SOMEONE FINALLY MEASURED IT

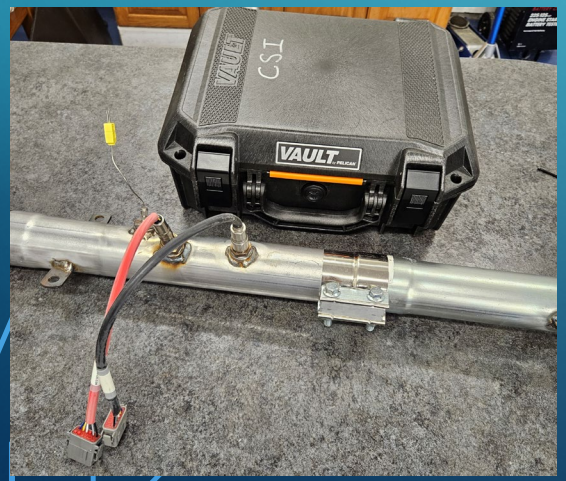
GREG BANISH

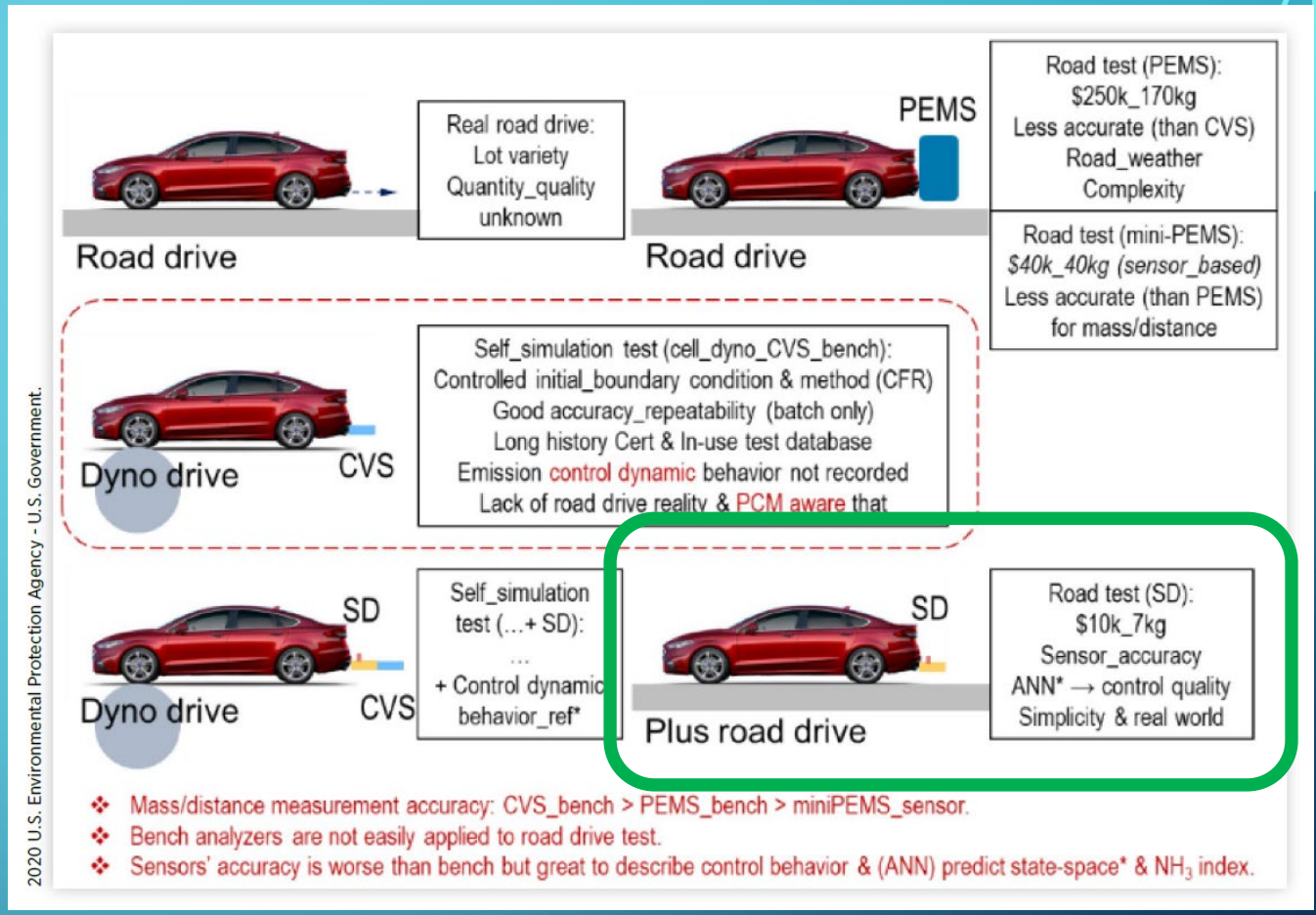
Calibrated Success
EFI Training - Tuning - Consulting

SOUNDS EASY AT FIRST

EPA Papers

- Signature Device Testing
- *2020-01-0372*
- *2018-01-0650*
- *2016-01-2324*

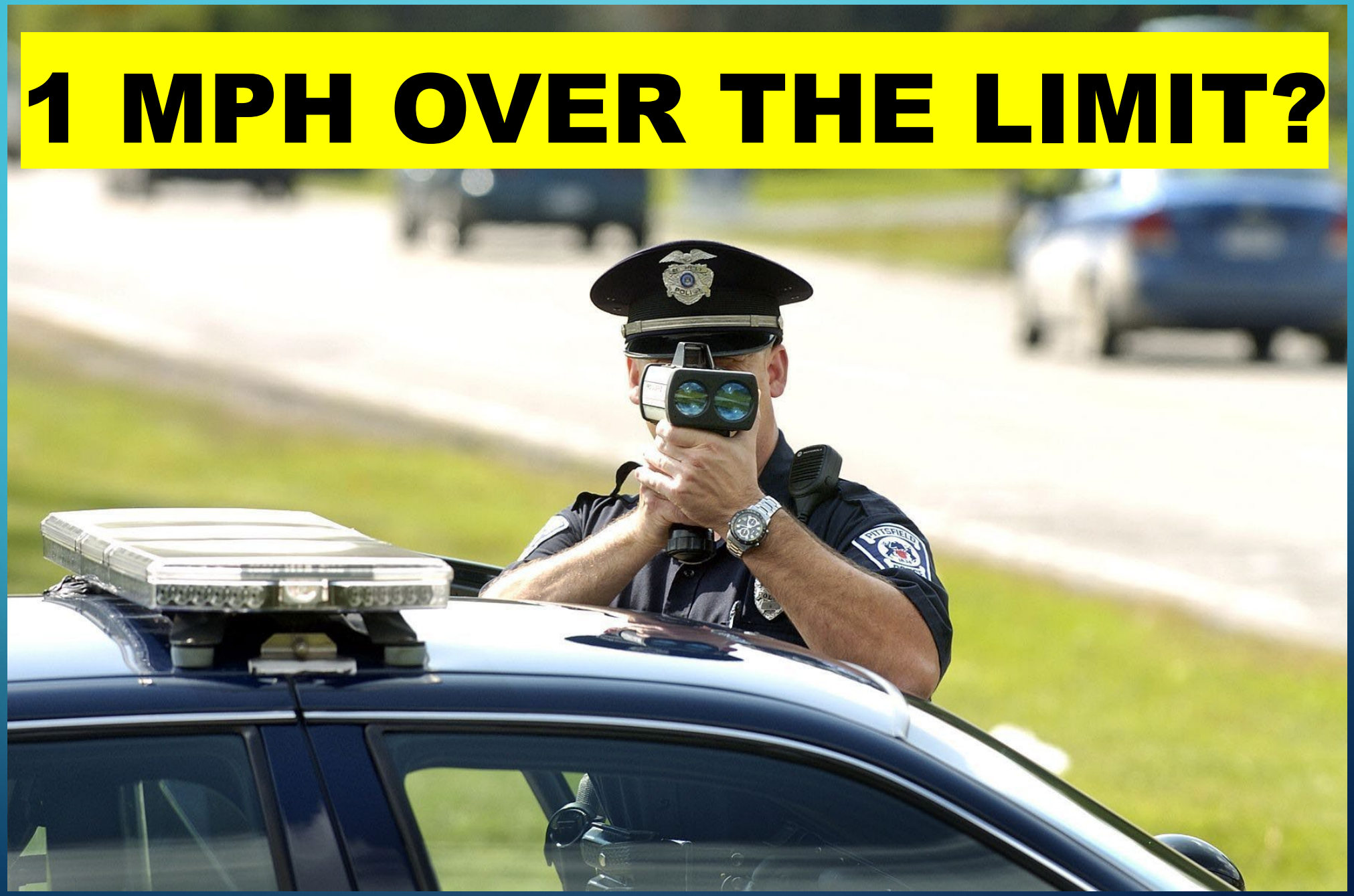




ECM "QBF"

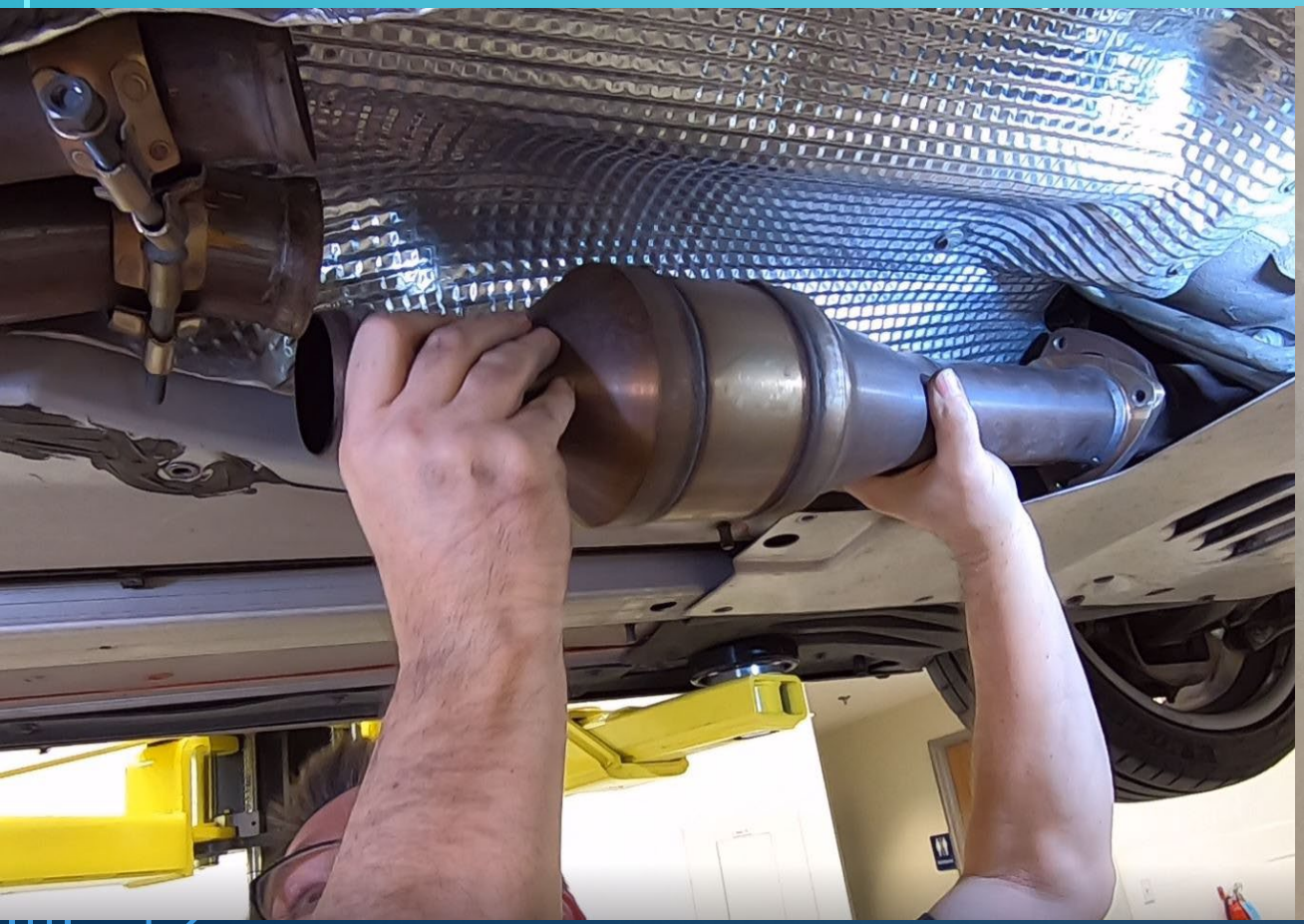
Sensors Inc. EOL Tester

1 MPH OVER THE LIMIT?



REALITY OF ENFORCEMENT NEEDS

DO WE NEED A 1066 LAB TO FIND THIS?



Emissions Report

Vehicle Description

Make	Chevrolet
Model	1500
Year	2022
VIN	
Mileage	11810
Note	SEMA Garage

Fuel Spec

Ethanol	9 %
Stoich	14.14 :1

Cert Bin

T3B50

Drive Cycle Score

102

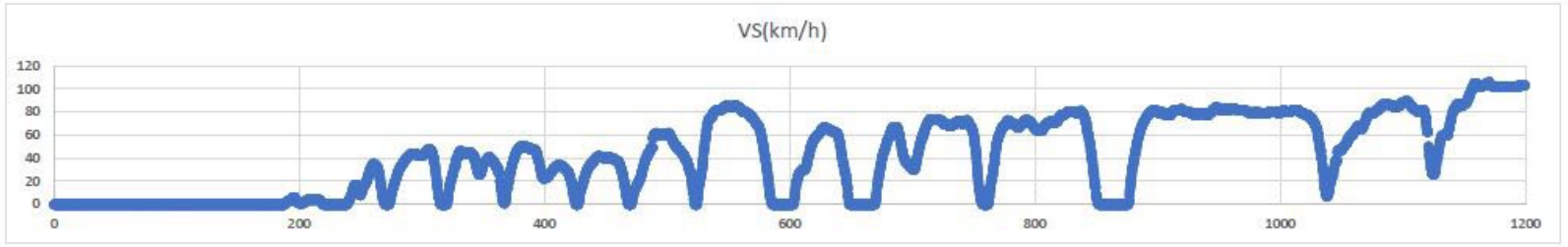
Weakest Element

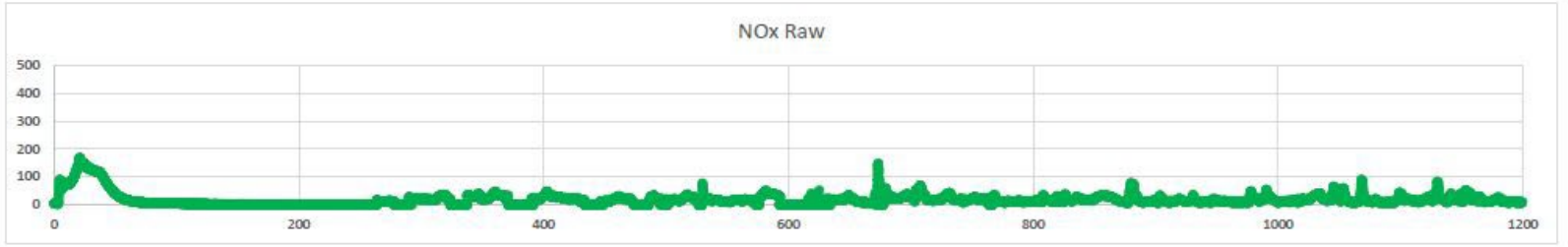
OBD Check

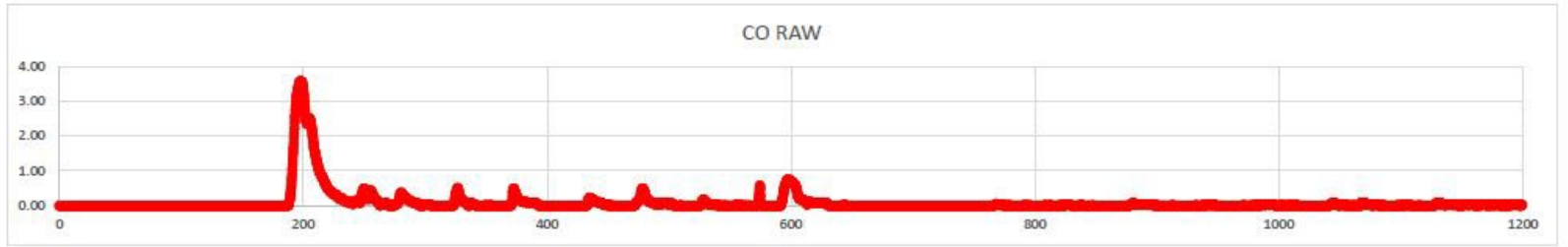
MIL OFF	
CCM	
Fuel Sys.	
O2	
Catalyst	
Misfire	
Evap	

Drive Cycle Validity

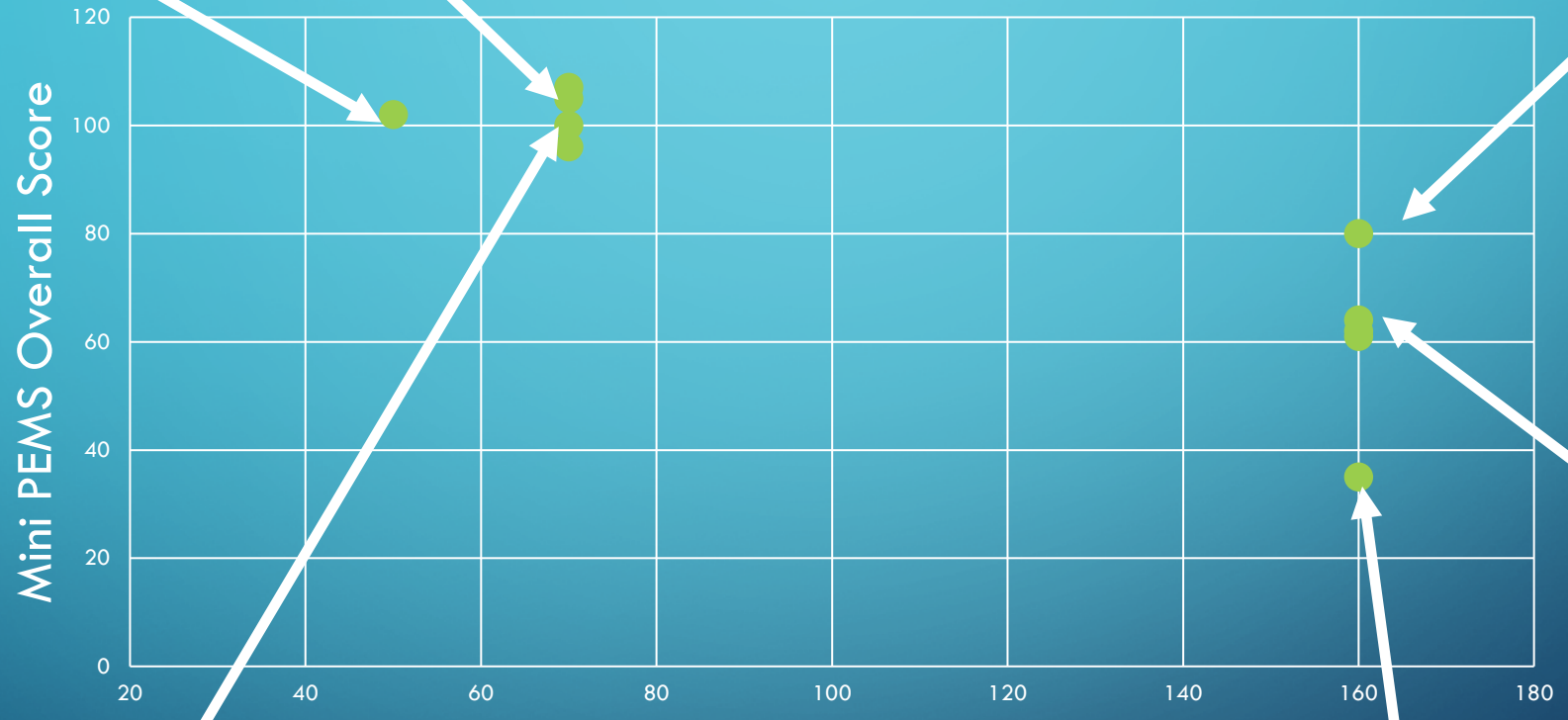
Cold Start	OK
Urban Distance	OK
Hwy Distance	OK
Stops	Fail



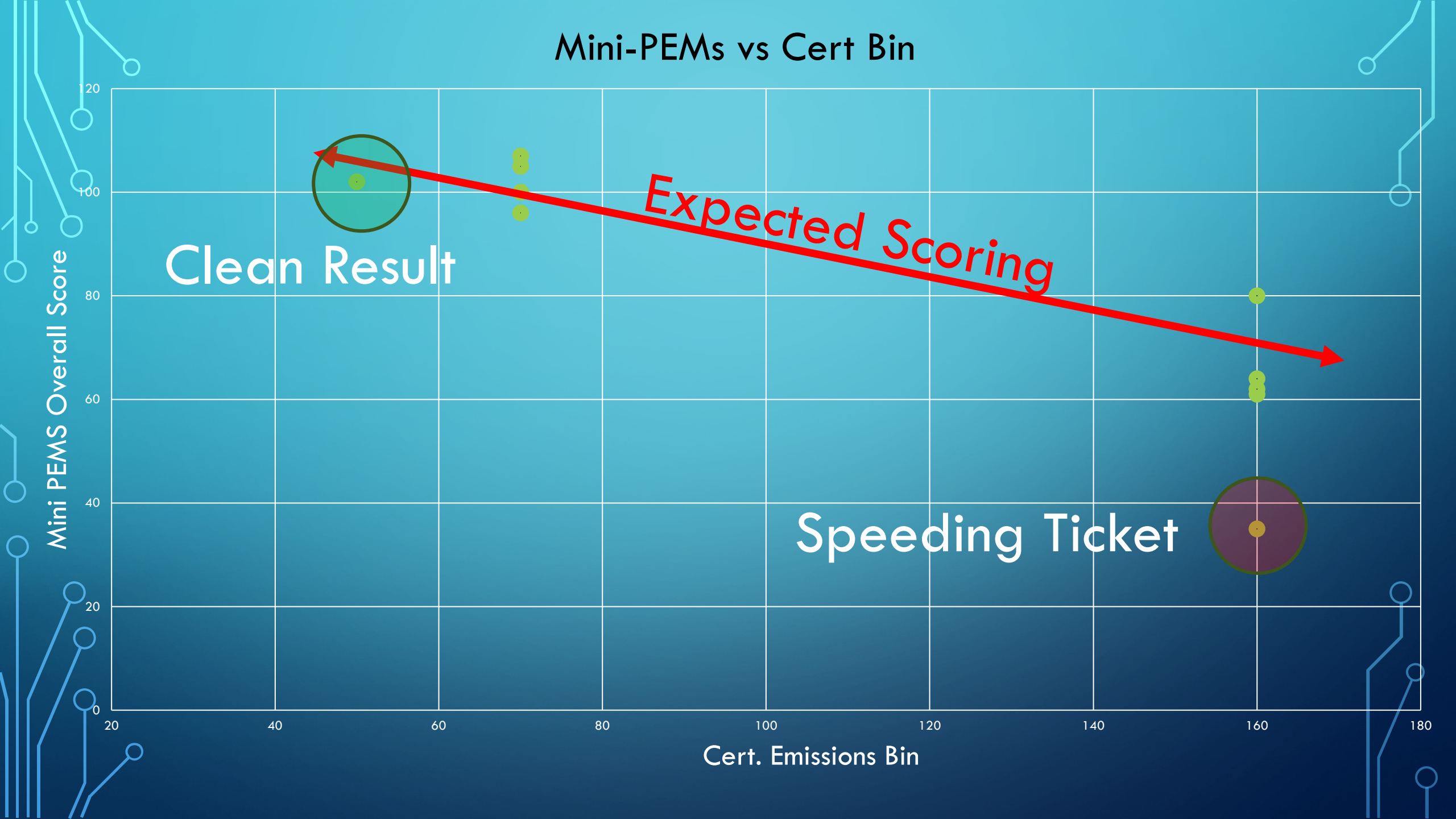




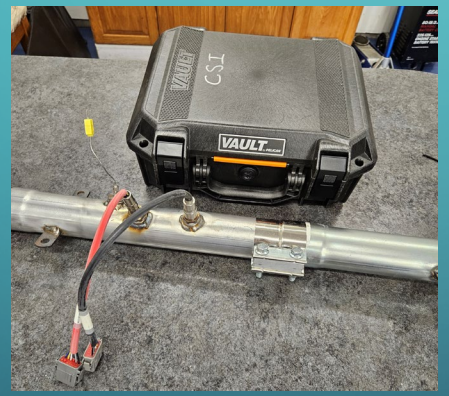
Mini-PEMs vs Cert Bin



Mini-PEMs vs Cert Bin



TIERED INSPECTION SCRUTINY



FORENSIC INVESTIGATION

File Edit Compare Flash Tools Window Help

Favorites | OS | Engine | Engine Diag | Trans | Trans Diag | Fuel Sys | System | Speedo

HPtuners

Comparison Log - Differences

- Temperature Control
  - Catalyst Protection
    - Catalyst Over-Temp Enable
  - Lean / Fuel-Saving
- Spark
  - Advance
  - Retard
- Torque Management
- Engine Diagnostics
  - Airflow
    - Throttle Position Sensor
      - P2101 Throttle Error Positive
      - P2101 Throttle Error Negative
    - Mass Airflow Sensor
      - P0101, P0106, P0121 Perf Test - Min ECT
      - P0101, P0106, P0121 Perf Test - Max ECT
    - Manifold Absolute Pressure Sensor
    - Airflow Correlation
  - Misfire
    - Cylinder Mode
      - Misfire Cylinder Mode Event Time - Idle
      - Misfire Cylinder Mode Event Time - Normal
  - DTCs
    - List
      - Master DTC List
- Transmission

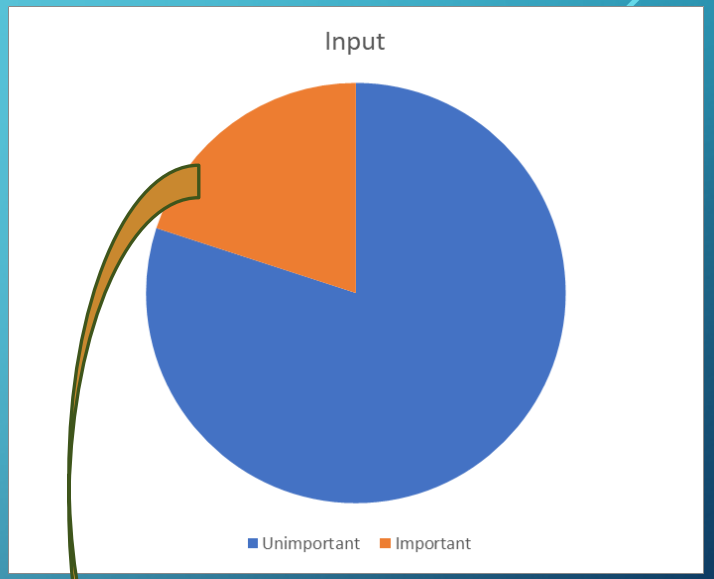
Engine Diagnostics

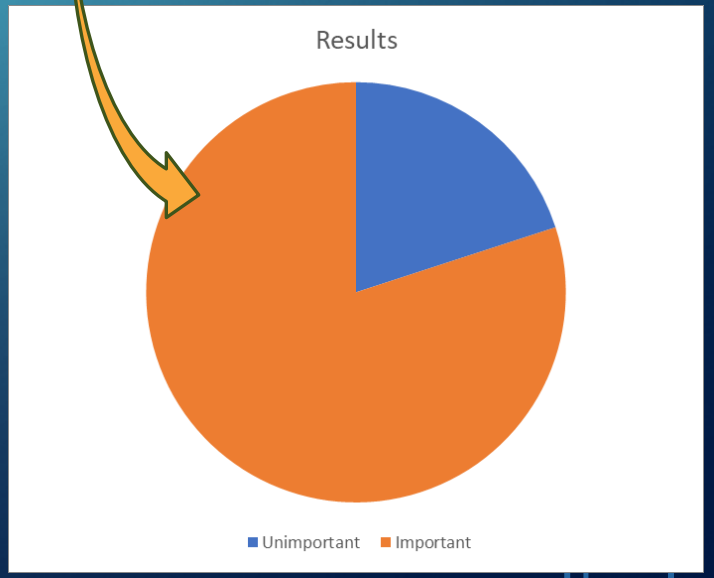
General | Airflow | Pressure | Misfire | DTCs

DTC	Description	SES Enable	Error Mode
P0137	O2 Circuit Low Voltage (Bank 1, Sensor 2)	☑	MIL on Second Error
P0138	O2 Circuit High Voltage (Bank 1, Sensor 2)	☑	MIL on Second Error
P013A	O2 Sensor Slow Response - Rich to Lean (Bank 1 and Sensor 2)	☐	No Error Reported
P013B	O2 Sensor Slow Response - Lean to Rich (Bank 1, Sensor 2)	☐	No Error Reported
P013C	O2 Sensor Slow Response - Rich to Lean (Bank 2, Sensor 2)	☐	No Error Reported
P013D	O2 Sensor Slow Response - Lean to Rich (Bank 2, Sensor 2)	☐	No Error Reported
P013E	O2 Sensor Delayed Response - Rich to Lean (Bank 1 Sensor 2)	☐	No Error Reported
P013F	O2 Sensor Delayed Response - Lean to Rich (Bank 1 Sensor 2)	☐	No Error Reported
P0141	O2 Heater Circuit (Bank 1, Sensor 2)	☐	No Error Reported
P014A	O2 Sensor Delayed Response - Rich to Lean (Bank 2 Sensor 2)	☐	No Error Reported
P014B	O2 Sensor Delayed Response - Lean to Rich (Bank 2 Sensor 2)	☑	MIL on Second Error
P0151	O2 Circuit Low Voltage (Bank 2, Sensor 1)	☑	MIL on Second Error
P0152	O2 Circuit High Voltage (Bank 2, Sensor 1)	☑	MIL on Second Error
P0153	O2 Circuit Slow Response (Bank 2, Sensor 1)	☐	No Error Reported
P0155	O2 Heater Circuit (Bank 2, Sensor 1)	☑	MIL on Second Error
P0157	O2 Circuit Low Voltage (Bank 2, Sensor 2)	☐	No Error Reported
P0158	O2 Circuit High Voltage (Bank 2, Sensor 2)	☐	No Error Reported
P015A	O2 Sensor Delayed Response - Rich to Lean (Bank 1 Sensor 1)	☐	No Error Reported
P015B	O2 Sensor Delayed Response - Lean to Rich (Bank 1 Sensor 1)	☐	No Error Reported
P015C	O2 Sensor Delayed Response - Rich to Lean (Bank 2 Sensor 1)	☐	No Error Reported
P015D	O2 Sensor Delayed Response - Lean to Rich (Bank 2 Sensor 1)	☐	No Error Reported
P0161	O2 Heater Circuit (Bank 2, Sensor 2)	☐	No Error Reported
P0171	System Too Lean (Bank 1)	☑	MIL on Second Error

[ECM] 50 - Master DTC List: Tampering with emissions control devices can be illegal. Please check your local laws as well as EPA rules and regulations for legal modification. Disabling emissions controls should be used on off road use only vehicles. It is illegal to modify diagnostic test results in order to pass emissions testing. FOR OFF ROAD USE ONLY!

LIMITED BUDGET$ DRIVE TE$T PLAN$



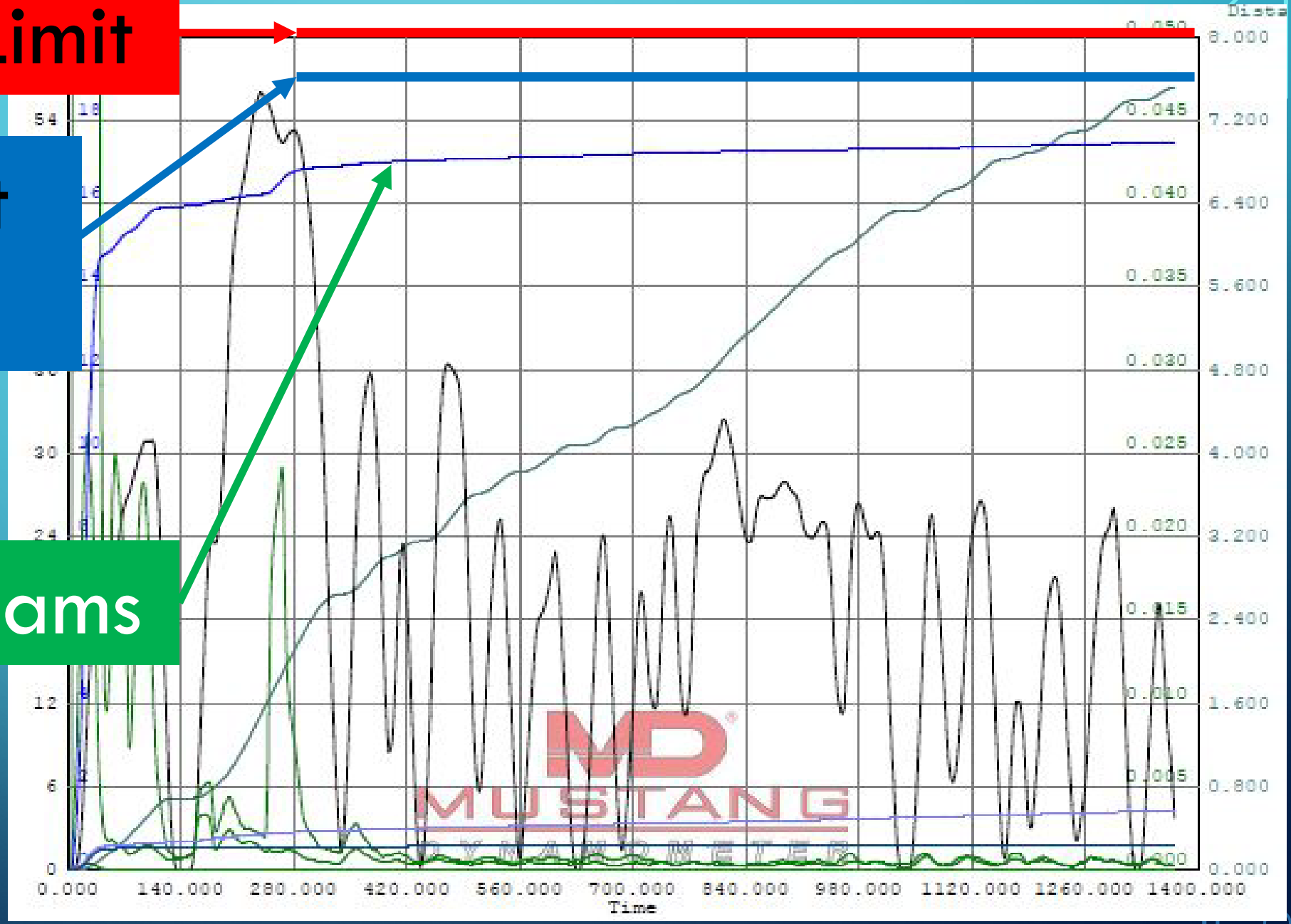


"What does CLEAN look like?"

Target Cert Limit

Measurement Uncertainty

Measured grams



CHALLENGES FOUND IN EARLY MINIPEMS TESTING

Testing Noise Factors Match Real World Usage

(Nobody actually drives the cycle!)

- Weather Changes
- Traffic
- Driving Habits
- Murphy's Law

CHALLENGES CONT'D…

Barriers to Access

- Cost
- Cost
- Cost

CHALLENGES CONT'D…

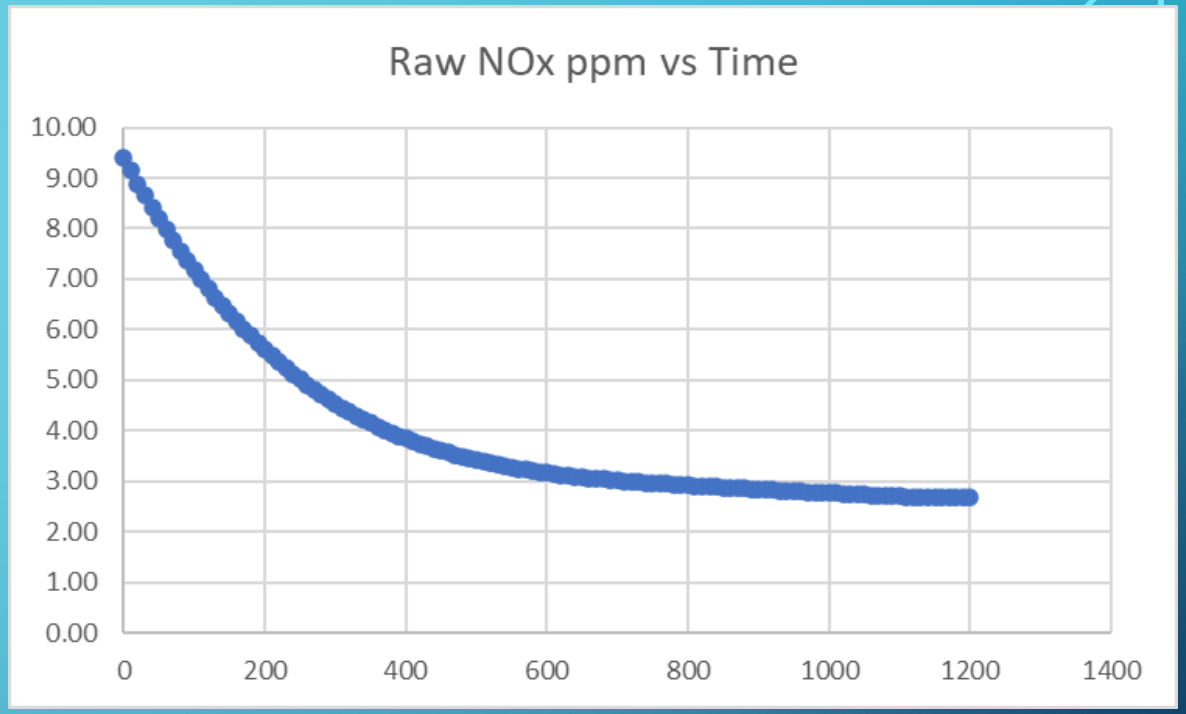
Random Fuel Quality

- Local Blends
- Summer/Winter Blend
- Ethanol Content
- Aging, loss of VOCs
- Formulation, H:C, O:C, Additives

CHALLENGES CONT'D…

Sensing Limits

- NOx Sensor Warmup Drift
- Ammonia vs NOx?



- Potentially Long Flight Path
  - Loss of Temperature
  - Continued Reactions Post-Cat
- Lambda Errors
  - Tailpipe vs Catalyst Out

CHALLENGES CONT'D…

Exhaust Leaks are Inevitable

- Weep Holes
- Open Exhaust Tips
- Joint Leaks
- Sample Tube Reversion

CHALLENGES CONT'D…

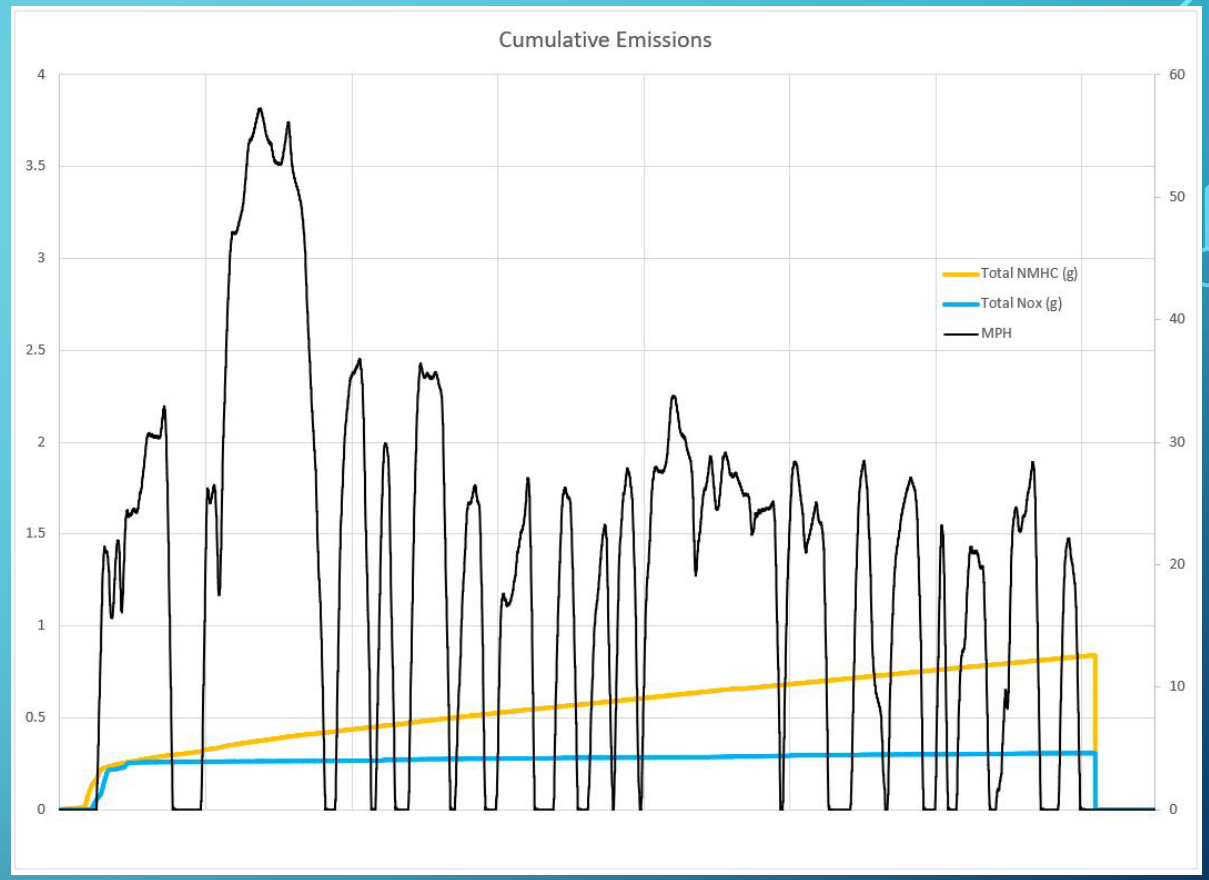
ECU Connectivity for Mode$01 data

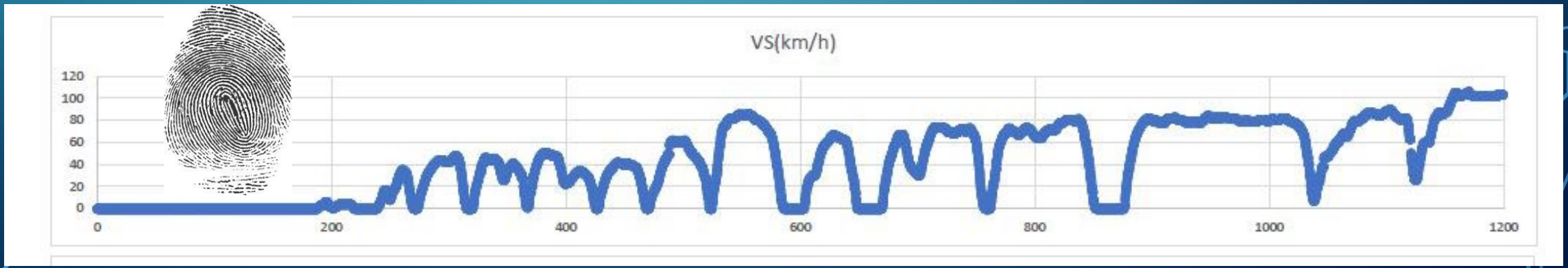
- CAN Channel vs Generic OBD
- Unique Channel IDs per OEM
  - Need to Connect Prior to Test
- Unavailable Channels
  - Narrow/Wideband O2
  - Missing Vehicle Speed PID

CHALLENGES CONT'D…

Test to the Cycle, Which One?

- Cold Start
- Urban Drive
- Extra-Urban Drive
- High Speed
- Idle
- Transients





EFILive

COBB

HONDATA

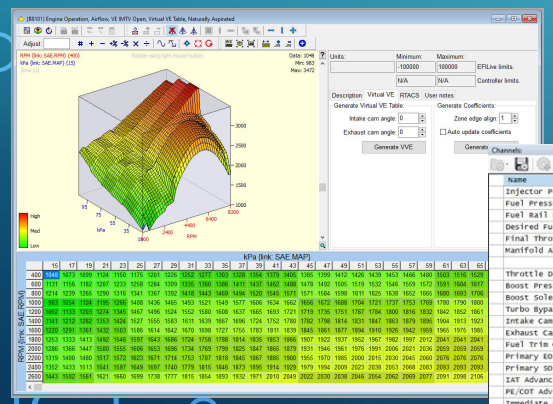
HPtuners

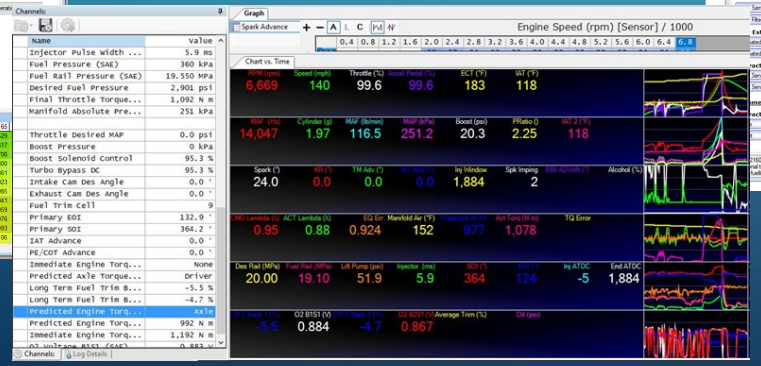
SCT

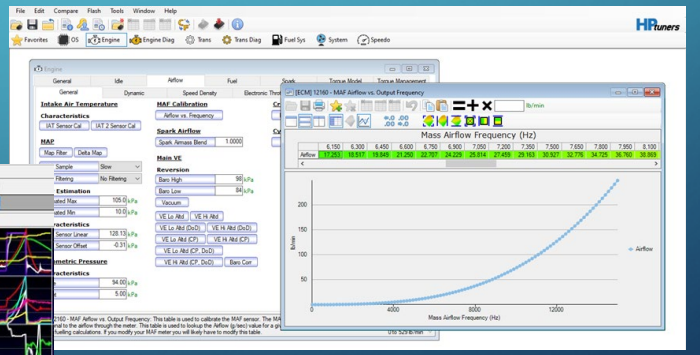
DIABLOSPORT

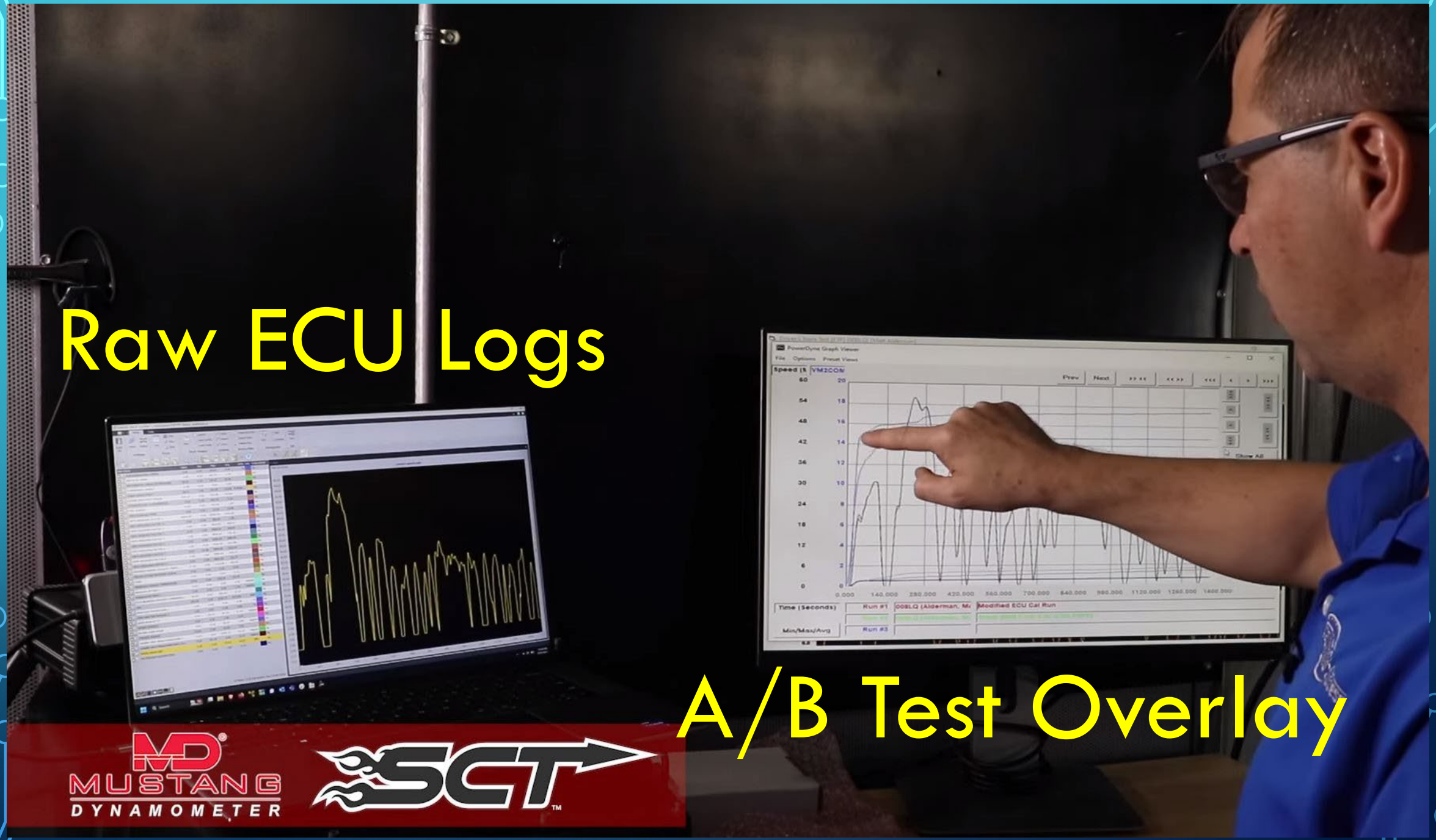
WinOLS 5
POWERED BY

DEADBEEF
FLASH








Raw ECU Logs
A/B Test Overlay
MUSTANG
DYNAMOMETER
SCT

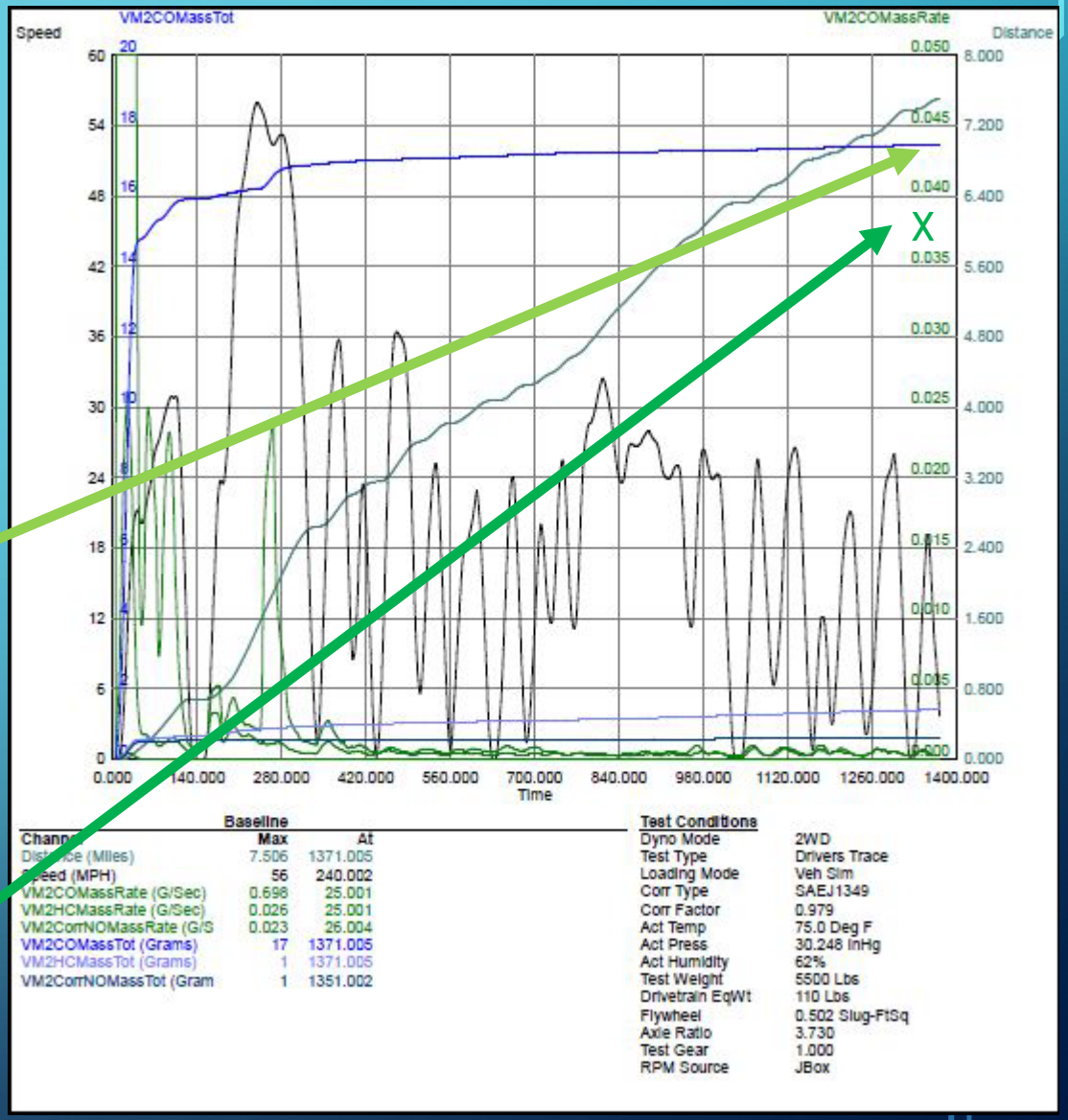
CASE STUDY – MODIFIED F150

2022 3.5L EcoBoost

- Aftermarket ECU Calibration
  - Increased Torque Limits, Max Boost Target
- 3WC Retained, Unmodified
- Larger PFI Injectors

Baseline

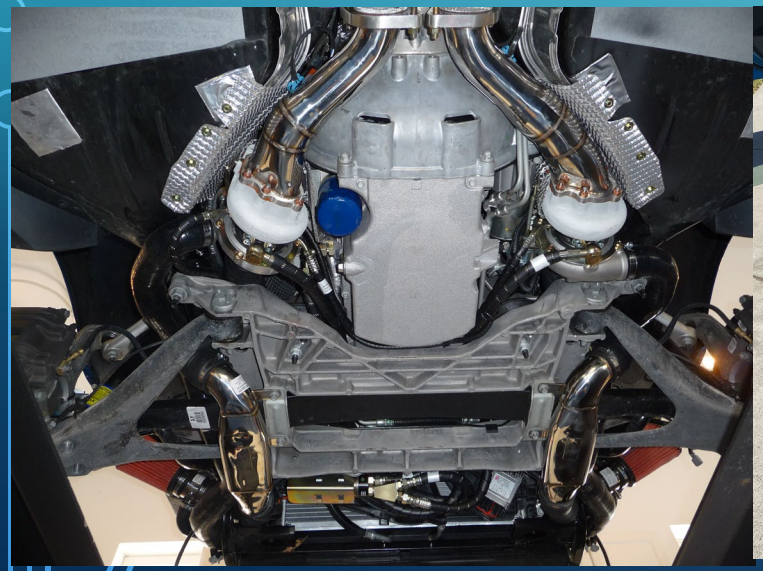
Final Test Result

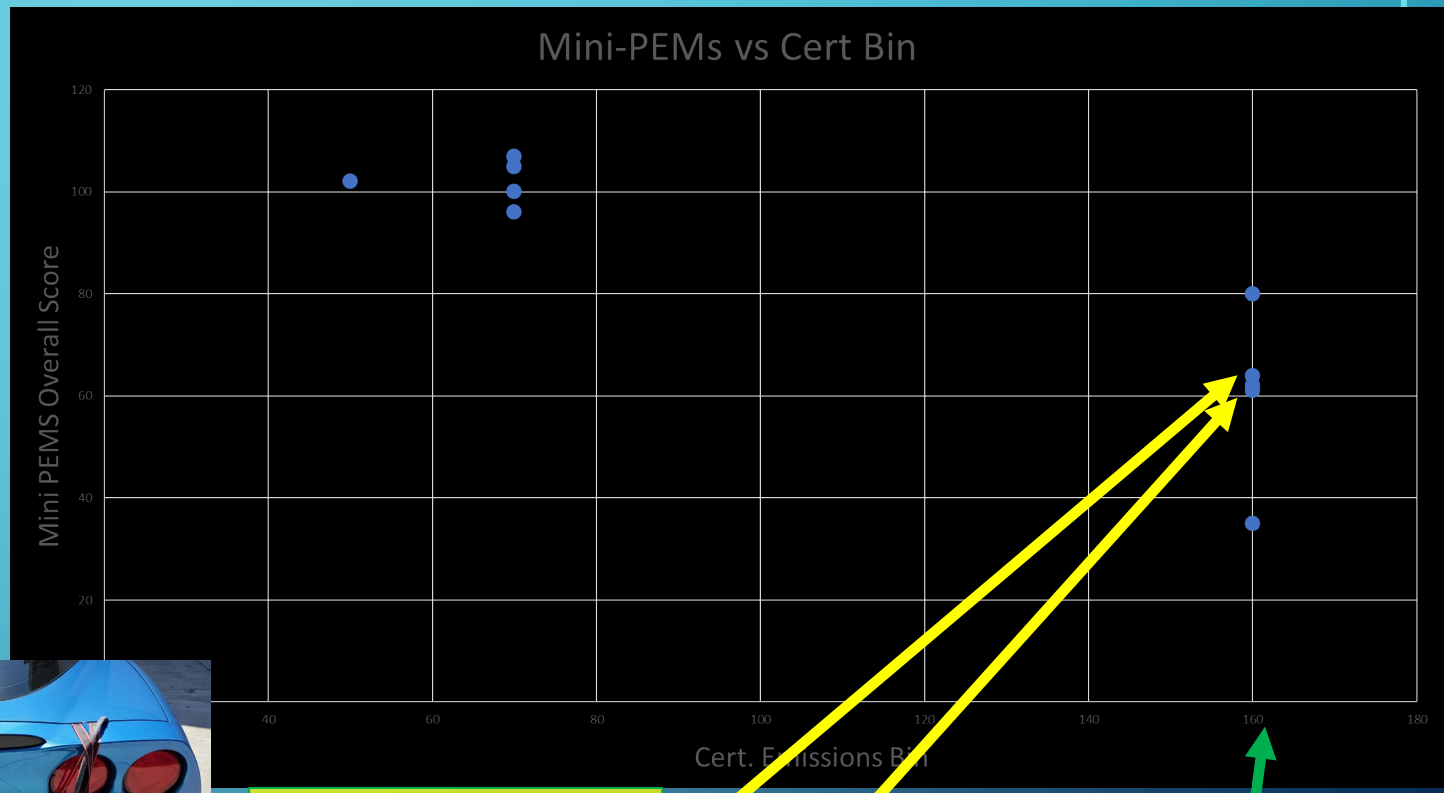


CASE STUDY – MODIFIED CORVETTE

2009 6.2L Manual Transmission

- Aftermarket Turbochargers
- 3WC Retained, Relocated
- Larger Cam, Ported Heads
- Flex Fuel
- ECU Recalibration





78% Eth

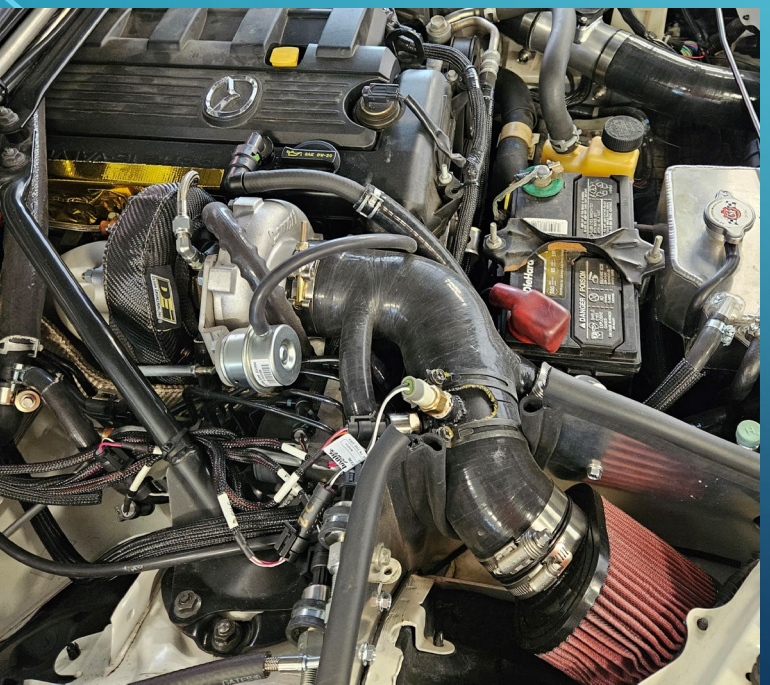
13% Eth

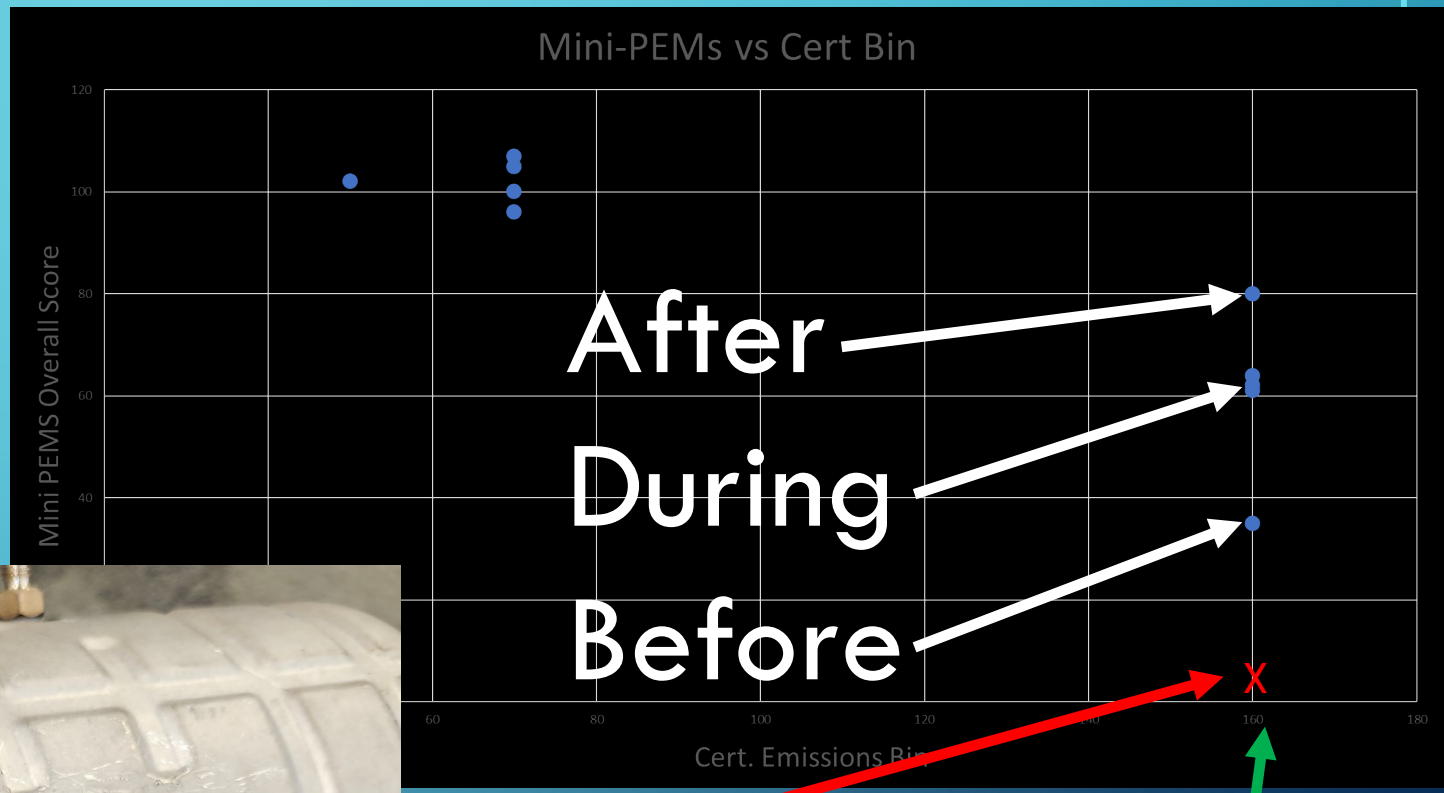
T2B5 Target

CASE STUDY – MODIFIED MIATA

2013 2.0L Manual Transmission

- Aftermarket Turbocharger
- 3WC Retained, Relocated
- Unmodified Long Block
- 91 Octane Fuel
- ECU Recalibration





T2B5 Target

Cheap Testing

PASS ON THE FIRST TEST

WHIPPLE Superchargers™

CARB EO# D-231-31

*The Whipple Supercharger kits listed below, if installed per Whipple's specifications, meets California and Federal emission requirements in all 50 states. California Air Resource Board Executive Order # **D-231-31.***

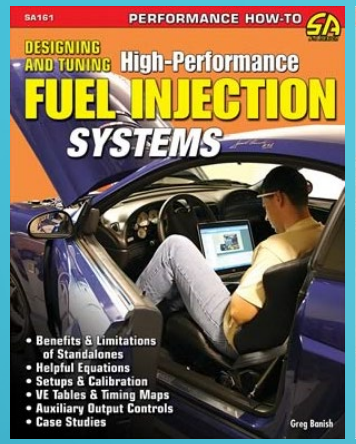
FORD KIT NUMBERS

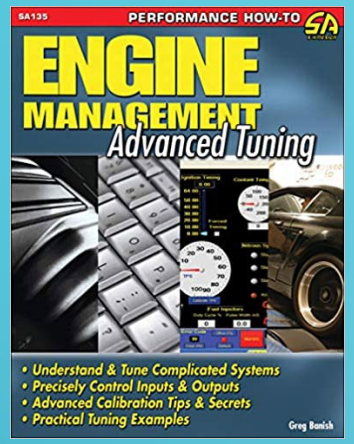
WIK-5.4L-4VGT WIK-5.4L-4VGT500

CUSTOM TUNING

Cheap Testing

CONTRIBUTIONS





POWER AND SPEED PODCAST

- On-site and Virtual Training
- Emissions/Performance Consulting