

P0420/P0430

A Murder Mystery On Who Killed The Cat

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Conversation Topics

- ☐ Theory and operation of the catalytic converter
- ☐ Suggested tools for the investigation
- ☐ How the P.C.M condemns the catalytic converter
- ☐ Suggested tests and the outcomes of each test
- ☐ Mode 6
- ☐ Code setting criteria
- ☐ Data analysis
- ☐ Case studies

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Tools For The Investigation



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Year: _____

Make: _____

Model: _____

Engine _____

DTC: _____

☐ Pending/Current/History _____

☐ Permanent _____

☐ Does Freeze Frame show any useful data

☐ Mode 6 Data _____

☐ T.S.B. _____

☐ Visual Inspection of exhaust

Data Collection:

☐ Oxygen sensor appear to switching

Tests: Ok Fail

Battery Test ☐ ☐

Relative Comp ☐ ☐

Cylinder Cont. ☐ ☐

Vacuum Testing: ☐ ☐

Idle ☐ ☐

Snap Throttle ☐ ☐

Air Intake Test ☐ ☐

V.E. ☐ ☐

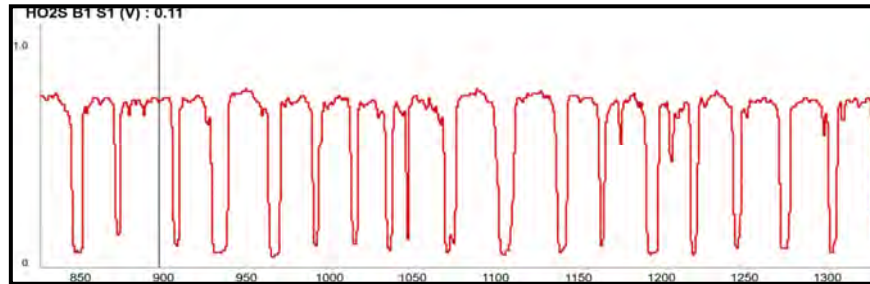
Fuel Trims ☐ ☐

Fuel Pressure ☐ ☐

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Oxygen Sensor Info – The Witnesses

The oxygen sensor measures the **remaining oxygen in the exhaust stream** after the combustion process. The control module uses this sensor to help regulate air/fuel ratio for optimal combustion in a gasoline engine.

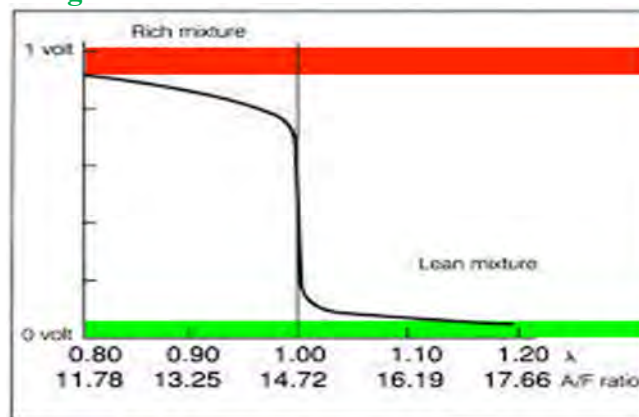


Good oxygen sensors have even waves in the **150 mV to 850 mV** range that switch from **rich to lean or lean to rich in 100 ms or less** when the system is in Closed Loop.

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Oxygen Sensor Info– The Witnesses

Less oxygen than optimal in the exhaust results in a signal voltage over 900 mV. This reflects a RICH CONDITION. More oxygen in the exhaust than optimal results in a signal voltage under 100 mV. This reflects a LEAN CONDITION.

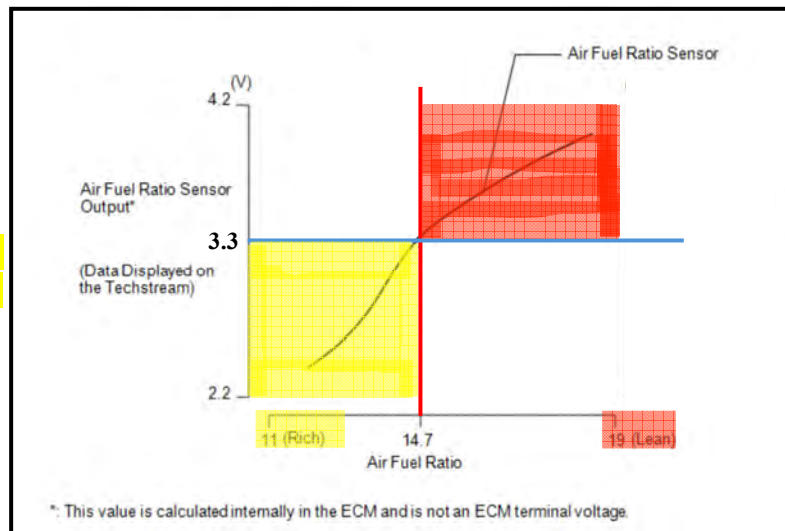


Voltage switching between 150-850 MV is stoichiometric and is a lambda of 1

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Toyota Air Fuel Sensor – Example – The Witnesses

Voltage
under 3.3
volts is rich
from 11:1 –
14.7:1



Voltage
over 3.3
volts is lean
from 14.7:1
– 19:1

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Why do we have Cat Converter – The Victim

- In the late 1960s and early 1970s, cities like Los Angeles were experiencing severe smog problems caused largely by car exhaust.
- The main pollutants coming out of tailpipes were:
 - **Carbon monoxide (CO) – poisonous gas**
 - **Nitrogen oxides (NOx) – also major contributors to smog and acid rain**
 - **Unburned hydrocarbons (HC) – contribute to smog and ozone**
- The U.S. Clean Air Act of 1970 required drastic reductions in these emissions. The most practical way to achieve that on a gasoline engine was to add a catalytic converter to the exhaust system

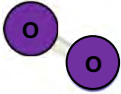


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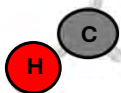
Gases – The Suspects



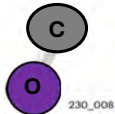
Nitrogen (N₂) - a non-flammable, colorless, and odorless gas. Makes up for 78% of the air we breathe



Oxygen (O₂) is a colorless, odorless, and tasteless gas. Makes up for 21% of the air we breathe



Hydrocarbons (HC) are unburnt fuel components that occur in the exhaust emissions after incomplete combustion.



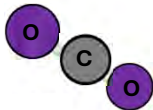
Carbon monoxide (CO) - results from the incomplete combustion of combustibles containing carbon. It is colorless, odorless, explosive, and highly toxic.

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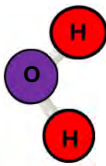
Gases – The Suspects



Nitrogen oxides (NOX) are produced by high pressure, high temperature, and a surplus of oxygen in the engine during the combustion cycle.



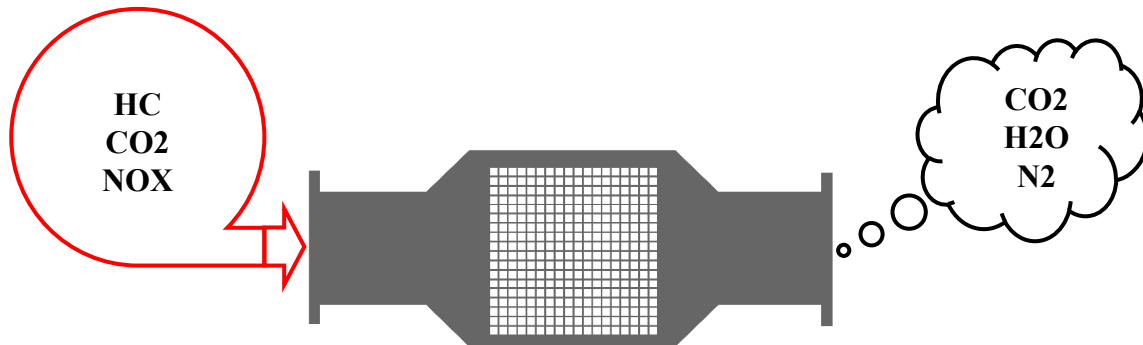
Carbon dioxide (CO₂) is a colorless, non-flammable gas. It is produced by the combustion of fuel containing carbon (e.g., petrol, diesel). Carbon combines with oxygen induced into the engine.



Water (H₂O) is partly induced by the engine (atmospheric humidity) or occurs during low-temperature combustion (warm-up period). Water is a harmless exhaust gas component.

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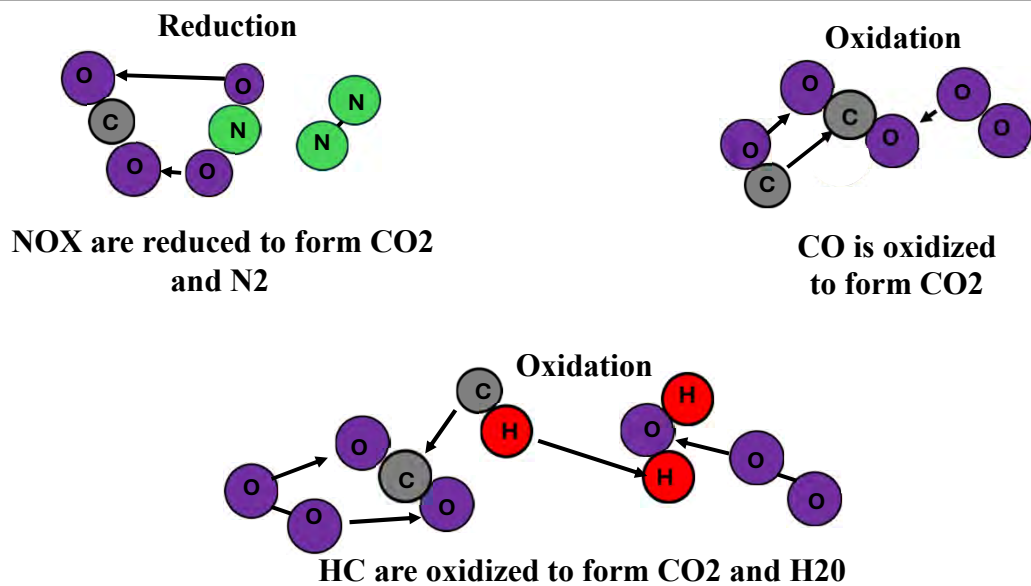
What Goes In-Must Come Out



- **Reduction part** → gets rid of NO_x (rhodium)
- **Oxidation part** → gets rid of CO and HC (platinum/palladium)
- **Oxygen-storage part** → keeps everything working perfectly (cerium)

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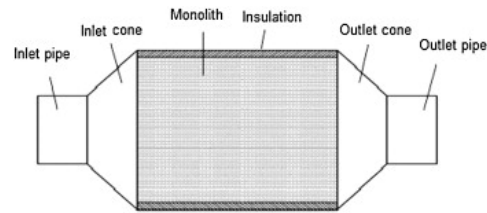
What Goes In-Must Come Out



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Monolith

- Catalytic converters contain a honeycomb structure called a monolith
- The monolith contains a washcoat that has platinum, palladium, cerium, rhodium, and other materials
- The washcoat enlarges the affected area that it applied to but a factor of 10k
- These metals are the actual catalysts — they make reactions happen much faster without being consumed

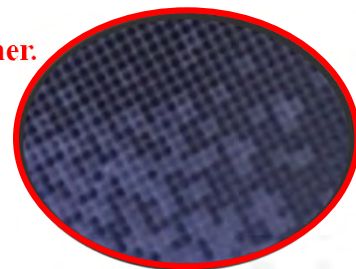


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Sintering

Sintering is the irreversible loss of active surface area of the precious-metal catalyst particles (Pt, Pd, Rh) and the wash coat support (mainly alumina and ceria-zirconia) caused by prolonged exposure to **high temperatures**.

- At normal operating temperatures (~800–1200 °F) the tiny catalyst nanoparticles (1–10 nm) are stable.
- Above ~1500°F, the metal atoms become mobile and start migrating.
- Small particles merge into larger ones or clump together.
- Severely sintered catalyst: dull, larger shiny metal
- beads or clumps visible even without magnification; washcoat looks glassy or collapsed



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Stoichiometric

A catalytic converter can only convert all 3 gases at the same time when the engine runs at or extremely close to the stoichiometric air-fuel ratio

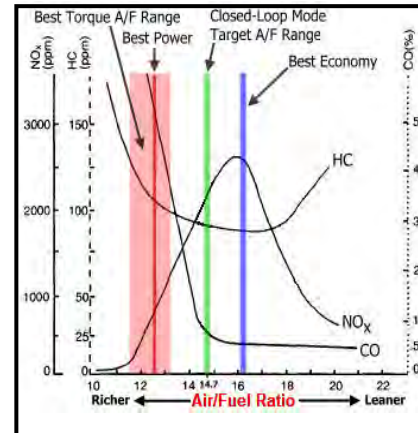
When the mixture is lean ($>14.7:1$)

- plenty of extra O_2
- but there is no CO/HC left to reduce NO_x

When the mixture is rich ($<14.7:1$)

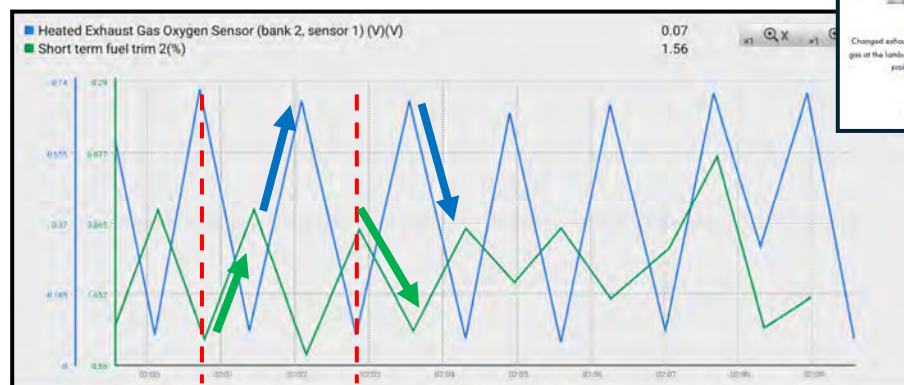
- plenty of CO and HC - NO_x is reduced beautifully
- almost no O_2 left $\rightarrow$ CO and HC conversion collapses.

Only right at stoichiometric (or within ± 0.1 AFR, lambda 0.99–1.01) do all three gases have exactly what they need at the same time.



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Stoichiometric



Fuel Trims Drive the oxygen sensor signal rich and lean by switching back and forth.

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Light Off

A catalytic converter, when at proper operating temperatures, has a 100% conversion rate

- **HC and CO emissions are high when the engine is cold**
- Fuel condenses when cold and leaves unburned HC on the cylinder and intake manifold walls
- **This rise in pollutants can not be cleaned up when the converter is cold**

This light-off time can be sped up through different processes:

- **Exhaust design**
- **High speed idle**
- **Ignition timing**
- **Homogeneous split injection**
- **Camshaft timing**
- **Secondary air injection**

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Light Off

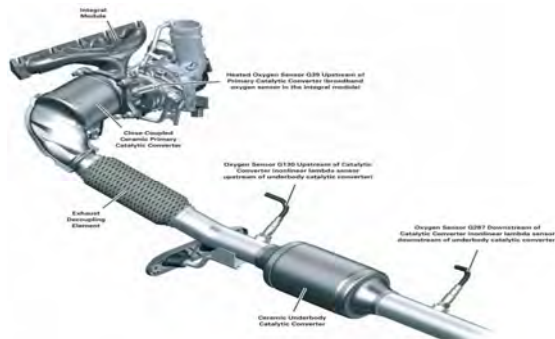
To get the vehicle in to closed loop status the catalytic converter needs to be up to operating temp as quickly as possible



To minimize light-off time of the primary catalytic converter is mounted as close to the engine as possible along with other strategies

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SULEV 2.0L TFSI Engine



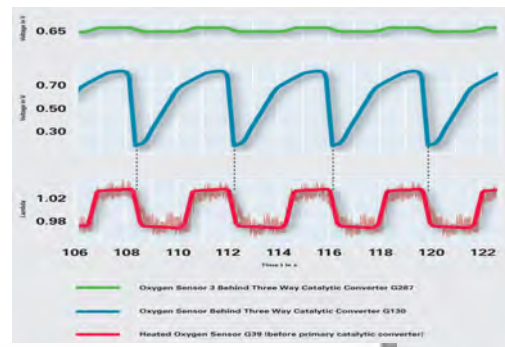
Catalytic Converter System

The exhaust system was developed with the following goals in mind:

- Easy compliance with SULEV exhaust emission limits
- High long-term stability over 150,000 miles (240,000 km) and 15 years
- Minimized increase in exhaust back-pressure in catalytic converters with a high cell density
- Reduced light-off time

The primary catalytic converter is designed to comply with statutory emission limits. To achieve this, cell density has been increased and wall thickness reduced.

To minimize light-off time of the primary catalytic converter, it is close coupled to the exhaust turbocharger turbine (directly in the integral module).



Courtesy Of Volkswagen

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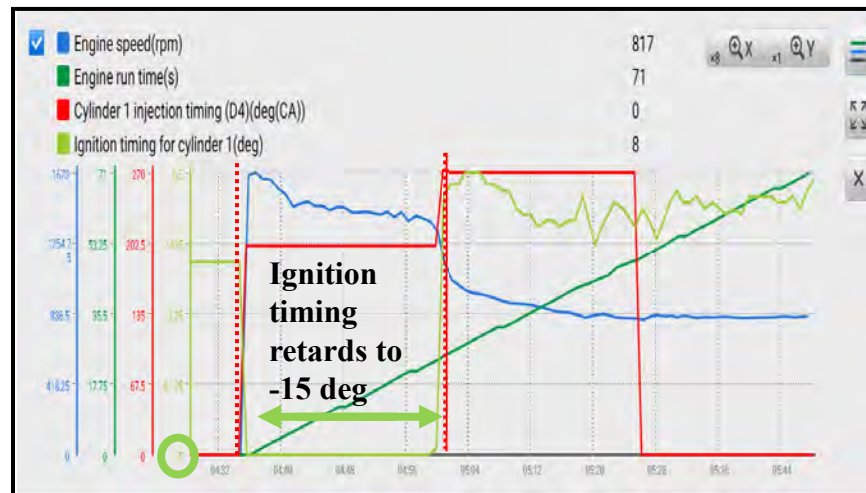
Cold Start Emission Strategy – Toyota Dual Fuel Injection

On a cold start, the system will start and run on direct injection only. This is done for cold start emissions to help light off the catalytic converter faster.

- For the first 30 seconds of engine run time, the ignition timing is retarded to - 15 degrees. **Retarded ignition timing reduces the efficiency of the combustion chamber**, at the same time raising combustion gas temperature. **This results in hotter exhaust entering the catalytic converter and reduces the time for it to light off.**
- The other strategy is by injecting fuel closer to the top dead center compression. This late injection time increases exhaust gas temperature. **This results in hotter exhaust entering the catalytic converter and reduces the time for it to light off.** Toyota will inject fuel via the direct-injection system **200 degrees** before top dead center compression, and after 30 seconds, move it further away to **270 degrees**.

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Cold start after setting 5 hours – catalyst heat mode



In the first 30 seconds, the ignition timing is retarded to -15 degrees, then moves to 8 degrees.

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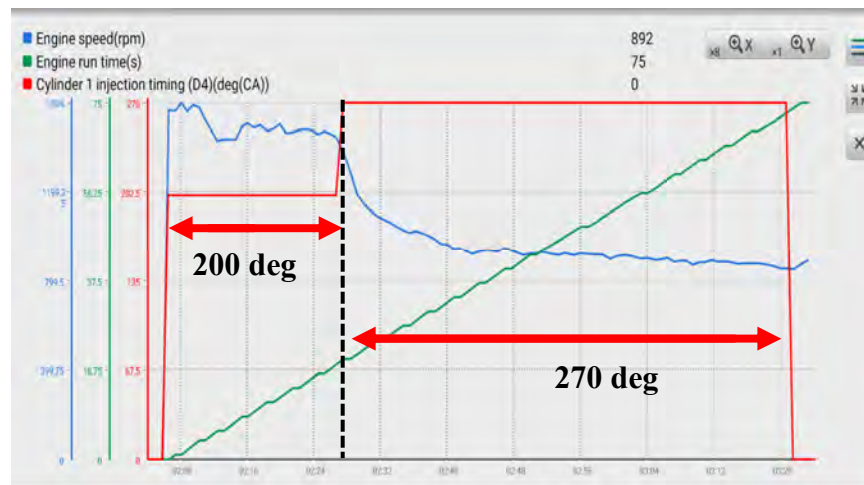
Cold engine start - Toyota



The first 90 seconds on a cold start show being run in direct injection

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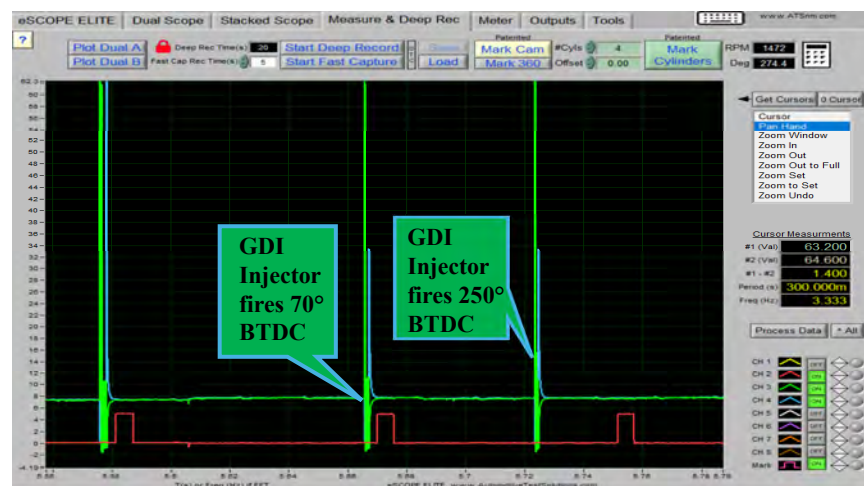
Cold engine start - Toyota



The first 30 seconds direct-injection timing is about 200 degrees and then changes to 270

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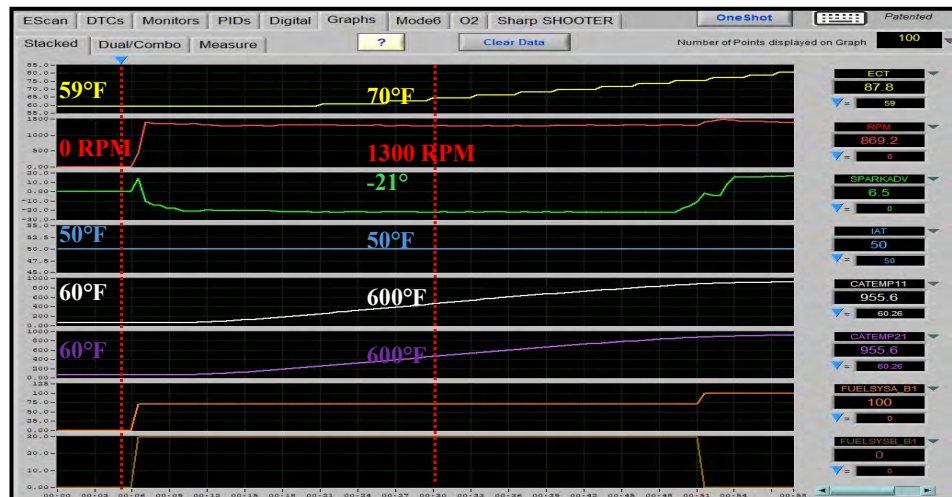
Cold engine start – General Motors



Red is cylinder 1 ignition, green and blue are cylinder 1 GDI injector

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Cold engine start – Ford F-150



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Catalyst Break-In

Starting in the 2010 ½ Model Year and later, the catalyst monitor will employ catalyst break-in logic. This logic will prevent the catalyst monitor from running until after a catalyst break-in period.

The catalyst monitor will not run on a new vehicle from the assembly plant until 60 minutes of time above a catalyst temperature (typically 800 to 1100 deg F) has been accumulated or 300 miles has elapsed.

New modules at the assembly plant will have an NVRAM flag initialized to delay the catalyst monitor. Service modules and re-flash software will have the flag set to allow that catalyst monitor to run. The flag cannot be reset to delay the catalyst monitor from running by any tool or service procedure.



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Catalyst Break-In

Eastern Catalytic Tech Tip
Proper Break-In Procedure
Prevents Future Problems



Catalytic Converter Installation Alert!

All replacement catalytic converters require a "break-in" period before the vehicle is driven. This break-in period allows the converter matting to expand and provide a snug fit between the converter shell and the ceramic substrate and matting.

Without proper break-in, catalytic converter matting does not expand correctly, allowing substrate to become loose, rattle and even break up over time.

If you hear a rattling sound shortly after an installation, it's likely an indication that the converter was not properly broken in.

To avoid this, and other potential problems, be sure to follow this "break-in" procedure immediately after the converter is installed:

1. Start the engine, but do not rev.
2. Idle the engine and allow it to warm up slowly.
3. After 5 minutes, increase the engine speed to 2500 RPM.
4. Hold at 2500 RPM for 2 minutes.
5. Allow engine to cool down.
6. Road test vehicle to confirm correct installation.

WARNING: Failure to follow these steps can result in converter failure.

EASTERN CATALYTIC

Courtesy of Eastern Catalytic

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Catalyst Break-In

Why do catalytic converters need a break-in?



FIGURE 1

MATTING
CERAMIC SUBSTRATE

The "working" components in a catalytic converter are high performance ceramic "bricks," which are coated with a catalytic "washcoat" and held in place by converter matting.

The converter matting is made with a mineral called vermiculite and is held together by a fiber mat and an organic binder. This matting is wrapped around the converter's ceramic brick. (See Figure 1.)

The matting is installed in the converter in an unexpanded state. (See Figure 2.)

During the first heat up, the fiber mat and binder burn off and the matting actually gets looser before it expands to fill the converter cavity to hold the ceramic brick in place. (See Figure 2.)

If that warm up is not done properly, the brick can come loose, causing rattling and damage to the brick.

Break-in that cat, first.

Courtesy of Eastern Catalytic

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Catalyst Break-In



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Switch/Index Ratio

In order to determine catalyst oxygen storage, the monitor counts front and rear HO₂S switches during closed-loop fuel conditions after the engine is warmed up and inferred catalyst temperature is within limits

When the required number of front switches has accumulated in each cell (air mass region), the total signal length of the rear HO₂S is divided by the total signal length of the front HO₂S to compute a catalyst index ratio.

- An index ratio near 0.0 indicates high oxygen storage capacity
- A switch ratio near 1.0 indicates low oxygen storage capacity
- If the actual index ratio exceeds the threshold index ratio, the catalyst is considered failed.

Courtesy of Ford

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Toyota

MONITOR DESCRIPTION

The ECM uses sensors mounted in front of and behind the Three-Way Catalytic Converter (TWC) to monitor its efficiency.

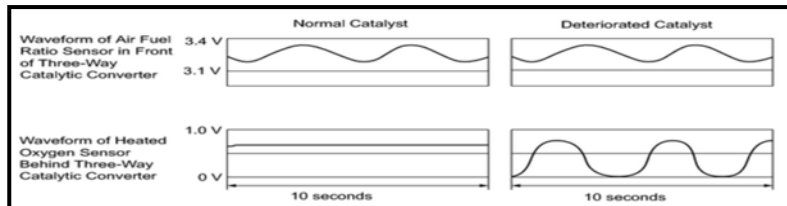
The first sensor, the air fuel ratio sensor, sends pre-catalyst information to the ECM. The second sensor, the heated oxygen sensor, sends post-catalyst information to the ECM.

In order to detect any deterioration in the three-way catalytic converter, the ECM calculates the oxygen storage capacity of the three-way catalytic converter. This calculation is based on the voltage output of the heated oxygen sensor while performing active air fuel ratio control.

The oxygen storage capacity value is an indication of the oxygen storage capacity of the three-way catalytic converter. When the vehicle is being driven with a warm engine, active air fuel ratio control is performed for approximately 15 to 20 seconds. When it is performed, the ECM deliberately sets the air fuel ratio to lean or rich levels. If the cycle of the waveform for the heated oxygen sensor is long, the oxygen storage capacity is great. There is a direct correlation between the heated oxygen sensor and the oxygen storage capacity of the three-way catalytic converter.

The ECM uses the oxygen storage capacity value to determine the state of the three-way catalytic converter. If any deterioration has occurred, the ECM illuminates the MIL and stored the DTC.

This system determines the deterioration of the entire catalyst system (including the front and rear catalysts), by using the oxygen storage capacity value of the front catalyst, that is more sensitive than the rear catalyst, as the representative value. Therefore, be sure to replace the front and rear catalysts together when catalyst replacement is necessary.



Courtesy of Toyota

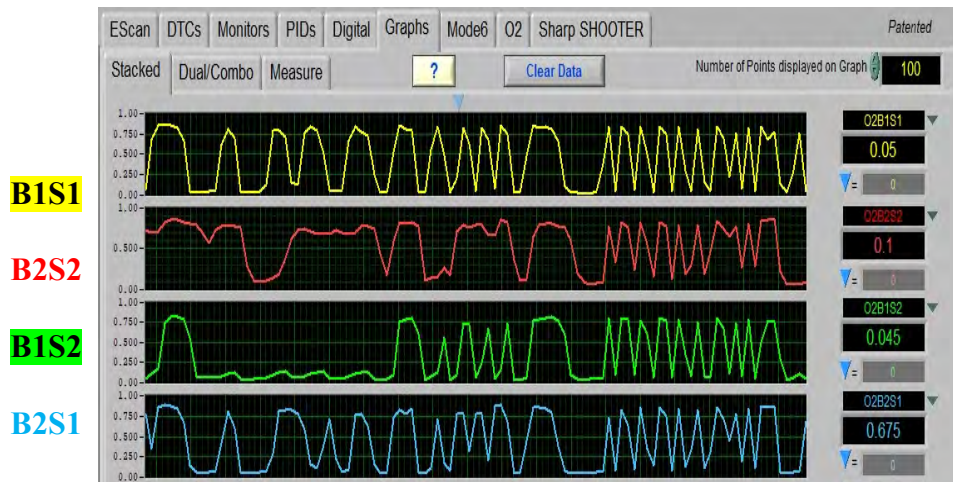
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Switch/Index Ratio - Graphing Data - Good



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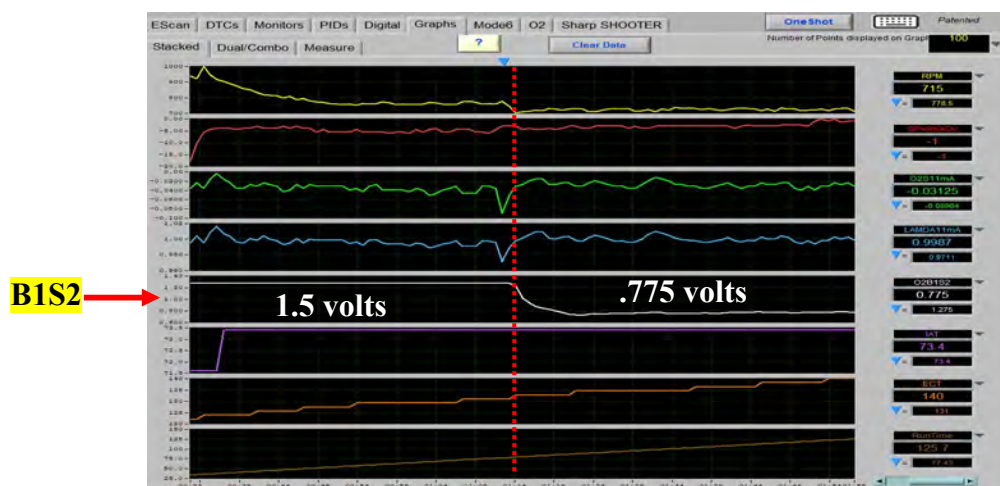
Switch/Index Ratio – Graphing Data



The Front and rear oxygen sensors mimic each other

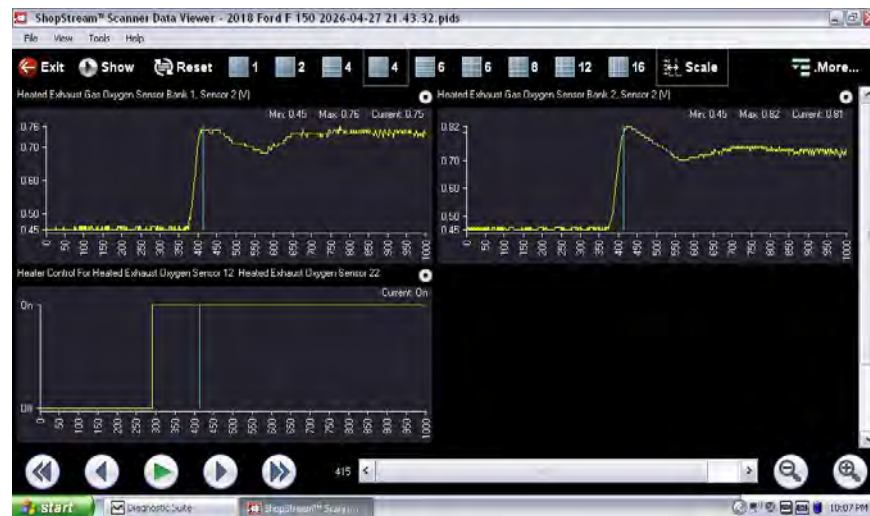
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Rear O2 Operation



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Rear O2 Operation – Heater Circuit



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Switch/Index Ratio - Escan

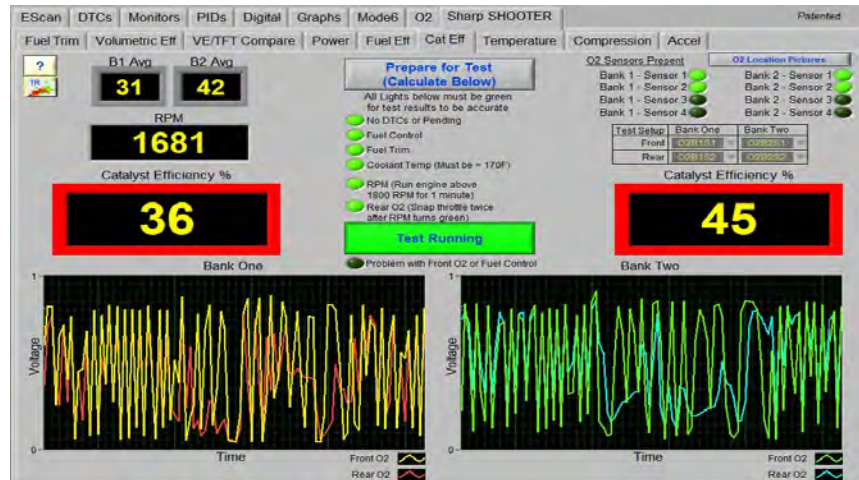


Bad

Good

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Switch/Index Ratio - EScan



Both banks are bad

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Switch/Index Ratio - EScan



Both banks good

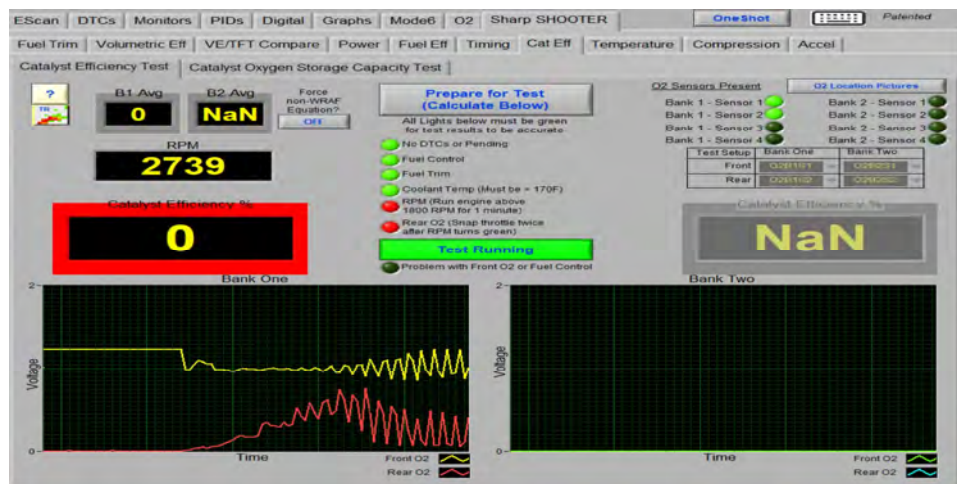
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Switch/Index Ratio – Escan – Air/Fuel Sensor



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Switch/Index Ratio – Escan – Air/Fuel Sensor



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Integrated Air/Fuel Method

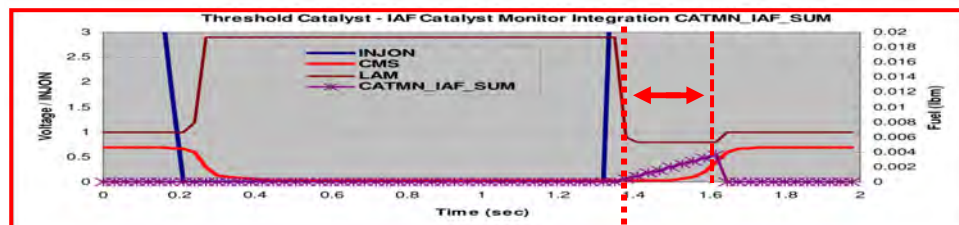
The Integrated Air/Fuel Catalyst Monitor assesses the oxygen storage capacity of a catalyst after a fuel cut event.

- The monitor integrates how much excess fuel is needed to drive the monitored catalyst to a rich condition starting from an oxygen-saturated, lean condition.
- The monitor is a measure of how much fuel is required to force catalyst breakthrough from lean to rich.
- To accomplish this, the monitor runs during fuel reactivation following a Decel Fuel Shut Off (DFSO) event.

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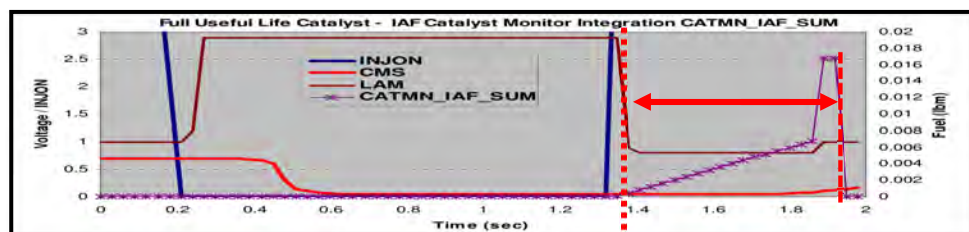
Integrated Air/Fuel Method

Bad



Very little fuel is needed to bring the rear o2 from lean to rich

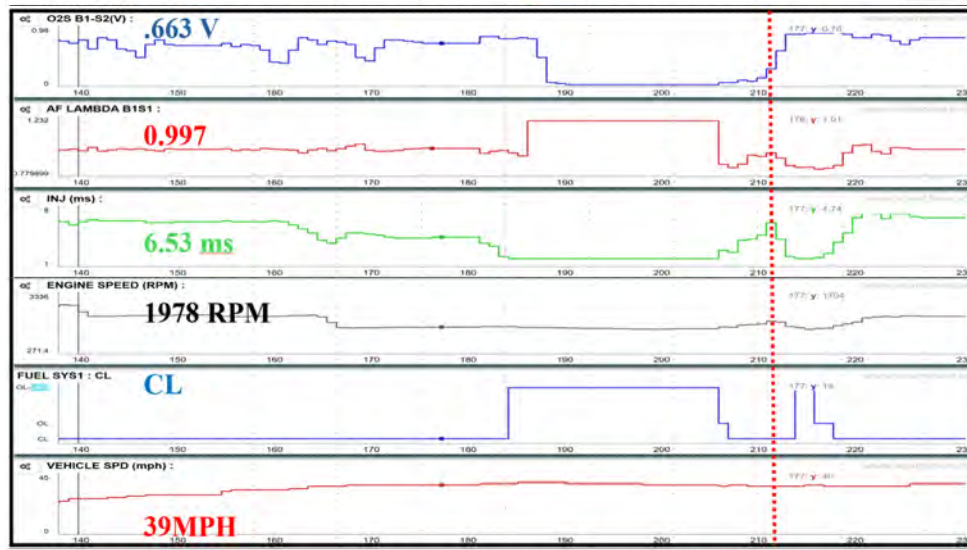
Good



Substantial amount of fuel is needed to bring the rear o2 from lean to rich

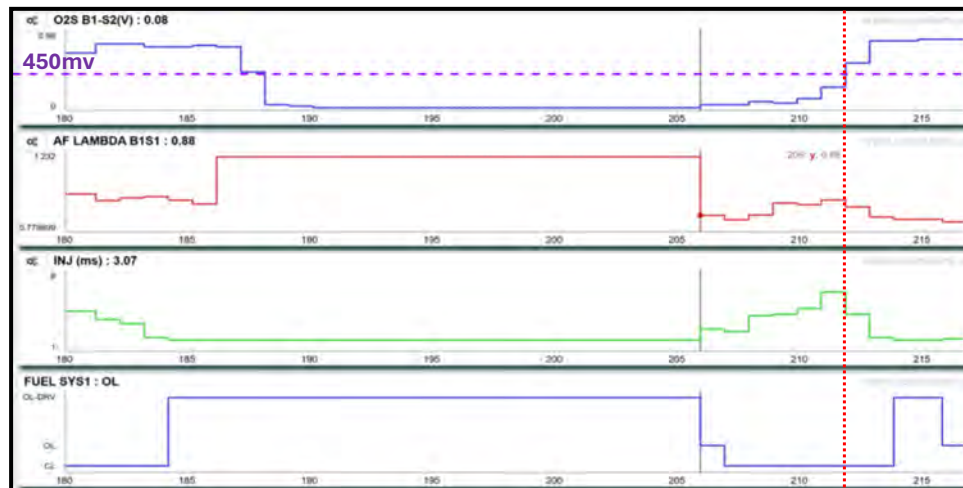
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2010 Toyota Corola



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2010 Toyota Corola

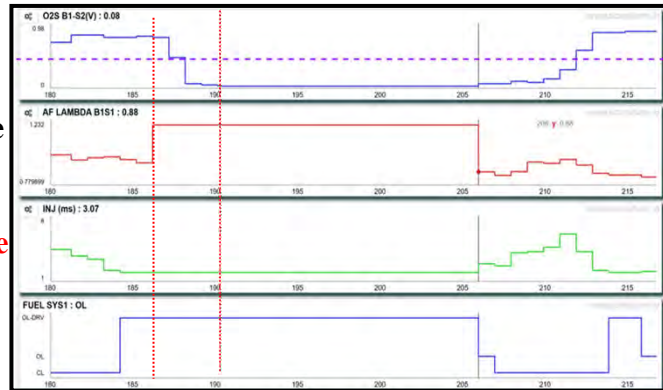


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The Gap

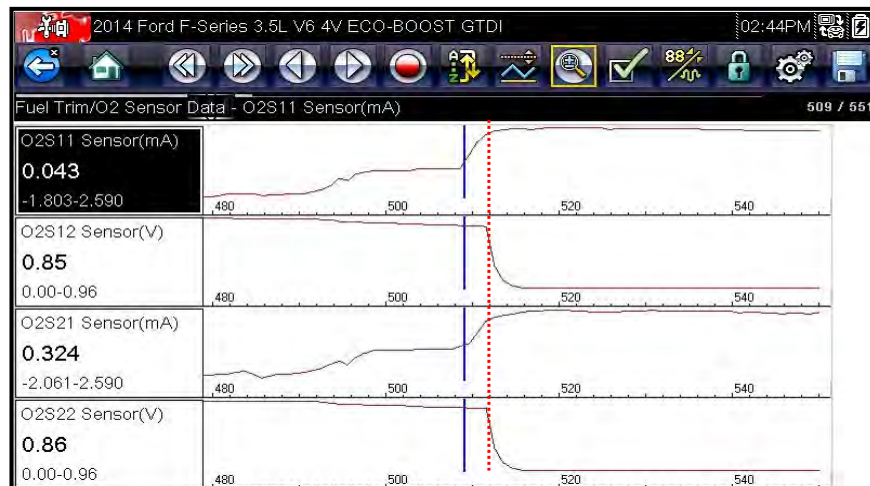
The internal combustion engine is a pump. On DeCell Fuel, Shut off the control module, which shuts off the injectors, and large amounts of air are pumped into the exhaust. The catalytic converter will store as much of this oxygen as it can.

- The “Gap” that I’m referring to is the time the front O2 goes full lean to when the rear O2 goes full lean
- The better the oxygen storage
- the longer the gap will be
- The worst oxygen storage
- the shorter the gap will be



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The Gap Known Good



There is a delay from when the front air/fuel sensor goes full lean and the rear o2 goes full lean

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The Gap - Bad



All 4 sensor go lean at the exact same time

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On-Board Monitoring Test Results for Non-Continuously Monitored Systems"

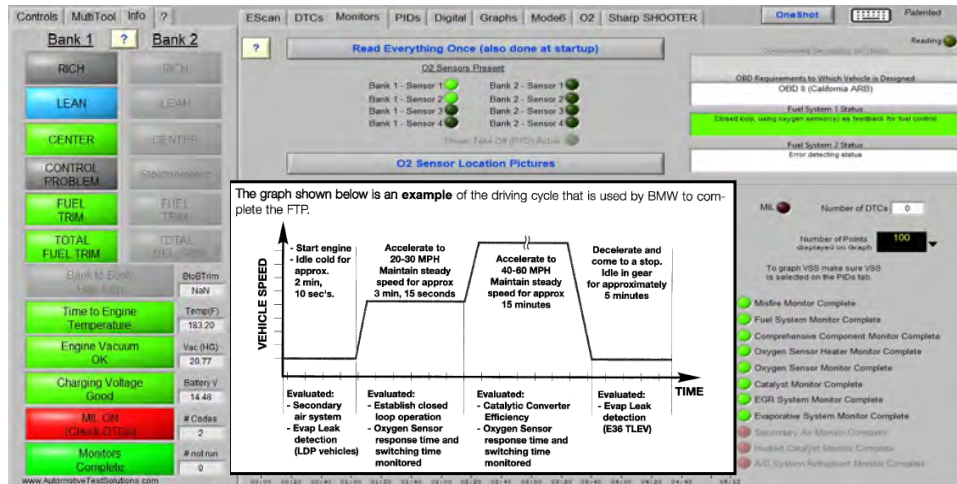
EScan DTCs Monitors PIDs Digital Graphs Mode6 O2 Sharp SHOOTER					OneShot		Patented
Select Make					Read All Mode6 Once		
Generic					Read All Mode6 Continuous		
Test Value background color: Red if outside of limit, Yellow if close to limit					Read Selected Continuous		
Test ID (TID)	Component ID (CID)	Test Value	Min Limit	Max Limit	Units	Term Meaning	
S05: Description Unavailable	S46: Description Unavailable	1088.000		16320.000			
S05: Description Unavailable	S44: Description Unavailable	179.000		1450.000			
S05: Description Unavailable	S4C: Description Unavailable	10970.000		11199.000			
S05: Description Unavailable	S4D: Description Unavailable	32799.000	32653.000	32938.000			
S05: Description Unavailable	S87: Description Unavailable	1182.000	35.000			TID Test ID: what is being tested	
S05: Description Unavailable	S88: Description Unavailable	1179.000	35.000				
S05: Description Unavailable	S8B: Description Unavailable	23330.000	22719.000				
S05: Description Unavailable	SC7: Description Unavailable	213.000	35.000				
S05: Description Unavailable	SCB: Description Unavailable	214.000	35.000				
S05: Description Unavailable	SCB: Description Unavailable	23330.000	22719.000			CID Component ID: which sensor or bank	
S0A: Description Unavailable	S01: Description Unavailable	10.000		150.000			
S0A: Description Unavailable	SC2: Description Unavailable	10000.000	10000.000				
S0A: Description Unavailable	S13: Description Unavailable	2958.000		18000.000			
S0A: Description Unavailable	S84: Description Unavailable	0.000	0.000				
S0A: Description Unavailable	S0A: Description Unavailable	0.000		0.000		Test Value: The actual measured number	
S0A: Description Unavailable	S87: Description Unavailable	600.000	600.000				
S0A: Description Unavailable	S4B: Description Unavailable	32770.000		32868.000			
S0A: Description Unavailable	S0B: Description Unavailable	0.000		0.000			
S0A: Description Unavailable	S0C: Description Unavailable	0.000		0.000			
S0A: Description Unavailable	S0D: Description Unavailable	0.000		0.000		Min: Minimum limit to pass	
S0C: Description Unavailable	S60: Description Unavailable	30918.000		32942.000			
S0C: Description Unavailable	S70: Description Unavailable	30919.000		32952.000			
S0E: Description Unavailable	S11: Description Unavailable	0.000	8.000				
S0E: Description Unavailable	S12: Description Unavailable	0.000	8.000				
S0E: Description Unavailable	S21: Description Unavailable	0.000	8.000			Max: Maximum limit to pass	
S0E: Description Unavailable	S22: Description Unavailable	0.000	8.000				
S16: Description Unavailable	S11: Description Unavailable	31227.000	25268.000	37338.000			
S16: Description Unavailable	S12: Description Unavailable	32608.000	25268.000	37338.000			
S16: Description Unavailable	S21: Description Unavailable	32912.000	25268.000	37338.000			
S16: Description Unavailable	S22: Description Unavailable	32883.000	25268.000	37338.000			

Raw test values and pass/fail results for many of the Non-Continuous emissions-related monitors that the ECU runs in the background.

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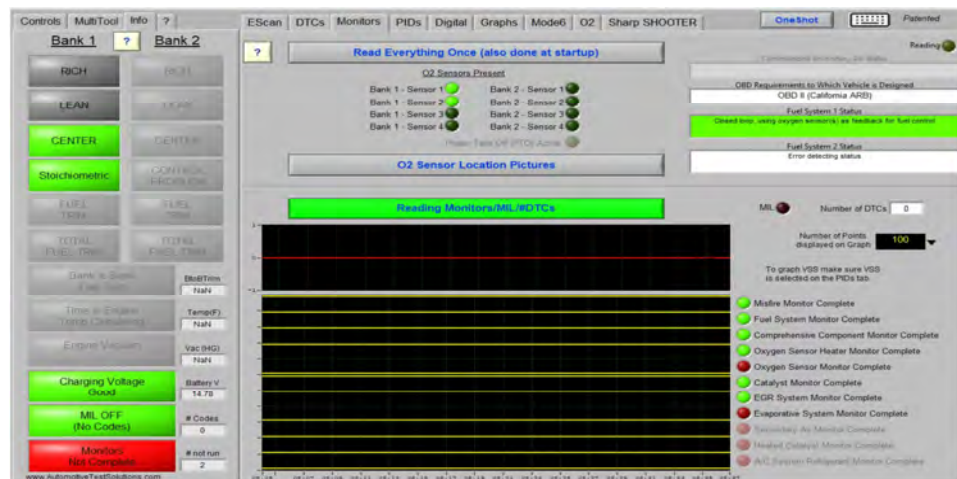
Monitors

To use mode 6 data, the monitors should be run and completed



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Monitors



Catalyst Monitor is set, but Oxygen Sensors are not?

D.A.D.S

If the catalyst monitor conditions are met, the catalyst monitor may run and complete after all the upstream HO2S functional tests are complete and the EVAP system is functional, with no stored DTCs

- However, **the catalyst monitor may run and complete before the downstream HO2S deceleration fuel shut-off test is complete.** In this case, the catalyst monitor readiness flag may indicate **complete** before the O2S I/M readiness flag indicates complete.
- If the catalyst monitor does not complete during a particular driving cycle, the already accumulated switch/signal data is retained in the KAM and is used during the next driving cycle to allow the catalyst monitor a better opportunity to complete



D.A.D.S

Fuel Shut off Rich to Lean Response Rate

EScan DTCs Monitors PIDs Digital Graphs Mode6 O2 Sharp SHOOTER Patented									
Select Make Ford 2003-2016									
Test Value background color: Red if outside of limit, Yellow if close to limit									
Reading									
OBID Monitor ID (OBDMID)	TestID (TID)	Test Value	Min Limit	Max Limit	Units				
\$01: O2 Heater Monitor/Front UEGO	\$81: B1S1 Heater Current	1.809	0.550	3.000	A				
\$01: Front UEGO Monitor	\$87: B2S1 Rich to Lean Response Time	0.008	0.000	0.500	sec				
\$01: Front UEGO Monitor	\$88: B1S1 Lean to Rich Response Time	0.012	0.000	0.500	sec				
\$02: Rear Oxygen Sensor Monitor	\$01: B1S2 Sensor Switch Point Voltage	0.450	0.000	7.995	V				
\$02: O2 Heater Monitor	\$81: B1S2 Heater Current	1.127	0.400	3.000	A				
\$02: Rear O2 DFSO Response Rate	\$85: B1S2 Fuel Shut off Rich to Lean Res	1.938	0.000	101072.000	mV/s				
\$02: Rear O2 DFSO Response Rate	\$86: B1S2 Fuel Shut off Rich to Lean Time	1.938	0.000	6.000	sec				
\$05: O2 Heater Monitor/Front UEGO	\$81: B2S1 Heater Current	1.669	0.550	3.000	A				
\$05: Front UEGO Monitor	\$87: B2S1 Rich to Lean Response Time	0.000	0.000	0.500	sec				
\$05: Front UEGO Monitor	\$88: B2S1 Lean to Rich Response Time	0.000	0.000	0.500	sec				
\$06: Rear Oxygen Sensor Monitor	\$01: B2S2 Sensor Switch Point Voltage	0.450	0.000	7.995	V				
\$06: O2 Heater Monitor	\$81: B2S2 Heater Current	1.151	0.400	3.000	A				
\$06: DFSO Response Rate	\$85: B2S2 Fuel Shut off Rich to Lean Res	1.954	0.000	101072.000	mV/s				
\$06: DFSO Response Rate	\$86: B2S2 Fuel Shut off Rich to Lean Res	1.954	0.000	6.000	sec				
\$01: Catalyst Efficiency Monitor	\$80: Bank 1 Index Ratio	0.051	0.000	0.459	Ratio				
\$02: Catalyst Efficiency Monitor	\$80: Bank 2 Index Ratio	0.055	0.000	0.459	Ratio				

D.A.D.S

Catalyst Monitor Operation – Ford Example

Why does
the monitor
not run?

CATALYST MONITOR OPERATION:		
DTCs	P0420 Bank 1 (or Y-pipe), P0430 Bank 2	
Monitor execution	once per driving cycle	
Monitor Sequence	HO2S response test complete and no DTCs (P0133/P0153) prior to calculating switch ratio, no SAIR pump stuck on DTCs (P0412/P1414), no evap leak check DTCs (P0442/P0443)	
Sensors OK	ECT, IAT, TP, VSS, CKP	
Monitoring Duration	Approximately 700 seconds during appropriate FTP conditions (approximately 100 to 200 oxygen sensor switches are collected)	
TYPICAL SWITCH RATIO CATALYST MONITOR ENTRY CONDITIONS:		
Entry condition	Minimum	Maximum
Time since engine start-up (70 °F start)	330 seconds	
Engine Coolant Temp	170 °F	230 °F
Intake Air Temp	20 °F	180 °F
Engine Load	10%	
Throttle Position	Part Throttle	Part Throttle
Time since entering closed loop fuel	30 sec	
Vehicle Speed	5 mph	70 mph
Inferred Catalyst Mid-bed Temperature	900 °F	
EGR flow (Note: an EGR fault disables EGR)	1%	12%
Fuel Level	15%	
Steady Air Mass Flow for each Air Mass cell (typically three cells)	1.0 lb/min	5.0 lb/min
(Note: FTP cycle is biased towards the low air mass range, 25 - 35 mph steady state driving must be performed to complete the monitor)		
FORD MOTOR COMPANY		
REVISION DATE: NOVEMBER 12, 2007		
PAGE 5 OF 66		

Always check for pending DTC's

D.A.D.S

Mode 9 - In-Use Performance Tracking

In-Use Performance Tracking:

- It provides counters for emissions-related monitors

How In-Use Performance Tracking Works:

- The ECU tracks two main values for each supported monitor:
- Numerator/**Completion** - Counts how many times the monitor has completed a diagnostic test (ran fully and checked for faults under suitable conditions)
- Denominator/**Condition** - Counts how many times the vehicle has met the general driving conditions required for that monitor to run (based on a standardized drive cycle), potentially.

D.A.D.S

Mode 9 - In-Use Performance Tracking

```

PCM
VIN 1FTEW1EP0JFE72567
CAL BNSR396.H32
CVN 415BB1F9
IPT OBDCOND = 1627
  IGNCNTR = 4895
  CATCOMP1 = 1840
  CATCOND1 = 1625
  CATCOMP2 = 1840
  CATCOND2 = 1625
  O2SCOMP1 = 2757
  O2SCOND1 = 1625
  O2SCOMP2 = 2757
  O2SCOND2 = 1625
  EGRCOND = 1664
  AIRCOND = 1626
  AIRCOMP = 0
  EVAPCOMP = 245
  EVAPCOND = 226
  SO2SCOMP1 = 1458
  SO2SCOND1 = 1625
  SO2SCOMP2 = 1458
  SO2SCOND2 = 1625
ECU PCM-PowertrainCtrl
          
```

The In-Use Performance Ratio is calculated as Numerator / Denominator. This ratio indicates how frequently the monitor runs in real-world driving compared to regulatory expectations

$$1840/1625=1.13$$

A low ratio might explain why readiness monitors aren't completing after repairs, or DTC clears

D.A.D.S

O.E.M. Information

The screenshot shows the OEM1Stop website interface. At the top, there's a navigation bar with 'Home', 'Position Statements', and 'Statement on Repair Procedures'. Below this is a section titled 'What is OEM1Stop?' which explains that the site provides vehicle repair information for various manufacturers. A 'Recently Added' section lists updates for Nissan, Ford, and Honda/Acura. The main body of the page features a grid of logos for 24 different car manufacturers, including Audi, BMW, Chevrolet, Ford, Honda, Hyundai, Infiniti, Isuzu, Jeep, Kia, Lexus, Lincoln, Mercedes-Benz, Mitsubishi, Nissan, Ram, Subaru, Suzuki, Tesla, Toyota, Volkswagen, and Volvo. At the bottom, there's a 'More Resources' section with logos for A2C2, NHTSA, and DEG.

D.A.D.S

Ford FDRS – Mode 6 – Brand New F150

Monitor ID	Description	Test ID	Min	Max	Value
HBD011 Monitor: 0x1	020111 Lean to Rich Slow Response Time	0x09	0 ms	500 ms	42 ms
	020111 Rich to Lean Slow Response Time	0x0A	0 ms	501 ms	50 ms
	020111 Rich to Lean Delay Response Time	0x0C	0 ms	531 ms	0 ms
	020111 Lean to Rich Delay Response Time	0x0D	0 ms	607 ms	0 ms
HBD012 Monitor: 0x2	HBD012 Fuel Shut-off Rich to Lean Response Rate	0x05	0 mV/s	-30000 mV/s	-14778 mV/s
	HBD012 Stock Rich Min Voltage	0x07	0 mV	175-629 mV	85.614 mV
HBD021 Monitor: 0x3	HBD012 Stock Min Voltage	0x09	448-692 mV	4987-12 mV	678.318 mV
	020211 Rich to Lean Slow Response Time	0x0A	0 ms	641 ms	48 ms
	020211 Lean to Rich Slow Response Time	0x0B	0 ms	558 ms	74 ms
	020211 Rich to Lean Delay Response Time	0x0C	0 ms	437 ms	41 ms
	020211 Lean to Rich Delay Response Time	0x0D	0 ms	603 ms	0 ms

Catalyst Monitor Bank 1 : 0x21

Oxygen Storage Capacity

0x81

0 Ratio

0.6211 Ratio

0.207 Ratio

Catalyst Monitor Bank 2 : 0x22

Oxygen Storage Capacity

0x81

0 Ratio

0.6016 Ratio

0.2227 Ratio

B15E VSC Monitor Bank 1 Bank Monitor: 0x11

ECM Exhaust Flow Test

0x07

0 Ratio

0.2016 Ratio

0.2016 Ratio

0.2016 Ratio

0.2016 Ratio

0.2016 Ratio

0.2016 Ratio

0.2016 Ratio

0.2016 Ratio

0.2016 Ratio

0.2016 Ratio

0.2016 Ratio

0.2016 Ratio

0.2016 Ratio

1FTEWLP58FA13931 F150 3.7L DOHC 4V DI GT V6 GAS

FDRS 44.4.7

Connected to Device

D.A.D.S

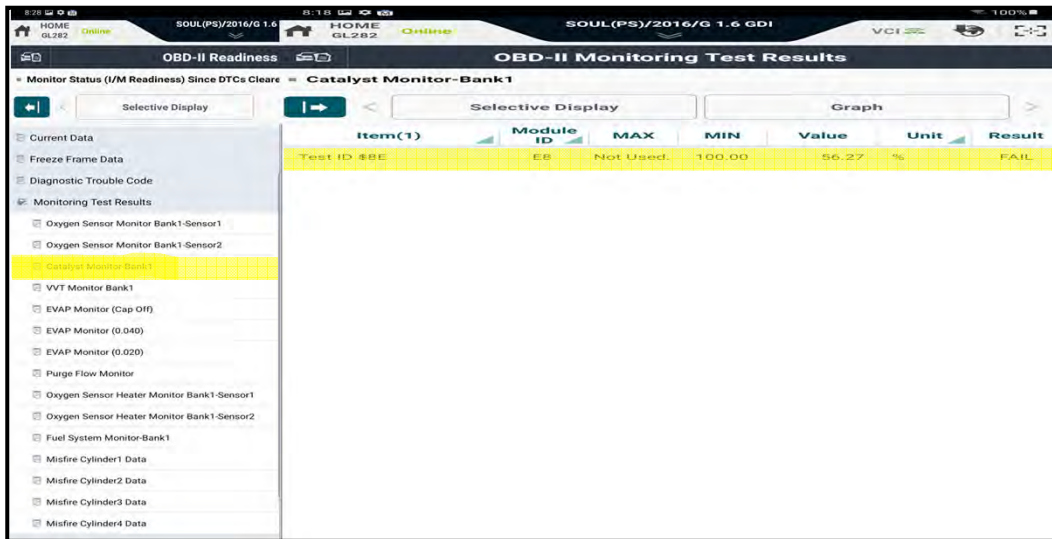
Mode 6 - Good

EScan	DTCs	Monitors	PIDs	Digital	Graphs	Mode6	O2	Sharp SHOOTER
Select Make								
Ford 2003-2016								
Test Value background color: Red if outside of limit, Yellow if close to limit								
Reading								
OBD Monitor ID (OBDMID)	Test ID (TID)	Test Value	Min Limit	Max Limit	Units			
\$01: Front UEGO Monitor	\$87: B2S1 Rich to Lean Response Time	0.016	0.000	0.400	sec			
\$04: Front UEGO Monitor	\$88: B4S1 Lean to Rich Response Time	0.063	0.000	0.400	sec			
\$21: Catalyst Efficiency Monitor	\$81: Description Unavailable	0.090	0.000	0.766	Ratio			
\$21: Catalyst Efficiency Monitor	\$81: Description Unavailable	0.090	0.000	0.766	Ratio			
\$35: VCT Monitor	\$82: Description Unavailable	0.020	0.000	21.210	Deg			
\$35: VCT Monitor	\$83: Description Unavailable	0.000	0.000	10.000	Deg			
\$35: VCT Monitor	\$84: Description Unavailable	0.000	0.000	14.140	Deg			
\$35: VCT Monitor	\$85: Description Unavailable	0.100	0.000	14.140	Deg			
\$3A: EVAP System 0.020 Leak Check	\$80: Phase 0 Initial Tank Vacuum	-112.500	-996.250	8191.750	Pa			
\$3A: EVAP System 0.020 Leak Check	\$82: Phase 0 Initial Gross Leak	-1992.500	-8192.000	-1992.500	Pa			
\$3B: EVAP System 0.020 Leak Check	\$80: Phase 2.040 Cruise Leak Check	0.000	-8192.000	1191.000	Pa			
\$3C: EONV EVAP System Monitor	\$81: Positive Pressure Test	181.500	108.500	8191.750	Pa			
\$3C: EONV EVAP System Monitor	\$82: Negative Pressure Test	0.000	0.000	0.000	Pa			
\$3C: EONV EVAP System Monitor	\$83: Average of 4 EONV Tests	0.100	0.000	0.400				
\$3D: Evaporative System	\$80: Blocked Evap Sys Line-Screening test	-2011.750	-2490.750	8191.750	Pa/sec			
\$3D: EVAPSV Monitor	\$81: Blocked Evap Sys Line-Fault Confirm	0.000	0.000	0.000	Pa			
\$3D: EVAPSV Monitor	\$82: Vapor blocking valve performance	0.000	0.000	0.000	Pa			
\$42: O2 Heater Monitor	\$81: B1S2 Heater Current	0.573	0.230	3.000	A			
\$81: AFIMN Monitor	\$80: Bank 1 imbalance-ratio and max. lim	0.000	0.000	0.750	Ratio			
\$A1: Misfire Monitor	\$80: Total Engine Misfire - 200 Revs.	0.000	0.000	23.000	%			
\$A1: Misfire Monitor	\$81: Total Engine Misfire - 1000 Revs.	0.150	0.000	1.000	%			
\$A1: Misfire Monitor	\$84: Inferred Catalyst Mid-Bed Temp.	469.200	-40.000	845.100	C			
\$A2: Misfire Monitor Cylinder 1	\$0B: Cyl. 1 EVMA Misfire Counts	0.000	0.000	65535.000	Counts			
\$A2: Misfire Monitor Cylinder 1	\$0C: Cyl. 1 Misfire Current Drive Cycle	7.000	0.000	65535.000	Counts			
\$A2: Misfire Monitor Cylinder 1	\$80: Cyl. 1 Misfire Catalyst Damage	0.000	0.000	23.000	%			

Click on above row of interest to get Related DTC and explanation if available.

D.A.D.S

Kia Factory Scan Tool – Mode 6



Courtesy Of Smitty's Maintenance and Repair

D.A.D.S

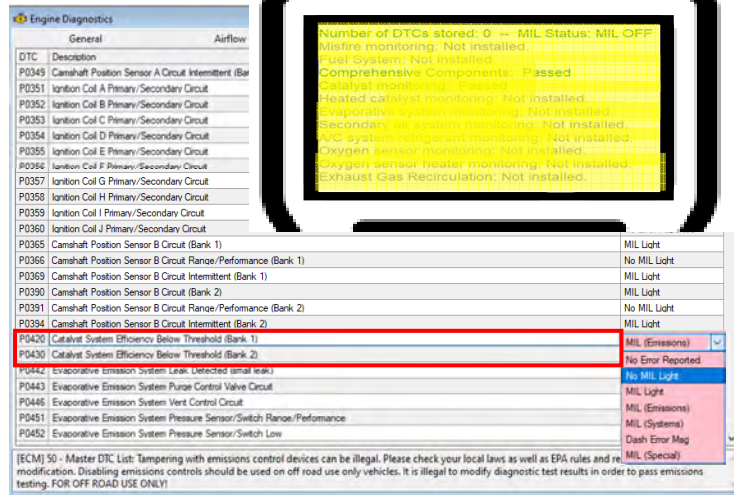
Mode 6 - Misfire

EScan DTCs Monitors PIDs Digital Graphs Mode6 O2 Sharp SHOOTER						
Select Make Ford 2003-2016						
Test Value background color: Red if outside of limit, Yellow if close to limit						
Read All Mode6 Once Read All Mode6 Continuous Read Selected Continuous						
OBD Monitor ID (OBDMID)	Test ID (TID)	Test Value	Min Limit	Max Limit	Units	
\$3A: EVAP System 0.020 Leak Check	\$81: Phase 4 Vapor Generation Pressure	0.000	0.000	0.000	Pa	
\$3A: EVAP System 0.020 Leak Check	\$82: Phase 0 Initial Gross Leak	0.000	0.000	0.000	Pa	
\$3B: EVAP System 0.020 Leak Check	\$80: Phase 2.040 Cruise Leak Check	139.000	-8192.000	859.250	Pa	
\$3C: EVAP System 0.020 Leak Check	\$80: Phase 2.020 Idle Leak Check	0.000	0.000	0.000	Pa	
\$A1: Misfire Monitor	\$30: Total Engine Misfire - 200 Revs.	0.000	0.000	24.500	%	
\$A1: Misfire Monitor	\$81: Total Engine Misfire - 1000 Revs.	0.000	0.000	1.000	%	
\$A1: Misfire Monitor	\$82: Highest Catalyst Damaging Misfire	18.500	0.000	24.500	%	
\$A1: Misfire Monitor	\$83: Highest Emission Threshold Misfire	1.000	0.000	1.000	%	
\$A1: Misfire Monitor	\$84: Inferred Catalyst Mid-Bed Temp.	426.100	-40.000	926.600	C	
\$A2: Misfire Monitor Cylinder 1	\$0B: Cyl. 1 EWMA Misfire Counts	0.000	0.000	65535.000		
\$A2: Misfire Monitor Cylinder 1	\$80: Cyl. 1 Misfire Catalyst Damage	0.000	0.000	24.500	%	
\$A2: Misfire Monitor Cylinder 1	\$81: Cyl. 1 Misfire Emission Threshold	0.000	0.000	1.000	%	
\$A3: Misfire Monitor Cylinder 2	\$0B: Cyl. 2 EWMA Misfire Counts	51.000	0.000	65535.000		
\$A3: Misfire Monitor Cylinder 2	\$0C: Cyl. 2 Misfire Current Drive Cycle	1150.000	0.000	65535.000		
\$A3: Misfire Monitor Cylinder 2	\$80: Cyl. 2 Misfire Catalyst Damage	0.000	0.000	24.500	%	
\$A3: Misfire Monitor Cylinder 2	\$81: Cyl. 2 Misfire Emission Threshold	0.000	0.000	1.000	%	
\$A4: Misfire Monitor Cylinder 3	\$0B: Cyl. 3 EWMA Misfire Counts	0.000	0.000	65535.000		
\$A5: Misfire Monitor Cylinder 4	\$0B: Cyl. 4 EWMA Misfire Counts	0.000	0.000	65535.000		
\$A5: Misfire Monitor Cylinder 4	\$0C: Cyl. 4 Misfire Current Drive Cycle	1.000	0.000	65535.000		
\$A5: Misfire Monitor Cylinder 4	\$80: Cyl. 4 Misfire Catalyst Damage	0.000	0.000	24.500	%	
\$A5: Misfire Monitor Cylinder 4	\$81: Cyl. 4 Misfire Emission Threshold	0.000	0.000	1.000	%	
\$A6: Misfire Monitor Cylinder 5	\$0B: Cyl. 5 EWMA Misfire Counts	0.000	0.000	65535.000		

Related DTC: Unavailable
Explanation: Misfire counts for last/current driving cycle

D.A.D.S

Aftermarket Tunes



Aftermarket Tuning software can Disable Monitors and DTC's

D.A.D.S

Integrated Air/Fuel Method – Mode 6 - Ford

TYPICAL MALFUNCTION THRESHOLDS:

Catalyst monitor index ratio > 0.75 (bank monitor)
 Catalyst monitor index-ratio > 0.60 (Y-pipe monitor)
 Catalyst monitor index ratio > 0.50 for E10 to > 0.90 for E85 (flex fuel vehicles)

Mode \$06 reporting for IAF Catalyst Monitor

The catalyst monitor results are converted to a ratio for Mode \$06 reporting to keep the same look and feel for the service technician. The equation for calculating the Mode \$06 monitor result is:

$$1 - (\text{Actual reactivation fuel} / \text{Good catalyst reactivation fuel})$$

Good catalyst reactivation fuel is intended to represent what the monitor would measure for a green catalyst.

J1979 CATALYST MONITOR MODE \$06 DATA

Monitor ID	Test ID	Description	
\$21	\$81	Bank 1 Oxygen Storage Capacity and max. limit (P0420)	unitless
\$22	\$81	Bank 2 Oxygen Storage Capacity and max. limit (P0430)	unitless

** NOTE: In this document, a monitor or sensor is considered OK if there are no DTCs stored for that component or system at the time the monitor is running.

D.A.D.S

Kia – Hyundai Mode 6 Data

EScan DTCs Monitors PIDs Digital Graphs Mode6 O2 Sharp SHOOTER						Patented			
Select Make Kia-Hyundai 2006-2017						Read All Mode6 Once Read All Mode6 Continuous Read Selected Continuous			
Test Value background color: if outside of limit, if close to limit						Reading			
OBD Monitor ID (OBDMID)		Test ID (TID)		Test Value	Min Limit	Max Limit	Units		
\$01: Oxygen Sensor Monitor B1 - S1		\$30: B1S1 6 point diagnosis		1.198	0.200	1.999			
\$01: Oxygen Sensor Monitor B1 - S1		\$32: B1S1 Sensor diagnosis		2.769	0.000	3.100	V		
\$01: Oxygen Sensor Monitor B1 - S1		\$33: B1S1 Sensor diagnosis		0.572	0.010	7.995	V		
\$02: Oxygen Sensor Monitor B1 - S2		\$04: High sensor voltage for switch T calc		0.678	0.678	1.244	V	0.678	1.244
\$02: Oxygen Sensor Monitor B1 - S2		\$05: B1S2 R/L Response Time		0.050	0.000	0.300	sec		
\$02: Oxygen Sensor Monitor B1 - S2		\$06: B1S2 L/R Response Time		0.020	0.000	0.450	sec		
\$02: Oxygen Sensor Monitor B1 - S2		\$07: Minimum Sensor Voltage Achieved		0.113	0.000	0.249	V		
\$02: Oxygen Sensor Monitor B1 - S2		\$08: Maximum Sensor Voltage Achieved		0.718	0.661	1.250	V		
\$21: Bank1		\$8E: Catalyst Efficiency Monitoring		106.320	100.000	855.350	%		
\$35: Bank1 Ex-Cam		\$91: Slow Response		16.910	4.810	25.810	Deg		
\$35: Bank1 In-Cam		\$94: Target Response		-7.950	-14.500	1.500	Deg		
\$35: Bank1 Ex-Cam		\$95: Locking		-20.590	-276.250	235.730	Deg		
\$35: Bank1 In-Cam		\$96: Locking		27.890	-228.110	283.880	Deg		
\$39: EVAP Monitor		\$80: 0.150" Leak		-2504.750	-8192.000	-2500.000	Pa		
\$3B: EVAP Monitor		\$80: 0.040" Leak		130.250	-8192.000	473.000	Pa		
\$3C: EVAP Monitor		\$80: 0.020" Leak		70.200	0.000	100.000	%		
\$3D: Canister close		\$88: Purge valve diagnosis		-105.000	-32768.000	-10.000	Pa		
\$3D: Canister close		\$88: Purge valve diagnosis		47.000	-2500.000	8191.750	Pa		
\$41: B1S1 O2S		\$81: Heater Performance Diagnosis		779.900	720.000	8513.500	C		
\$42: B1S2 O2S		\$8C: Heater Performance Diagnosis		158.000	0.000	1260.000	Ohm		
Related DTC: Unavailable									
Explanation: Canister close/purge valve diagnosis									

D.A.D.S

- As the catalyst ages, air/fuel fluctuations begin to break through the catalyst and the “GAP” length will tend to decrease.
- Eventually, the length of the “GAP” signal becomes too short to identify a failure for the catalyst monitor.
- When an HO2S sensor ages, its response to air/fuel fluctuations slows down.
- A slowdown stream HO2S, therefore, may cause the catalyst monitor to incorrectly pass a failed catalyst.
- The purpose of the Rear DFSO Response diagnostic is to ensure the catalyst monitor has a valid HO2S to perform the catalyst monitor diagnostic.
- The monitor is set to trigger at the level of degradation that will cause the catalyst monitor to falsely pass a malfunction threshold catalyst.

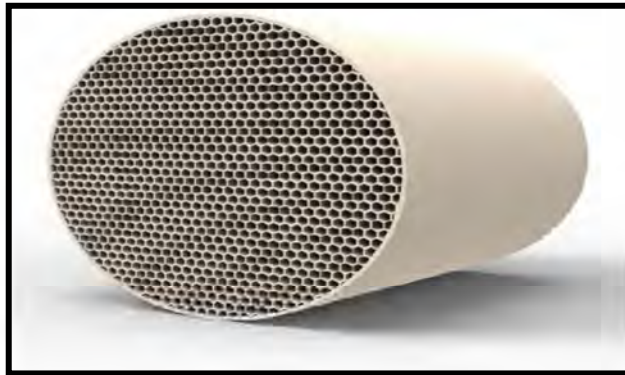
D.A.D.S

Fuel Shut off Rich to Lean Response Rate

EScan DTCs Monitors PIDs Digital Graphs Mode6 O2 Sharp SHOOTER Patented						
Select Make Ford 2003-2016						
Test Value background color: red if outside of limit, yellow if close to limit						
Reading						
Read All Mode6 Once Read All Mode6 Continuous Read Selected Continuous						
OBD Monitor ID (OBDMID)	Test ID (TID)	Test Value	Min Limit	Max Limit	Units	
\$01: O2 Heater Monitor/Front UEGO	\$81: B1S1 Heater Current	1.809	0.550	3.000	A	
\$01: Front UEGO Monitor	\$87: B2S1 Rich to Lean Response Time	0.008	0.000	0.500	sec	
\$01: Front UEGO Monitor	\$88: B1S1 Lean to Rich Response Time	0.012	0.000	0.500	sec	
\$02: Rear Oxygen Sensor Monitor	\$01: B1S2 Sensor Switch Point Voltage	0.450	0.000	7.995	V	
\$02: O2 Heater Monitor	\$81: B1S2 Heater Current	1.127	0.400	3.000	A	
\$02: Rear O2 DFSO Response Rate	\$85: B1S2 Fuel Shut off Rich to Lean Res	101072.000	0.000	101072.000	mV/s	
\$02: Rear O2 DFSO Response Rate	\$86: B1S2 Fuel Shut off Rich to Lean Time	1.938	0.000	6.000	sec	
\$05: O2 Heater Monitor/Front UEGO	\$81: B2S1 Heater Current	1.669	0.550	3.000	A	
\$05: Front UEGO Monitor	\$87: B2S1 Rich to Lean Response Time	0.000	0.000	0.500	sec	
\$05: Front UEGO Monitor	\$88: B2S1 Lean to Rich Response Time	0.000	0.000	0.500	sec	
\$06: Rear Oxygen Sensor Monitor	\$01: B2S2 Sensor Switch Point Voltage	0.450	0.000	7.995	V	
\$06: O2 Heater Monitor	\$81: B2S2 Heater Current	1.151	0.400	3.000	A	
\$06: DFSO Response Rate	\$85: B2S2 Fuel Shut off Rich to Lean Res	101072.000	0.000	101072.000	mV/s	
\$06: DFSO Response Rate	\$86: B2S2 Fuel Shut off Rich to Lean Res	1.954	0.000	6.000	sec	
\$21: Catalyst Efficiency Monitor	\$80: Bank 1 Index Ratio	0.051	0.000	0.459	Ratio	
\$22: Catalyst Efficiency Monitor	\$80: Bank 2 Index Ratio	0.055	0.000	0.582	Ratio	

D.A.D.S

Melting Or Damaged



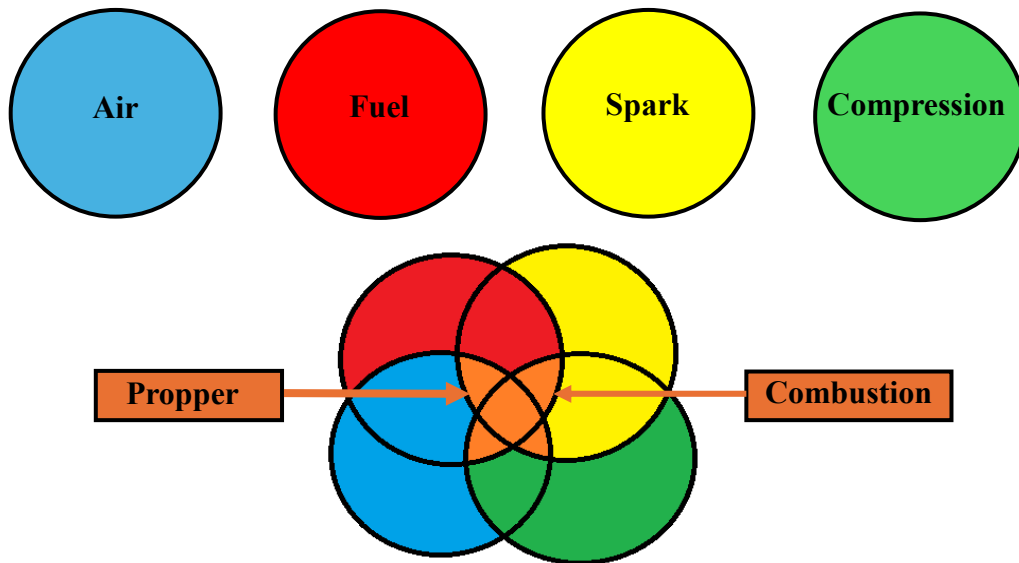
If heat damage or melting is observed, other repairs to the engine or related systems may be required to prevent a repeat catalyst repair that would not be warrantable.

- Check and address all other powertrain / engine management DTCs.
- Check for evidence of engine oil or coolant in the inner exhaust system. Identify the root cause and repair as needed.
- Check for excessive unburned fuel per Workshop Manual: Section 303-04, Fuel Charging And Controls.
- Inspect the entire exhaust system for damage and repair as needed.

Courtesy of Ford

D.A.D.S

What Is Needed For Complete Combustion



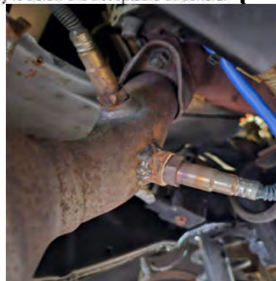
D.A.D.S

Possible Causes For Catalyst Below Threshold

P0420 - Catalyst System Efficiency Below Threshold (Bank 1)

Description: This DTC sets when the bank 1 catalyst system efficiency is below the acceptable threshold.

- Possible Causes:**
- Damaged heated oxygen sensor (HO2S)
 - Exhaust leaks
 - Damaged exhaust manifold
 - Damaged catalytic converter
 - Oil contamination
 - Cylinder misfiring
 - Downstream HO2S wires incorrectly connected
 - Damaged exhaust system pipe
 - Damaged muffler and tailpipe assembly
 - Leaking fuel injector
 - Oil contamination of the catalyst
 - Damaged turbocharger
 - Base engine concerns



2013 Dodge Dart 1.4L I-4 160 HP

112-2694/10

Mis-Fire Monitor Status

Mis-Fire Monitor Status	Global Diagnostic
Mis-Fire Counter CAT (00 Rev/Ho Unit)	ST
Cylinder 1 (CAT Mis-Fire Counter/Ho Unit)	0
Cylinder 2 (CAT Mis-Fire Counter/Ho Unit)	ST
Cylinder 3 (CAT Mis-Fire Counter/Ho Unit)	0
Cylinder 4 (CAT Mis-Fire Counter/Ho Unit)	0



D.A.D.S

Possible Causes For Catalyst Below Threshold



D.A.D.S

How Does It Work with a High Current Clamp?



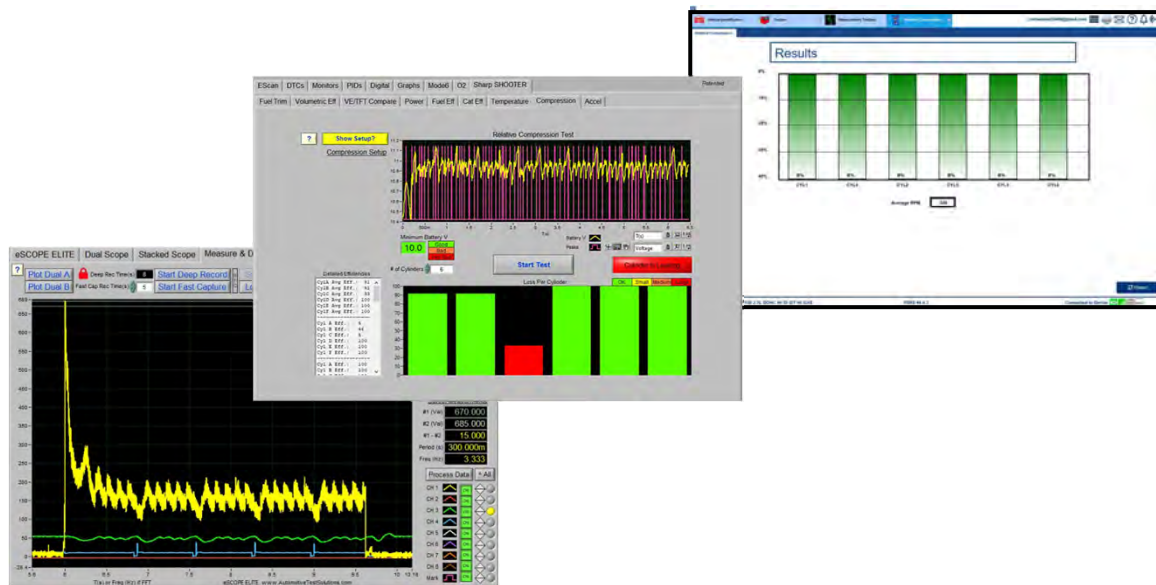
The test leverages the fact that during cranking:

- The starter motor draws more current when a cylinder has good compression (as the motor works harder against the rising piston)
- less current with lower compression.
- A high amp clamp measures this starter current draw, which can be displayed as waveform peaks on a lab scope.



D.A.D.S

Mechanical Testing – Relative Compression testing



D.A.D.S

Running Compression Test

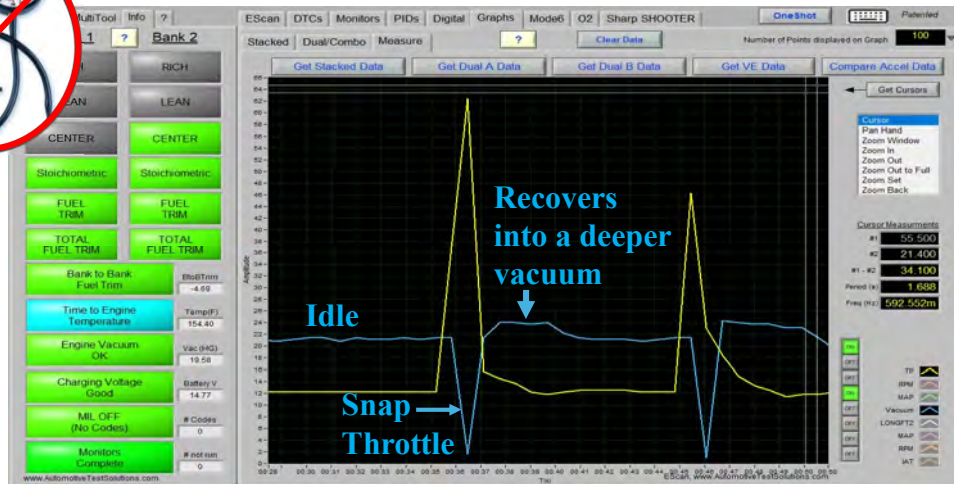
A cylinder power balance test is a diagnostic procedure used on internal combustion engines to **evaluate the relative power output of each cylinder**. In a healthy engine, all cylinders should contribute equally to the engine's total power. **This test compares the engine's RPM drop when each cylinder is temporarily disabled**. A normal cylinder will cause a noticeable RPM drop (typically 50-100 RPM at idle), **while a weak one will cause little or no drop**.



Cylinder Power Balance			
Misfire Data			
Selected Injector: Disabled			
1	2	3	4
Engine Speed			
400			1200
Misfire Current Cyl. 2 0			
Misfire Current Cyl. 3 0			
Misfire Current Cyl. 4 0			
Misfire Current Cyl. 5 112			
6 / 33 -			
Misfire Current Cyl. 5			
Select Injector	Enable	Disable	More

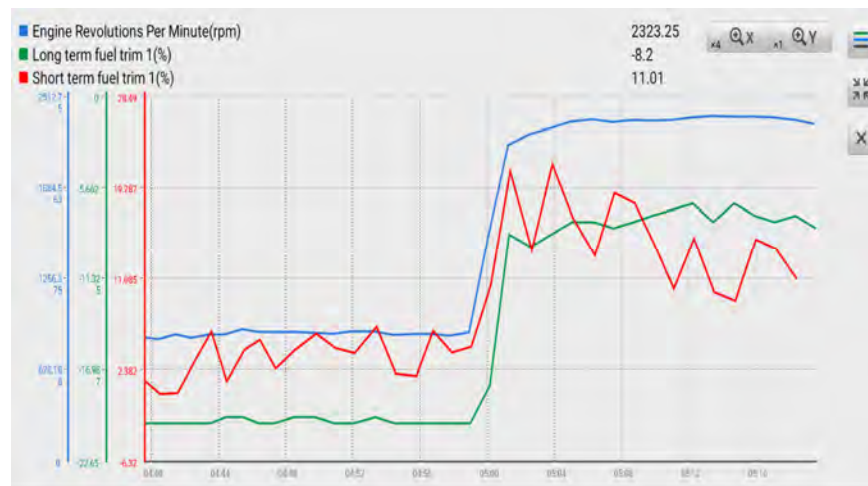
D.A.D.S

Snap Throttle Vacuum Test



D.A.D.S

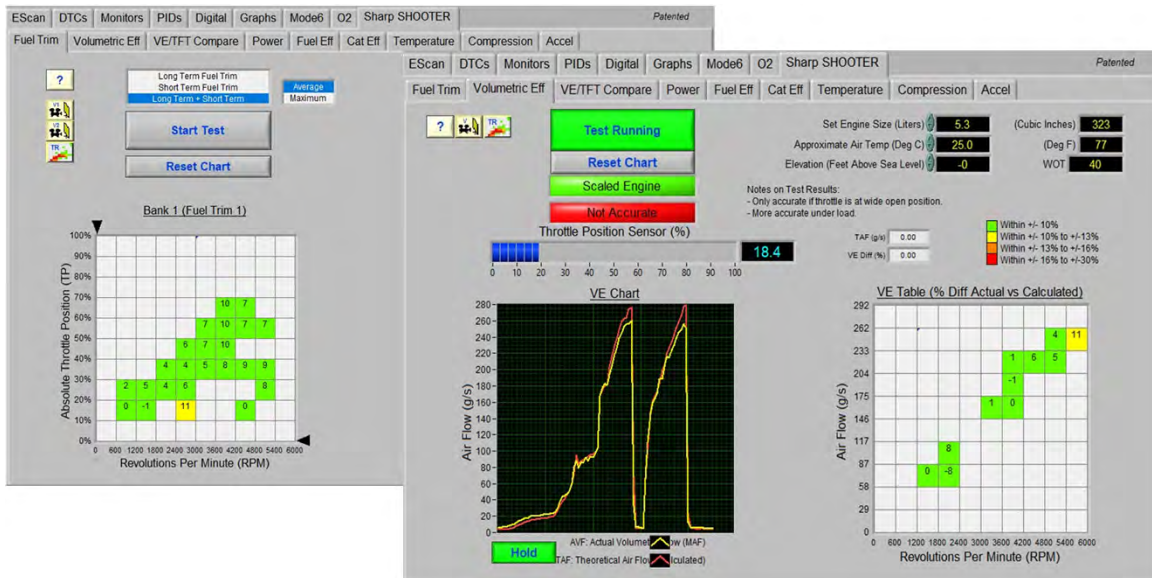
Checking Fuel Trims



Always check fuel trims at all RPM's

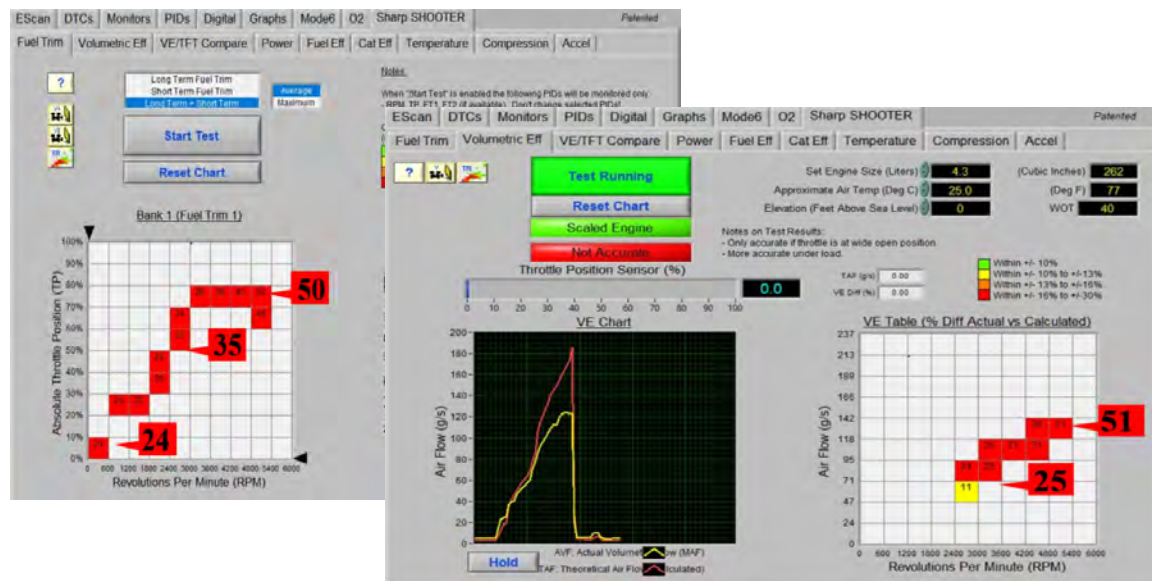
D.A.D.S

What Good V.E. and Good Fuel Trims Should Look Like



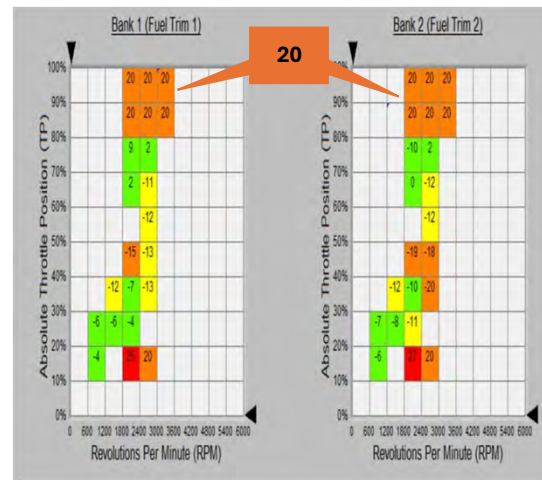
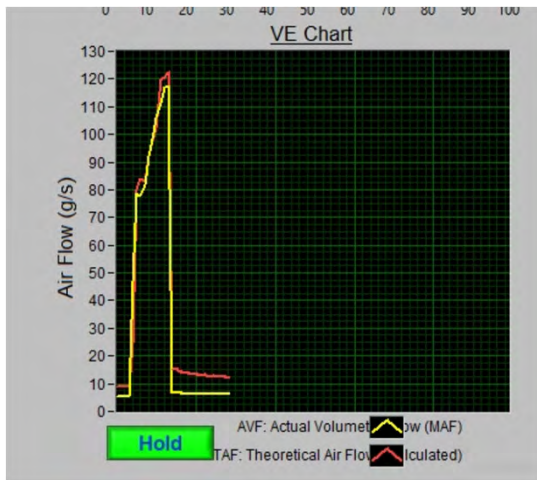
D.A.D.S

Low V.E. And Positive Fuel Trims From Bottom To Top



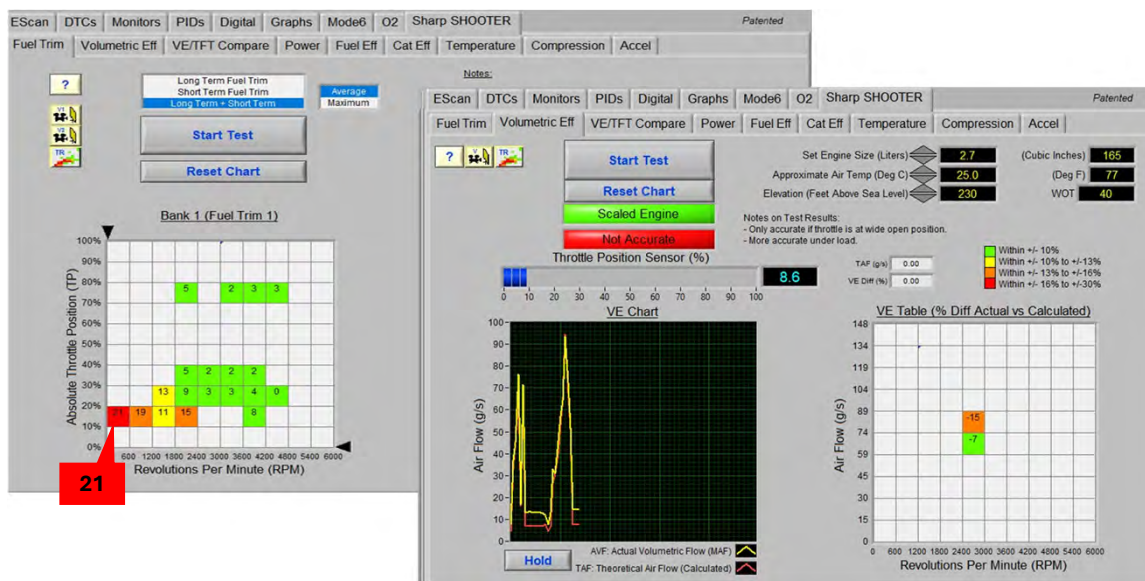
D.A.D.S

Good V.E and Positive Fuel Trims At Wide Open Throttle



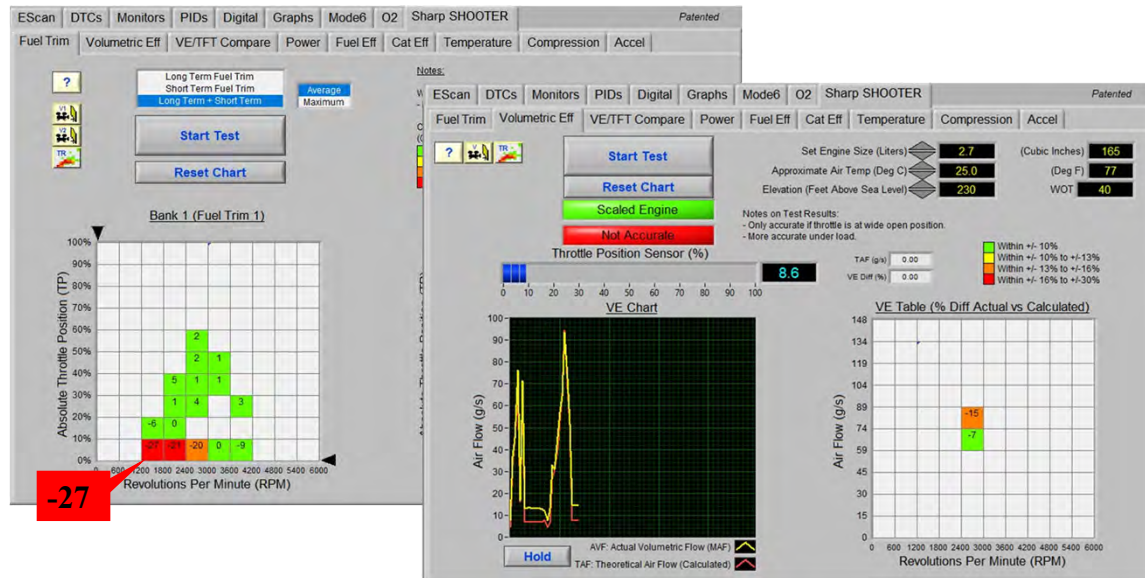
D.A.D.S

Good V.E and Positive Fuel Trim Correction at Idle



D.A.D.S

Good V.E and Negative Fuel Trim Correction at Idle



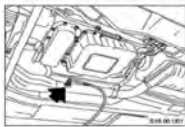
D.A.D.S

Back Pressure Test

PROCEDURE

If the above customer complaints are received and a restricted catalytic converter is suspected:

1. Remove the pre-catalytic converter oxygen sensor as outlined in the appropriate repair manual, group 11 section 11 78.



2. Install the exhaust back pressure gauge hose connector in place of the pre-catalytic converter oxygen sensor.
Note: Lightly tighten (snug) the tool fitting. Do not over tighten.



3. Mount the gauge in an upright position - the hose connection must be located at the bottom of the gauge for proper back pressure readings.
Note: Incorrect test readings will be the result if the gauge is not in the upright position, for example: hung up side down, laid flat, etc.



- If the gauge indicates readings in the green zone (less than 1.5psi) the catalytic converter is not restricted.



- If the gauge indicates readings beyond the green zone (greater than 1.5psi) the catalytic converter is restricted and should be replaced.

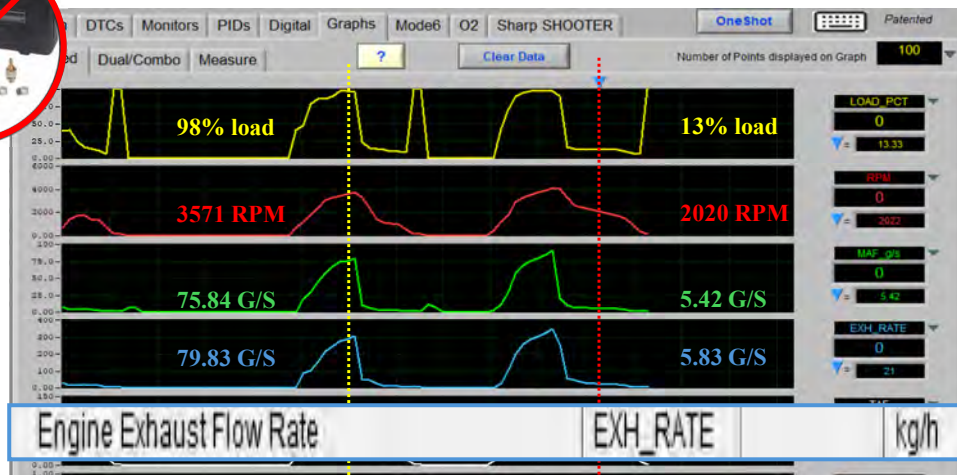
Note: A restricted catalytic converter will typically indicate readings greater than 2psi during the 2500 rpm test as described above.

D.A.D.S

New Way To look At Back Pressure



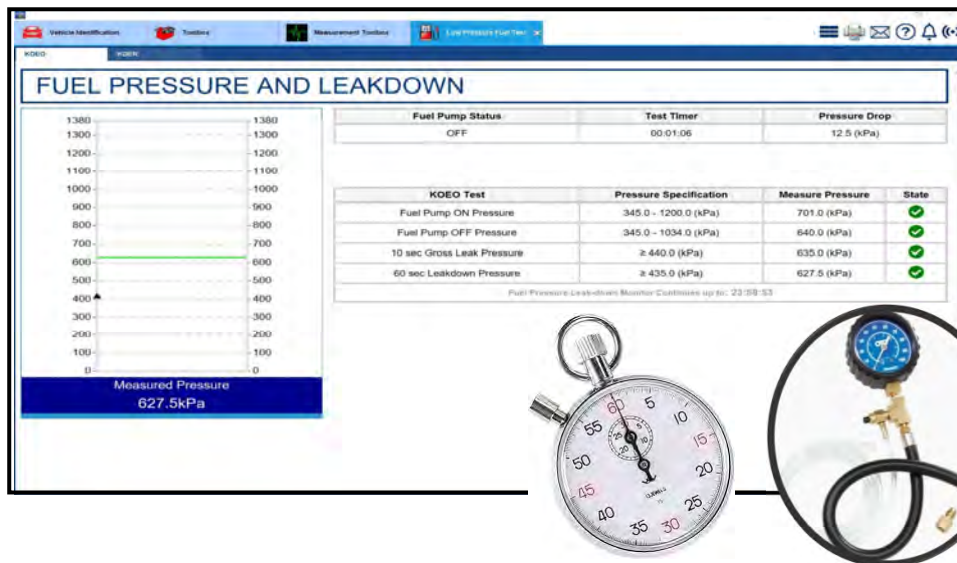
What goes in should come out



At 98% load the Mass Airflow read a little under what the exhaust rate reading is

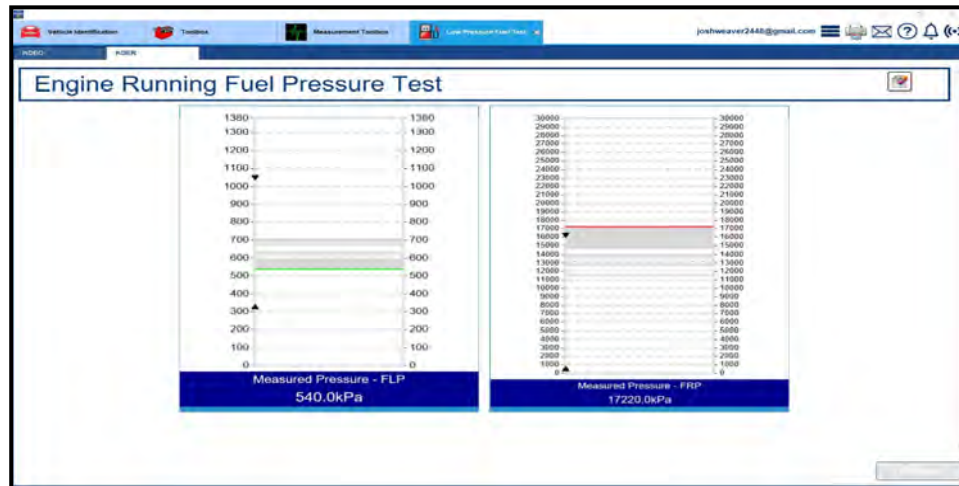
D.A.D.S

Fuel Pressure K.O.E.O



D.A.D.S

Fuel Pressure Running Test



D.A.D.S

Fuel Pressure Desired VS. Actual



D.A.D.S



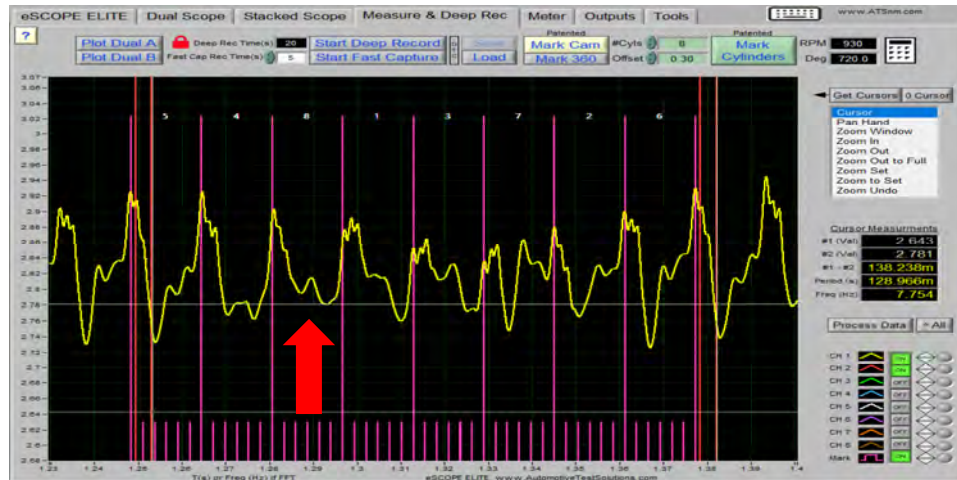
Fuel Injector Flow Test With A Scope



D.A.D.S

Fuel Injector Flow Test With A Scope

Red injector #4 and Yellow is the fuel rail Pressure sensor



Cylinder 8 shows very low fuel drop across the injection event

D.A.D.S

Fuel Trim Resets

Special function			
Ambient air temperature calculation reset	Brake pedal position sensor learn	Crankshaft position variation learn	Engine air filter life reset
Engine air filter monitor setup	Engine block coolant valve position learn	Engine coolant control valve learn	Engine coolant pump data reset
Engine oil life reset	Fuel pump trim reset	Fuel trim reset	HO2S heater resistance learned values reset
Heater core coolant temperature sensor reset	Intake system learned values reset	Particulate filter pressure sensor reset	Particulate filter reset

Do not forget to RESET Fuel Trim / Adaptive Fuel before giving the vehicle back to the customer. Clearing DTCs will not reset fuel trims. If not done could be harmful to the catalytic converter.

D.A.D.S

Often Overlooked



D.A.D.S

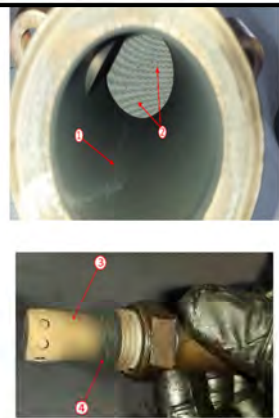
Technical Service Bulletins

HONDA		Service Bulletin		18-027
March 16, 2018				Version 1
2015-16 Fit: MIL Is On with DTC P0420				
AFFECTED VEHICLES				
Year	Model	Trim	VIN Range	
2015	Fit	ALL	ALL	
2016	Fit	ALL	3HG.....GM700001 - 3HG.....GM704625 JHM.....GX000001 - JHM.....GX026880	
SYMPTOM				
The MIL is on and DTC P0420 (catalyst system efficiency below threshold) is set.				
PROBABLE CAUSE				
Faulty fuel injectors in one or more cylinders may be affecting combustion and causing a false DTC P0420.				
CORRECTIVE ACTION				
Replace the fuel injector set and fuel joint pipe set. If DTC P0300-P0304 is also set, refer to S/B 16-034 before doing this bulletin.				

D.A.D.S

GM 16 – NA-111

	Service Bulletin File in Section: - Bulletin No.: 16-NA-111 Date: April 2, 2016
	TECHNICAL
Subject: Diagnostic Tip for Malfunction Indicator Light (MIL) Illuminated, DTC P0420 and P0430 Set	
Condition	Some customers may comment that the Malfunction Indicator Light (MIL) is illuminated. Technician may find DTC P0420 and P0430 set.
Service Procedure	
	

Cause	
Correction	This may be caused by excessive sand and/or debris entering the air filter box and bypassing the seal of the air filter, due to not properly sealing, causing damage to the HO2 sensor element (3) and the catalytic converter to become blocked with sand and debris particles (1, 2). Do not replace any of the parts until the air filter housing has been validated to be completely sealed. If the condition is evident, inspection of the air box and air filter seal must be done. Follow the Service Procedure steps in order to verify the sealing of the air filter to housing surface.

D.A.D.S

Ford - TSB 22-2260

TECHNICAL SERVICE BULLETIN
Illuminated MIL With DTC P0420 And/Or P0430
22-2260
 23 January
 2023

This bulletin supersedes 22-2137.

Model:

Ford	
2020-2021 Expedition	
2018-2020 F-150	Engine: 2.7L EcoBoost
Lincoln	
2020-2021 Navigator	

Summary

This article supersedes TSB 22-2137 to update the Parts List and Service Procedure.

Issue: Some 2018-2020 F-150 vehicles equipped with a 2.7L EcoBoost and 2020-2021 Expedition/Navigator vehicles may exhibit an illuminated malfunction indicator lamp (MIL) with diagnostic trouble codes (DTCs) P0420 and/or P0430 stored in the powertrain control module (PCM). This may be due to high sulfur content in the fuel. To correct the condition, follow the Service Procedure to de-sulfate the catalytic converters.

Action: Follow the service procedure to correct the condition on vehicles that meet all of the following criteria:

- One of the following vehicles
 - 2018-2020 F-150 equipped with 2.7L engine
 - 2020-2021 Expedition/Navigator
- Illuminated MIL with DTCs P0420 and/or P0430 stored in the PCM

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Ford - TSB 22-2260**Service Procedure**

NOTE: Perform the de-sulfate procedure one time only. If the vehicle exhibit this condition again, proceed with the replacement of the catalytic converter(s).

1. Perform pinpoint tests steps HF1-HF6.

(1). For 2018-2020 vehicles, refer to the Powertrain Control/Emissions Diagnosis (PC/ED) Manual.

(2). For 2021 vehicles, refer to Workshop Manual (WSM) Section 309-00 > Diagnosis and Testing > PC/ED Pinpoint Test HF.

2. Is the concern still present?

(1). Yes - proceed to Step 3.

(2). No - this article does not apply.

3. Retrieve onboard diagnostics (OBD) Mode 6 Data from the Ford Diagnosis and Repair System (FDRS) and record oxygen storage values from both banks.

4. Perform the following sulfur removal cycle.

(1). Warm up the engine to its normal operating temperature.

(2). Identify an appropriate route to allow speeds around 65 mph (105 km/h).

(3). From 30 mph (48 km/h) or slower, accelerate at wide open throttle (WOT) until the vehicle reaches 65 mph (105 km/h).

(4). Perform periodic light acceleration/deceleration events for 5 minutes, driving alternately between 50 mph and 65 mph (80 km/h and 105 km/h).

(5). Reduce speed to under 30 mph (48 km/h).

(6). Repeat the WOT with periodic acceleration/deceleration events 3-4 times.

D.A.D.S**Ford - TSB 22-2260**

(7). Park the vehicle and let the engine idle for 1 hour.

5. Clear DTCs P0420 and/or P0430 stored in the PCM. This resets the Mode 6 data to zero.

6. Drive the vehicle at 55-65 mph (88-105 km/h) for 15 minutes.

7. Run a catalyst monitor drive cycle. Refer to pinpoint test HF11 > On Board Diagnostics (OBD) Drive Cycle.

8. Retrieve OBD Mode 6 Data after the catalyst oxygen storage values have been populated. Have the oxygen storage values decreased from what was recorded in Step 3 and are they less than 0.5 on either bank?

(1). Yes - repair is complete.

(2). No - replace the catalytic converter(s) on the affected bank(s). Refer to the WSM, Section 309-00 > Exhaust System > Removal and Installation > Catalytic Converter.

D.A.D.S

Ford Recall

October 22, 2024

TO: All U.S. Ford and Lincoln Dealers

SUBJECT: **NEW VEHICLE DELIVERY HOLD - Emission Recall 24E12**
 Certain 2018-2020 Model Year F-150 Vehicles Equipped with a 2.7L EcoBoost Engine
 Powertrain Control Module (PCM) Reprogramming

AFFECTED VEHICLES

Vehicle	Model Year	Assembly Plant	Build Dates
F-150	2018	Dearborn	January 10, 2017 through October 22, 2018
	2019		May 1, 2018 through October 5, 2019
	2020		August 6, 2019 through September 5, 2020
F-150	2018	Kansas City	January 25, 2017 through November 5, 2018
	2019		June 5, 2018 through November 10, 2019
	2020		July 24, 2019 through October 22, 2020

US population of affected vehicles: 505,633. Affected vehicles are identified in OASIS and FSA VIN Lists.

REASON FOR THIS EMISSION RECALL
 The affected vehicles have a Powertrain Control Module (PCM) calibration that could, over time, reduce the effectiveness of the emissions control system and the monitoring accuracy of the catalytic converter's efficiency. As a result, the Malfunction Indicator Light (MIL) may illuminate for low catalyst efficiency even though a catalytic converter repair may not be necessary.

SERVICE ACTION
 Before delivering any new in-stock vehicles involved in this recall, dealers are to update the Powertrain control Module (PCM) software. This service must be performed at no charge to the vehicle owner. For new vehicle storage guidelines, refer to EFC13033, Storage Guidelines for New Vehicles.

NOTE: The State of California and the Commonwealth of Massachusetts require the completion of emission recall repairs before vehicle registration renewal. For vehicles registered in these states, please provide the owner with a Vehicle Emission Recall Proof of Correction certificate after the repair has been performed. These certificates may be obtained by contacting your regional office.

D.A.D.S

2018 Ford F-150

The screenshot shows the eSCANELITE diagnostic software interface. The top menu bar includes options like EScan, DTCs, Monitors, PIDs, Digital, Graphs, Mode6, O2, Sharp SHOOTER, OneShot, and Patented. The main window displays the vehicle information for a 2018 Ford F-150, including the engine name (EcoBoost 2.7L), year (2018), and model (F-150). A red box highlights the calibration information: Cal. ID#1: BNSR2B6.H32, Cal. ID#2: Not Available, Cal. CVN#1: ABFC0F00, and Cal. CVN#2: 0000. The DTC list shows a P0430 code: Catalytic converter system, bank 2 -efficiency below threshold. The bottom section shows various vehicle parameters like AD_PCT, I, WFTY1, WFTY2, NGFT2, P, U, S, ARADV, B1B2, B1B2, B2B2, RTIME, AP_PCT, JMM_UPS, R_ColT, RD, S11mA, and S11mA.

D.A.D.S

2018 Ford F-150

EScan DTCs Monitors PIDs Digital Graphs Mode6 O2 Sharp SHOOTER						
Select Make Ford 2003-2019						
Test Value background color: Red if outside of limit, Yellow if close to limit						
Reading						
OBD Monitor ID (OBDMID)	Test ID (TID)	Test Value	Min Limit	Max Limit	Units	
\$01: Front UEGO Monitor	\$87: B2S1 Rich to Lean Response Time	0.007	0.000	0.400	sec	
\$01: Front UEGO Monitor	\$88: B1S1 Lean to Rich Response Time	0.021	0.000	0.400	sec	
\$02: Rear O2 DFSO Response Rate	\$85: B1S2 Fuel Shut off Rich to Lean Res	1.765	0.000	101072.000	mV/s	
\$02: Rear O2 DFSO Response Rate	\$86: B1S2 Fuel Shut off Rich to Lean Time	1.765	0.000	10.000	sec	
\$05: Front UEGO Monitor	\$87: B2S1 Rich to Lean Response Time	0.042	0.000	0.400	sec	
\$05: Front UEGO Monitor	\$88: B2S1 Lean to Rich Response Time	0.045	0.000	0.400	sec	
\$06: DFSO Response Rate	\$85: B2S2 Fuel Shut off Rich to Lean Res	1.451	0.000	101072.000	mV/s	
\$06: DFSO Response Rate	\$86: B2S2 Fuel Shut off Rich to Lean Res	1.451	0.000	10.000	sec	
\$21: Catalyst Efficiency Monitor	\$81: B1 O2 Storage Capacity & max limit	0.355	0.000	0.691	Ratio	
\$22: Catalyst Efficiency Monitor	\$81: B2 O2 Storage Capacity & max limit	0.668	0.000	0.660	Ratio	
\$31: DPFE EGR System Monitor	\$87: Flow ratio excess flow test and three	0.004	0.000	0.387	Ratio	
\$31: DPFE EGR System Monitor	\$86: Description Unavailable	0.004	0.000	0.617	Ratio	

\$02: Rear O2 DFSO Response Rate	\$85: B1S2 Fuel Shut off Rich to Lean Res	1.765	0.000	101072.000	22.000	mV/s
\$02: Rear O2 DFSO Response Rate	\$86: B1S2 Fuel Shut off Rich to Lean Time	1.765	0.000	10.000	10.000	sec
\$05: Front UEGO Monitor	\$87: B2S1 Rich to Lean Response Time	0.042	0.000	0.400	0.400	sec
\$05: Front UEGO Monitor	\$88: B2S1 Lean to Rich Response Time	0.045	0.000	0.400	0.400	sec
\$06: DFSO Response Rate	\$85: B2S2 Fuel Shut off Rich to Lean Res	1.451	0.000	101072.000	20.000	mV/s
\$06: DFSO Response Rate	\$86: B2S2 Fuel Shut off Rich to Lean Res	1.451	0.000	10.000	10.000	sec
\$21: Catalyst Efficiency Monitor	\$81: B1 O2 Storage Capacity & max limit	0.355	0.000	0.691	0.691	Ratio
\$22: Catalyst Efficiency Monitor	\$81: B2 O2 Storage Capacity & max limit	0.668	0.000	0.660	0.660	Ratio

\$82: A/FM Monitor	\$80: Bank 2 Imbalance-Ratio and max limit	0.000	0.000	0.767	Ratio
\$A1: Misfire Monitor	\$80: Total Engine Misfire - 200 Revs.	0.000	0.000	32.673	%

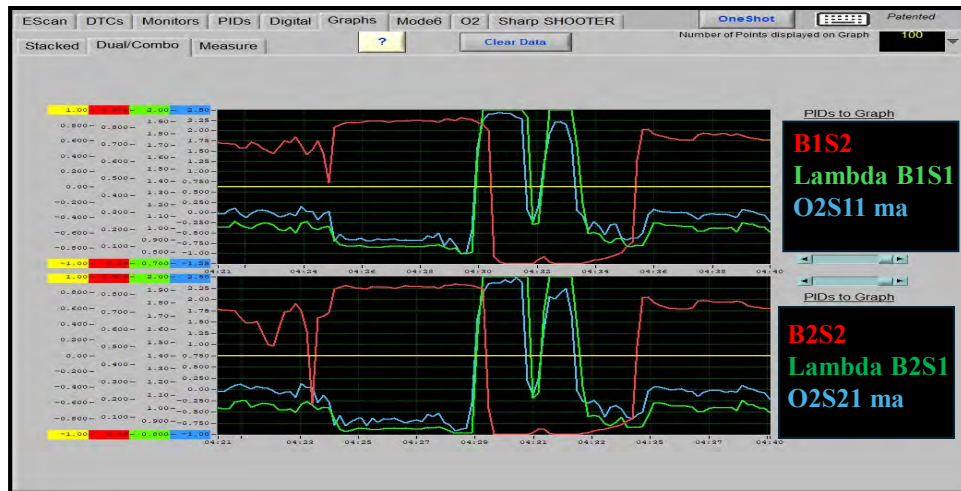
B2 cat shows a failure with a test value of .668, which is .008 more than the max of .660

D.A.D.S

2018 Ford F-150

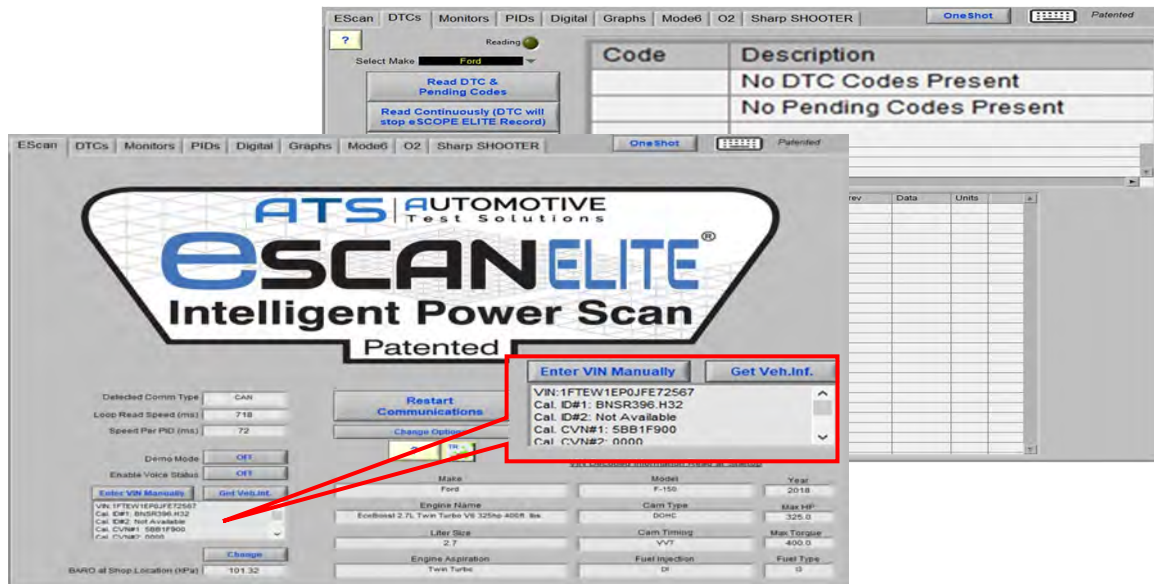
Bank 1

Bank2



D.A.D.S

2018 Ford F-150 – After Reflash



D.A.D.S

2018 Ford F-150 – After Reflash

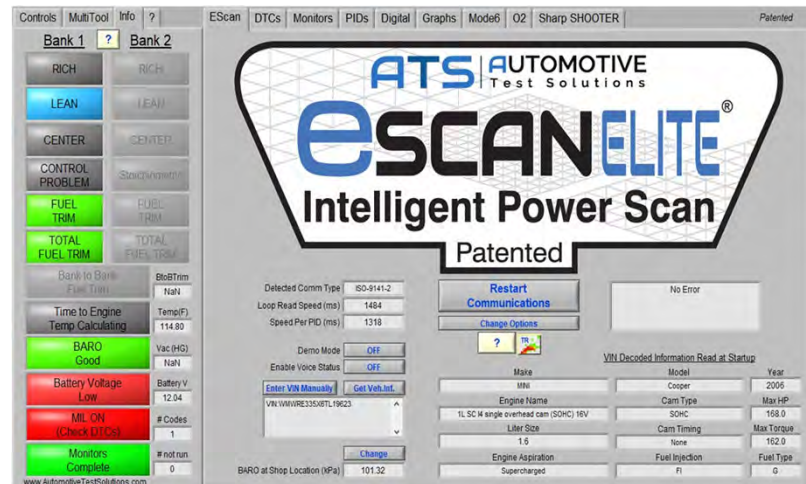
eSCAN ELITE						
Test Value background color: Red if outside of limit, Yellow if close to limit						
OBD Monitor ID (OBDMID)	Test ID (TID)	Test Value	Min Limit	Max Limit	Units	
\$01: Front UEGO Monitor	\$87: B2S1 Lean to Lean Response Time	0.000	0.000	0.400	sec	
\$01: Front UEGO Monitor	\$88: B1S1 Lean to Rich Response Time	0.016	0.000	0.400	sec	
\$02: Rear O2 DFSO Response Rate	\$85: B1S2 Fuel Shut off Rich to Lean Res	12.420 m/s	101072.000	22.000	mV/s	
\$02: Rear O2 DFSO Response Rate	\$86: B1S2 Fuel Shut off Rich to Lean Res	2.027	0.000	10.000	sec	
\$05: Front UEGO Monitor	\$87: B2S1 Rich to Lean Response Time	0.003	0.000	0.400	sec	
\$05: Front UEGO Monitor	\$88: B2S1 Lean to Rich Response Time	0.036	0.000	0.400	sec	
\$06: DFSO Response Rate	\$85: B2S2 Fuel Shut off Rich to Lean Res	12.410 m/s	101072.000	20.000	mV/s	
\$06: DFSO Response Rate	\$86: B2S2 Fuel Shut off Rich to Lean Res	2.035	0.000	10.000	sec	
\$21: Catalyst Efficiency Monitor	\$81: B1 O2 Storage Capacity & max. limit	0.332	0.000	0.820	Ratio	
\$22: Catalyst Efficiency Monitor	\$81: B2 O2 Storage Capacity & max. limit	0.363	0.000	0.750	Ratio	
\$30: Evaporative System	\$89: Check valve test for dual path prg.	-576.500	-8192.000	-86.000	PS/sec	
\$81: AFIMN Monitor	\$80: Bank 1 imbalance-ratio and max. lim	0.000	0.000	0.797	Ratio	
\$82: AFIMN Monitor	\$80: Bank 2 imbalance-ratio and max. lim	0.000	0.000	0.797	Ratio	
\$81: Misfire Monitor	\$80: Total Engine Misfire - 200 Revs	0.000	0.000	32.967	%	

Max value have been changed on B1 from .691 -.820 and B2 has been changed from .668 -.750

D.A.D.S

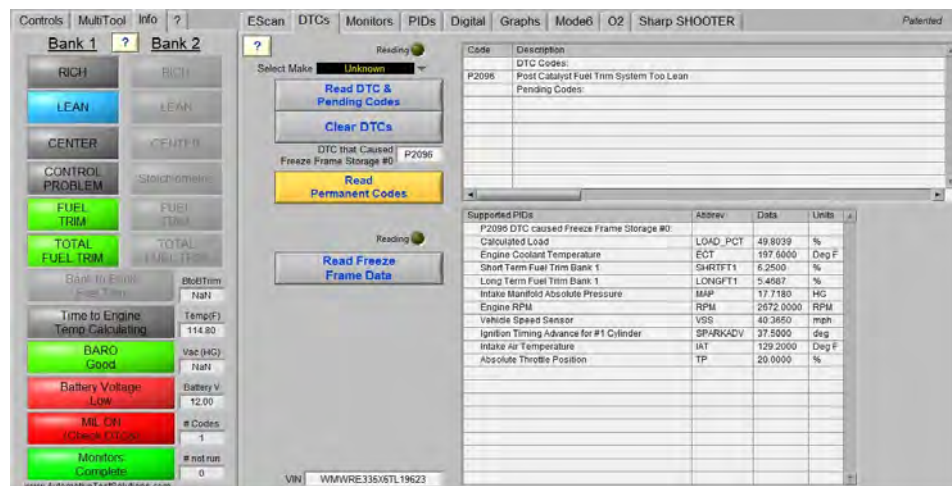
2006 Mini Cooper

Year: 2006
Make: Mini
Model: Cooper
Engine 1.6L
Concern:
 Check engine light is on



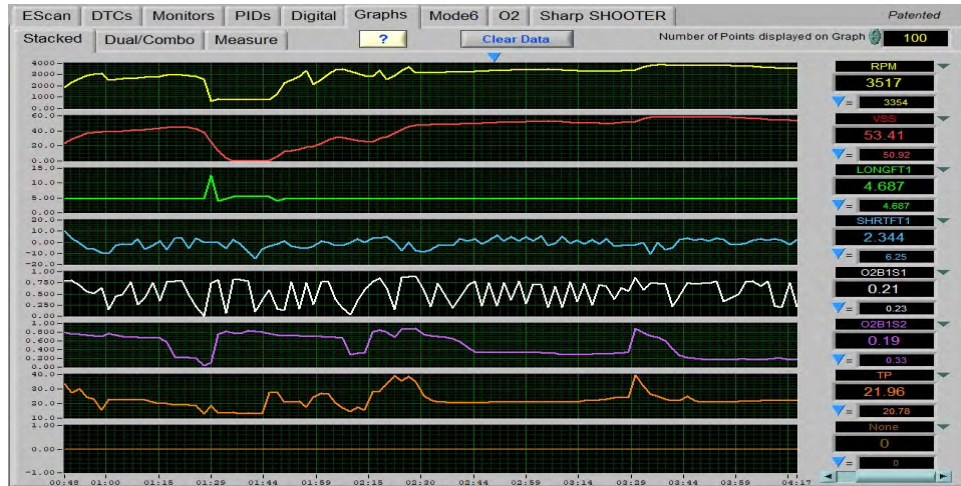
D.A.D.S

2006 Mini Cooper



D.A.D.S

2006 Mini Cooper



B1S2

B1S2 stay lean but moves up and follows T.P.S.

D.A.D.S

2006 Mini Cooper



D.A.D.S

2006 Mini Cooper

SOLERA Direct-Hit
Vehicle Repair by idmccore

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Search | Information Available | Post Fix | Can't Find Service Manual Info? | New Vehicle | Payment Settings | Referral | Logout

2006 Mini Cooper S 1.6L, L4, Asp S/C, Des W11B16A, USA/Canada

SEARCH

P2096

☐ Service Manuals Only

Models wise same Engine Package

SEARCH RESULT QUICK LINKS

TechXpert Hub
Hotline Archives & Confirmed Fixes

HOTLINE ARCHIVES WITH SERVICE MANUAL DIAGRAMS, COMPONENTS, TSBS, AND R&R PROCEDURES

Description	Potential Causes	Confirmed Fix
1. Check engine light with code P2096 ... 2006 Mini Cooper S 1.6L, L4, Asp S/C, Des W11B16A, USA Test Details... Confirmed Fix Details...	Leaking Exhaust System Fuel Pressure Injectors Leaking Intake System	66 - Oxygen (O2) Sensor(s) 47 - Adaptive Fuel Memory 13 - Catalytic Converter(s) 10 - Rear Oxygen (O2) Sensor 5 - Oxygen (O2) Sensor, Bank 1 Sensor 2 4 - Fuel Pump 4 - Exhaust System

199 Confirmed fixes

D.A.D.S

2006 Mini Cooper

SI M12 01 06
Engine Electrical Systems

December 2006
Technical Service

EMS2K FC 2096 - Post-cat Oxygen Sensor Lean Mixture

New information provided by this revision is preceded by this symbol

This Service Information bulletin supersedes S.I. M12 01 06 August 2006.

MODEL

R50 W10, R53 W11 with EMS2K

SITUATION

Check Engine Light is illuminated and the DME fault code 2096 – "O2 sensor bank 1 after **catalyst**, exhaust gas composition indicates lean mixture – currently present" is stored.

CORRECTION

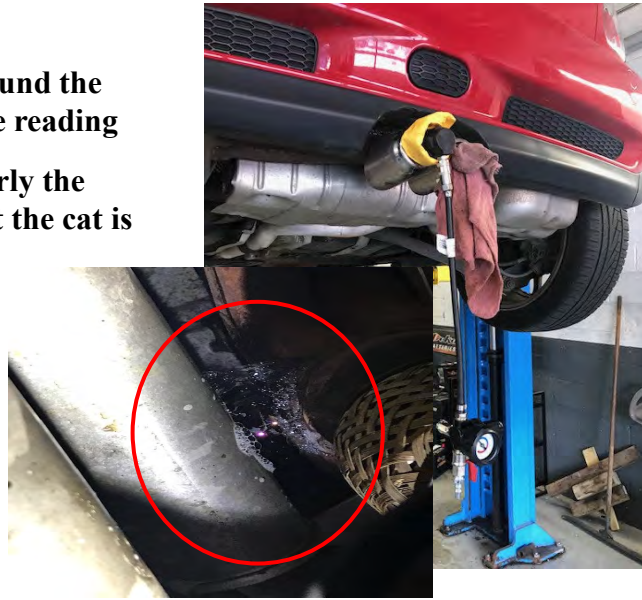
The post-**cat** O2 sensor FC 2096 is only an indication of a lean mixture condition; the oxygen sensor is not a root cause of the fault.

- Follow the appropriate GT1/DIS test plan modules.
- Check long-term multiplicative adaptation values (in most cases, readings are in the range of positive 5%-7%, indicating a lean mixture problem).
- Perform basic diagnostic of the intake air filter, intake system, fuel delivery, and exhaust systems. Look for vacuum leaks in the intake manifold, supercharger boots, by-pass valve, etc. Check for leaks in the exhaust manifold and **oxygen sensor** area (preferably by using a diagnostic smoke machine). Check fuel pressure, swap MAP/TMAP sensors, swap injectors from a known good car and observe changes to the short-term adaptation values. Perform appropriate repairs as needed.
- Reset long-term adaptation values.
- Perform post-**cat** O2 sensor test to verify effectiveness of the repair (the specified post-**cat** O2 voltage should be in the range of 500-700 mV after 5 minutes of engine idling).
- Provide feedback via PuMA case.

D.A.D.S

Air Testing For Exhaust Leaks

- Oxygen sensor sense oxygen
- If there's a leak in front of or around the oxygen sensors it can lean out the reading
- If the sensor does not read properly the engine computer could think that the cat is not storing oxygen



D.A.D.S

2015 Hyundai Accent

Year: 2015

Make: Hyundai

Model: Accent

Engine 1.5L

Concern:

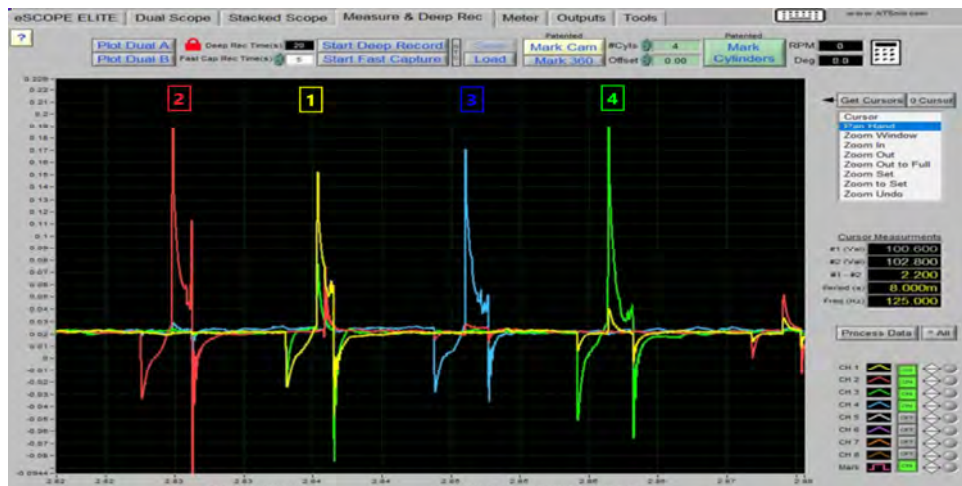
- Check engine light is on for P0420
- Car has a hard time accelerating
- Catalytic converter replaced
A year ago, with after market



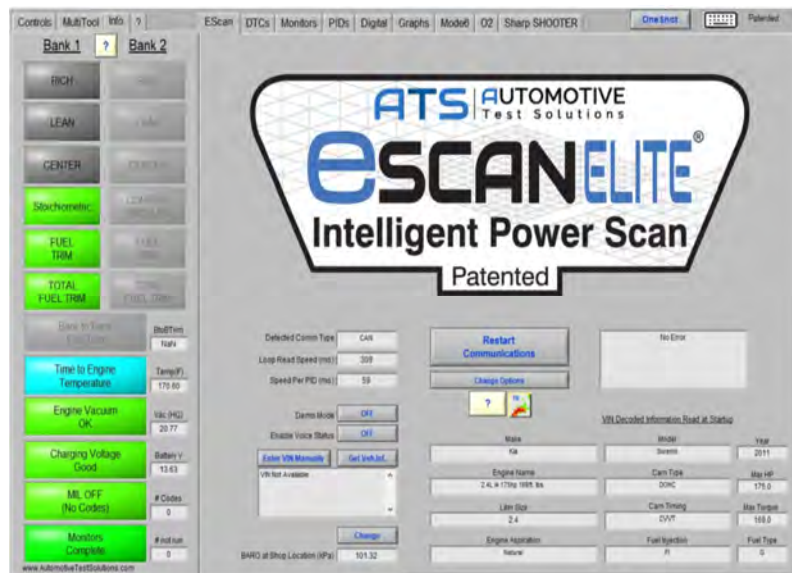
D.A.D.S

2015 Hyundai Accent

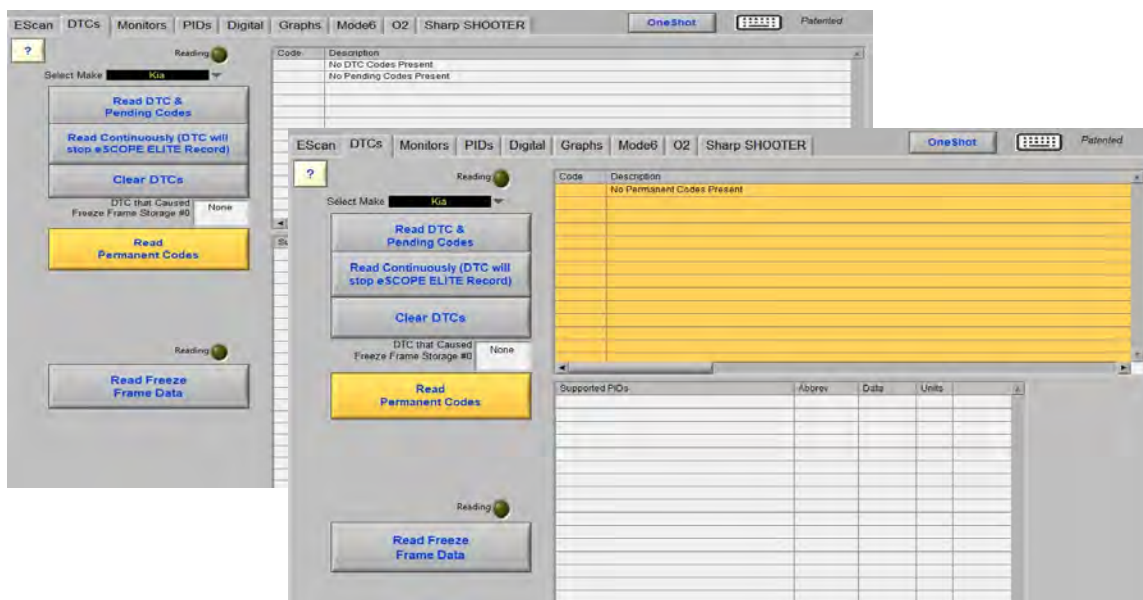
Black Black White Black

D.A.D.S**D.A.D.S**

Year: 2011
Make: Kia
Model: Sorento
Engine 2.4L
Concern:
Check engine light goes
On and off.



D.A.D.S



D.A.D.S

EScan | DTCs | Monitors | PIDs | Digital | Graphs | Mode6 | O2 | Sharp SHOOTER | OneShot | Patented

Select Make: **Generic**

Test Value background color: **Red** if outside of limit, **Yellow** if close to limit

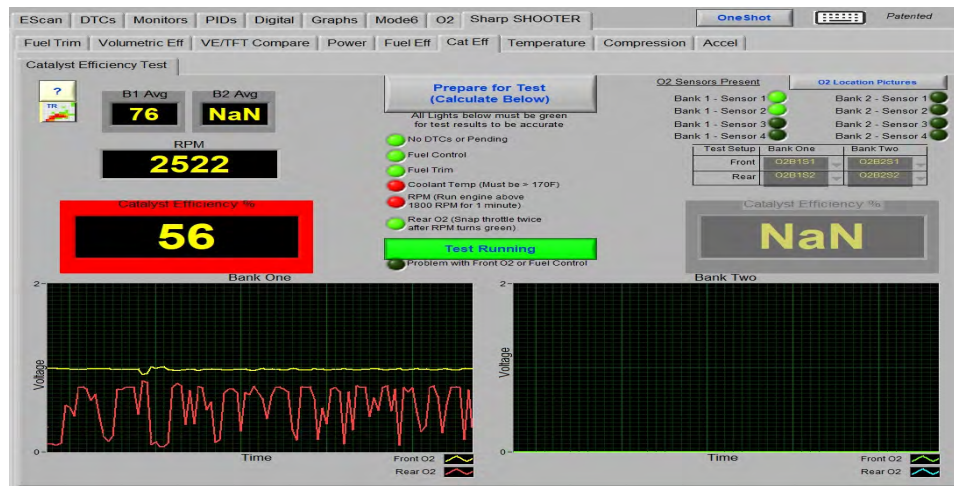
Buttons: Read All Mode6 Once, Read All Mode6 Continuous, (P)end (S)witch (C)ontinuous

OBD Monitor ID (OBDMOND)	Test ID (TID)	Test Value	Min Limit	Max Limit	Units
\$01: Oxygen Sensor Monitor B1 - S1	\$B4: Description Unavailable	0.155	0.000	1.000	
\$01: Oxygen Sensor Monitor B1 - S1	\$B8: Description Unavailable	0.900	0.000	0.900	
\$01: Oxygen Sensor Monitor B1 - S1	\$B2: Description Unavailable	32.767	1.049	32.767	
\$02: Oxygen Sensor Monitor B1 - S2	\$B5: Description Unavailable	0.010	0.000	1.000	Ratio
\$02: Oxygen Sensor Monitor B1 - S2	\$B9: Description Unavailable	0.844	0.000	7.995	V
\$02: Oxygen Sensor Monitor B1 - S2	\$B9: Description Unavailable	0.000	0.000	0.200	V
\$02: Oxygen Sensor Monitor B1 - S2	\$B9: Description Unavailable	0.000	0.000	0.200	V
\$21: Catalyst Monitor Bank 1	\$B4: Description Unavailable	0.830	0.000	1.000	
\$35: Unknown OBDMOND	\$E4: Description Unavailable	0.000	0.000	44.995	
\$35: Unknown OBDMOND	\$E1: Description Unavailable	30.000	3.360	655.350	Deg
\$35: Unknown OBDMOND	\$F0: Description Unavailable	0.000	0.000	29.990	
\$35: Unknown OBDMOND	\$C4: Description Unavailable	0.000	0.000	44.995	
\$35: Unknown OBDMOND	\$E2: Description Unavailable	22.000	3.360	655.350	Deg
\$35: Unknown OBDMOND	\$F1: Description Unavailable	0.000	0.000	29.990	
\$39: EVAP Monitor (Cap Off)	\$A2: Description Unavailable	-2502.500	-4095.000	-300.250	Pa
\$3A: EVAP Monitor (S95)	\$A2: Description Unavailable	-2502.500	-4095.000	-2500.000	Pa
\$3B: EVAP Monitor (S 040)	\$A2: Description Unavailable	0.000	0.000	0.780	
\$3C: EVAP Monitor (S 020)	\$A2: Description Unavailable	0.000	0.000	0.420	
\$42: Mis-Fire Monitor Cylinder 1 Data	\$0B: Description Unavailable	0.000	0.000	65535.000	Counts
\$43: Mis-Fire Monitor Cylinder 2 Data	\$0C: Description Unavailable	0.000	0.000	65535.000	Counts
\$43: Mis-Fire Monitor Cylinder 2 Data	\$0B: Description Unavailable	0.000	0.000	65535.000	Counts
\$44: Mis-Fire Monitor Cylinder 3 Data	\$0C: Description Unavailable	0.000	0.000	65535.000	Counts
\$44: Mis-Fire Monitor Cylinder 3 Data	\$0B: Description Unavailable	0.000	0.000	65535.000	Counts
\$45: Mis-Fire Monitor Cylinder 4 Data	\$0C: Description Unavailable	0.000	0.000	65535.000	Counts
\$45: Mis-Fire Monitor Cylinder 4 Data	\$0B: Description Unavailable	0.000	0.000	65535.000	Counts

Click on above row of interest to get Related DTC and explanation if available.

\$21: Catalyst Monitor Bank 1	\$B4: Description Unavailable	0.830	0.000	1.000
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D.A.D.S



D.A.D.S

2014 BMW 2 Series

Year: 2014

Make: BMW

Model: 2 Series

Engine 3.0L

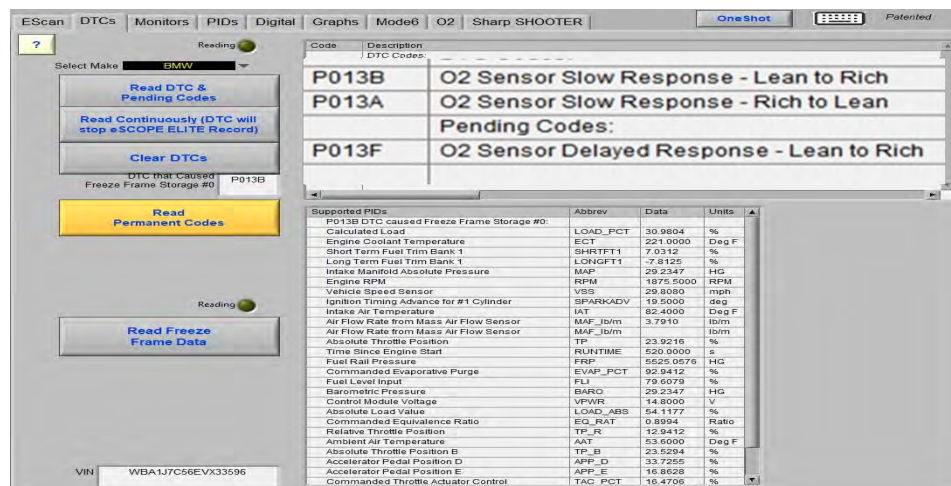
Concern:

Customer just bought and the check engine light is on



D.A.D.S

2014 BMW 2 Series



D.A.D.S

2014 BMW 2 Series

EScan DTCs Monitors PIDs Digital Graphs Mode6 O2 Sharp SHOOTER OneShot Patented

Select Mode: Generic

Test Value background color: red if outside of limit, yellow if close to limit.

ORBD Monitor ID (ORNCARD)	Test ID (TID)	Test Value	Min Limit	Max Limit	Units
\$01: Oxygen Sensor Monitor B1 - S1	\$83: Description Unavailable	1.267	0.300	1.999	
\$02: Oxygen Sensor Monitor B1 - S2	\$01: Description Unavailable	0.708	0.708	0.708	V
\$02: Oxygen Sensor Monitor B1 - S2	\$02: Description Unavailable	0.708	0.708	0.708	V
\$02: Oxygen Sensor Monitor B1 - S2	\$05: Description Unavailable	0.000	0.000	0.750	sec
\$02: Oxygen Sensor Monitor B1 - S2	\$06: Description Unavailable	0.000	0.000	0.000	sec
\$02: Oxygen Sensor Monitor B1 - S2	\$86: Description Unavailable	0.000	0.000	0.000	sec
\$02: Oxygen Sensor Monitor B1 - S2	\$87: Description Unavailable	0.000	0.000	0.000	sec
\$02: Oxygen Sensor Monitor B1 - S2	\$07: Description Unavailable	0.220	0.000	0.234	V
\$02: Oxygen Sensor Monitor B1 - S2	\$08: Description Unavailable	0.815	0.810	7.995	V
\$21: Catalyst Monitor Bank 1	\$81: Description Unavailable	205.350	100.000	655.350	%

Click on above row of interest to get Related DTC and explanation if available.

D.A.D.S

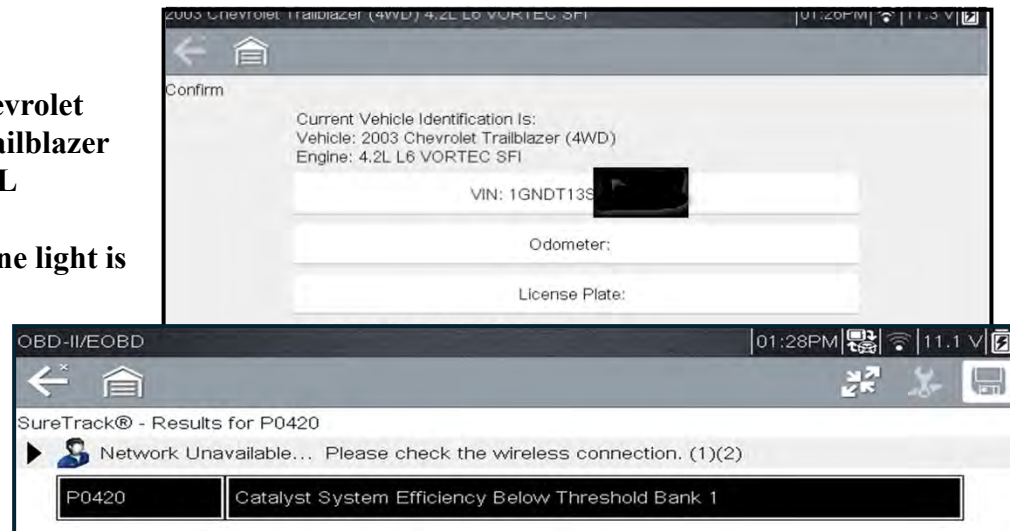
2014 BMW 2 Series



D.A.D.S

2003 Chevy Trailblazer

Year: 2003
Make: Chevrolet
Model: Trailblazer
Engine 4.2L
Concern:
check engine light is on



D.A.D.S

2003 Chevy Trailblazer

OBD-II/EOBD 01:30PM 11.1 V

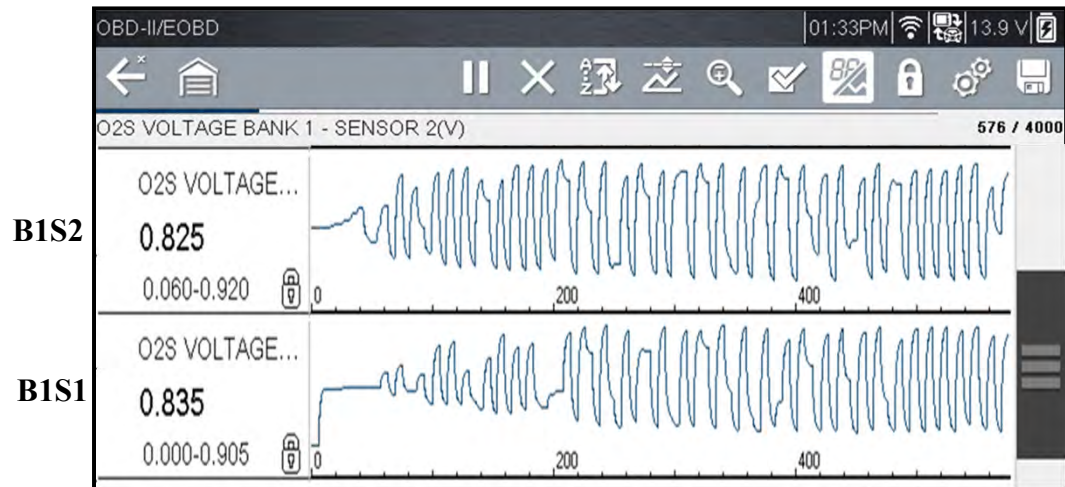
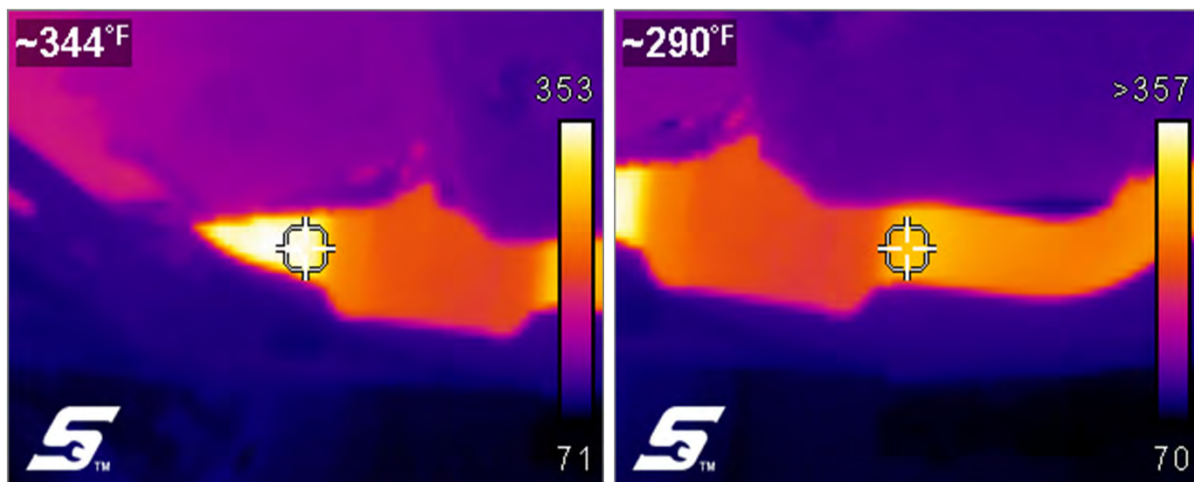
Non-Cont. Monitoring Test Results

Manufacturer Specific Test

ECU ID: \$10 Test ID: \$0C Component: \$60
 Min: N/A Max: 32768 Value: 33770
 Result: Failed

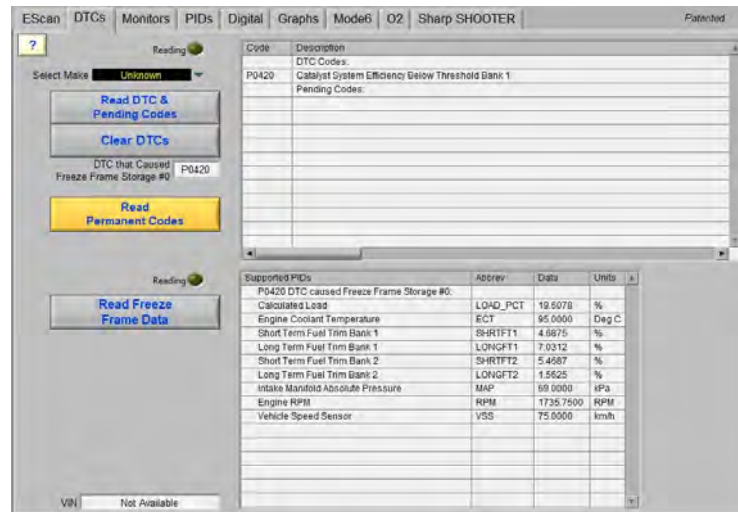
Catalyst Efficiency Monitor						
0C	20	0-High	Idle catalyst efficiency test - bank 1 ⁽¹⁾	-32.768 -to- +32.767 seconds	8000 - 7FFF	
0C	30	0-High	Idle catalyst efficiency test - bank 2 ⁽¹⁾	-32.768 -to- +32.767 seconds	8000 - 7FFF	
0C	60	0-High	Catalyst Test Bank 1 (using OSC compensation units)	-32.768 -to- +32.767 seconds	0000 - FFFF	
0C	61	1-Low	Catalyst Test Bank 2 (using OSC normalized ratio units)	0.000 -to- 1.999	0000 - FFFF	
0C	70	0-High	Catalyst Test Bank 2 (using OSC compensation units)	-32.768 -to- +32.767 seconds	0000 - FFFF	
0C	71	1-Low	Catalyst Test Bank 2 (using OSC normalized ratio units)	0.000 -to- 1.999	0000 - FFFF	
0C	E1	1-Low	Catalyst Test Bank 1 (using OSC normalized ratio units)	0.000 -to- 1.999	0000 - FFFF	
0C	F1	1-Low	Catalyst Test Bank 2 (using OSC normalized ratio units)	0.000 -to- 1.999	0000 - FFFF	

D.A.D.S

Data**D.A.D.S****Bad Cat****D.A.D.S**

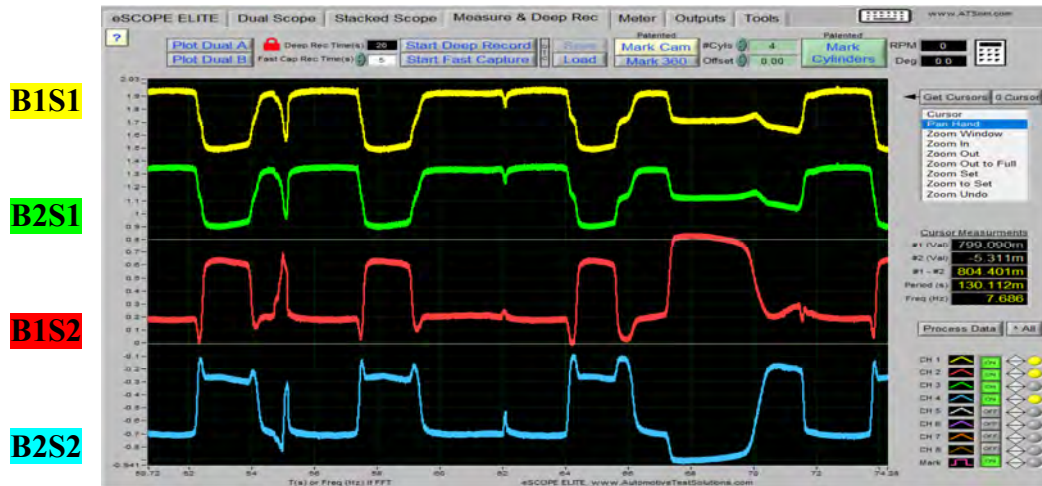
2007 Subaru Tribeca

Year: 2006
Make: Subaru
Model: Tribeca
Engine 3.0L
Concern:
 check engine light is on



D.A.D.S

2007 Subaru Tribeca



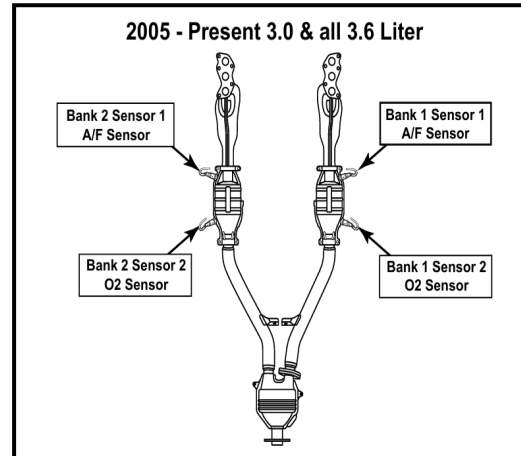
Both rear O2 sensors mimic the front Air/fuel sensors

D.A.D.S

2007 Subaru Tribeca

No P0430 ?

P0333	Knock Sensor 2 Circuit High (Bank 2)
P0335	Crankshaft Position Sensor "A" Circuit
P0336	Crankshaft Position Sensor "A" Circuit Range/Performance
P0340	Camshaft Position Sensor "A" Circuit (Bank 1 or Single Sensor)
P0345	Camshaft Position Sensor "A" Circuit (Bank 2)
P0420	Catalyst System Efficiency Below Threshold (Bank 1)
P0442	Evaporative Emission Control System Leak Detected (Small Leak)
P0447	Evaporative Emission Control System Vent Control Circuit Open
P0448	Evaporative Emission Control System Vent Control Circuit Shorted



D.A.D.S

2009 Volvo XC90

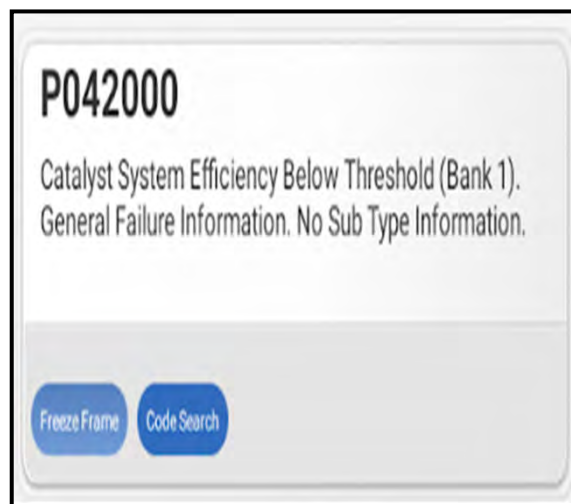
Year: 2009

Make: Volvo

Model: XC90

Concern: The check engine light is on and has been at the dealer several times.

- Dealership replaced the converter
- both oxygen sensors
- replaced all gaskets
- Light comes back on within 60 miles



D.A.D.S

2009 Volvo XC90 – Mode 6

Item	Value	Details
Exhaust Gas Sensor Monitor B1S1:&01	OK	>>
Exhaust Gas Sensor Monitor B1S2:&02	OK	>>
Exhaust Gas Sensor Monitor B2S1:&05	OK	>>
Exhaust Gas Sensor Monitor B2S2:&06	OK	>>
Catalyst Monitor Bank 1:&21	Fail	>>
Catalyst Monitor Bank 2:&22	OK	>>

D.A.D.S

2009 Volvo XC90 – Mode 6

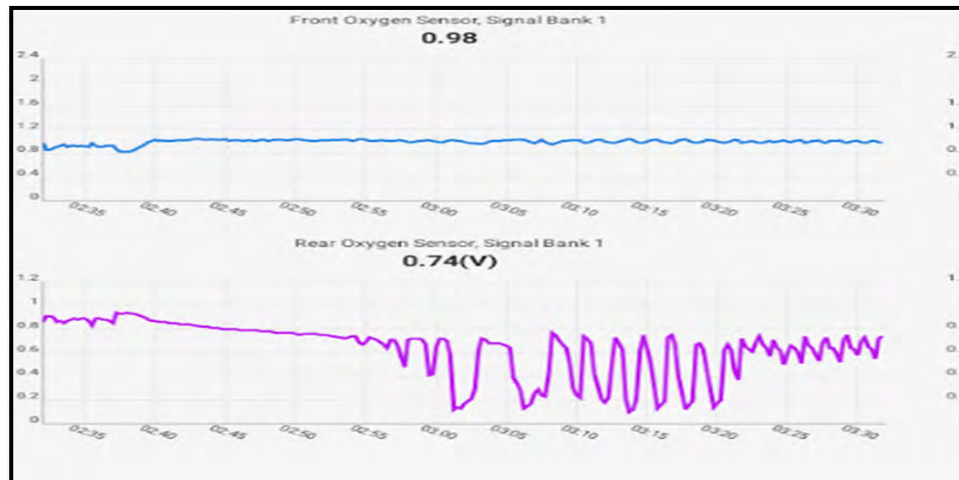
Catalyst Monitor Bank 1:&21				
Test Name(Tids)	Test Value	Stand Value	Unit	Value
TID: &85 Test	1056	0.949	mHz	Fail

Catalyst Monitor Bank 2:&22				
Test Name(Tids)	Test Value	Stand Value	Unit	Value
TID: &85 Test	356	0.949	mHz	OK

Mode 6 shows that B1 Catalyst monitor has failed and is past the maximum limit

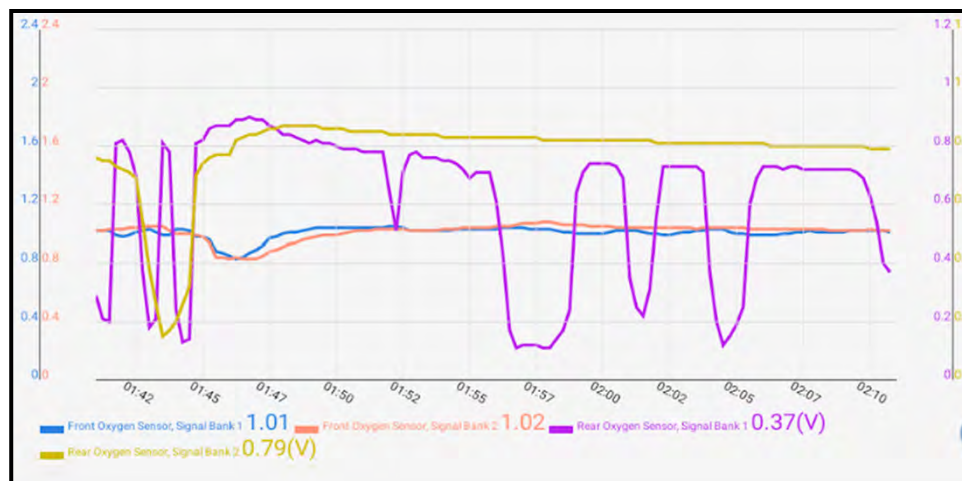
D.A.D.S

2009 Volvo XC90



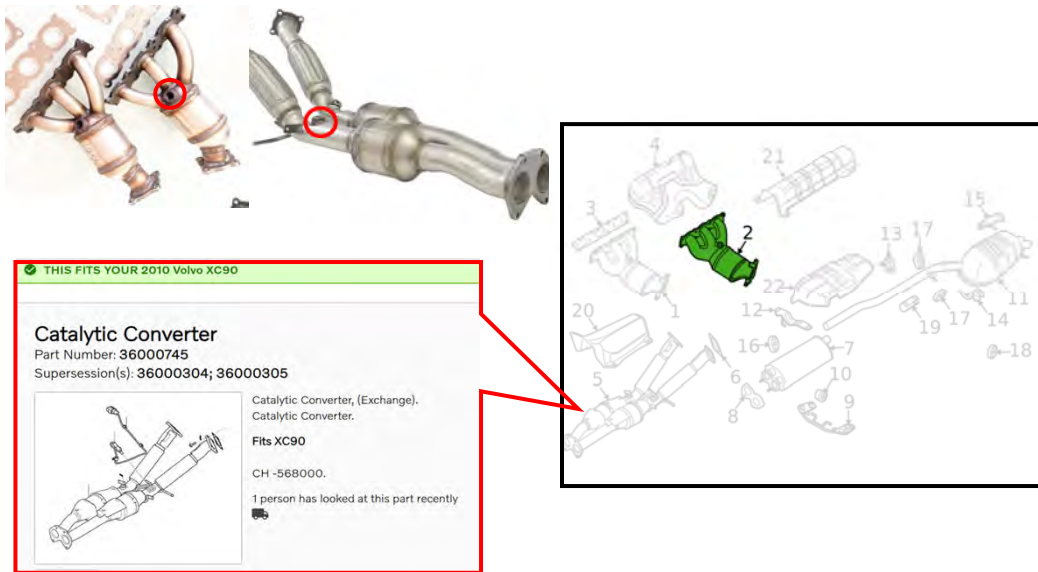
D.A.D.S

2009 Volvo XC90



D.A.D.S

2009 Volvo XC90 - O.E.M. Confusion

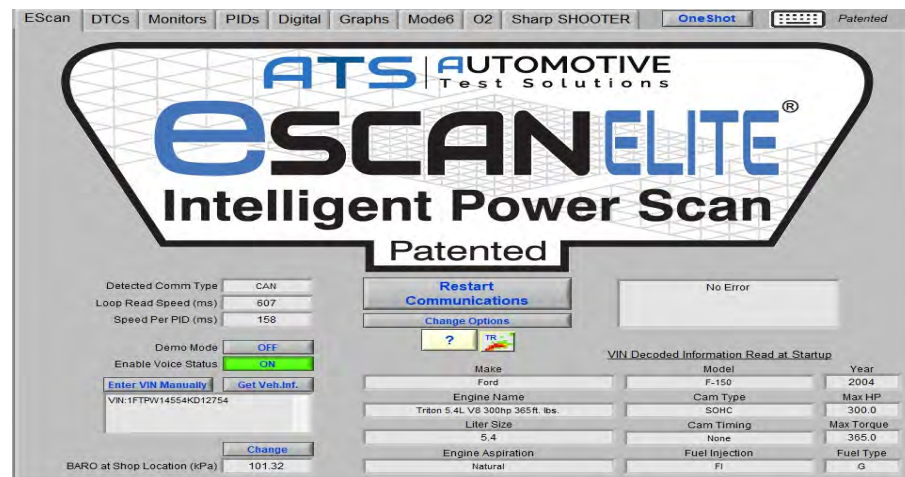


D.A.D.S

2004 Ford F-150

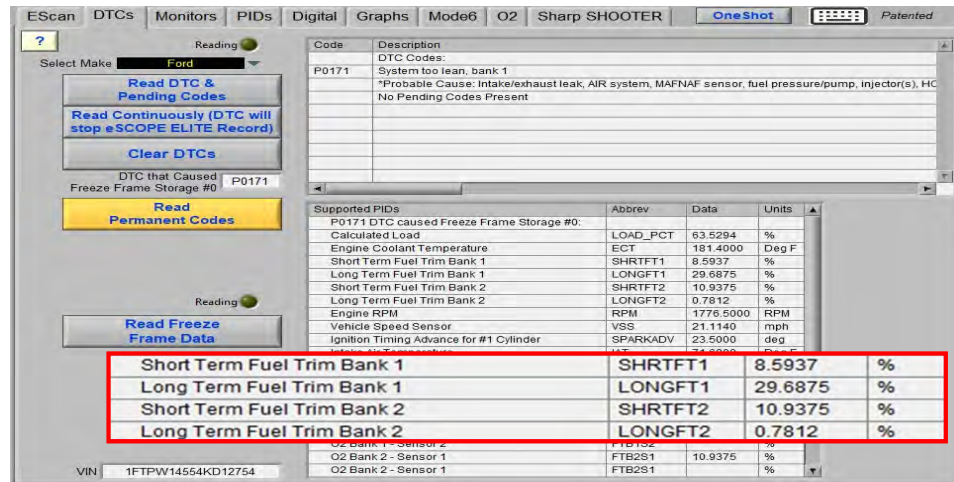
Year: 2004
Make: Ford
Model: F-150
Engine: 5.4L

Concern:
No Power and
misfires



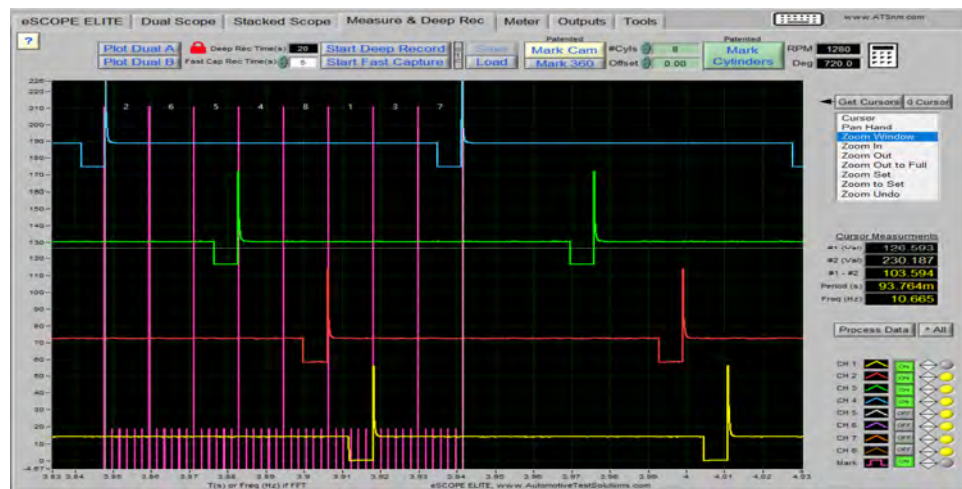
D.A.D.S

2004 Ford F-150



D.A.D.S

2004 Ford F-150

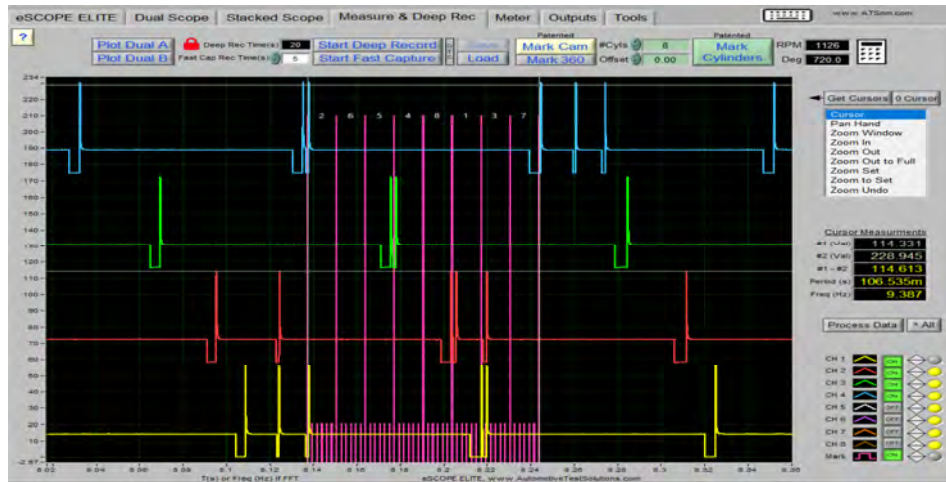


Fuel injectors from B1 are firing in order **2,4,1** and **3**

D.A.D.S

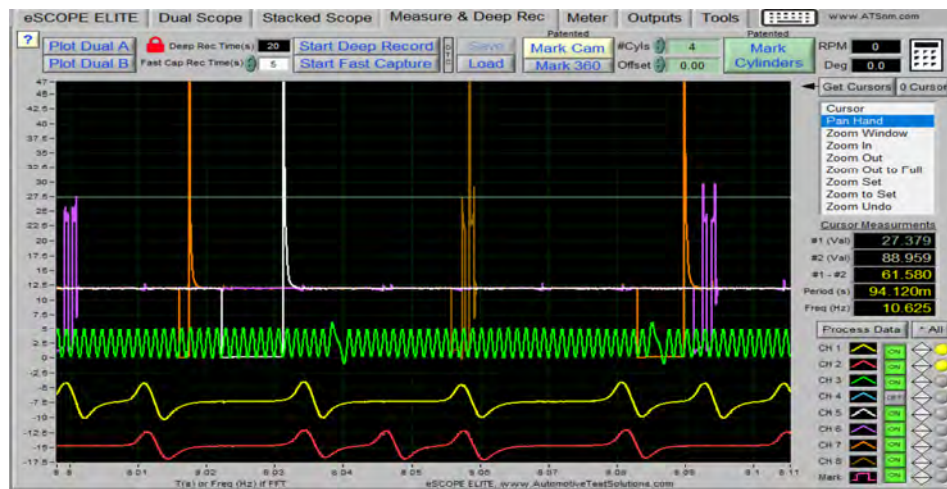
2004 Ford F-150

Fuel Injectors fire and stay in order but double strike



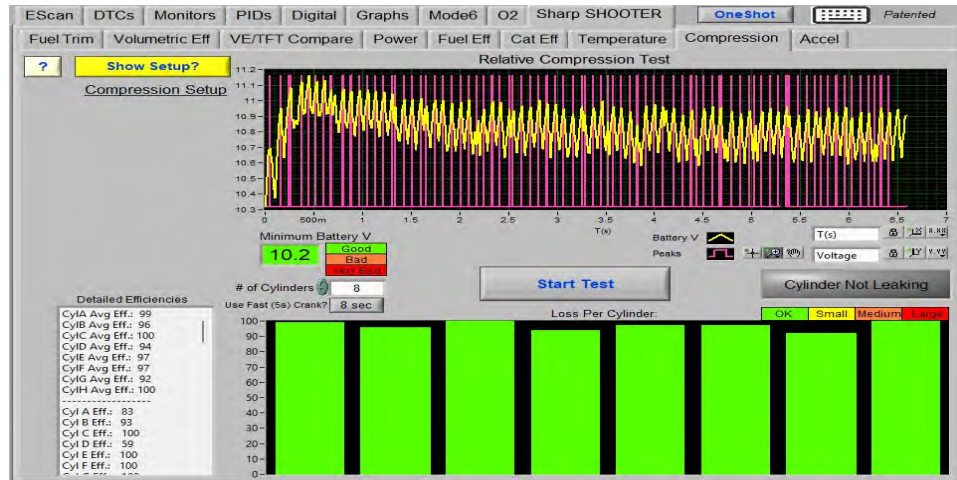
D.A.D.S

2004 Ford F-150



D.A.D.S

2004 Ford F-150



D.A.D.S

IAT Test

IAT Temp Test is a go to test to see if the motor is drawing in fresh air.

Set up:

Hood Open – lets all the hot air out of the engine bay

PID's Selection – IAT, RPM, Engine Run Time

Raise the RPM to 2000

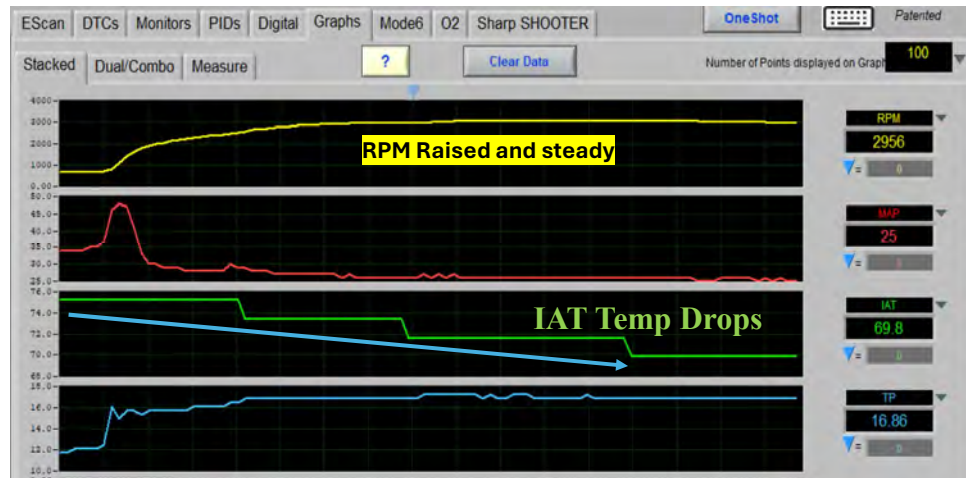
Results:

- IAT temp should drop if the motor is capable of drawing in fresh air
- IF Temp goes up there maybe a in-haling or ex-haling issue in the engine



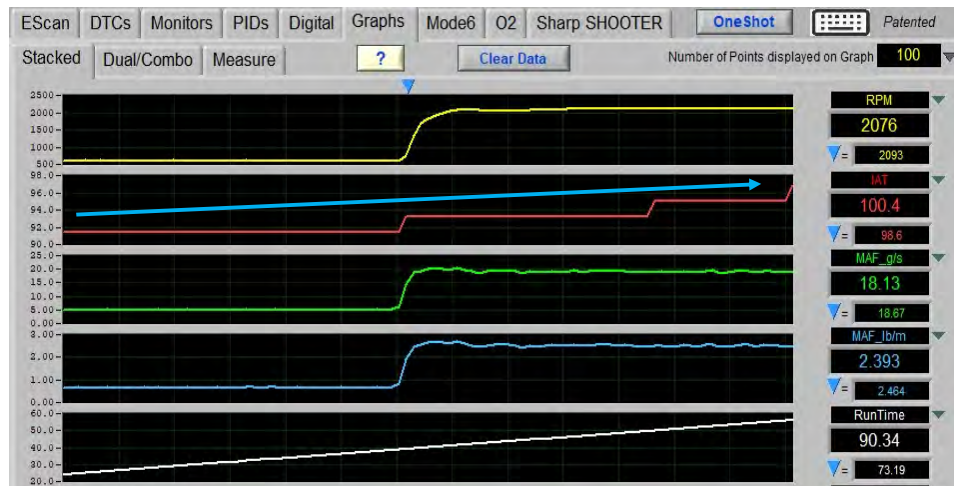
D.A.D.S

Known Good Vehicle



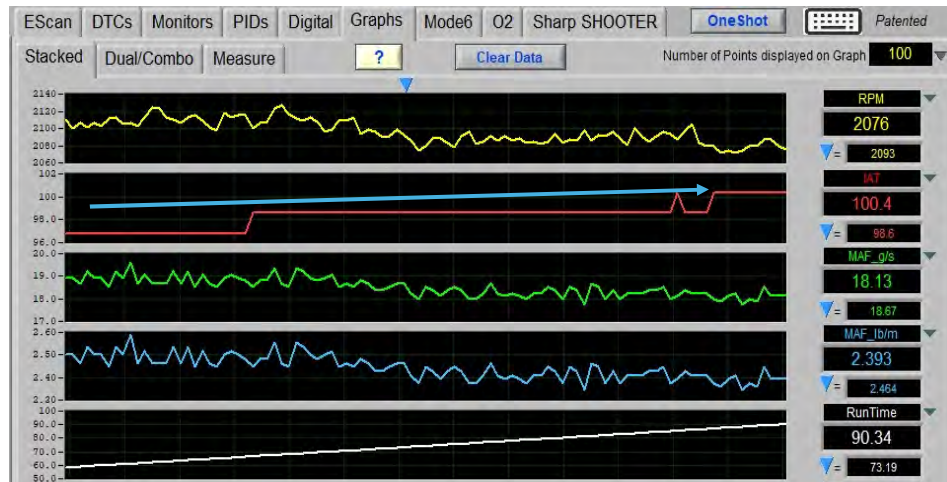
D.A.D.S

2004 Ford F-150



D.A.D.S

2004 Ford F-150



D.A.D.S

2004 Ford F-150



D.A.D.S

2004 Ford F-150



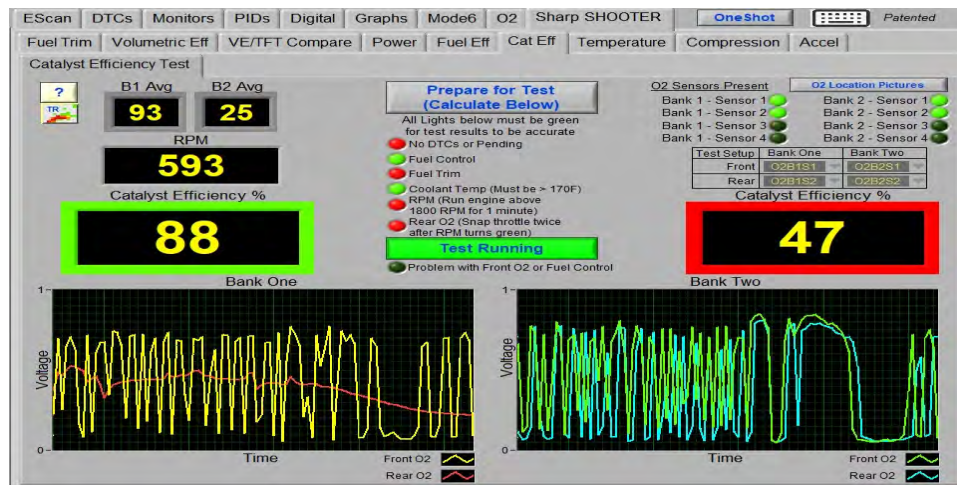
D.A.D.S

2004 Ford F-150



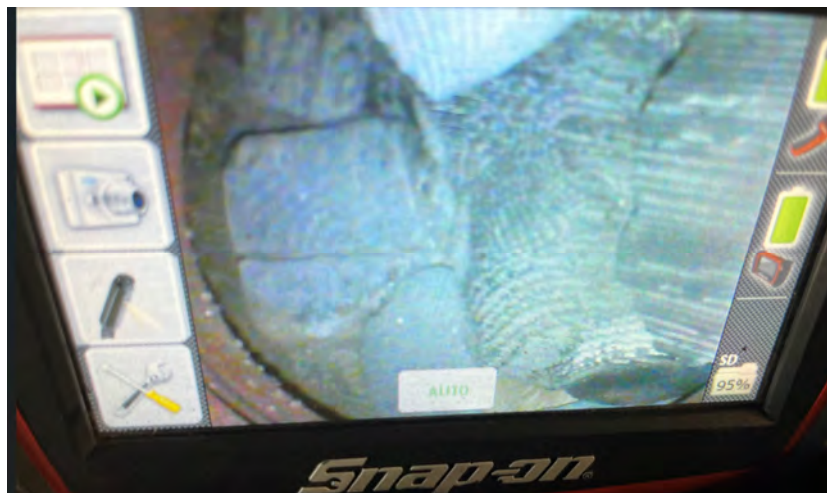
D.A.D.S

2004 Ford F-150



D.A.D.S

2004 Ford F-150



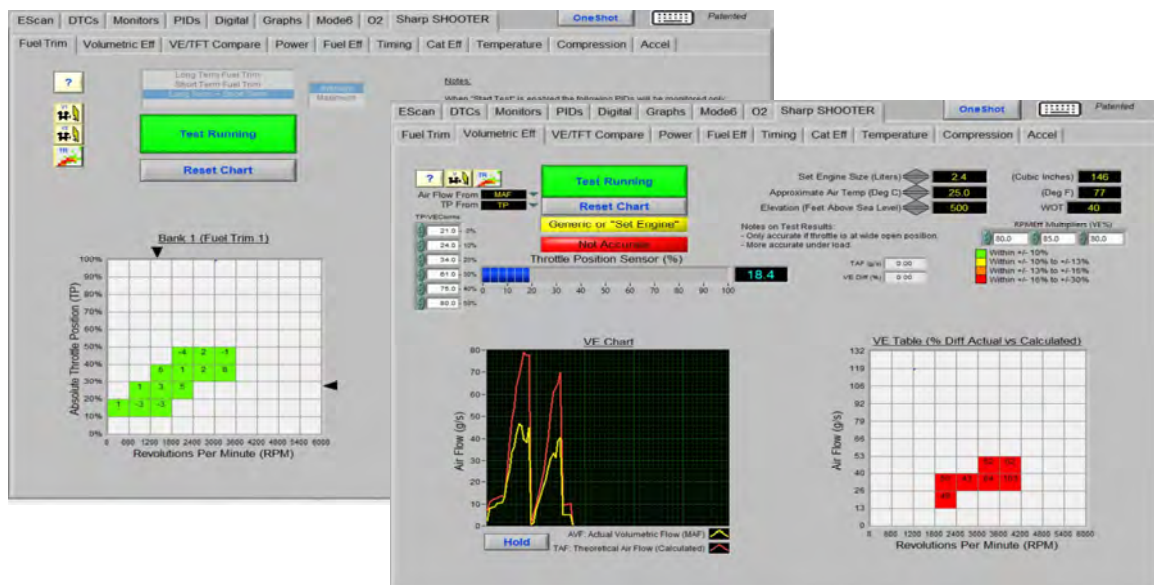
D.A.D.S

Year: 2011
Make: Toyota
Model: Camry
Engine: 2.4L Hybrid
Concern:
No power on acceleration

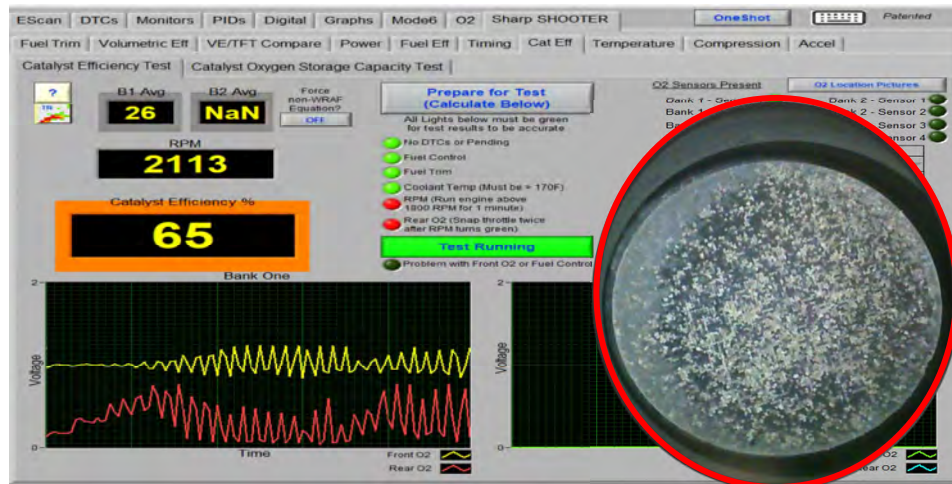
Enhanced	Generic	System	Monitor Status	Calibration	Update	Configure	RoB	DTC
-	Engine and ECT	Com	37503100	Yes	No	-	-	4
DTC information								
DTC	Description	Cur / Conf	Pending	History	Test Failed	FFD	TGD	Priority
P0420	Catalyst System Efficiency Below Threshold (Bank 1)	X		X			-	No
P3190	Poor Engine Power	X		X			-	No
P0441	Evaporative Emission Control System Incorrect Purge Flow			X			-	No
P0455	Evaporative Emission Control System Leak Detected (Gross Leak)			X			-	No

D.A.D.S

Low V.E. And No Fuel Trim Correction



D.A.D.S



D.A.D.S

2011 Kia Sorento

Year: 2011

Make: Kia

Model: Sorento

Engine: 2.4L

Concern:

- Check engine light is on
- Has no power
- Won't accelerate



D.A.D.S

Code Description

DTC Codes:

P0420 Catalytic converter system, bank 1 -efficiency below threshold

*Probable Cause: Catalytic converter, wiring, HO2S 2

P0106 Manifold absolute pressure (MAP) sensor barometric pressure (BARO) sensor -range/performance problem

*Probable Cause: Intake/exhaust leak, wiring, MAP sensor, BARO sensor

Pending Codes:

*Probable Cause: Catalytic converter, wiring, HO2S 2

P0170 Fuel trim (FT), bank 1 -malfunction

*Probable Cause: Intake leak, AIR system, fuel pressure/pump, injector(s), EVAP canister purge valve, HO2S

Freeze Frame Storage #0:

Read Permanent Codes

Reading

Read Freeze Frame Data

VIN 5XYKUCA17BG021480

Supported PIDs

PID	Abbrev	Data	Units
P0420 DTC caused Freeze Frame Storage #0:			
Calculated Load	LOAD_PCT	70.9804	%
Engine Coolant Temperature	ECT	86.0000	Deg C
Short Term Fuel Trim Bank 1	SHRTFT1	0.0000	%
Long Term Fuel Trim Bank 1	LONGFT1	-7.0312	%
Intake Manifold Absolute Pressure	MAP	72.0000	kPa
Engine RPM	RPM	2368.0000	RPM
Vehicle Speed Sensor	VSS	57.0000	km/h
Ignition Timing Advance for #1 Cylinder	SPARKADV	22.5000	deg
Intake Air Temperature	IAT	31.0000	Deg C
Absolute Throttle Position	TP	22.7451	%
Time Since Engine Start	RUNTIME	879.0000	s
Commanded Evaporative Purge	EVAP_PCT	95.2942	%
Fuel Level Input	FLI	40.2922	%
Barometric Pressure	BARO	102.0000	kPa
Control Module Voltage	VPWR	14.0700	V
Absolute Load Value	LOAD_ABS	58.8235	%
Commanded Equivalence Ratio	EQ_RAT	0.9955	Ratio
Relative Throttle Position	TP_R	15.6853	%
Ambient Air Temperature	AAT	16.0000	Deg C
Absolute Throttle Position B	TP_B	22.3529	%
Accelerator Pedal Position D	APP_D	30.5882	%
Accelerator Pedal Position E	APP_E	30.1961	%
Commanded Throttle Actuator Control	TAC_PCT	17.6471	%
Short Term Secondary O2 Sensor Trim Bank 1/Bank	STSO2FT1	-2.3437	%
Long Term Secondary O2 Sensor Trim Bank 1/Bank	LGSO2FT1	3.1250	%

D.A.D.S

2011 Kia Sorento



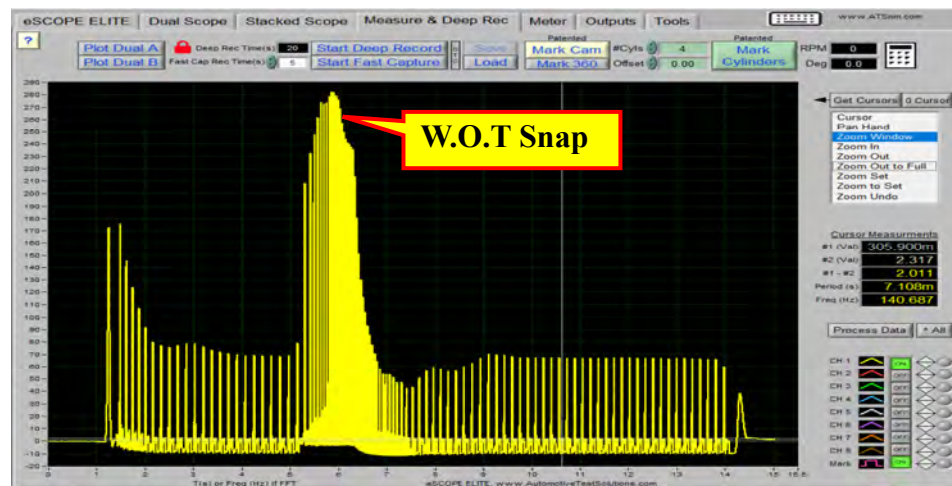
D.A.D.S

2011 Kia Sorento

EScan DTCs Monitors PIDs Digital Graphs Mode6 O2 Sharp SHOOTER Patented						
Select Make Kia-Hyundai 2006-2017						
Test Value background color: If outside of limit, If close to limit						
Read All Mode6 Once Read All Mode6 Continuous Read Selected Continuous						
OBD Monitor ID (OBDMID)	Test ID (TID)	Test Value	Min Limit	Max Limit	Units	
S01: Oxygen Sensor Monitor B1 - S1	S84: Description Unavailable	0.105	0.000	1.000		
S01: Oxygen Sensor Monitor B1 - S1	S88: Description Unavailable	0.000	0.000	0.900		
S01: Oxygen Sensor Monitor B1 - S1	S8C: Description Unavailable	32.767	1.049	32.767		
S02: Oxygen Sensor Monitor B1 - S2	S85: Description Unavailable	0.070	0.000	1.000	Ratio	
S02: Oxygen Sensor Monitor B1 - S2	S89: Description Unavailable	0.000	0.000	0.200	V	
S02: Oxygen Sensor Monitor B1 - S2	SA0: Description Unavailable	18668.000	1500.000	65534.000	mV/s	
S21: Bank1	SB4: Description Unavailable	1.400	0.000	1.000		
S35: Bank1 In-Cam	SC3: Description Unavailable	0.000	0.000	44.990		
S35: Bank1 In-Cam	SE1: Description Unavailable	31.870	3.360	655.350	Deg	
S35: Bank1 In-Cam	SF0: Description Unavailable	0.000	0.000	29.990		
S36: EVAP Monitor Tank Leakage	SA2: Description Unavailable	0.000	0.000	0.420		
S3C: EVAP Monitor Tank Leakage Rough	SA8: Description Unavailable	99.250	-299.750	4096.000	Pa	
S41: B1S11 Lambda Sensor Wire	S60: Description Unavailable	830.000	755.000	900.000	C	
S42: B1S2 O2S	S60: Description Unavailable	297.000	0.000	10000.000	Ohm	
SA1: Description Unavailable	SA0: Description Unavailable	3.000	0.000	65535.000	Counts	
SA2: Misfire Cylinder 1 Data	S0C: Cyl. #1 Current Misfire Counts	0.000	0.000	65535.000	Counts	
SA2: Misfire Cylinder 1 Data	S0B: Cyl. #1 EVMA Misfire Counts	1.000	0.000	65535.000	Counts	
SA3: Misfire Cylinder 2 Data	S0C: Cyl. #2 Current Misfire Counts	3.000	0.000	65535.000	Counts	
SA3: Misfire Cylinder 2 Data	S0B: Cyl. #2 EVMA Misfire Counts	0.000	0.000	65535.000	Counts	
SA4: Misfire Cylinder 3 Data	S0C: Cyl. #3 Current Misfire Counts	0.000	0.000	65535.000	Counts	
SA4: Misfire Cylinder 3 Data	S0B: Cyl. #3 EVMA Misfire Counts	0.000	0.000	65535.000	Counts	
SA5: Misfire Cylinder 4 Data	S0C: Cyl. #4 Current Misfire Counts	0.000	0.000	65535.000	Counts	
SA5: Misfire Cylinder 4 Data	S0B: Cyl. #4 EVMA Misfire Counts	0.000	0.000	65535.000	Counts	

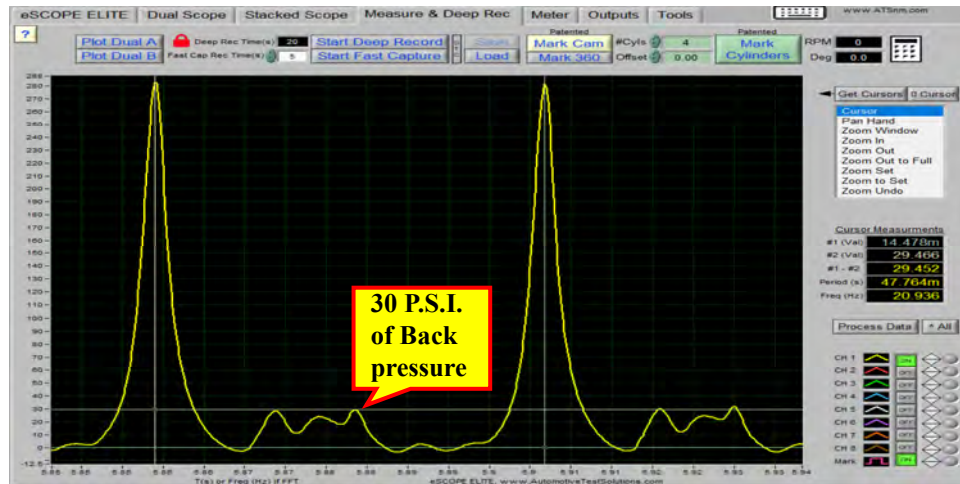
D.A.D.S

2011 Kia Sorento



D.A.D.S

2011 Kia Sorento



D.A.D.S

2016 Nissan Versa

Year: 2016

Make: Nissan

Model: Versa

Engine 1.6L

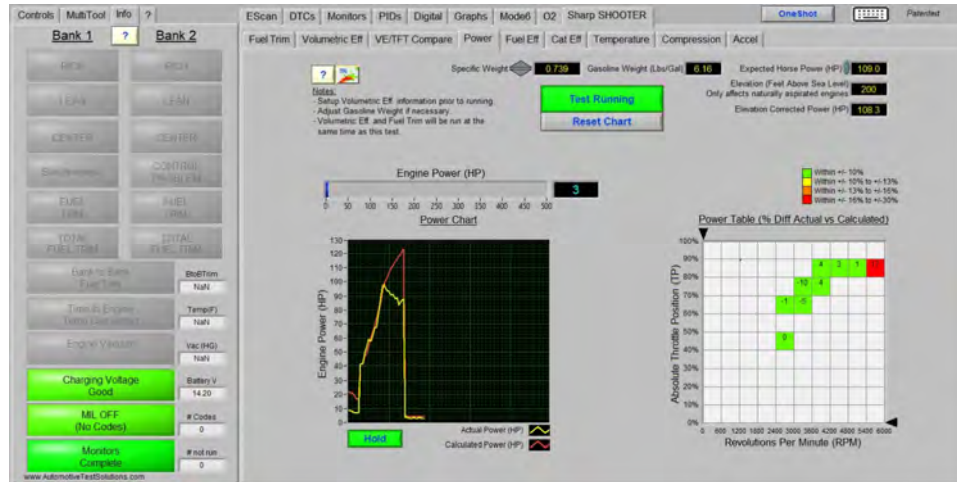
Concern:

- Vehicle has no power
- Boyfriend replaced spark plugs
- No check engine light on



D.A.D.S

Horsepower Test



D.A.D.S

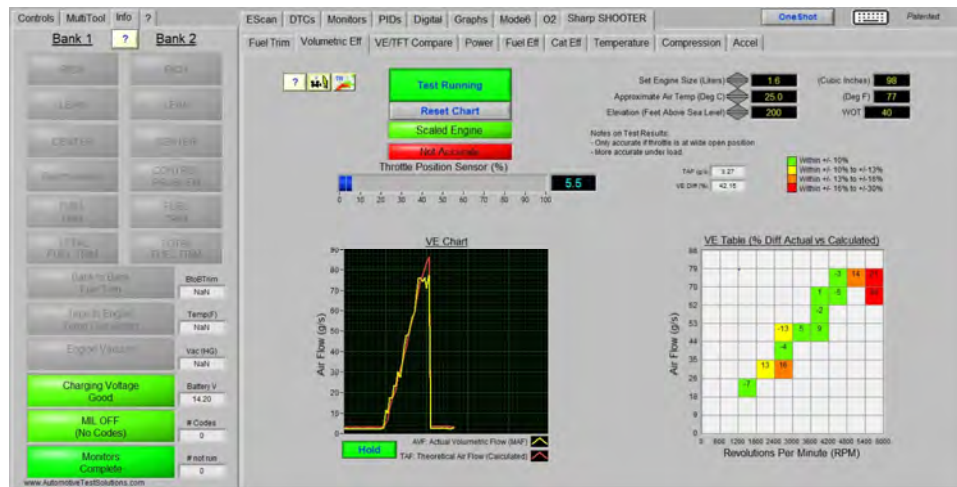
Fuel Trims



Fuel is -27% at idle and -11 at W.O.T.

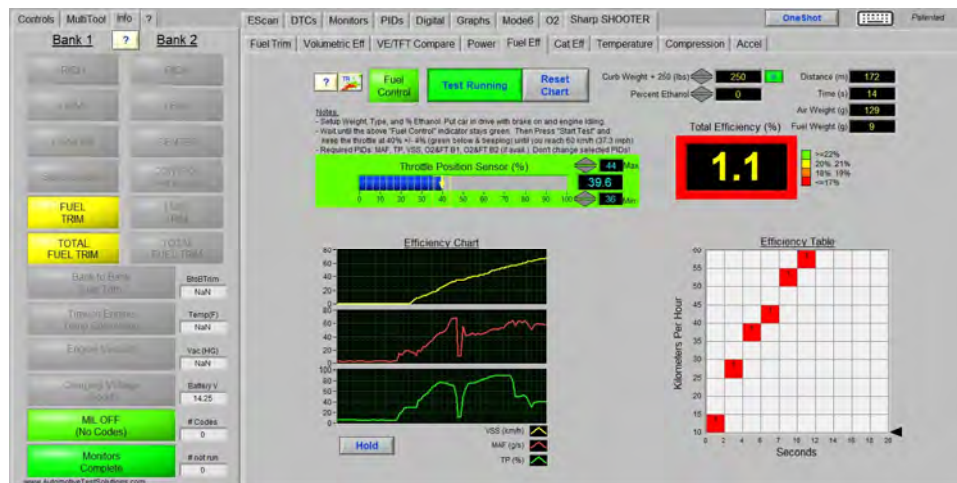
D.A.D.S

Volumetric Efficiency



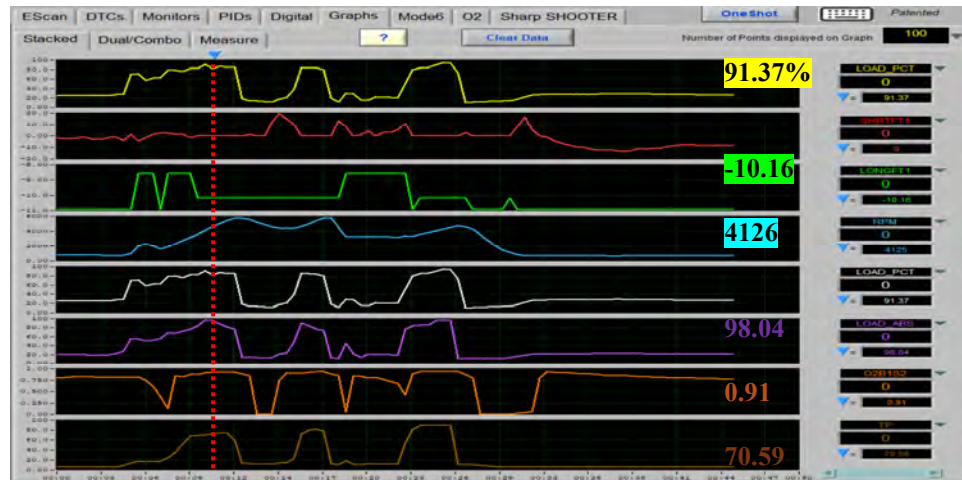
D.A.D.S

Fuel Efficiency



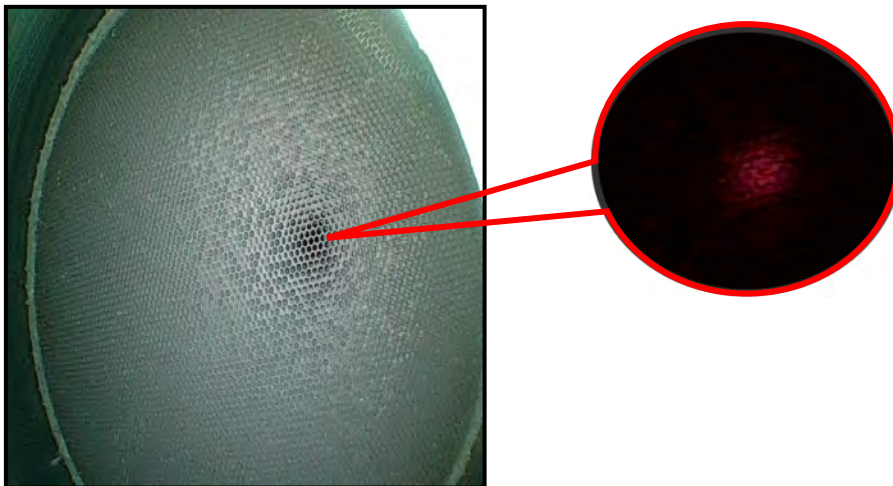
D.A.D.S

W.O.T. Data



D.A.D.S

Clogged Cat



D.A.D.S

Questions

Thank You

**Email:
joshweaver2448@gmail.com**

D.A.D.S