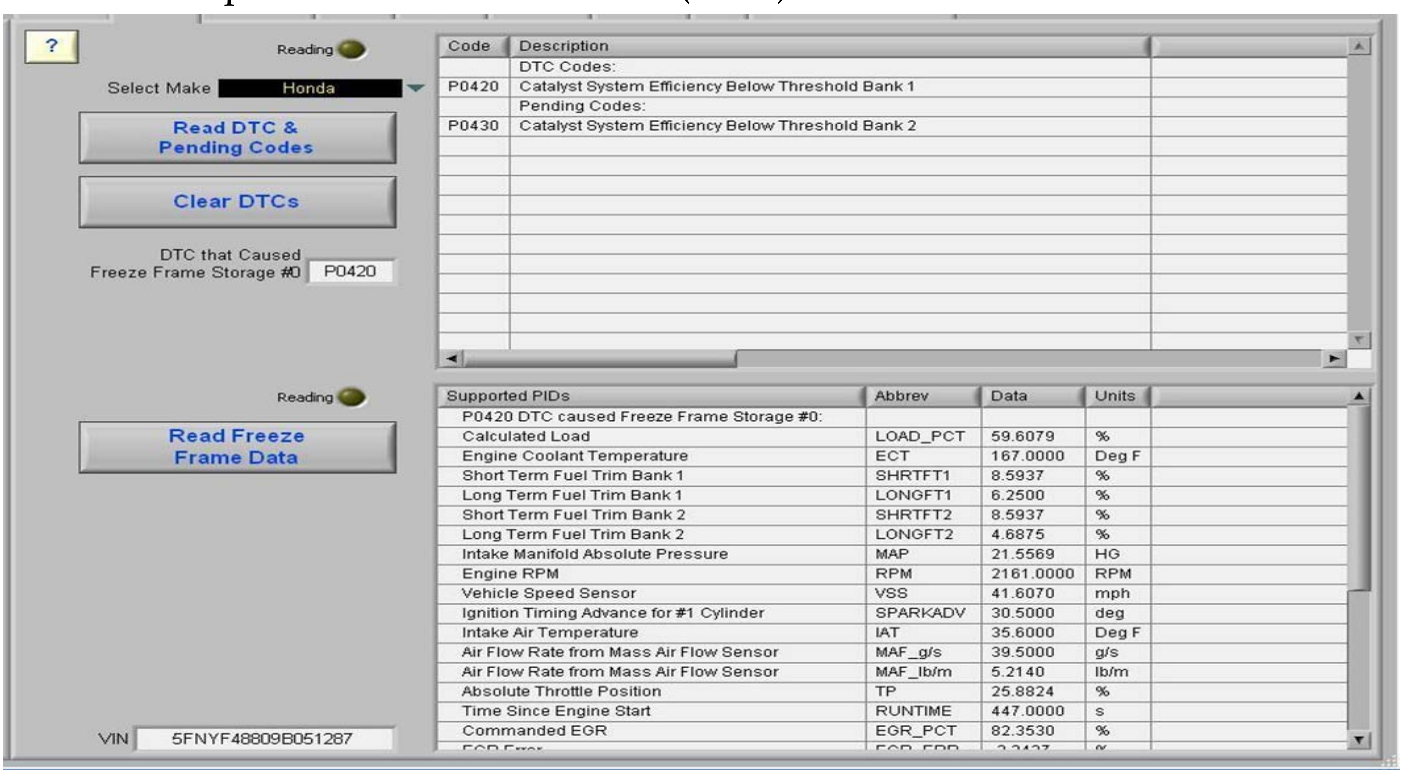
"P0420 and P0430 Catalytic Converter DTCs"

The most common codes repair technicians encounter are the P0420 and the P0430 (Catalyst Efficiency Below Threshold) Diagnostic Trouble Codes (DTCs). They cover the same problem, differing only in the side of the engine to which they refer. Although catalytic converters should be examined, other key components that may be causing the DTCs are exhaust leaks, oxygen (O2) sensor heaters, the O2 sensors themselves, and the Powertrain Control Module (PCM) software that performs the catalytic efficiency test.

(Con't on page 2)

"P0420 and P0430 Catalytic Converter DTCs" (con't from p. 1)

First, we should understand what catalytic efficiency is. A catalytic converter is the last device involved in the cleanup of the unhealthy gasses left over after combustion, such as carbon monoxide, hydrocarbons, and nitrogen oxides. Catalytic efficiency is a measure of how well the converter can do its job. Most vehicles (that is, those certified to OBD II) have both a pre-catalytic (upstream) O2 sensor (or air-fuel sensor) and an O2 sensor located behind at least one of the catalytic converters (downstream). Whereas conventional upstream O2 sensors respond to the amount of oxygen in an exhaust stream and provide feedback to the PCM for fuel control, a downstream O2 sensor is designed to measure a relatively stable voltage signal when the catalytic converter is functioning properly. When catalytic efficiency decreases, this rear sensor voltage will fluctuate up and down at steady RPMs. The PCM programming will determine how much voltage variation is acceptable. If the PCM interprets a catalytic converter efficiency failure from its O2 sensor readings, a P0420 or P0430 pending DTC is first set. If the decreased efficiency still occurs on the next consecutive converter test, a hard DTC is set, and Freeze Frame data parameter identifications (PIDs) are recorded and stored.



(Con't on page 4)

What is TST?

TST is a group of dedicated technicians and instructors committed to the continuing education of our fellow technicians. We provide training seminars to technicians at a reasonable price. TST brings our members nationally known instructors and state of the art training.

Our Goal & Mission Statement

- ***Keep our fellow technicians up to date with the latest technology.***
- ***Provide training seminars for a reasonable price.***
- ***Deliver information that the technician can use now.***
- ***Keep technicians informed of information affecting our industry.***
- ***Increase consumer awareness of what a good technician is.***

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Jorge Menchu the "Labscope Guru," AES Wave
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"P0420 and P0430 Catalytic Converter DTCs" *(con't from p. 2)*

As with any other diagnostic challenge, technicians should address the root cause of these DTCs using a systematic approach. Even if the converter efficiency is truly degraded, that failure often has an underlying reason. Left unresolved, the problem will eventually recur, and any newly installed converter will quickly suffer the same fate as the degraded converter.

An often overlooked but extremely valuable source of information is the Freeze Frame data stored with the hard DTC. Even with an original equipment scan tool on hand, technicians should first make use of the Generic/ Global mode of the tool. The Generic/Global mode does not substitute engine values to get a true reading (also known as parameter IDs or PIDs). Instead, it provides access to Freeze Frame data and Mode 6 test results and is especially helpful for diagnosing DTCs. When using the Generic/Global mode, do not erase or clear DTCs because Freeze Frame recordings will also be erased in the process. Freeze Frame data is helpful for uncovering a sensor value that is out of the normal range, and it highlights the conditions that were present when the DTC was set.

It is crucial to remember that Freeze Frame data does not record the exact moment at which a fault occurs. Instead, it records within a 15-second frame window, meaning what is seen in the Freeze Frame may have occurred within 15 seconds before or after the fault actually occurred. Nevertheless, Freeze Frame data can still be very helpful in duplicating a problem by providing insight into the condition of the vehicle when the problem was first detected. In other words, diagnosing and repairing a vehicle without Freeze Frame data will be more difficult.

After reviewing and understanding the conditions and criteria of the DTCs, it is always a good idea to check your service information for any related Technical Service Bulletins (TSBs) before attempting to work on a problem vehicle In some cases, a software glitch can simply be fixed if a reprogramming procedure or a part upgrade is available.

(Con't on page 7)

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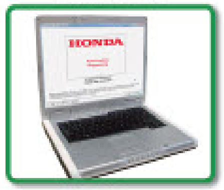

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"P0420 and P0430 Catalytic Converter DTCs" *(con't from p. 4)*

Staying updated with such information can help to avoid unnecessary work and wasted time.

Always perform a thorough visual inspection of the vehicle's engine and pollution control components before starting work on a vehicle. During the inspection, check for maintenance care and other obvious factors that can affect the PCM's test results.

The following are the top 10 causes of catalytic converter efficiency codes and failures. Check off the entire list before you attribute a converter failure DTC to converter efficiency problems alone.

- **Engine mechanical problem**
- **Cylinder misfire**
- **Exhaust leaks or damage**
- **O2 sensors (HO2S/WR/AF)**
- **Fuel pressure**
- **Injector problems**
- **Oil contamination**
- **Engine coolant temperature (ECT) problems**
- **Intake leaks**
- **Ignition timing**

Compression and Fuel Trim Testing

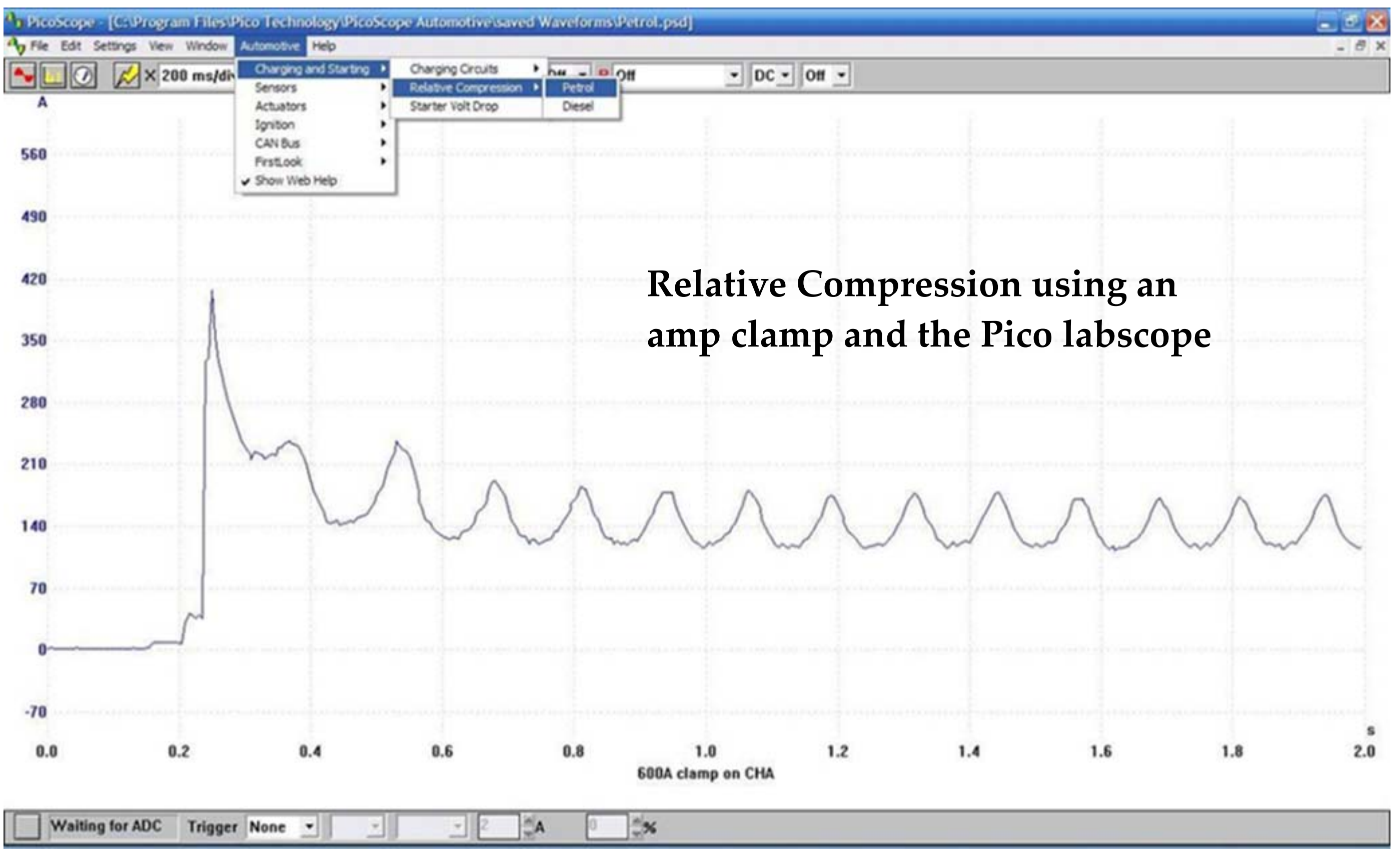
Every input and output on the vehicle relies on a stable power source and dependable grounds. Therefore, the first step in your diagnostic strategy is to make sure the vehicle's battery is healthy.

After the battery's condition is verified, the first step to starting a code-specific diagnosis is to check the overall engine health by performing a Relative Compression test.

(Con't on page 8)

"P0420 and P0430 Catalytic Converter DTCs" (con't from p. 7)

A Relative Compression test can be easily performed via a scan tool (if available) or on a labscope AC coupled as displayed on page 7 and by using a high amp clamp with a labscope. Scan tools such as the Ford IDS (factory scan tool) can perform the test within 20 seconds. Using a labscope to perform a Relative Compression test takes about 2 minutes to complete. If the engine passes the relative compression test, the next step is to diagnose the component failure. **If it does not pass, STOP.** An engine that fails the Relative Compression test is the root of the problem, and installing new sensors or actuators **will not fix the problem.**



Relative Compression using an amp clamp and the Pico labscope

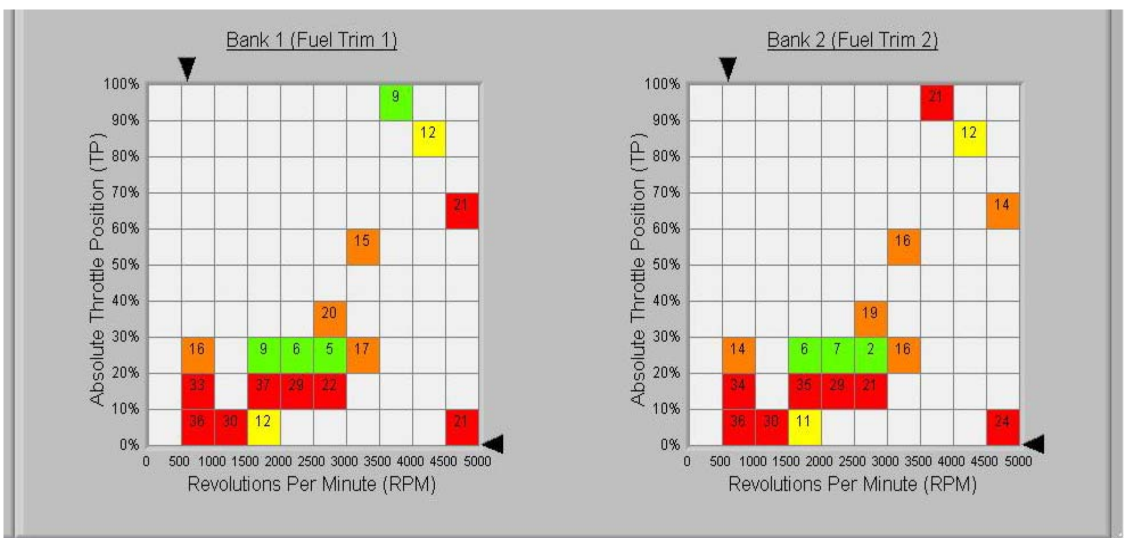
In addition to battery and engine health, short-term fuel trim (STFT) and long-term fuel trim (LTFT) should also be reviewed carefully. Fuel Trims are programs that affect how much fuel the PCM commands the injectors to deliver. For example, if the upstream O2 sensor reports that the engine has a lean condition (not enough fuel), the PCM will increase the injector pulse width to add fuel. Alternatively, if the sensor reports a

(Con't on page 10)

"P0420 and P0430 Catalytic Converter DTCs" (con't from p. 8)

rich condition (too much fuel), the PCM will shorten the pulse width to reduce the amount of fuel injected. STFT and LTFT numbers represent the amount of pulse width change, typically as a percentage. A positive Fuel Trim signals the PCM to add fuel, and a negative fuel trim causes the PCM command to reduce the delivery of fuel. A value of 0 indicates a perfect Fuel Trim.

STFT is an immediate response to the air/fuel mix being reported by the O2 or Air Fuel sensors and will adjust above and below a perfect value of 0 Fuel Trim in shifts of no more than ±10 percent; however, a shift of ±6 percent is more ideal for diagnosing a problem vehicle because any fluctuation larger than ±6 percent indicates a problem. Because LTFT is an adaptive response to excesses in the STFT, its immediate response does not fluctuate above or below 0 on a scan tool data stream as with STFT. Even so, responses exceeding ±10 percent indicate a problem, and, depending on the make of the vehicle, a shift of more than ±15 percent variance in the LTFT will set a "System Lean/ Rich" DTC on most vehicles.



Understanding Fuel Trims and the information they provide is a learned skill that will save time and effort when diagnosing many drivability issues. For example, a Ford diagnostic flow chart for the P0420 and P0430 DTCs indicates that the wiring for the O2 sensor and the fuel pressure should be checked when no other DTCs are present (confirmation of this wiring and fuel pressure/volume is crucial).

(Con't on page 11)

“P0420 and P0430 Catalytic Converter DTCs” *(con’t from p. 10)*

However, if we apply a thorough understanding of Fuel Trims and notice that both the O2 or AF sensor and the Fuel Trim readings are good on our scan tool, we can save time and effort by skipping the inspections altogether.

Working smart is always better than working hard. The most important tools are knowledge and observation, so remember to perform a good visual inspection on a vehicle, look up related TSBs, and check out any PID data carefully before performing unnecessary work.

Catalytic Converter DTC Case Studies

In the first case study involving a 2001 Nissan Frontier, the problem was resolved quickly by finding a TSB. A customer brought in a Frontier that was displaying the P0420 DTC. Using the search function on our service information system, we looked up the specifics on the DTC. The search provided us a TSB that indicated correct catalytic converter functions despite the presence of the P0420 DTC, which told us that the problem was internal and could not be resolved simply by replacing parts. **The TSB reads, in part, “IMPORTANT: Do NOT replace the catalytic converters as part of this procedure.”** In such cases, the technicians responsible for the fix could have saved time and effort by referring to the TSB, which advised that a PCM reflash was required for this converter DTC.

(Con’t on page 13)

"P0420 and P0430 Catalytic Converter DTCs" (con't from p. 11)

KA24, MIL "ON" DTC P0420 CATALYST

TECHNICAL SERVICE BULLETIN

Reference Number(s): NTB02-092, Date of Issue: September 5, 2002
NISSAN: 2001 Frontier, Xterra
CLASSIFICATION: EC02-022
SECTION: Engine Control System
APPLIED VEHICLE(S): 2001 Frontier (D22); 2001 Xterra (WD22)
APPLIED ENGINE: KA24 (4 cylinder) ONLY
Superceded Bulletin(s): NTB02-034

TSB from the 2001 Nissan Frontier on p.11

SERVICE INFORMATION

NOTE: This bulletin supersedes NTB02-034. Please discard previously released copies of NTB02-034.

If an applied vehicle has a MIL "ON" and the following DTC stored in the ECM:

- P0420

Use the appropriate Service Procedure steps to determine if the bulletin applies to this vehicle. If the bulletin applies, complete the applicable Service Procedure steps to repair the incident, if it should occur.

SERVICE PROCEDURE

You will perform the following, as required:

- Determine the DTC Stored in the ECM from the CONSULT-II Self-diagnosis results.
- ECM Part Number Check to determine if this bulletin applies.
- ECM Reprogramming (required if the ECM P/N in the vehicle matches one of those listed under "Current ECM P/N" in CURRENT ECM P/N'S).

IMPORTANT: Do NOT replace the catalytic converters as part of this procedure.

DETERMINE THE DTC STORED IN THE ECM

1. Determine which DTC code is stored in the vehicle's ECM by performing CONSULT-II Self-Diagnosis.
2. Print out the Self-Diagnosis results for use in ECM Part Number Check, below. See Fig. 1 for an example of the CONSULT-II Self-Diagnosis printout.

The next case study is of a 2004 Nissan Altima 2.5 L that had a P0420 DTC after unrelated work was performed on the vehicle. The car itself was maintained well and only had about 90,000 miles on the odometer. With numbers that low, we suspected that the root cause of the DTC went beyond the scope of a catalytic converter failure. This case brought together all the basic knowledge of conventional O2 sensor and air-fuel sensors (AF) that technicians should be familiar with.

After performing basic checks and inspections on the vehicle, we looked for TSBs and discovered that the PCM might have to be reprogrammed. However, after checking the calibration codes of the car's PCM, it was clear that the PCM had the most up-to-date software already installed.

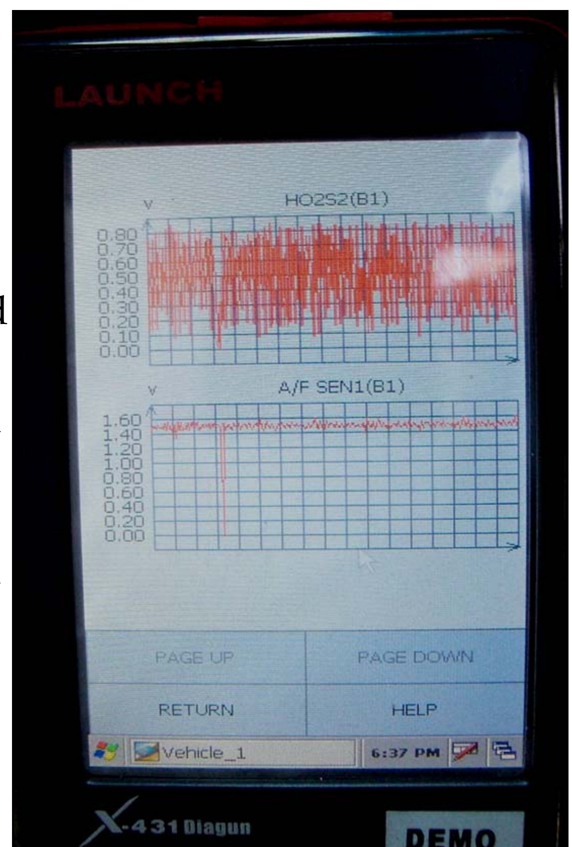
To proceed with the diagnosis, we used an exhaust gas

(Con't on page 15)

"P0420 and P0430 Catalytic Converter DTCs" (con't from p. 13)

analyzer to check the emission readings at the tailpipe. The gas analyzer emissions results looked clean and correct, but they did not correlate with the OBD II test data. How could the vehicle set a P0420 DTC but still have clean emissions? Because of this mismatch in information, we thought that the vehicle might have a bad sensor, an exhaust leak, a faulty or worn converter, or a defective PCM.

To check the air fuel and oxygen sensors for proper operation we used bi-directional controls to make the fuel mixture richer and leaner, that confirmed that the sensors were acting normally. This led us to question why the PCM indicated a converter problem when both the sensors and emission analyzer measurements readings were good.



We then investigated whether an exhaust leak was throwing off the sensors, but a test conducted with a smoke machine found no leaks. After we performed a simple Enhanced OBD II test and inspected the data on a scan tool, we looked up the proper voltage for AF sensors on Nissans and found that Nissan AF sensors should be at 1.47 volts. At 1.50 volts, the vehicle's air-fuel sensors were within the proper range and not problematic.

What eventually revealed the problem and directed us to the right course for repair was graphing the oxygen and air-fuel sensors' voltages.

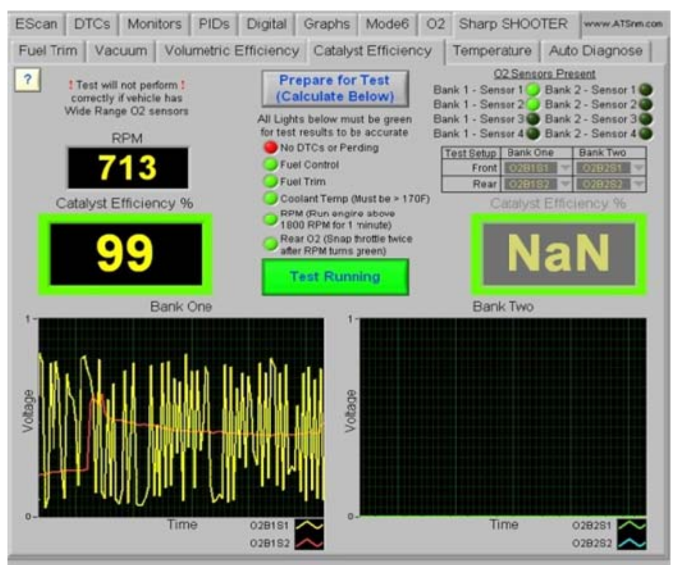
(Con't on page 16)

"P0420 and P0430 Catalytic Converter DTCs" (con't from p. 15)

The car had two catalytic converters in series. Because the downstream O2 sensor on the vehicle was located after the first converter but before the second converter, the second converter cleaned up all pollution coming from the first bad converter so that our exhaust gas analyzer did not measure elevated pollution levels. However, the functional HO2S B1 sensor 2 sensor did detect the pollution from the first converter.

The scan tool graph on page 15 explained why the post-cat HO2S sensor was measuring rapid voltage value changes up and down when, if the first converter was still working efficiently, it should have had a relatively flat value. This evidence indicated that the front catalytic converter was worn out and had to be replaced. (Note: Nissan recommends replacing both converters if one fails, so they only sell their converters in pairs.)

Our third case study is of a 2004 Toyota Camry and involves the Catalyst Efficiency test using the Automotive Test Solutions EScan OBD II scan tool. Tested at idle, the Camry's first catalyst efficiency test passed with a value of 99 percent efficiency; however, the Camry's second catalyst efficiency test, which was performed at cruising revolutions per minute (RPM), failed with 42 percent efficiency.



(Con't on page 17)

"P0420 and P0430 Catalytic Converter DTCs" (con't from p. 16)

The key learning point is to use the Freeze Frame data to assess when the failure occurred. In some cases, vehicles fail a Catalyst Efficiency test at idle but pass at higher RPM. Freeze Frame data can provide invaluable and time saving information on a DTC. For this Toyota, the Freeze Frame data definitely revealed that the problem was occurring at a high speed (2,709 RPM) and engine temperature in the proper hot range.

The fix for this Toyota was to reprogram the PCM (per the TSB) and apply several cans of Run Rite fuel system cleaner through the system to restore proper function to the catalytic converter. After the converter was cleaned , the vehicle returned to normal driving conditions without the Malfunction Indicator Lamp (MIL) on.

Note: Engines that have severe carbon deposits may spew chunks of loosened carbon into the exhaust stream during the cleaning process (some other chemicals may also cause this problem), especially when the cleaning process is improperly performed. The cleaner should be used at a slow rate to prevent blockage; some chemicals may be too aggressive. The carbon particles may actually lead to exhaust flow blockages and/or damage to the catalytic converter's substrate.

Our last case study, involving a 2000 Honda Civic that was in desperate need of maintenance, came in with a P0420 DTC. Unlike the previous cases, the converter problem could clearly have been avoided if the owner had maintained the vehicle properly. From visual inspection alone, we could observe that the ignition system was in poor shape; the converter was loaded with excess fuel, causing the catalyst to deteriorate.

After running the Catalytic Efficiency and the Mode 6 tests, data confirmed that the converter was in such poor condition that it was unlikely to be salvaged with a tune-up and fuel system cleaning. Although our tune-up attempt seemed to get the engine running, results from both the

(Con't on page 18)

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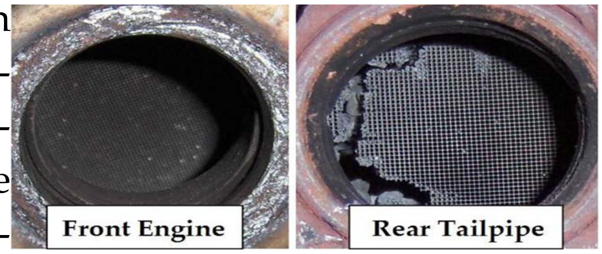
Catalytic Efficiency and the Mode 6 tests still indicated that the catalytic converter was dead.

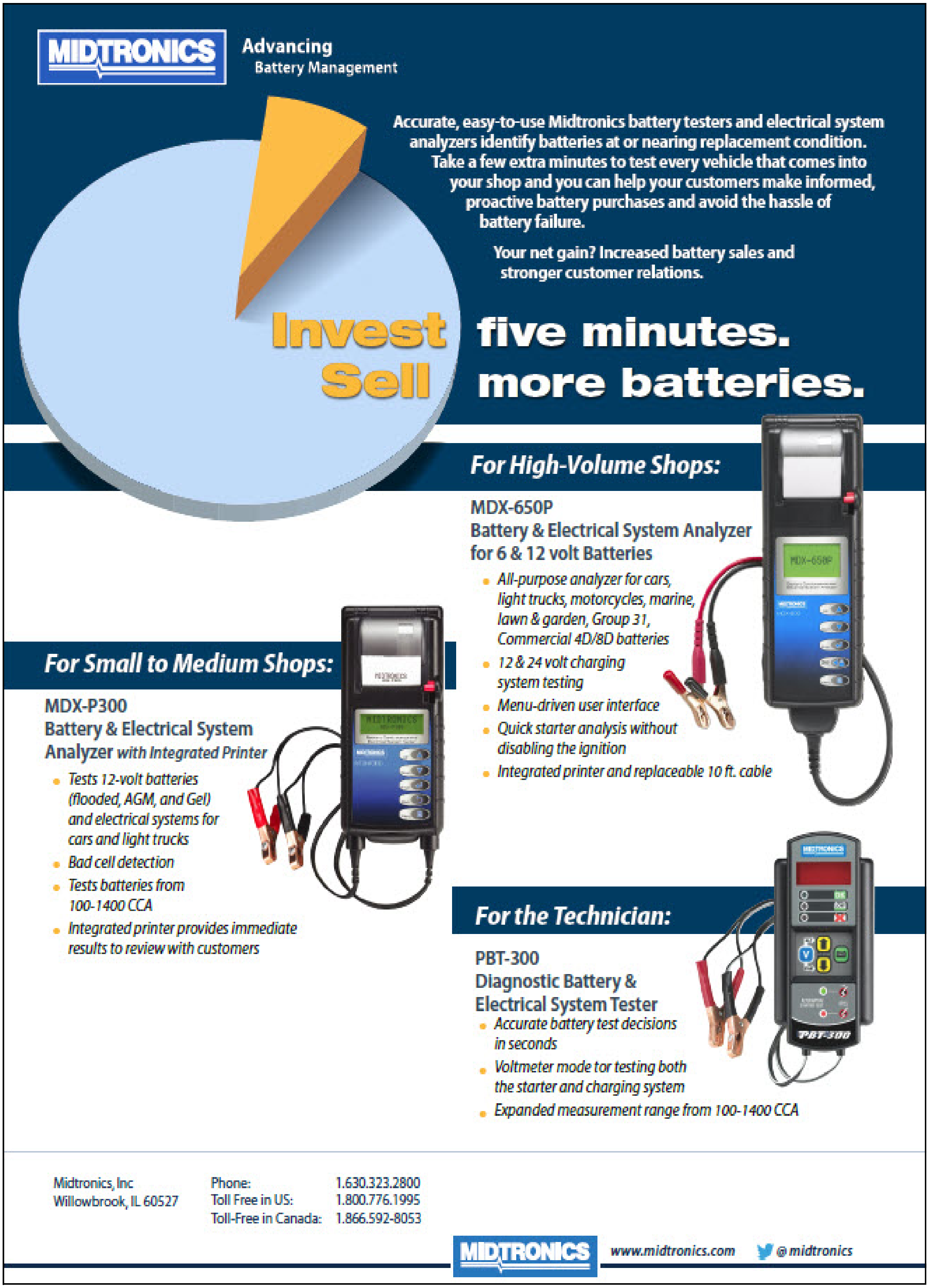
Our next course of action was to remove both the front and rear O2 sensors and insert a video scope to examine the front and rear openings of the converter. The picture from the front opening of the converter (where the upstream O2 sensor would be mounted) revealed that the substrate was in poor shape, and the picture from the rear opening of the converter (where the downstream O2 sensor would be mounted) confirmed that the converter could not be salvaged and had to be replaced.



In many cases, repairing a catalytic efficiency DTC will require a catalytic converter replacement. However, the condition of the old catalytic converter's substrate should always be inspected prior to replacing the part. Blocked, broken, or melted substrate is a sure sign that the catalytic converter failed as a result of an upstream engine problem rather than of age.

Another common mistake worth noting is installing a cheap replacement converter. The problem with installing a poor quality converter is that the MIL may be triggered; this may occur because the replacement's substrate cannot meet the minimum requirements of the engine or the PCM's standards. To avoid having to replace a converter twice, be sure to install an original equipment converter or one that is sourced from a quality aftermarket manufacturer.

Diagnosing the P0420 and P0430 DTCs involves more than just swapping converters. It takes the dedication of a professional technician to discover and correct the root cause of the failure to prevent a recurrence of the problem. To properly resolve these DTCs, technicians should always research the service information and verify that all other systems are working properly before working on a vehicle; this way, you can save effort and time while ensuring that the MIL stays off.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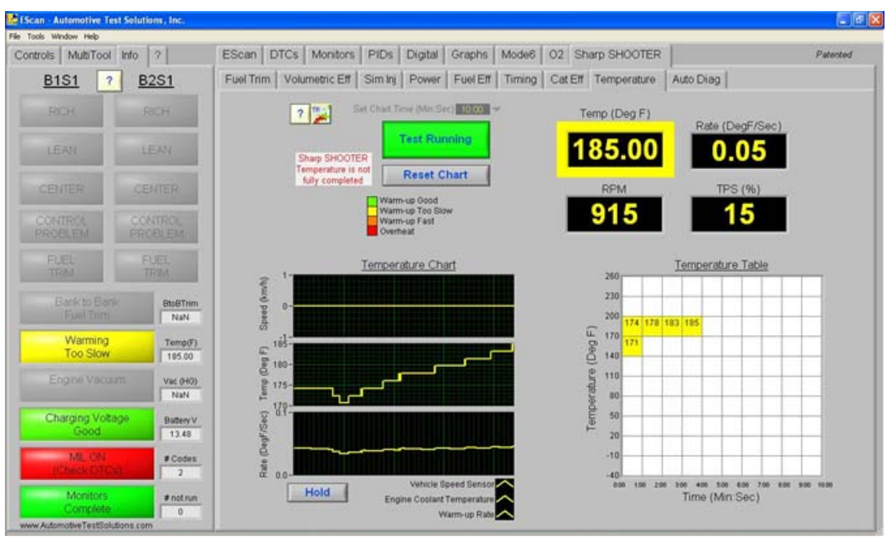
"Thermostat and Temperature"

Many technicians encounter vehicles with monitors that are difficult to complete or that exhibit driveability problems. These problems can be a result of many different issues.

The coolant mixture, air pockets, and thermostat calibration are all important factors that can prevent system monitors from becoming Ready and can cause driveability and emission problems. The cooling system is often overlooked because the engine's coolant/antifreeze stays good for such a long time. Another factor is that diagnostic trouble codes (DTCs) for a cooling system problem are not commonly set, and if the passenger compartment is receiving warm air, or if the engine is not overheating, the cooling system is assumed to be working correctly, but this is not always the case. In fact, the coolant can look good but its pH level and lubricating properties could be in bad condition. Or the thermostat could be out of calibration, which would cause the cooling system to take longer to reach the proper operating temperature. Remember that the rise in coolant temperature is checked by the Powertrain Control Module (PCM); if the PCM does not see the temperature rising at the correct rate, it will prevent system monitors from becoming Ready.

Read the full article in our next issue…



All Articles in this newsletter by "G" Truglia TST Founder, President and World Class Triple Master ASE L1, L3 Technician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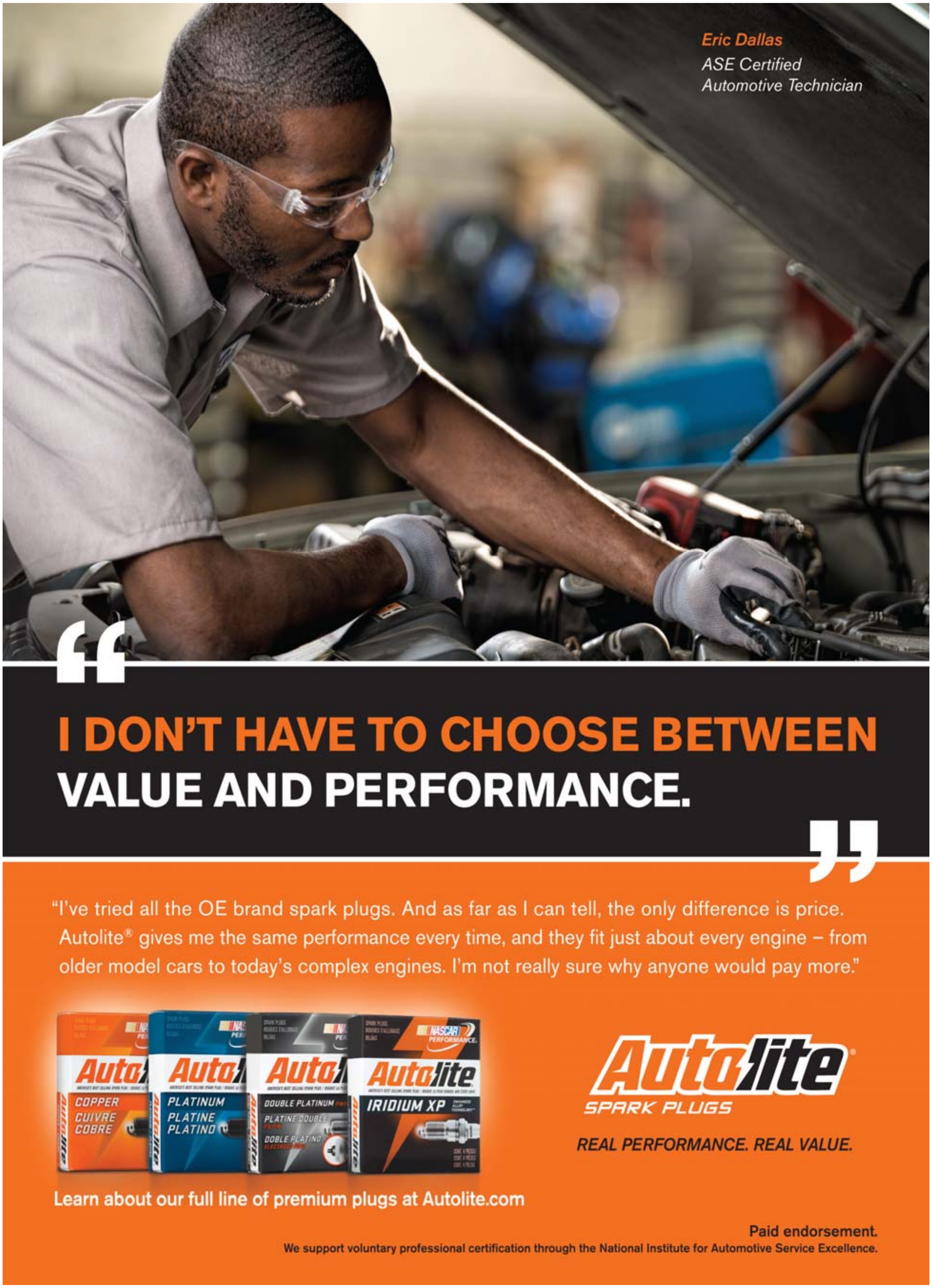
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FIND LEAKS QUICKLY AND ACCURATELY IN ALL SEALED SYSTEMS IN 3 EASY STEPS
1. Pressurize sealed system with CO2 gas.
2. Quickly locate CO2 gas at the leak site.
3. Foam color change pinpoints leak site.
BULLSEYE Leak Detector
Fast – Easy – Accurate
CO2 Gas Pressurization – Safe – Easy – Effective
Electronic CO2 leak detector to quickly zero in on leak site
Color changing foam to identify exact leak location
Safe for All Systems – EVAP, Fuel, Air Conditioning, Intercooler, Induction Systems, Air Suspension, Cooling Systems, Wheel and Tire – Any Sealed System
ATS
AUTOMOTIVE
Test Solutions