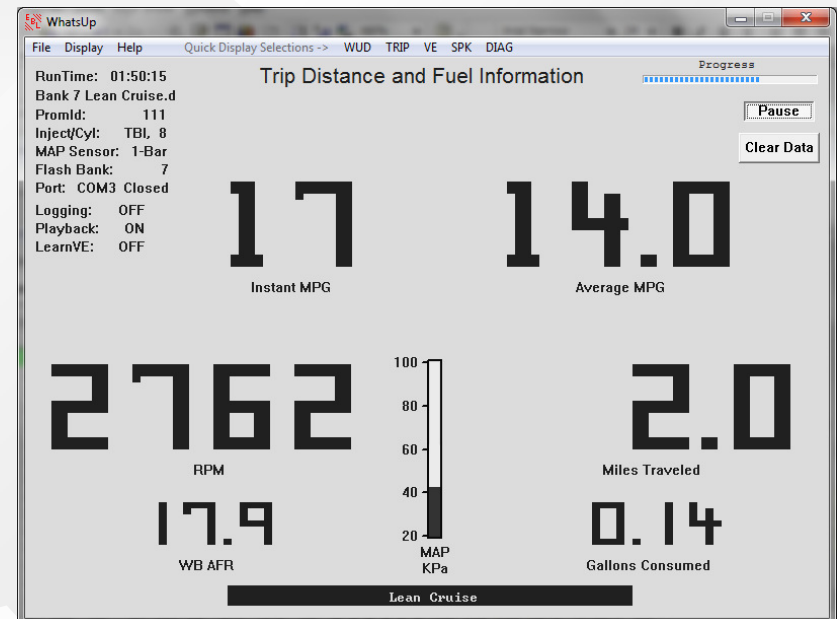
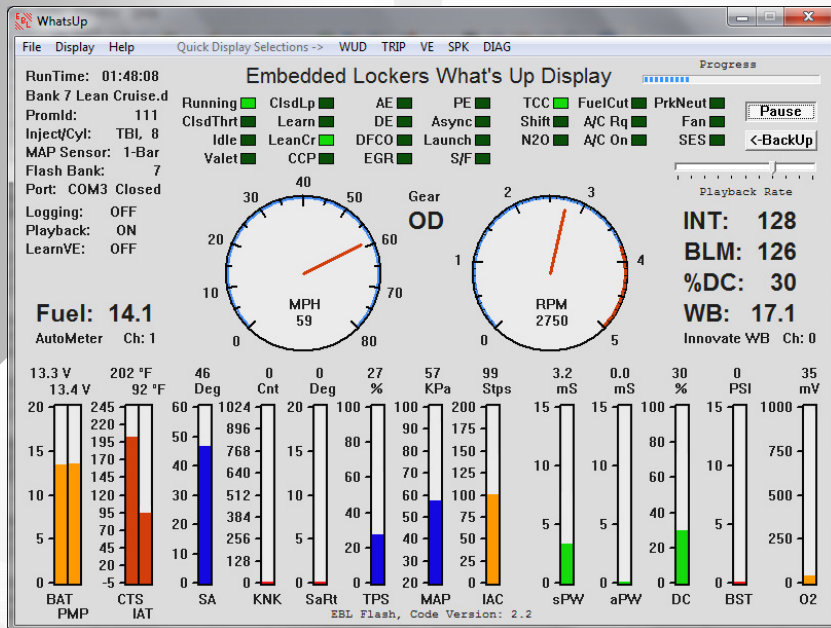




“What’s Up” with Electronic Fuel Injection



Discussion Leaders: George Beckman
Randy Van Winkle

Disclaimer: Seminar materials are contributed by GMCWS members and are published as a service to GMCWS members. Accuracy is not guaranteed. Independent verification is urged.

October 2, 2014

GMCWS Rally - Manteca

Introductions – Scooters to GMC Motorhomes





Shade Tree Guys





California CARB

- ★ No free lunch
- ★ Referee
- ★ Executive Order
- ★ Never Was EFI for 455
- ★ Howell- Jeep Only
- ★ Atomic-? Hope...



Today's Focus

- ★ Today's discussion will focus on EBL
- ★ Format will be primarily Q&A
- ★ Typical tuning scenario



Questions

October 2, 2014

GMCWS Rally - Manteca



Gas Engine Basics

- ✱ No free lunch
- ✱ What a carburetor does
- ✱ What fuel injection does
- ✱ How cars cool the combustion
- ✱ Volumetric efficiency
- ✱ How cars get good mileage
- ✱ Carbs are not bad
- ✱ Spark is important



Objectives

- ✱ Evolution of EFI on the GMC
- ✱ EFI Components
- ✱ EBL Operation
- ✱ Tuning
- ✱ Going for Better mpg
- ✱ Summary



Evolution of EFI in the GMC Community

Fuel Management

•Howell, AFI, Turbo City

Spark Control (ESC)

•Distributor from 307 Olds

Vehicle Speed Sensor (VSS)

Enhanced ECM with EBL

Toys – WB-O2, EGT,
FP, special displays

Port Injection

• If starting from scratch, consider? ...

- RYO TBI with EBL add-on (less expensive option)
- Howell, AFI with EBL add-on
- Holley
- Edelbrock
- FAST
- MegaSquirt
- MSD Atomic EFI



Support Resources Available



- ★ Google Groups for GMC EFI discussion
 - ★ Discussion of common problems and solutions
 - ★ Over 90 members
 - ★ <http://groups.google.com/group/gmcmh-efi>
- ★ Detailed Help with Tuning
 - <<https://sites.google.com/site/gmcmhefi/>>
 - ★ Tweaks – common procedures with detailed instructions for specific EBL parameters
 - ★ Tips – items of interest
 - ★ Files - A place to upload and share log files, images or other files of interest



EFI Components

- ★ Throttle Body Injection (TBI)
 - ★ Need at least a 2" bore
- ★ Idle Air Control (IAC)
- ★ Throttle Position Sensor (TPS)
- ★ Manifold Absolute Pressure (MAP) Sensor
- ★ O2 sensor
- ★ Electronic Control Module (ECM)
- ★ Computer Controlled Distributor (CCD)
- ★ Knock Sensor (KS) & Electronic Spark Control (ESC)
- ★ Vehicle Speed Sensor (VSS)
- ★ Software with ability to make changes to ECM programs



EBL Operation

★ What's up display (WUD)

★ Main display

- ★ mph and rpm displays
- ★ Indicators for idle, closed loop, PE, DFCO, etc.
- ★ Gauges displaying information from sensors

★ Trip screen - distance and fuel information

★ Volumetric Efficiency (VE) learn screen

★ Areas of spark knock screen

★ Sensor diagnostics screen

WUD Link



Tuning - Tools

- ★ Tuner Pro – Freeware

- ★ <http://www.tunerpro.net/>

- ★ Laptop

- ★ Need to be able to run Windows

- ★ Many are using a Mac with ability to run windows – works without any problems.

- ★ iPad also works as a touch screen

- ★ Serial to USB adapter





Tuning – Additional Tools

- ★ Wideband Oxygen Sensor (WB-O2)
 - ★ DynamicEFI
 - ★ Innovate
 - ★ Zeitronic
- ★ Exhaust Gas Temperature (EGT)
- ★ Fuel Pressure Gauge (manual or electronic)





Tuning – Getting Started

- ★ EBL came in the mail – now what?
- ★ Determine which .bin to use
 - ★ Several choices
 - CD comes with one for the 455
 - Ask for one matching your engine configuration



1. Unplug two plugs from old ECM and plug into EBL
2. Plug in laptop
3. Flash in new .bin





Tuning – VE Learns

- ★ VE learn is major feature of EBL
 - ★ With the original ECM (7747) one would generate a log then do some fairly complex calcs to arrive at new VE tables
 - ★ EBL does this process for you
 - ★ Does not update automatically – yet



DEMO



Tuning – Advanced



No getting your hands dirty
No getting out wrenches/screwdrivers



SA - Main Table												
	20	30	40	50	60	70	75	80	85	90	95	100
4800	45.70	45.70	45.70	45.70	45.35	43.24	41.13	36.91	34.80	33.75	33.05	31.9
4400	45.70	45.70	45.70	45.70	45.35	43.24	40.43	36.91	34.80	33.75	33.05	31.9
4000	45.35	45.35	45.35	45.35	45.00	42.89	39.73	36.56	34.45	33.40	32.70	31.6
3600	45.00	45.00	45.00	45.00	44.65	42.54	39.38	36.21	34.10	33.05	32.34	31.2
3200	45.00	45.00	45.00	45.00	44.30	41.84	38.67	35.51	33.40	32.34	31.64	30.5
2800	45.00	45.00	45.00	45.00	43.95	40.78	37.62	34.80	32.70	31.29	30.59	29.5
2400	45.00	45.00	45.00	44.65	43.59	39.02	36.56	34.45	31.99	30.23	29.18	27.7
2200	45.00	45.00	45.00	44.30	42.89	37.97	35.51	33.75	31.64	29.53	28.48	27.0
2000	45.00	45.00	44.65	43.95	41.84	37.27	34.80	33.05	31.29	28.83	27.42	25.6
1800	45.00	45.00	43.95	43.24	40.43	36.21	34.80	32.70	30.94	28.13	26.72	24.9
1600	44.30	44.30	43.24	42.19	39.38	35.51	34.10	31.64	29.88	27.07	26.02	23.9
1400	42.54	42.54	41.48	40.78	37.97	34.45	33.05	30.94	28.83	26.02	24.96	23.5
1200	40.08	40.08	39.38	38.32	35.86	33.05	31.64	29.53	27.77	25.66	24.61	23.2
1000	35.51	35.51	35.16	34.45	33.05	30.94	29.88	27.77	26.37	23.55	23.20	22.5
800	30.59	30.59	30.59	29.53	28.48	26.72	26.02	24.61	23.20	20.74	20.39	20.0
600	29.18	29.18	29.18	28.13	25.66	24.61	23.91	21.80	21.45	18.98	18.63	18.2
400	26.72	26.02	24.96	24.26	23.55	22.85	22.50	20.74	20.39	17.93	17.58	17.5

View Graph

ToolboxCompare

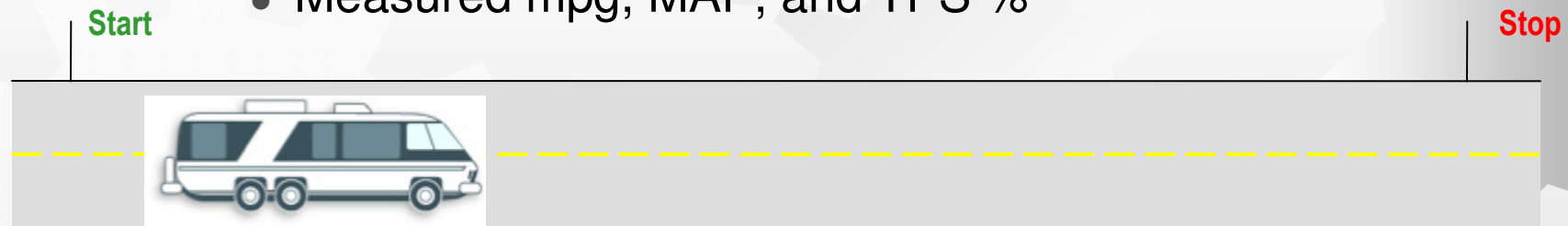
SaveCancel

Just change some table values
and give it a try



Tuning – Spark Control

- ★ Generally, spark should be knock limited
- ★ SA table and WUD display reflects actual crank SA
- ★ Tuning SA
 - ★ Looking for Maximum Brake Torque (MBT)
 - ★ Need a dyno but we are “shade tree” guys
 - ★ Laid out a 2 mile course
 - Ran course with CC
 - Measured mpg, MAP, and TPS %



E
F
I

Going For Better MPG



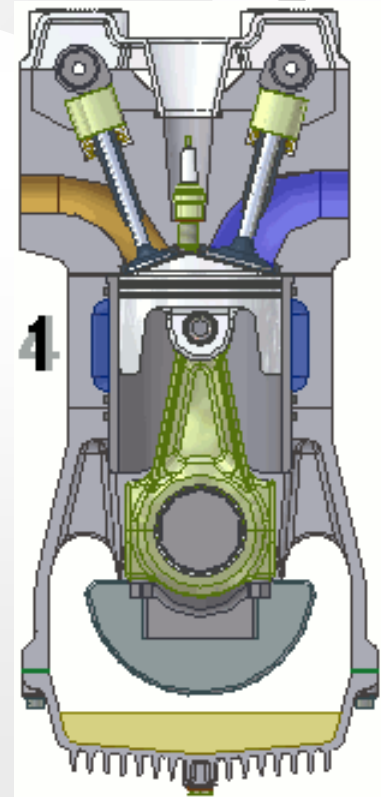
October 2, 2014

GMCWS Rally - Manteca



Going for Better MPG

- ★ Deceleration fuel cut off (DFCO)
- ★ Lean cruise (or HiWy mode)
 - ★ Controlled by mph, MAP and various time functions
 - ★ Set commanded AFR based on MAP
 - ★ 16.4:1 seems about right for 50 MAP
 - ★ Lower AFR as MAP increases
 - ★ Increase SA during lean cruise
 - ★ Parameter: SA-HiWy vs MAP
 - 5 degrees at 50 MAP seems about right
 - Decrease SA as MAP increases



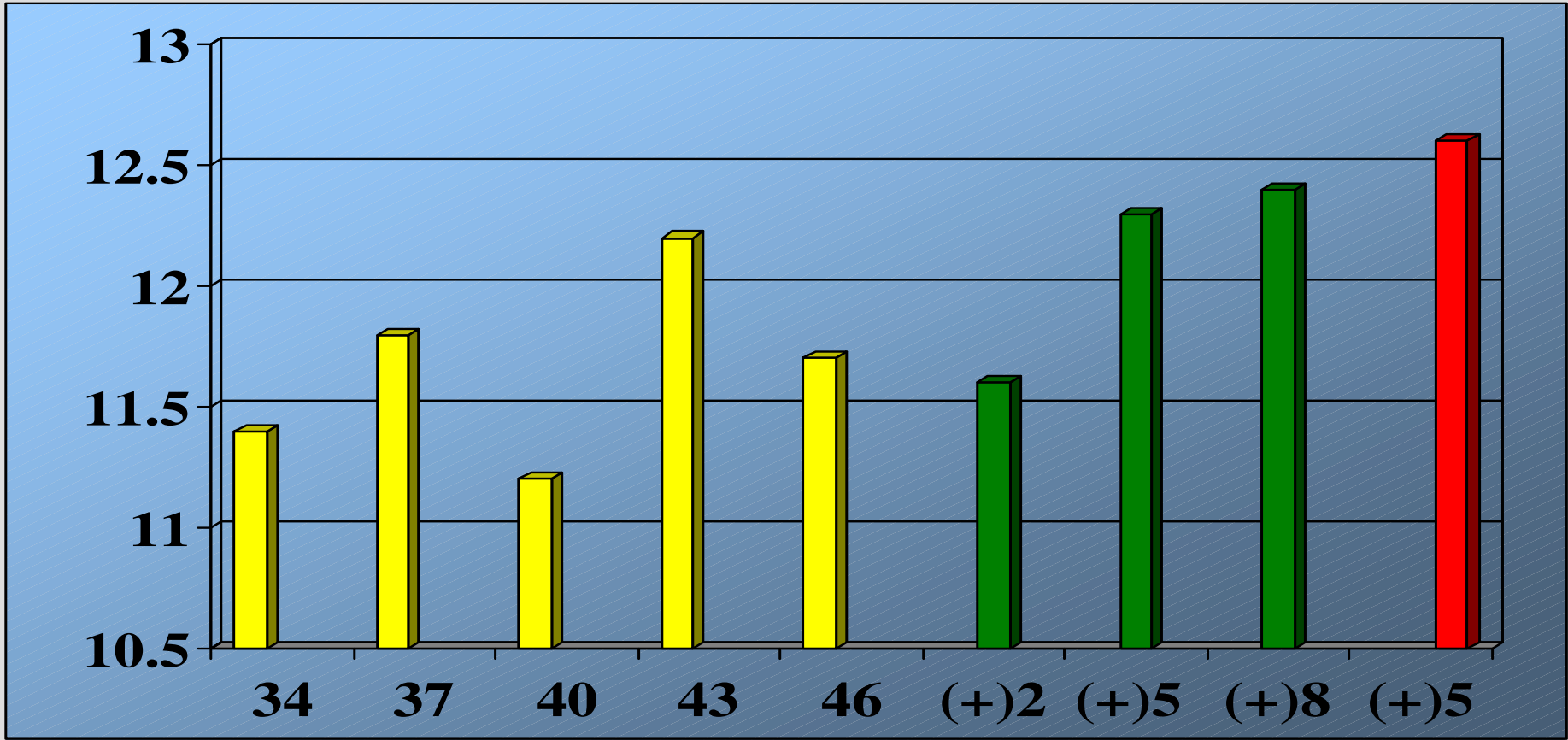


Going for Better MPG - Results

Start

26' Eleganza II 403 with 370 FD

Stop



MPG HiWy 16.4

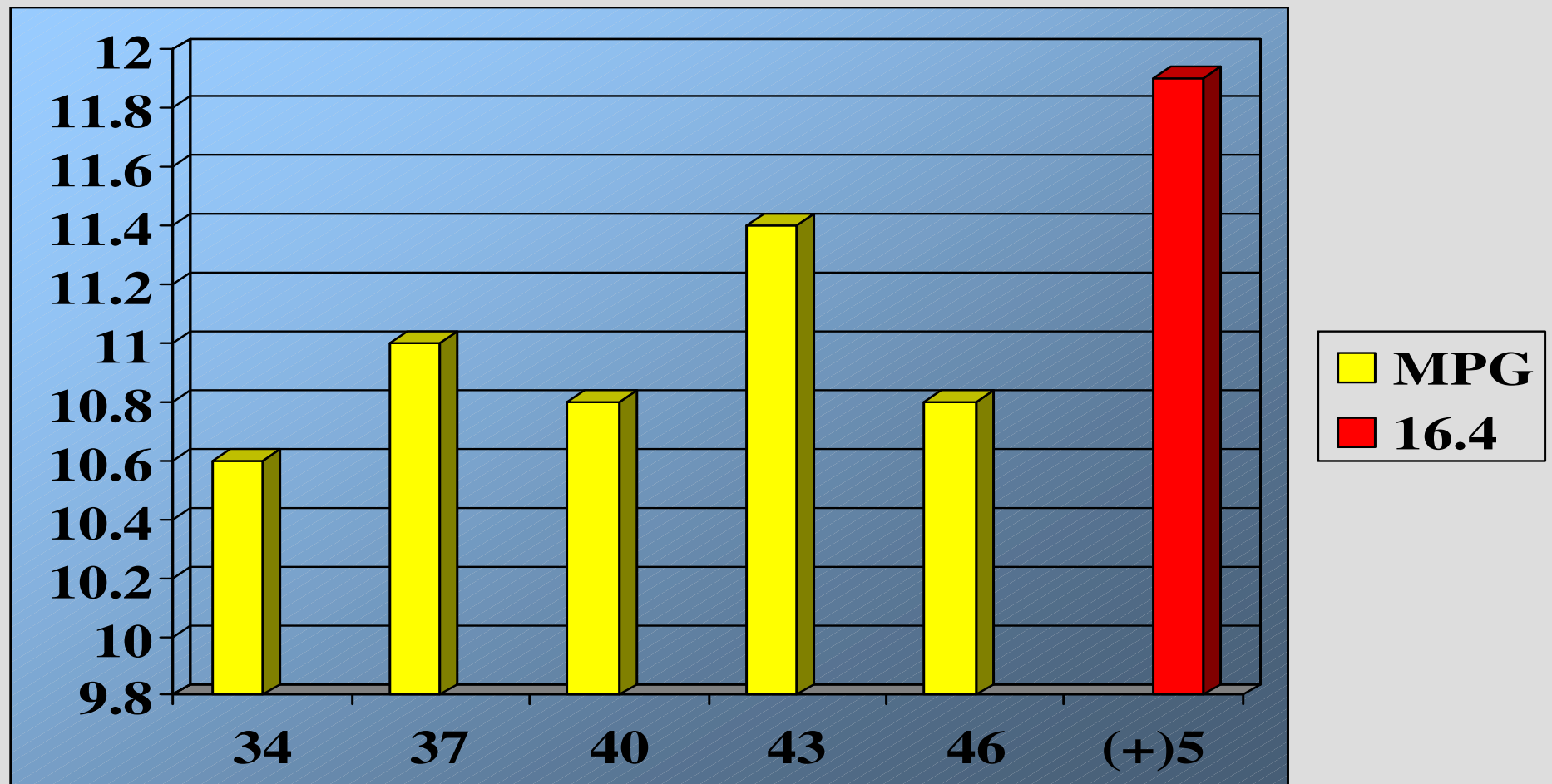


Going for Better MPG - Results

Start

26' Eleganza SE 455 with 307 FD

Stop



E
F
I

1	Total Miles	Odometer	Total Gallons	Trip MPG	Price	Location	Tank State	Tank MPG
2	3793.65	28830	348.14	10.89690929				
3	0	28830	0		3.99	Auburn		0
4	188	29018	18.75		3.97	Auburn		10.02
5	326	29344	32.8		4.37	Auburn		9.93
6	105	29449	21.8		4.02	<u>Arcata</u>		4.81
7	229	29678	18.6		4.03	Brooking, OR		12.31
8	295	29973	35.9		3.89	Lincoln, OR		8.21
9	302	30275	23.5		3.82	<u>Kennewick, WA</u>		12.85
10	233	30508	16.7		3.77	<u>Haegen, MT</u>		13.95
11	339	30847	21.12		4.66	Calgary, Canada		16.05
12	239	31086	26.3		3.79	Shelby, MT		9.08
13	248	31334	25.97		3.89	Glasgow, MT		9.54
14	327	31661	28		3.94	Minot, ND		11.67
15	275	31936	34.7		3.85	Aberdeen, SD	full	7.92
16	168	32104	16		3.8	<u>De Smet</u>		10.5
17	339	32443	28		3.73	Clear Lake, IA		12.1
18	0	0						0

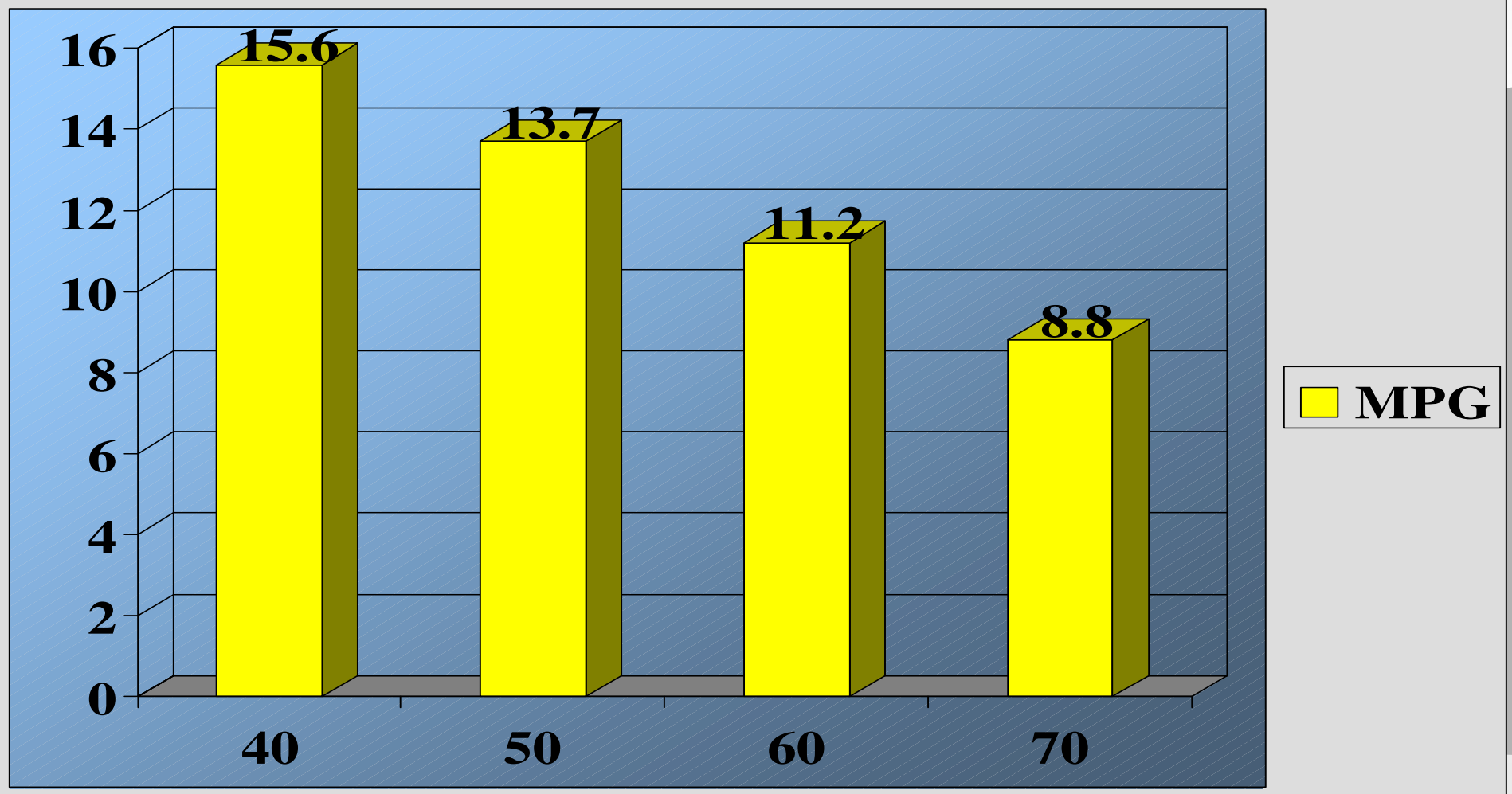


Speed Affects MPG

Start

26' Eleganza II 403 with 3.70 FD

Stop





EFI Common Problems

- ★ Stumble

 - ★ Spark

 - ★ Fuel

- ★ Too Lean

- ★ Too Rich

- ★ Idle Issues

 - ★ IAC Adjustments

 - ★ Spark advance at idle

 - ★ Idle speed when cold



Advantages of EFI

- ★ Spark
- ★ Fuel
 - ★ Lean Cruise
 - ★ Deceleration Fuel Cut Off (DFCO)
 - ★ Altitude
- ★ Starting
- ★ Shutting down
- ★ Vapor lock

Carb



Stop



Follow - up

- ★ Read EBL – Tweaks on the Google Pages
 - ★ <https://sites.google.com/site/gmcmhefi/>
 - ★ Ask questions on the Google Group discussions
 - ★ <http://groups.google.com/group/gmcmh-efi>
- ★ Catch Randy or George during the remainder of the Rally



Tuning

Additional Details

or

Too boring for the main show



What is EBL?

- 3rd gen hot-rodders
 - Most used 7747 ECU
 - Needed more control and easier tuning capabilities
- Add-on board with modern day capability
- Ease of chip updating (no chip burner)
- Self-tuning capability for fuel management
- What's Up Display (WUD) to enhance monitoring
- Additional functionality (lean cruise, etc.)





Tuning – Getting Started

- ★ EBL came in the mail – now what?
 - ★ Determine which .bin to use
 - ★ If you have a fuel pressure gauge, check FP – adjust to get approx. 70 - 74 pph injector capability
 - ★ Calculate BPC value to use
 - ★ Utility provided with EBL
 - ★ Set initial SA (SA-Initial SA)
 - ★ Should be the same as set at the crank. Set the physical / static timing by disconnecting the “brown” wire.
 - ★ Most are using 6 degrees
 - Current thinking is to up this to 8 or 10 degrees
 - ★ Confirm airflow setting – displacement scalar
- ★ Flash in new .bin
- ★ Start her up!



Tuning – Next Steps

- ✱ Log test run (keep it fairly short)
- ✱ Watch playback or review log paying particular attention to BLMs
 - ✱ If values are generally more than +/- 10 from 128 then:
 - ✱ Adjust BPC
 - Low BLM means computer is removing fuel – lower BPC value
 - High BLM means computer is adding fuel – raise BPC value
- ✱ Flash updated .bin
- ✱ Generate more test data
 - ✱ Review BLMs
 - ✱ If BLMs approaching +/- 10 of 128 then ready for VE learns



Tuning – Additional To-dos

★ Check VE tables

- ★ Values should not exceed 100%
 - ★ Ideally, upper numbers should be 85-90%
- ★ If adjustment needed
 - ★ Lower entries by 10% across the board
 - ★ Raise BPC values by 10%
- ★ Perform test runs with VE learns

★ Check injector duty cycle (DC)

- ★ 2nd gear at 3000 RPM – accelerate quickly up to 3200 – 3300
- ★ Maximum DC of 85% considered optimal
- ★ If DC approaches 100% then need to raise FP



Going for Better MPG - DFCO

- Deceleration fuel cut-off
 - Shuts off injectors when coasting
 - Especially good for long downgrades
 - Effective for slowing from speed down to a stop
 - Controlled by several factors
 - RPMs
 - Must be above set rpm to enter
 - Exits when below set rpm
 - Map
 - Must be below set MAP to enter
 - Exits when above set MAP
 - Mph
 - Must be above set mph to enter
 - Exits when below set mph



Bob Drewes

TBI Calibration and Computer Controlled Distributor Components



October 2, 2014

GMCWS Rally - Manteca

TBI Calibration

Why ?

The TBI needs to be matched to the engine it is used on. The ECM needs to know when the throttle plates are in the closed position and the voltage of the TPS (throttle position sensor)

How do we do this ?

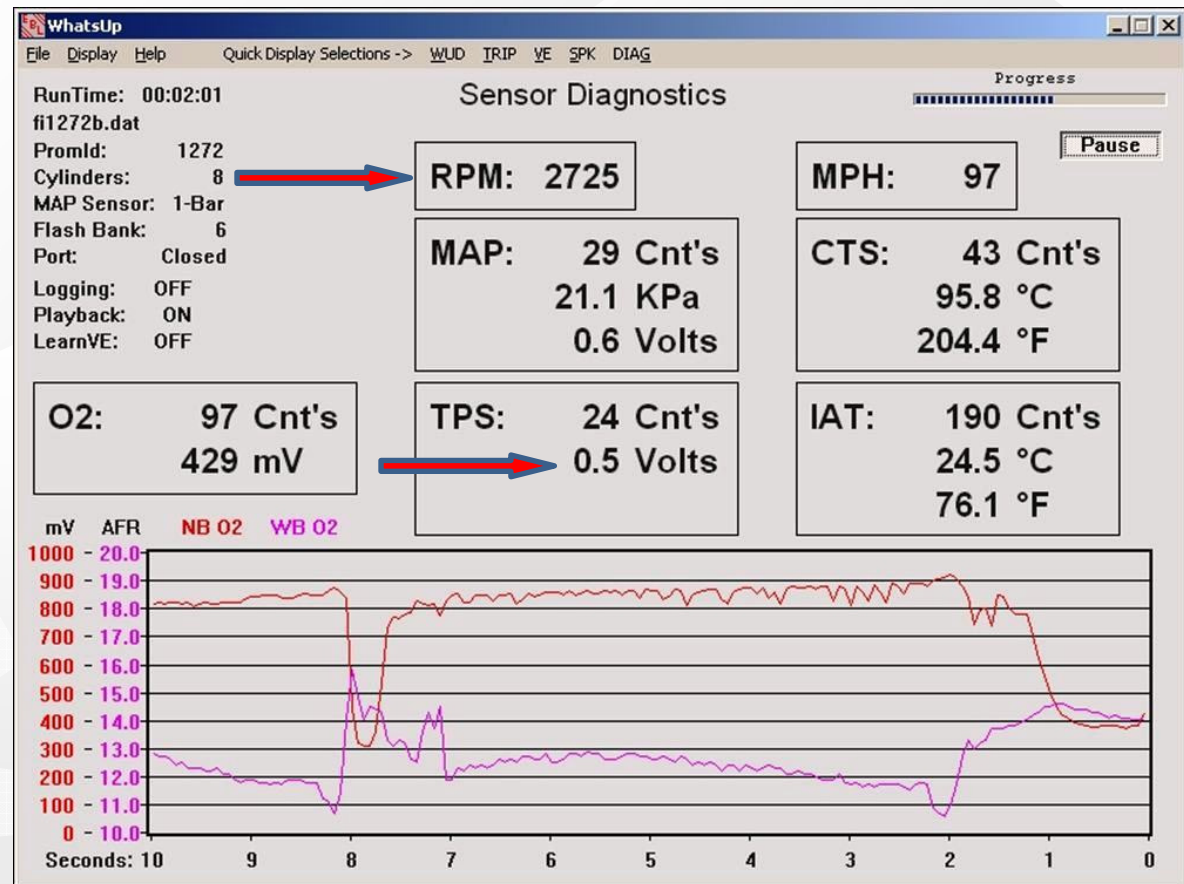
We do this by setting the “minimum idle speed” of the engine. After that adjustment is done, the IAC will control the engine idle speed from the engine idle tables in the ECM.

EFI

If you have NOT installed the EBL system, plug a scanner into the ALDL connector to get the sensor readings needed for the calibration. What is needed is engine RPM and TPS voltage.



If you have installed the EBL system then you can use the sensor diagnostics page of the WUD to view the sensor info needed to do the calibration.



October 2, 2014

GMCWS Rally - Manteca

throttle
screw



TPS

THROTTLE
POSITION
SENSOR

IAC

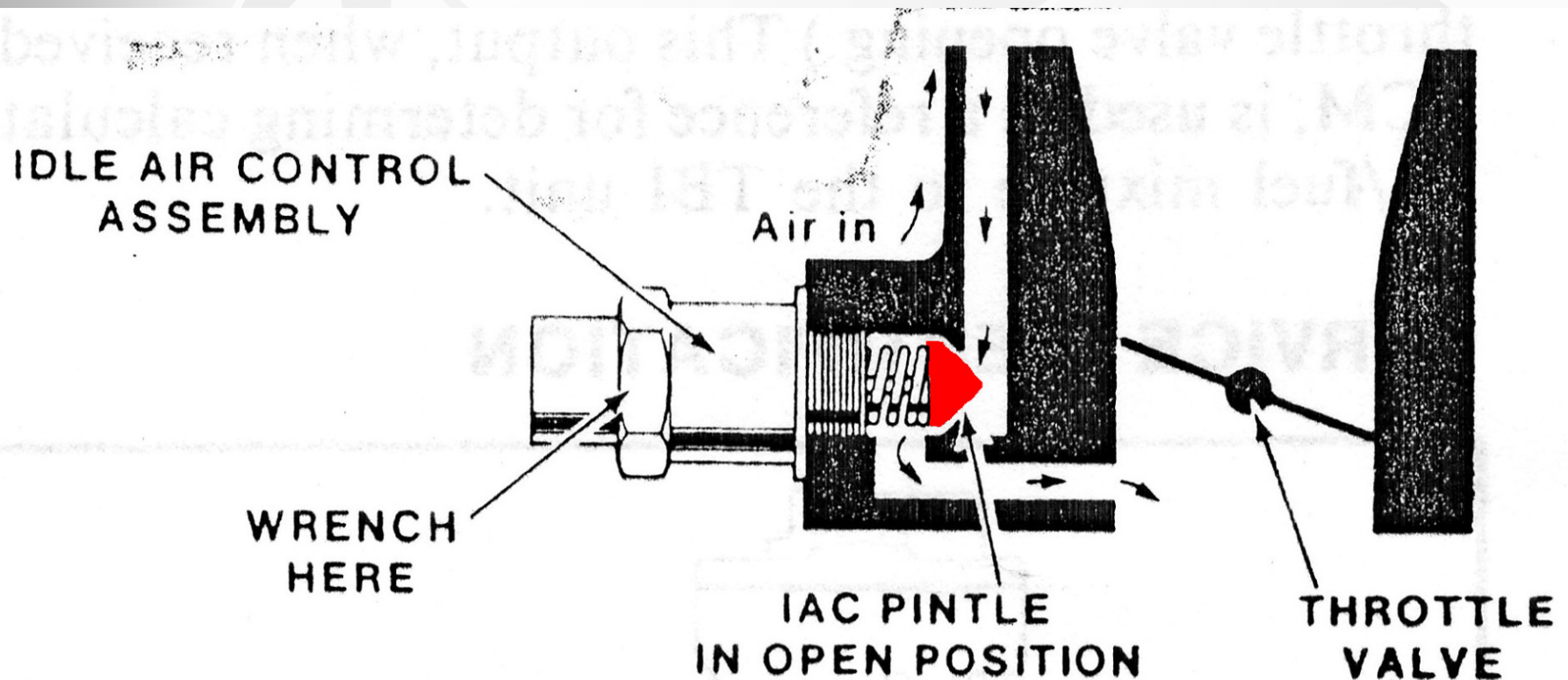


October 2, 2014

GMCWS Rally - Manteca

E
F
I

The diagram below shows how the IAC control will by-pass the air around the throttle valves when the chip controls the IAC and the idle speed. In doing the calibration, we are going to move the IAC pintle into the seat, shutting off any by-pass airflow, and then disable the IAC. Then we will adjust the throttle plates for “minimum idle” speed.



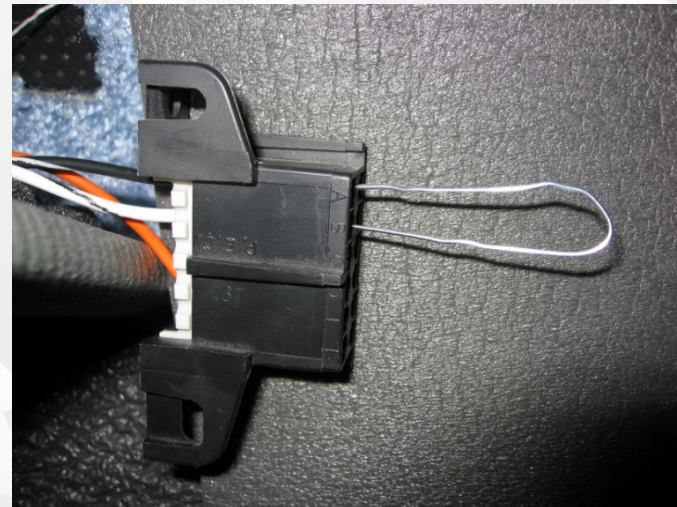
IDLE AIR CONTROL SYSTEM

October 2, 2014

GMCWS Rally - Manteca

How to calibrate the TBI

- 1-** Engine warmed up, key *OFF*, tranny in *PARK*
- 2-** Put a jumper wire from pin “A” to pin “B” on the ALDL connector (should be the black wire & white wire) A metal paper clip works good for this.



- 3-** Turn key to ON, do not start engine, wait 8 seconds. This will extend the IAC pintle and close off the air passage in the body of the TBI.

8- Start engine, in PARK, let it idle. The IAC is now controlling the idle speed of the engine from the idle tables in the ECM.

Note: *It's best to have the IAC counts in the 10-15 count range, but they can vary some from this. You want TPS voltage at or around 0.60 volts.*

For more information on this procedure, check here:

<<https://sites.google.com/site/gmcmhefi/eb1-tips-folder/eb1-tips---initial-iac-calibration> >

- 4-** Remove the electrical connection to the IAC by pulling it straight out. Turn the key to OFF and remove the jumper from the ALDL connector. The IAC is now seated and not controlling the idle speed.
- 5-** Start engine, and let it settle into idle speed. You may need to give it a little throttle to get it running. Turn the throttle screw until the idle RPM is 550-575.
- 6-** Turn engine OFF. Connect the IAC connector.
- 7-** Start engine and run for 5 seconds, turn engine OFF and wait at least 30 seconds. This will reset the IAC control.



Computer Controlled Distributor

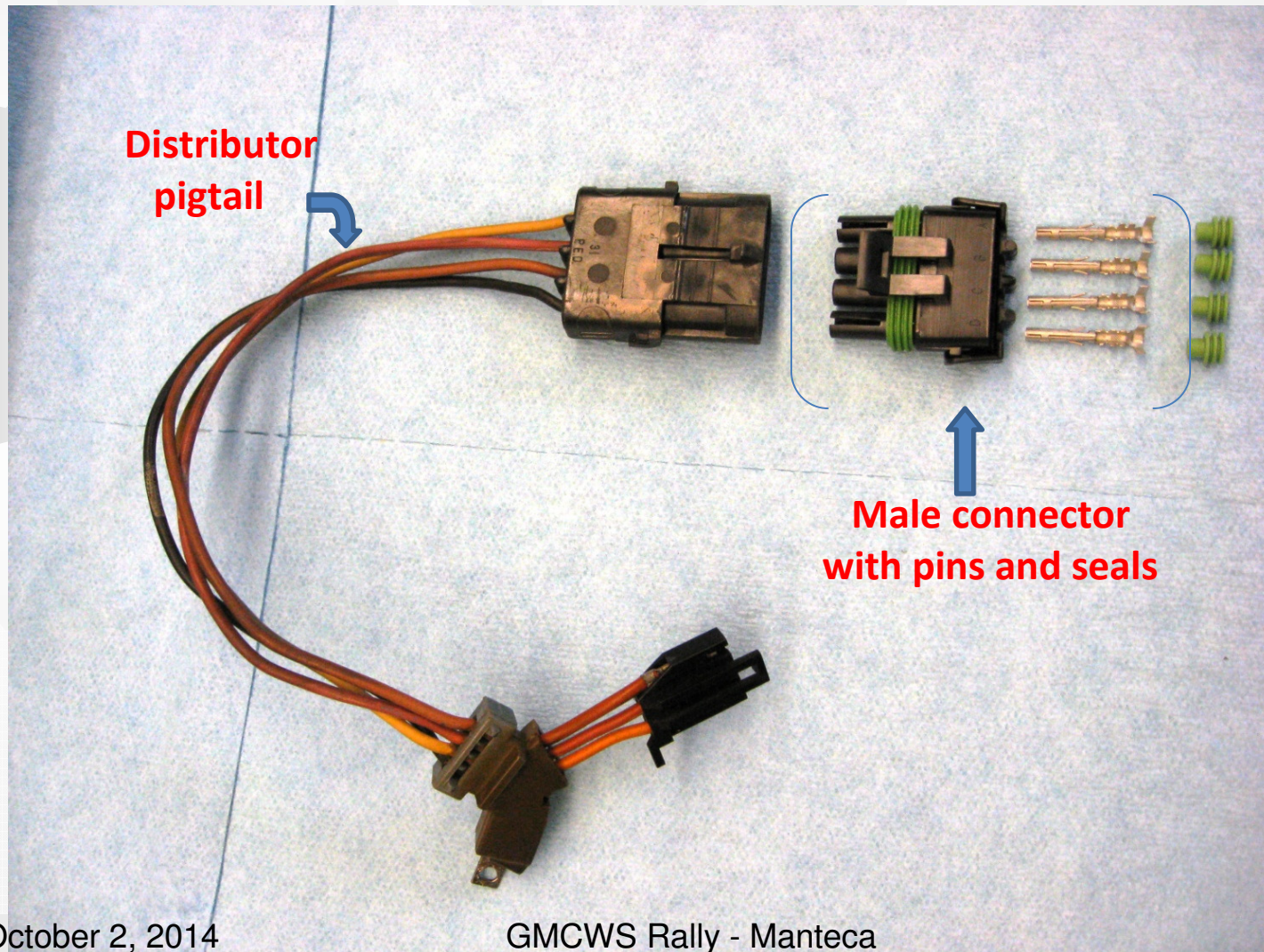
Used on the Oldsmobile 307-Y engines



OEM
Four wire
plug



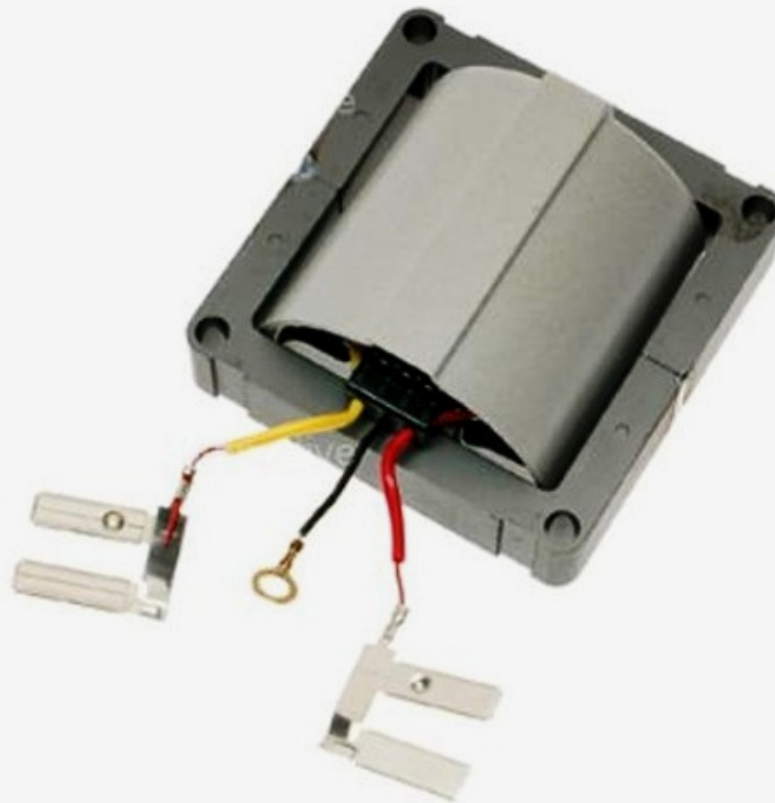
Attach a male weatherpack connector to the TBI wiring harness to connect to the distributor pigtail



October 2, 2014

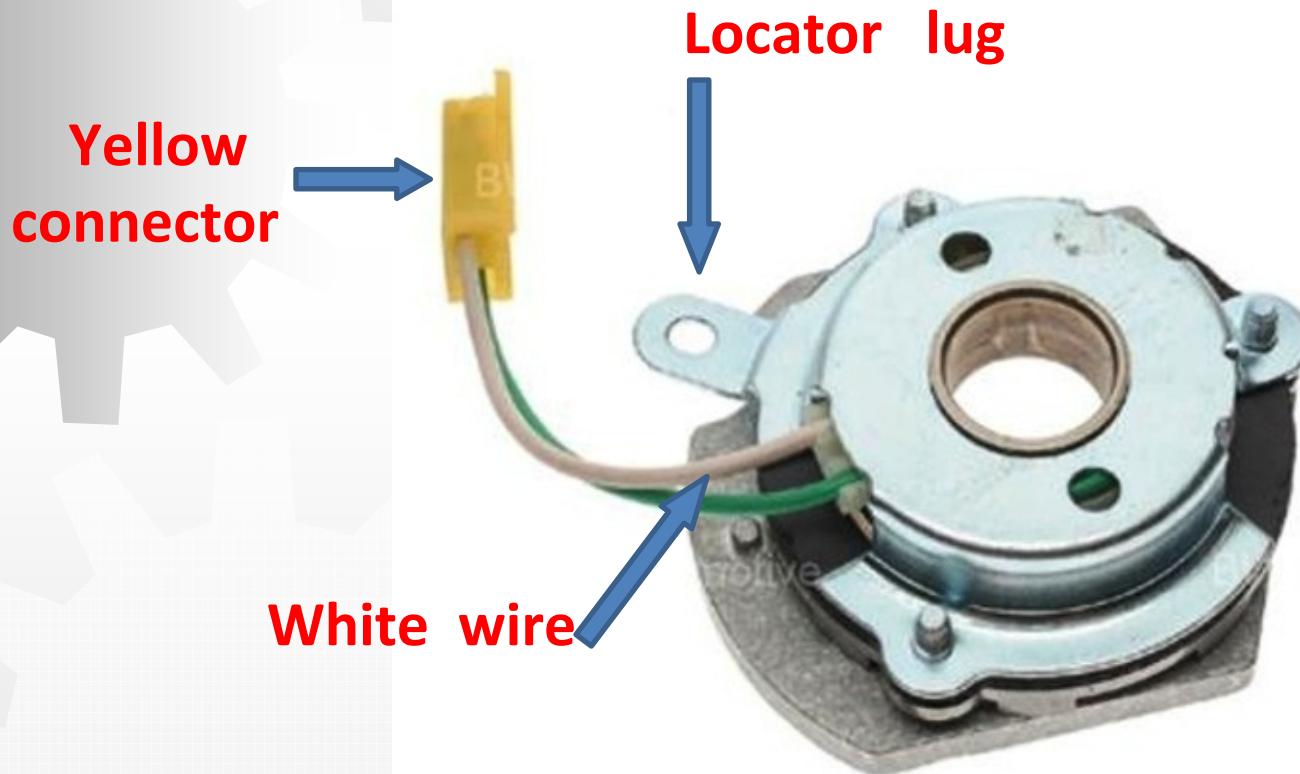
GMCWS Rally - Manteca

The ignition coil and the pick-up pole piece in the distributor need to be matched. Use the ignition coil with the **YELLOW** and **RED** wires



E
F
I

The pick-up pole piece needs to match the ignition coil. The WHITE wire needs to be closest to the locator lug that index's the pole piece to the distributor. The wires will have a YELLOW connector or cable tie.





The seven pin module that is mounted in the distributor, receives signals from the ECM spark tables and controls the spark to the engine

