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# Driveability: What is normal?

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# Driveability: What is Normal?

**Presented by Matt Dixon**
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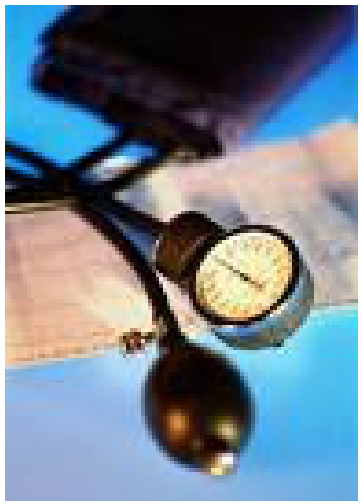
# Driveability: What is Normal?

Other industries have measurements and values to decipher

**Without understanding, numbers become meaningless**



# Driveability: What is Normal?

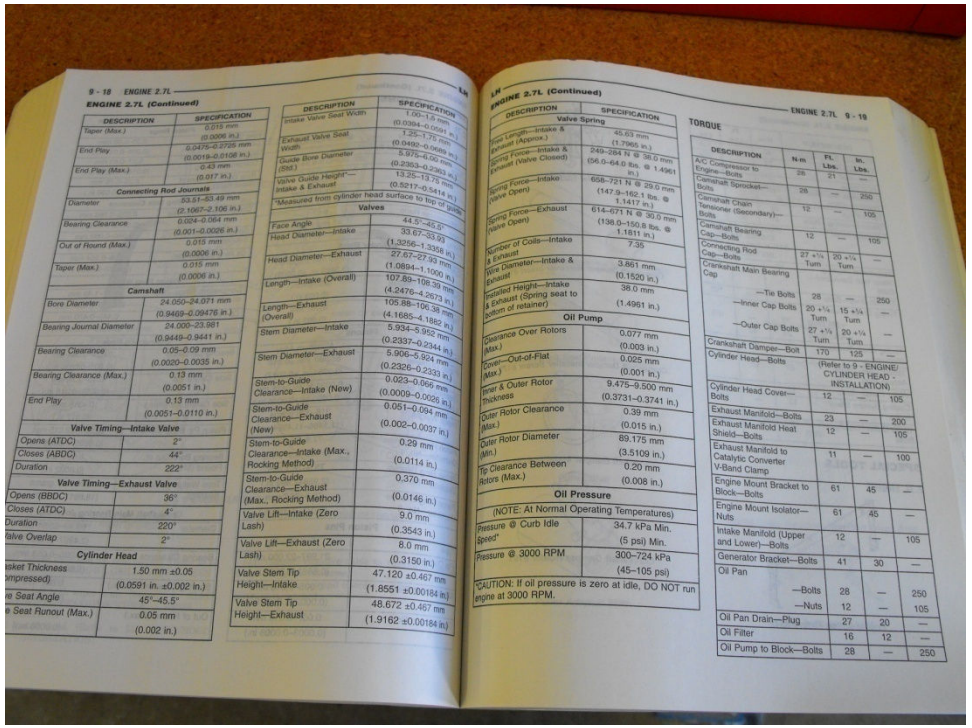
Like experts in other professions, technicians:

**Analyze normal and abnormal data during problem diagnosis**

# Driveability: What is Normal?

Because of variables, specifications are not usually available for driveability PIDs

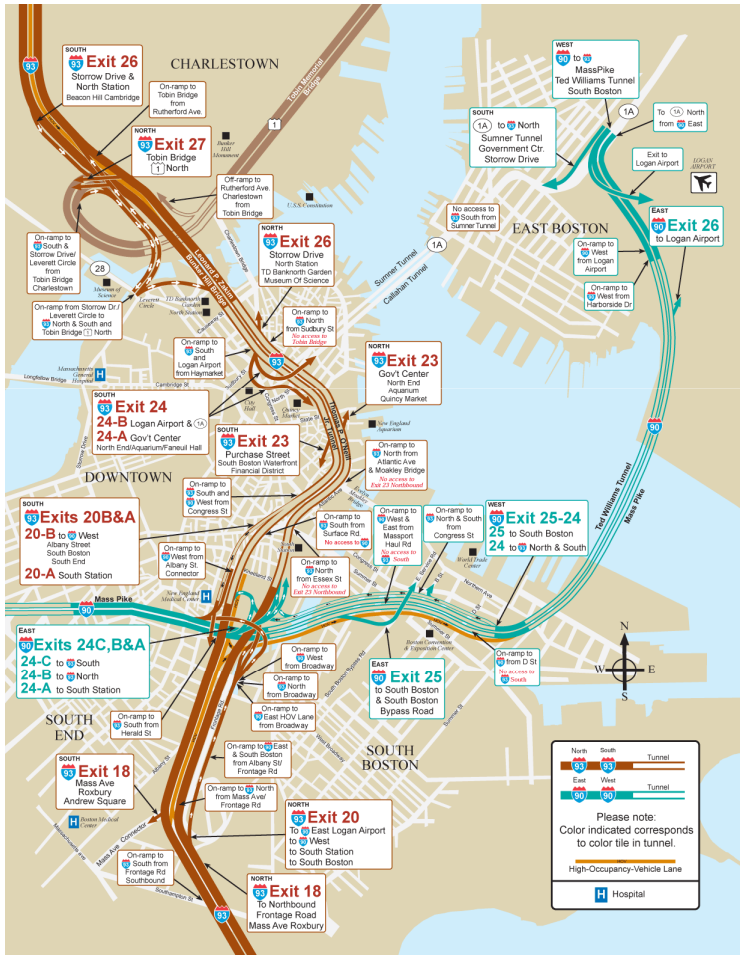
**Experience is paramount in value interpretation**



# Presentation Goal:

Promote experience with key values leading to the ability to determine what normal is

**Help students learn driveability points of reference**



# Vehicles measured:

| | Eclipse | Verona | Lucerne | Avenger | F-150 |
|---|---|---|---|---|---|
| **Manufacturer:** | Mitsubishi | Suzuki | GM | Chrysler | Ford |
| **Model Year:** | 2007 | 2006 | 2007 | 2008 | 2005 |
| **Engine:** | 3.8 V-6 | 2.5 I-6 | 3.8 V-6 | 2.7 V-6 | 5.4 V-8 |
| **EFI type:** | Port<br>MAF | Port<br>MAF | Port<br>MAF | Port<br>Speed Density | Port<br>MAF |
| **Throttle:** | Electronic | Electronic | Electronic | Electronic | Electronic |
| **Scan Tool used:** | MUT 3 (factory) | Actron Aftermarket | Tech 2 (factory) | Wi-Tech (factory) | WDS (factory) |

5 late model vehicles; 5 O.E.M.’s;
5 scan tools

# 2007 Mitsubishi Eclipse


# 2006 Suzuki Verona


# 2007 Buick Lucerne

Note: single up and downstream O2's

# 2008 Dodge Avenger

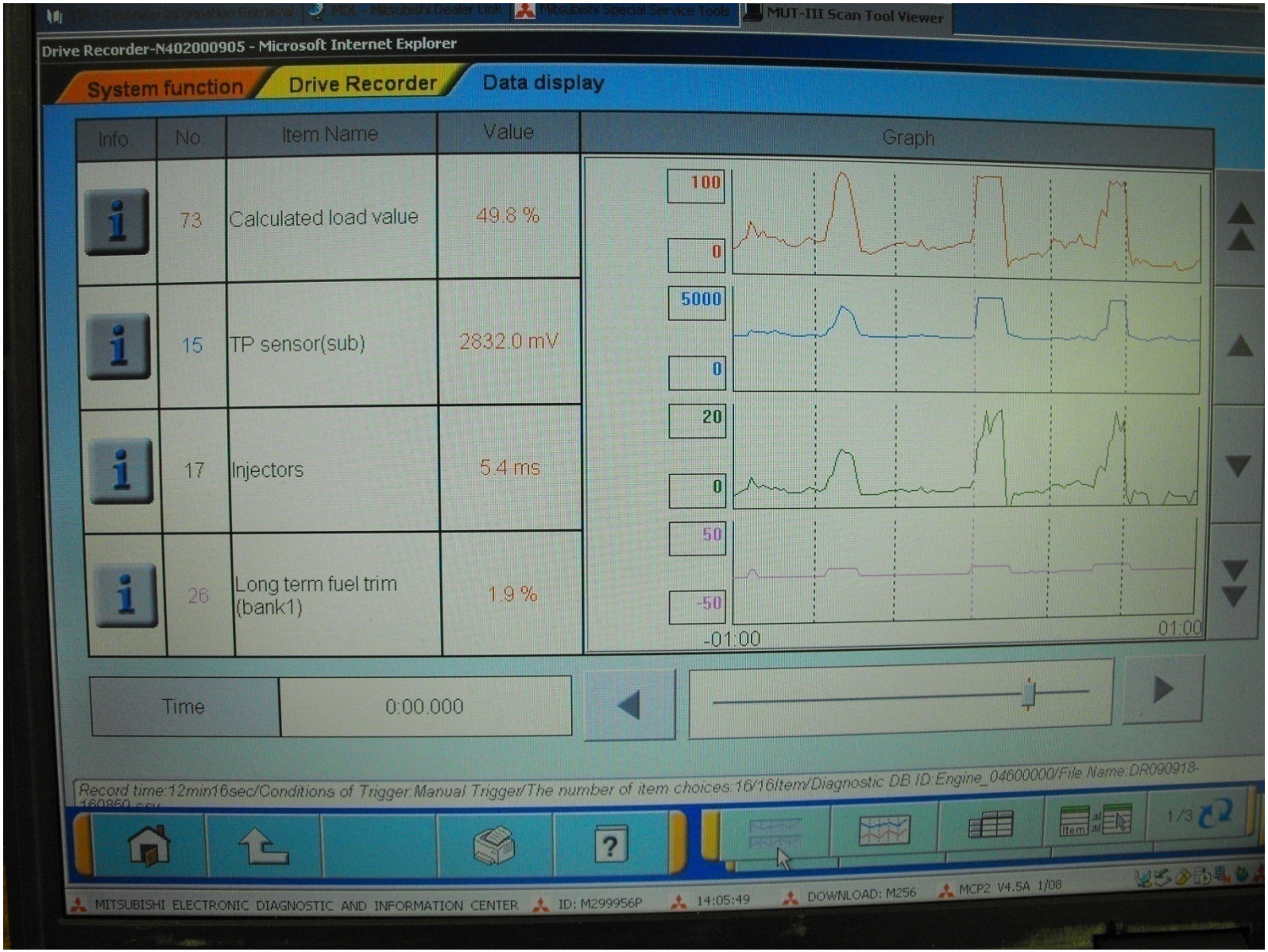

# 2005 Ford F-150


# Scan Tools Used

Mitsubishi **MUT 3**

**(MUT= Multi Use Tool)**

Used recording function


MUT-III Scan Tool Viewer
Drive Recorder-N402000905 - Microsoft Internet Explorer
System function
Drive Recorder
Data display
Info.
No.
Item Name
Value
Graph
73
Calculated load value
49.8 %
15
TP sensor(sub)
2832.0 mV
17
Injectors
5.4 ms
26
Long term fuel trim (bank1)
1.9 %
100
0
5000
0
20
0
50
-50
-01:00
01:00
Time
0:00.000
Record time:12min16sec/Conditions of Trigger:Manual Trigger/The number of item choices:16/16Item/Diagnostic DB ID:Engine_04600000/File Name:DR090918-
1/3
MITSUBISHI ELECTRONIC DIAGNOSTIC AND INFORMATION CENTER
ID: M299956P
14:05:49
DOWNLOAD: M256
MCP2 V4.5A 1/08

# Scan Tools Used

On the Suzuki: I used the

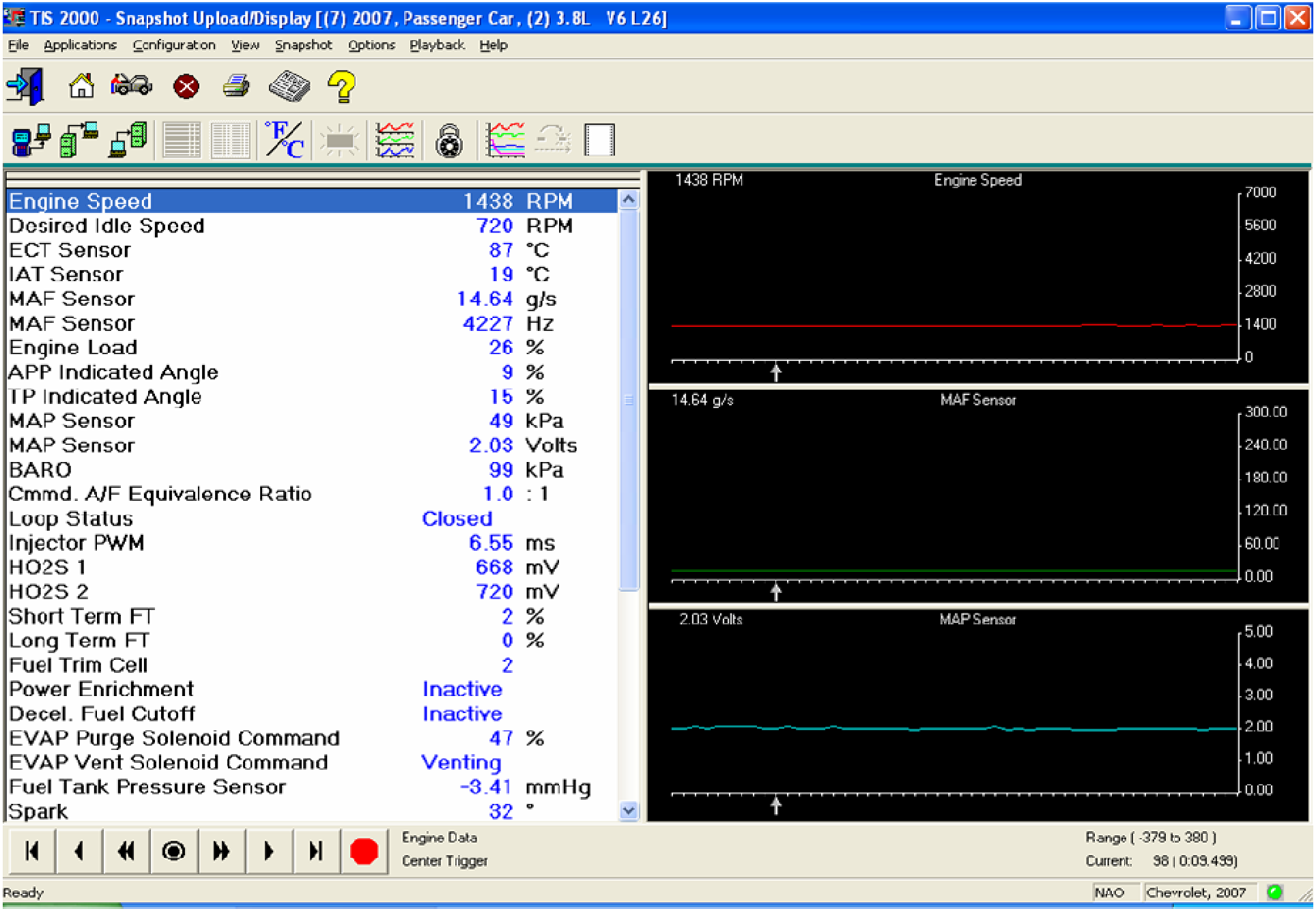
**Actron**

**Auto Scanner Plus**

# Scan Tools Used

GM **Tech 2**

**Snapshot function used**

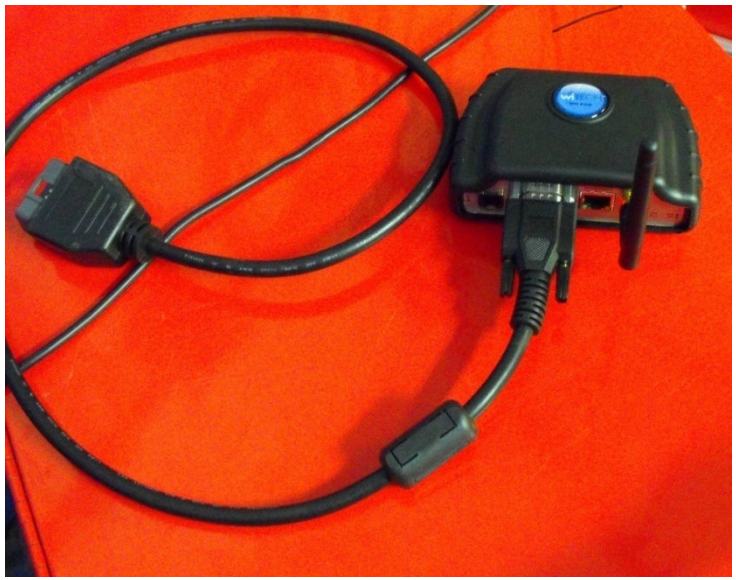

TIS 2000 - Snapshot Upload/Display [(7) 2007, Passenger Car, (2) 3.8L V6 L26]
File Applications Configuration View Snapshot Options Playback Help
Engine Speed 1438 RPM
Desired Idle Speed 720 RPM
ECT Sensor 87 °C
IAT Sensor 19 °C
MAF Sensor 14.64 g/s
MAF Sensor 4227 Hz
Engine Load 26 %
APP Indicated Angle 9 %
TP Indicated Angle 15 %
MAP Sensor 49 kPa
MAP Sensor 2.03 Volts
BARO 99 kPa
Cmmd. A/F Equivalence Ratio 1.0 : 1
Loop Status Closed
Injector PWM 6.55 ms
HO2S 1 668 mV
HO2S 2 720 mV
Short Term FT 2 %
Long Term FT 0 %
Fuel Trim Cell 2
Power Enrichment Inactive
Decel. Fuel Cutoff Inactive
EVAP Purge Solenoid Command 47 %
EVAP Vent Solenoid Command Venting
Fuel Tank Pressure Sensor -3.41 mmHg
Spark 32 °
1438 RPM
Engine Speed
7000
5600
4200
2800
1400
0
14.64 g/s
MAF Sensor
300.00
240.00
180.00
120.00
60.00
0.00
2.03 Volts
MAP Sensor
5.00
4.00
3.00
2.00
1.00
0.00
Engine Data
Center Trigger
Range ( -379 to 380 )
Current: 38 ( 0:03.439)
Ready
NAO
Chevrolet, 2007

# Scan Tools Used

Chrysler **Wi-Tech**

(Wireless pass-through)

**Data Recording function used**



Event Viewer REC_1B3LC56R98N671075_090916150503 - Wed Sep 16 15:05:03 CDT 2009

| Graph | ECU | Name | Value | Units |
|---|---|---|---|---|
| ☑ | PCM | APP 1 Volts | 0.8652 | Volts |
| ☐ | PCM | Actual EGR Position | 0.0003 | inch |
| ☐ | PCM | Actual Torque | -1.47 | Ft-Lbs |
| ☐ | PCM | Actual Purge Current | 157.297 | mA |
| ☐ | PCM | 1/1 O2 Sensor Volts | 2.5858 | Volts |
| ☐ | PCM | 1/2 O2 Sensor Volts | 3.2261 | Volts |
| ☐ | PCM | AC Hi-Side Pressure | 95.4 | psi |
| ☐ | PCM | AC Output Current | 0.00 | Amps |
| ☐ | PCM | Barometric Pressure | 29.44 | in Hg |
| ☐ | PCM | Battery Volt | 13.958 | Volts |
| ☐ | PCM | Cam Crank Difference | -4.50 | degr... |
| ☐ | PCM | Cam State | 4 | ... |
| ☐ | PCM | Crank Status | 3 | ... |
| ☐ | PCM | EGR Flow | 0.000 | g/s |
| ☐ | PCM | ETC Directional Duty Cycle | -30.0683 | % |
| ☐ | PCM | Engine Coolant Temp | 181.40 | F |
| ☐ | PCM | Engine Position | 496.4 | Engin... |
| ☐ | PCM | Engine Speed | 652 | rpm |
| ☐ | PCM | Engine Torque (40TE/41TE/42RLE) | 0 | lbft |
| ☐ | PCM | Ethanol Percent | 0.0 | % |
| ☐ | PCM | IGN_RUN_START_SW_INST | On | |
| ☐ | PCM | Injector Pulse Width Cylinder 1 | 1864.0 | US |
| ☐ | PCM | LR Clutch Fill Volume Index | 51 | ... |
| ☐ | PCM | OD Clutch Fill Volume Index | 123 | ... |
| ☐ | PCM | LR Pressure Switch | Closed | |
| ☐ | PCM | OD Pressure Switch | Open | |
| ☐ | PCM | Line Pressure | 121.0 | psi |
| ☐ | PCM | Line Pressure Sensor | 2.187 | Volts |
| ☑ | PCM | MAP Vacuum | 19.23 | in Hg |
| ☑ | PCM | Mass Airflow | 3.898 | g/s |
| ☐ | PCM | NGC Should Shut Off Fuel | Fuel On | |
| ☐ | PCM | OD Clutch | Not App... | |
| ☐ | PCM | Output Shaft Speed | 0 | rpm |
| ☐ | PCM | PRNDL Code | 128 | ... |
| ☐ | PCM | Present Gear TCC State | TCC Rel... | |
| ☐ | PCM | Present Gear | Neutral | |
| ☐ | PCM | Target Gear TCC State | TCC Rel... | |
| ☐ | PCM | ST Knock Retard | 0.0 | degr... |
| ☐ | PCM | Spark Advance | 3.5 | Engin... |
| ☑ | PCM | TPS 1 Volts | 0.6222 | Volts |
| ☐ | PCM | TPS 2 Volts | 4.3713 | Volts |
| ☐ | PCM | Target Idle Speed | 648 | rpm |
| ☐ | PCM | Throttle Blade Position | 2 | % |
| ☐ | PCM | Torque Converter Slip | 20 | rpm |
| ☐ | PCM | Trans Engine Speed | 660 | rpm |
| ☐ | PCM | Unlock Engine Position | 0.0 | Engin... |
| ☐ | PCM | Unlock RPM | 0 | rpm |
| ☐ | PCM | Vehicle Speed | 0.0 | MPH |

Select All | Deselect All

**Event Recording**

Template Name : avanger 2008 1

Total Recording Time : 60

Recording File Comment : 9-16-09

**Vehicle Information**

VIN : 1B3LC56R98N671075

Year / Body : 2007/JS

Engine : 2.7L

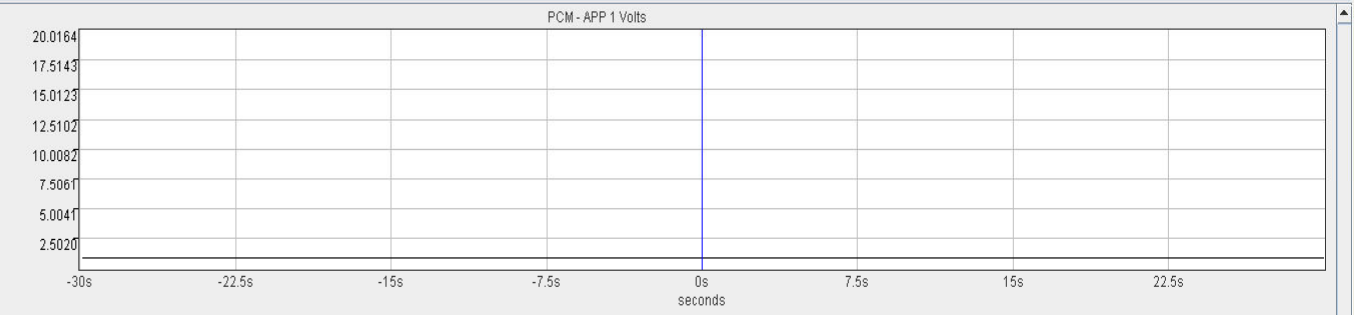
**Control Panel**

< Nudge | Time : 000.000 | Nudge >

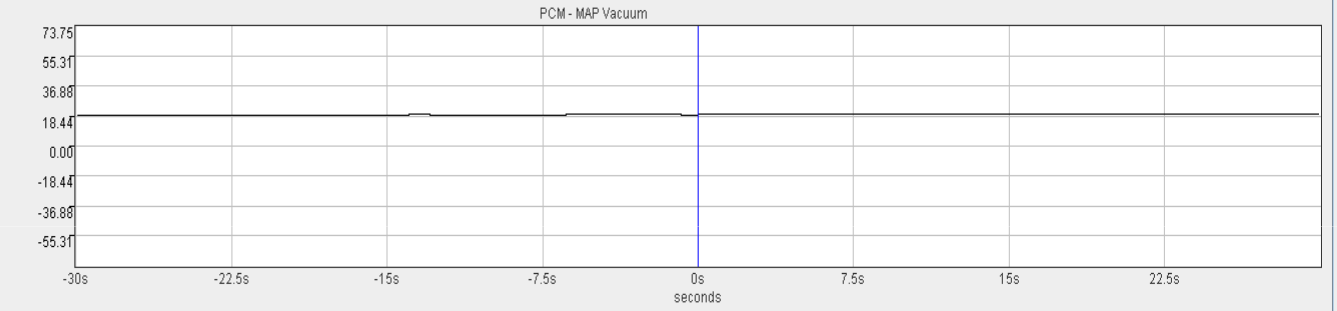
-30 ——— 30

Zoom In | Zoom Out | GoTo Trigger

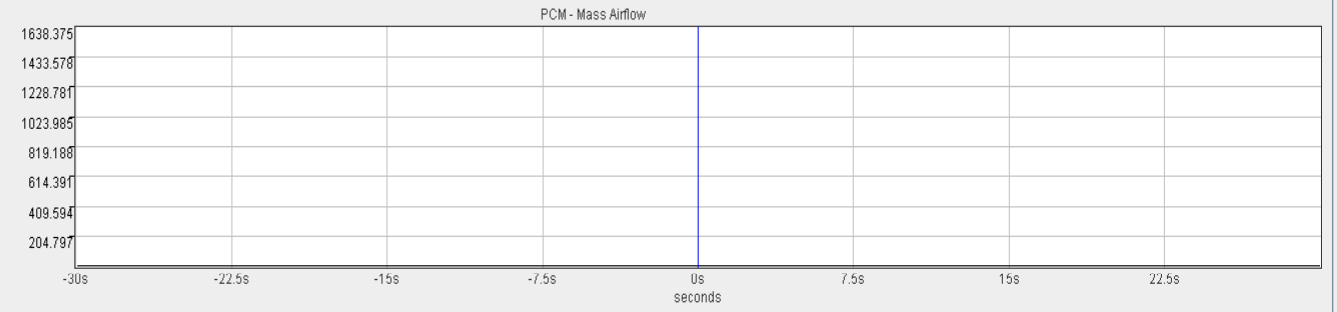
Fit



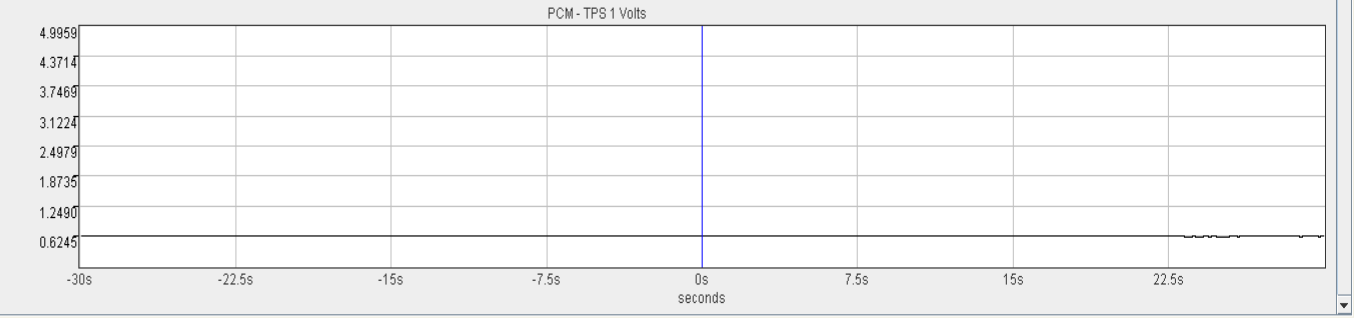

Fit




Fit




Fit

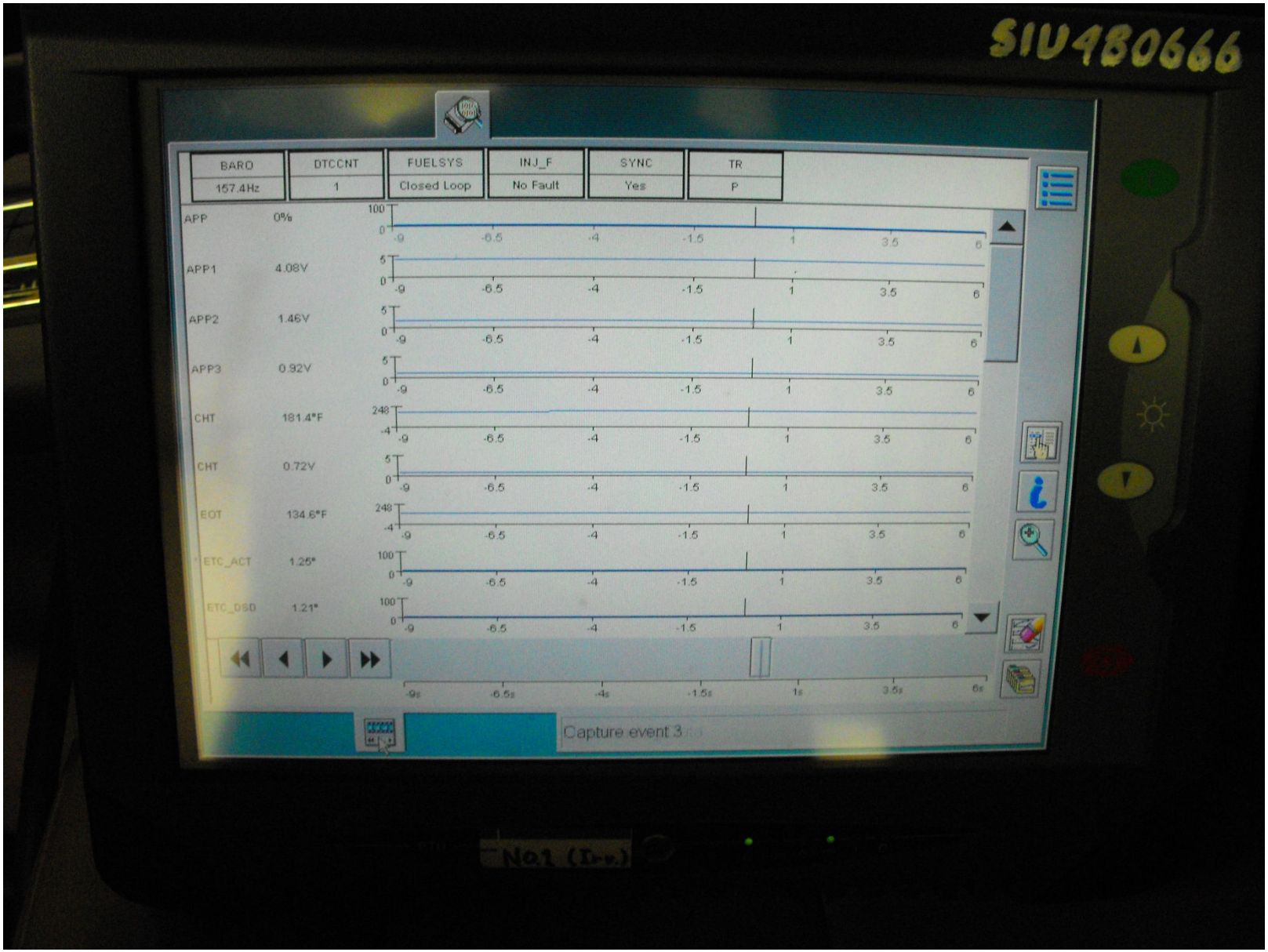


# Scan Tools Used

Ford **WDS**

**W**orld **D**iagnostic **S**ystem

Movie function used


SIU480666
BARO
157.4Hz
DTCCNT
1
FUELSYS
Closed Loop
INJ_F
No Fault
SYNC
Yes
TR
P
APP 0%
APP1 4.08V
APP2 1.46V
APP3 0.92V
CHT 181.4°F
CHT 0.72V
EOT 134.6°F
ETC_ACT 1.25°
ETC_DSD 1.21°
Capture event 3
No.1 (I-p.)

# Key values: airflow

**BARO**: Should be steady across operating conditions and vehicle to vehicle. Altitude most important variable. Watch units!

**MAP**: Critical indicator of engine health and breathing. Watch units!

**MAF**: Health and breathing indicator. Very important for pulsewidth. Watch units!

# Key values: control

**APPS**: 1,2,3? Slopes? What is operator input?

**TPS**: 1,2? Different slopes?

**Electronic throttle%:** There is no IAC, PCM moves to maintain target idle and prevent stalling during deceleration. On some vehicles may have to observe TP values to establish.

# Key values: feedback & corrective

**Upstream oxygen sensors**: Dance with the PCM (though A/F sensors should not)

**Downstream sensors**: Smooth sailing with little O2

**Short Term**: Response to upstream sensors

**Long Term**: Response over time to short term

# Vehicle Conditions Tested

**Cranking**

**Idle**

**Light Cruise**

**W.O.T.** wide open throttle

**Deceleration**

# Data by condition:

Allows vehicle to vehicle comparison

# Cranking

**Variable control: all vehicles**

Engine at/near operating temperature

Battery at/near full charge

Clear, good weather days 65-75° F ambient

Known good vehicles

Disabled fuel injectors and/or ignition system and cranked 5-8 seconds

| ***Cranking:*** | **Eclipse** | **Verona** | **Lucerne** | **Avenger** | **F-150** |
|---|---|---|---|---|---|
| **BARO** | 29.23” Hg | 100 kPa | 101 kPa | 29.50” Hg | 157.4 Hz |
| **MAP** | 26.9-28.2” Hg | 97 kPa | 98 kPa | .5” Hg vacuum | N/A |
| **MAF** | 2.3 g/s | 0 displayed | 4.9 g/s 2896 Hz | 4 g/s * | 5 g/s; .68 v |
| **APPS** | .6445 v | N/A | 0% | #1: .855v<br>#2: .439v | #1: 4.07v<br>#2: 1.46 v<br>#3: .92v |
| **TPS** | 2.578 (sub) | TPS 1 .8v**<br>TPS 2 4.3 | 18% | TPS1 .943v<br>TPS2 4.04 v | TPS1 4.3v<br>TPS 2 .88v |
| **Elec. Throttle** | N/A | 15.6% | N/A | 9% | 6.5˚ |
| **1/1 O2** | .02 v | 415 mV | 456 mV | 3.16 | .04 v |
| **2/1 O2** | .04 v | 415 mV | N/A | 3.12 | .03 v |
| **1/2 O2** | .840 v | 415 mV | 456 mV | 4.7 v | .9 v |
| **2/2 O2** | .720 v | 405 mV | N/A | 4.85 v | .91 v |
| **Short 1** | 0% (O/L) | 0% (O/L) | 0% (O/L) | 0% (O/L) | 0% (O/L) |
| **Short 2** | 0% (O/L) | 0% (O/L) | N/A | 0% (O/L) | 0% (O/L) |
| **Long 1** | -3.1% | +6.2% | 0% | +3.5% | 0% |
| **Long 2** | -3.1% | +5.4% | N/A | +1.6% | 0% |

# Cranking

**Observations**:

*Some* manifold vacuum and/or MAF

Oxygen sensor bias voltage differ between OEM

Open loop mode, RPM: 150-200

Electronic throttle has to open *some*

CKP/CMP, ECT, BARO, main cranking inputs

# Idle

**Variable control: all vehicles**

Engine at/near operating temperature

Transmission in park

A/C and other loads off

Clear, good weather days 65-75° F

Known good vehicles and fresh fuel

| ***IDLE:*** | **Eclipse** | **Verona** | **Lucerne** | **Avenger** | **F-150** |
|---|---|---|---|---|---|
| **BARO** | 29.23”Hg | 100 kPa | 101 kPa | 29.50”Hg | 157.4 Hz |
| **MAP** | 10.6”Hg absolute | 36 kPa | 33 kPa | 19.5”Hg vacuum | N/A |
| **MAF** | 5.4 g/s | 3.67 g/s | 5.1 g/s<br>2935 Hz | 3.6 g/s | 5 g/s<br>.72 v |
| **APPS** | 644.5 mV | N/A | 0% | .865 v<br>.445 v | 4.07 v<br>1.46 v<br>.92 v |
| **TPS** | 2.59 v | 12.5% | 18% | .61 v<br>4.38 v | 4.14 v<br>1.19 v |
| **Elec. Throttle** | N/A | N/A | N/A | 2% | 1.18° |
| **1/1 O2** | .1-.86 v | .1-.8 v | 65-751 mV | 2.59-3.37 v | .07-.69 v |
| **2/1 O2** | .1-.86 v | .09-.8 v | N/A | 2.58-3.38 v | .05-.71 v |
| **1/2 O2** | .67 v | .72 v | 729-738 mV | 3.27 v | .64 v |
| **2/2 O2** | .7 v | .715 v | N/A | 3.26 v | .65 v |
| **Short 1** | +.8 to + 2.3% | +/- 1% | +/-2% | -3 to -9% | -1 to -5% |
| **Short 2** | +.4 to +1.9% | +/- 1% | N/A | -8 to -12% | -2 to -6% |
| **Long 1** | -4.7% | +6.2% | -10% | +3.5% | +7.81% |
| **Long 2** | -3.9% | +5.4% | N/A | +1.6% | +8.98% |

# Idle

**Observations**:

Smooth, strong vacuum

Airflow inhalation 1+g/s per litre displacement

APPS 0%, electronic throttle acting to maintain target RPM (along with spark)

Upstream sensors dancing with the PCM

Downstream sensors steady on the high side

Fuel trims light corrective

# Cruise

**Variable control: all vehicles**

Driving on our campus roads at a steady speed

Accessories off

Road grade nearly flat

Engine at/near operating temperature

Known good vehicle/fresh fuel

| ***Cruise:*** | **Eclipse** | **Verona** | **Lucerne** | **Avenger** | **F-150** |
|---|---|---|---|---|---|
| **BARO** | 29.23” Hg | 100 kPa | 99 kPa | 29.38” Hg | 157.4 Hz |
| **MAP** | 11-16”Hg absolute | 22-44 kPa | 48 kPa | 14-16” Hg vacuum | N/A |
| **MAF** | 14-22 g/s | 14-20 g/s | 14.7 g/s; 4246 Hz | 16-19 g/s* | 24 g/s |
| **APPS** | 1.269 v | N/A | 9% | 1.4 v<br>.72 v | 4.08 v<br>1.46 v<br>.92 v |
| **TPS** | 2.89 v | 16-20% | 15% | .86-.89 v<br>4.2-4.3 v | 4.14 v<br>1.19 v |
| **Elec. Throttle** | N/A | N/A | N/A | 4-6% | 6.5° |
| **1/1 O2** | .6-.84 v | .1-.8 v | 95-703 mV | 2.6-3.3 v | .07-.72 v |
| **2/1 O2** | .08-.86 v | .1-.8 v | N/A | 2.6-3.2 v | .1-.79 v |
| **1/2 O2** | .4-.8 v | .745 v | 734 mV | 3.2 v | .79 v |
| **2/2 O2** | .4-.78 v | .75 v | N/A | 3.2 v | .79 v |
| **Short 1** | +2.7% | +/-2% | -3% | -1 to -8% | + 3.3% |
| **Short 2** | +3.9% | +/- 2% | N/A | -5 to -12% | +3.3% |
| **Long 1** | +1.9% | +3.5% | +1% | +1 to +3% | +6.64% |
| **Long 2** | +4.3% | +2.3% | N/A | +1 to +2% | + 6.64% |

# Cruise

**Observations**:

MAP/MAF very sensitive to throttle opening and road grade and road quality

Light throttle output follows light APPS input

Upstream O2's dance with the PCM

Downstream sensors smooth sailing

Trims light corrective

Purge, EGR, PCV flowing, monitors may be running

# Wide Open Throttle W.O.T.

**Variable control: all vehicles**

Driving on our campus roads

Accelerator all the way to floor

Engine 4,000-6,000 RPM; 1st or 2nd gear

Accessories off

Road grade nearly flat

Engine at/near operating temp.

Known good vehicle/fresh fuel

| ***W.O.T.*** | **Eclipse** | **Verona** | **Lucerne** | **Avenger** | **F-150** |
|---|---|---|---|---|---|
| **BARO** | 29.23” Hg | 100 kPa | 101 kPa | 29.2”Hg | 157.7 Hz |
| **MAP** | 29.2” Hg | 98 kPa | 97 kPa | .4-.9” Hg vacuum | N/A |
| **MAF** | 207 .2 g/s | 103 g/s | 160 g/s<br>9060 Hz | 183 g/s* | 201 g/s<br>4.01 v |
| **APPS** | 4.511 v | N/A | 100% | 4.5 v<br>2.24 v | .91 v<br>3.87 v<br>3.31 v |
| **TPS** | 4.628 v | 86 % | 100% | 4.33 v<br>.696 v | 1.17<br>4.48 |
| **Elec. Throttle** | N/A | N/A | N/A | 76% | 82.95° |
| **1/1 O2** | .940 v | .90 v | 924 mV | 3.40 v | .84 v |
| **2/1 O2** | .920 v | .90 v | N/A | 3.40 v | .85 v |
| **1/2 O2** | .900 v | .88 v | 890 mV | 3.30 v | .85 v |
| **2/2 O2** | .900 v | .88 v | N/A | 3.30 v | .85 v |
| **Short 1** | 0% (O/L) | 0% (O/L) | 0% (O/L) | 0% (O/L) | +16.61% |
| **Short 2** | 0% (O/L) | 0% ( O/L) | N/A | 0% (O/L) | +16.61% |
| **Long 1** | +1.9% | +3.1% | 0% | 0% | +10.16% |
| **Long 2** | +4.3% | +5.4% | N/A | 0% | +11.33% |

# Wide Open Throttle W.O.T.

**Observations**:

Manifold pressure near to BARO, BARO may update

MAF values high, varies with displacement etc.

Upstream and downstream oxygen sensors all high voltage, expected rich mixture

Open loop mode, most models ST moves to 0

# Deceleration

**Variable control: all vehicles**

Driving on our campus roads

Accelerator at full released position from about 40 MPH

**There is some RPM variation (Gearing etc.)**

Accessories off

Road grade nearly flat

Engine at/near operating temp.

| ***Decel.*** | **Eclipse** | **Verona** | **Lucerne** | **Avenger** | **F-150** |
|---|---|---|---|---|---|
| **BARO** | 29.23” Hg | 100 kPa | 101 kPa | 29.44”Hg | 157.7 Hz |
| **MAP** | 11-14” Hg absolute | 15-22 kPa | 21 kPa | 25” Hg vacuum | N/A |
| **MAF** | 13.2 g/s | 5.0 g/s | 9.85 g/s<br>3701 Hz | 10-13 g/s* | 18-24 g/s |
| **APPS** | 644.5 mV | N/A | 0% | .865 v<br>.439 v | 4.08 v<br>1.46 v<br>.92 v |
| **TPS** | 2.774 v | 13.3% | 8 % | .81-.69 v<br>4.2-4.3 v | 4.14 v<br>1.19 v |
| **Elec. Throttle** | N/A | N/A | N/A | 6-4% | 6.5° |
| **1/1 O2** | 0 v | 0 v | 100 mV | 2.50 v | 0 v |
| **2/1 O2** | 0 v | 0 v | N/A | 2.50 v | .005 v |
| **1/2 O2** | 0 v | 0 v | 868 mV | 2.50 v | 0 v |
| **2/2 O2** | 0 v | 0 v | N/A | 2.50 v | .005 v |
| **Short 1** | 0% (O/L) | 0% (O/L) | 0% then -7% | 0% (O/L) | -4.49% |
| **Short 2** | 0% (O/L) | 0% (O/L) | N/A | 0% (O/L) | -4.49% |
| **Long 1** | -4.3% | +3.31% | 0 to -3% | 0% to - 6.2% | +4.68% |
| **Long 2** | -1.9% | +5.4% | N/A | 0% to - 6.6% | +5.46% |

# Deceleration

**Observations**:

High vacuum/ low absolute manifold pressure,

Fairly low but still significant MAF values

Electronic throttle acts as dashpot and does not abruptly close

Systems typically exhibit **fuel cut**, open loop

Oxygen sensors read low voltage

# Data by vehicle:

Allows value comparison between conditions

| Eclipse | Crank | Idle | Light cruise | Decel | WOT |
|---|---|---|---|---|---|
| BARO | 29.23”Hg | 29.23”Hg | 29.23”Hg | 29.23” Hg | 29.23” Hg |
| MAP | 26.9-28.2”Hg | 10.6”Hg absolute | 11-16”Hg abs | 11-14” Hg absolute | 29.2” Hg |
| MAF | 2.3 g/s | 5.4 g/s | 14-22 g/s | 13.2 g/s | 207.2 g/s |
| APPS | .6445 mV | 644.5 mV | 1.269 v | 644.5 mV | 4.511 v |
| TPS | 2.578 (sub) | 2.597 v | 2.890 v | 2.774 v | 4.628 v |
| Elec. Throttle | N/A | N/A | N/A | N/A | N/A |
| 1/1 O2 | .02 | .1-.86 v | .6-.84 v | 0 v | .940 v |
| 2/1 O2 | .04 | .1-.86 v | .08-.86 v | 0 v | .920 v |
| 1/2 O2 | .840v | .67 v | .4-.8 v | 0 v | .900 v |
| 2/2 O2 | .720v | .7 v | .4-.78 v | 0 v | .900 v |
| Short 1 | 0% (O/L) | +.8 to + 2.3% | +2.7% | 0% (O/L) | 0% (O/L) |
| Short 2 | 0% (O/L) | +.4 to +1.9% | +3.9% | 0% (O/L) | 0% (O/L) |
| Long 1 | -3.1% | -4.7% | +1.9% | -4.3% | +1.9% |
| Long 2 | -3.1% | -3.9% | +4.3% | -1.9% | +4.3% |

| ***Verona*** | **Crank** | **Idle** | **Light cruise** | **Decel** | **WOT** |
|---|---|---|---|---|---|
| **BARO** | 100 kPa | 100 kPa | 100 kPa | 100 kPa | 100 kPa |
| **MAP** | 97 kPa | 36 kPa | 22-44 kPa | 15-22 kPa | 98 kPa |
| **MAF** | 0 displayed | 3.67 g/s | 14-20 g/s | 5.0 g/s | 103 g/s |
| **APPS** | N/A | N/A | N/A | N/A | N/A |
| **TPS** | TPS 1 .8v**<br>TPS 2 4.3 | 12.5% | 16-20% | 13.3% | 86 % |
| **Elec. Throttle** | 15.6% | N/A | N/A | N/A | N/A |
| **1/1 O2** | 415 mV | .1-.8 v | .1-.8 v | 0 v | .90 v |
| **2/1 O2** | 415 mV | .09-.8 v | .1-.8 v | 0 v | .90 v |
| **1/2 O2** | 415 mV | .72 v | .745 v | 0 v | .88 v |
| **2/2 O2** | 405 mV | .715 v | .75 v | 0 v | .88 v |
| **Short 1** | 0% (O/L) | +/- 1% | +/-2% | 0% (O/L) | 0% (O/L) |
| **Short 2** | 0% (O/L) | +/- 1% | +/- 2% | 0% (O/L) | 0% ( O/L) |
| **Long 1** | +6.2% | +6.2% | +3.5% | +3.31% | +3.31% |
| **Long 2** | +5.4% | +5.4% | +2.3% | +5.4% | +5.4% |

| ***Lucerne*** | **Crank** | **Idle** | **Light cruise** | **Decel** | **WOT** |
|---|---|---|---|---|---|
| **BARO** | 101 kPa | 101 kPa | 99 kPa | 101 kPa | 101 kPa |
| **MAP** | 98 kPa | 33 kPa | 48 kPa | 21 kPa | 97 kPa |
| **MAF** | 4.9 g/s<br>2896 Hz | 5.1 g/s<br>2935 Hz | 14.7 g/s<br>4246 Hz | 9.85 g/s<br>3701 Hz | 160 g/s<br>9060 Hz |
| **APPS** | 0% | 0% | 9% | 0% | 100% |
| **TPS** | 18% | 18% | 15% | 8 % | 100% |
| **Elec. Throttle** | N/A | N/A | N/A | N/A | N/A |
| **1/1 O2** | 46 mV | 65-751 mV | 95-703 mV | 100 mV | 924 mV |
| **2/1 O2** | N/A | N/A | N/A | N/A | N/A |
| **1/2 O2** | 456 mV | 729-738 mV | 734 mV | 868 mV | 890 mV |
| **2/2 O2** | N/A | N/A | N/A | N/A | N/A |
| **Short 1** | 0% (O/L) | +/-2% | -3% | 0% to -7% | 0% (O/L) |
| **Short 2** | N/A | N/A | N/A | N/A | N/A |
| **Long 1** | 0% | -10% | +1% | 0 to -3% | 0% |
| **Long 2** | N/A | N/A | N/A | N/A | N/A |

| ***Avenger*** | **Crank** | **Idle** | **Light cruise** | **Decel** | **WOT** |
|---|---|---|---|---|---|
| **BARO** | 29.50”Hg | 29.50”Hg | 29.38”Hg | 29.44”Hg | 29.2”Hg |
| **MAP** | .5” Hg vacuum | 19.5”Hg vacuum | 14-16” Hg vacuum | 25” Hg vacuum | .4-.9” Hg vacuum |
| **MAF** | 4 g/s * | 3.6 g/s* | 16-19 g/s* | 10-13 g/s* | 183 g/s* |
| **APPS** | #1: .865v<br>#2: .439v | .865 v<br>.439 v | 1.4 v<br>.72 v | .865 v<br>.439 v | 4.5 v<br>2.24 v |
| **TPS** | TPS1 .943v<br>TPS2 4.04 v | .61 v<br>4.38 v | .86-. 89 v<br>4.2- 4.3 v | .81- .69 v<br>4.2- 4.3 v | 4.33 v<br>.696 v |
| **Elec. Throttle** | 9% | 2% | 4 to 6% | 6 to 4% | 76% |
| **1/1 O2** | 3.16 | 2.59-3.37 v | 2.6-3.3 v | 2.50 v | 3.40 v |
| **2/1 O2** | 3.12 | 2.58-3.38 v | 2.6-3.2 v | 2.50 v | 3.40 v |
| **1/2 O2** | 4.7v | 3.27 v | 3.2 v | 2.50 v | 3.30 v |
| **2/2 O2** | 4.85v | 3.26 v | 3.2 v | 2.50 v | 3.30 v |
| **Short 1** | 0% (O/L) | -3 to -9% | -1 to -8% | 0% (O/L) | 0% (O/L) |
| Short 2 | 0% (O/L) | -8 to -12% | -5 to -12% | 0% (O/L) | 0% (O/L) |
| Long 1 | +3.5% | +3.5% | +1 to +3% | 0% to -.6.2% | 0% |
| Long 2 | +1.6% | +1.6% | +1 to +2% | 0% to – 6.6% | 0% |

| ***F-150*** | **Crank** | **Idle** | **Light cruise** | **Decel** | **WOT** |
|---|---|---|---|---|---|
| **BARO** | 157.4 Hz | 157.4 Hz | 157.4 Hz | 157.7 Hz | 157.7 Hz |
| **MAP** | N/A | N/A | N/A | N/A | N/A |
| **MAF** | 5 g/s; .68 v | 5 g/s<br>.72v | 27-32 g/s | 24 g/s | 201 g/s<br>4.01 v |
| **APPS** | #1: 4.07v<br>#2: 1.46 v<br>#3: .92v | 4.07 v<br>1.46 v<br>.92 v | 3.57 v<br>1.84 v<br>1.27 v | 4.08 v<br>1.46 v<br>.92 v | .91 v<br>3.87 v<br>3.31 v |
| **TPS** | TPS1 4.3v<br>TPS 2 .88v | 4.36 v<br>.77 v | 4.15 v<br>1.22 v | 4.14 v<br>1.19 v | 1.17 v<br>4.48 v |
| **Elec. Throttle** | 2.54° | 1.18° | 8.52° | 6.5° | 82.95° |
| **1/1 O2** | .04 | .07-.69v | .07-.72 v | 0 v | .84 v |
| **2/1 O2** | .03 | .05-.71 v | .1-.79 v | .005 v | .85 v |
| **1/2 O2** | .9v | .64 v | .79 v | 0 v | .85 v |
| **2/2 O2** | .91v | .65 v | .79 v | .005 v | .85 v |
| **Short 1** | 0% (O/L) | -1 to -5% | + 3.3% | -4.49% | +16.61% |
| **Short 2** | 0% (O/L) | -2 to -6% | +3.3% | -4.49% | +16.61% |
| **Long 1** | 0% | +7.81% | +6.64% | +6.25% | +10.16% |
| **Long 2** | 0% | +8.98% | + 6.64% | +5.85% | +11.33% |

# Potential Student Activity

Have students fill in charts as a laboratory learning activity

Test variables: cold vs. hot cranking, idle etc.

Modify with other PIDs: pulsewidth, IAC etc.

| Vehicle | Crank cold | Crank hot | Idle cold | Idle hot | Idle A/C on |
|---|---|---|---|---|---|
| BARO | | | | | |
| PW | | | | | |
| IAC | | | | | |
| ECT | | | | | |
| IAT | | | | | |
| MAP | | | | | |
| MAF | | | | | |
| 1/1 | | | | | |
| 1/2 | | | | | |
| ST 1 | | | | | |
| ST 2 | | | | | |
| LT 1 | | | | | |
| LT 2 | | | | | |

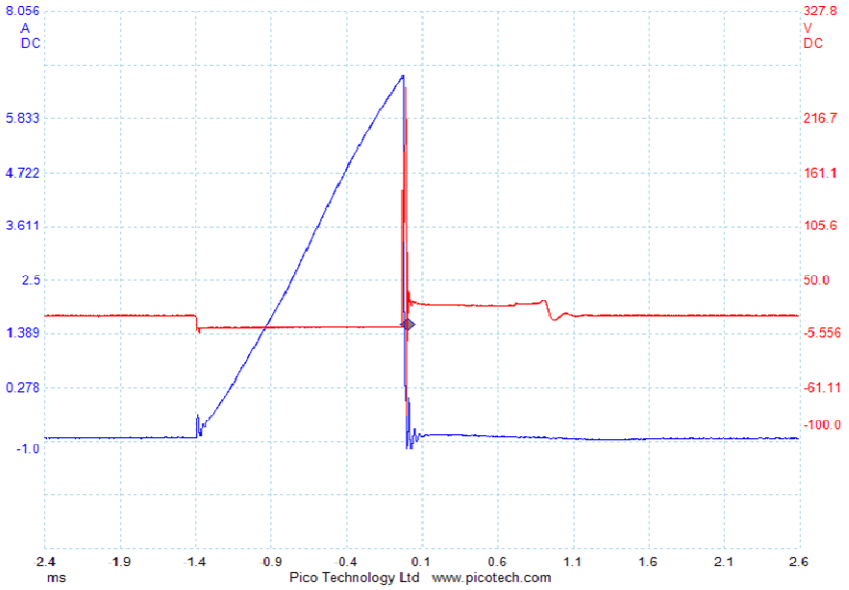
# Potential Student Activity

Collect data from different teams and have students average and chart the results

Collect other data such as 5 gas readings or lab scope readings and let student **make their own "normal" book**

"Normal" values

By
AUTO 340 class
Mr. D Fall 2009



# Potential Student Activity

For reinforcement, bug a vehicle and observe if students can detect the fault using indicators

| Charger R/T | Cranking |
|---|---|
| BARO | 100 kPa |
| MAP | 50 kPa |
| RPM | 200 |

Example **restricted throttle body**: simulates no start due to air cleaner box packed with nuts etc.

# Questions/ Comments

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Presentation available at:
http://opensiuc.lib.siu.edu/

Google: open SIU