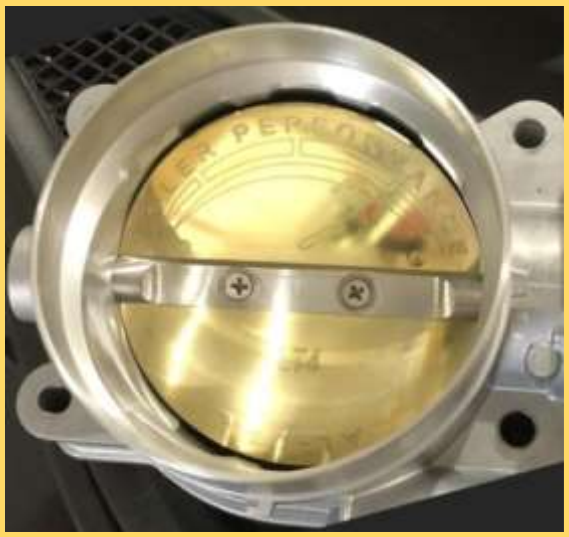
W A Technology

Soler Throttle Body "WHY & HOW TO" Install in Grand Sport



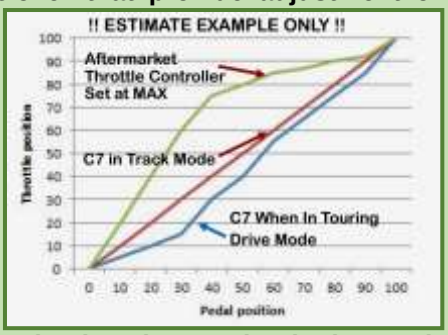
Since "HOW TO" is easy, we'll start off with "WHY TO" Install a Soler Modified Throttle Body!

There Are Two Issues Related to Throttle Response

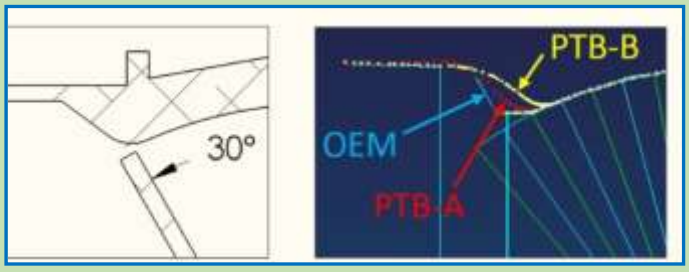
As the Owner's Manual defines, the C7 varies the amount the throttle butterfly opens versus the amount the throttle pedal is depressed from "slow" in Weather Mode to more linear in Sport and Track.

For Touring Mode, the fly-by-wire in the C7 appears to be set so a 15% throttle pedal depression only opens the throttle butterfly about 7%. That is a slow tip-in making the car easier to control in traffic. When in Sport and Track Mode the C7 offers a more aggressive, more linear throttle body butterfly movement with pedal movement.

There are aftermarket devices, like the Vitesse Throttle Controller that provide adjustment of throttle movement from an OEM setting to very aggressive where when the pedal is depressed 45% the throttle is opened 75%. In fact, I added a Vitesse to my Grand Sport since I was driving in Touring mode and felt the slow tip-in compared to the 3½ years I had driven my 2014 Z51 non-MRC always in Sport or Track (for the other benefits and aggressive throttle response.) It was a help. Could feel the difference particularly when talking off from a stop. When I got the Grand Sport MRC software update I now drive in Sport and the C7 response is about the same as my the Vitesse controller 4/5 setting!



A "tuner" posted he drove a Z51 and documented with a data log the throttle mapping in the stock ECM calibrations lags behind pedal movement. He modified with a "tune" and the lag was gone. His data log showed the throttle plate movement was following pedal movement very closely.



Mike from Soler responded in a post, stating in in addition to working better though all throttle positions, where the butterflies work on a contoured Throttle Body surface *(pic left,)* the Soler modified Throttle Body works better to control tip-in than a "tune," aftermarket throttle controllers or other modified throttle bodies they have tested. Note: a "tune" can increase power at larger throttle openings to WOT by changing timing and air/fuel ratio. An aftermarket throttle controller does not increase power. The Soler Modified Throttle Body has some increased power effect due to reduced throttle shaft restriction, polishing surfaces and other throttle body shape modifications. BUT a "tune" that changes the ECM programing will void a warranty. A throttle body modification nor an aftermarket controller do not.

In the following picture/text overview I'll try to explain what's occurring followed by my installation.

Photo/Text Details

CHOKED FLOW

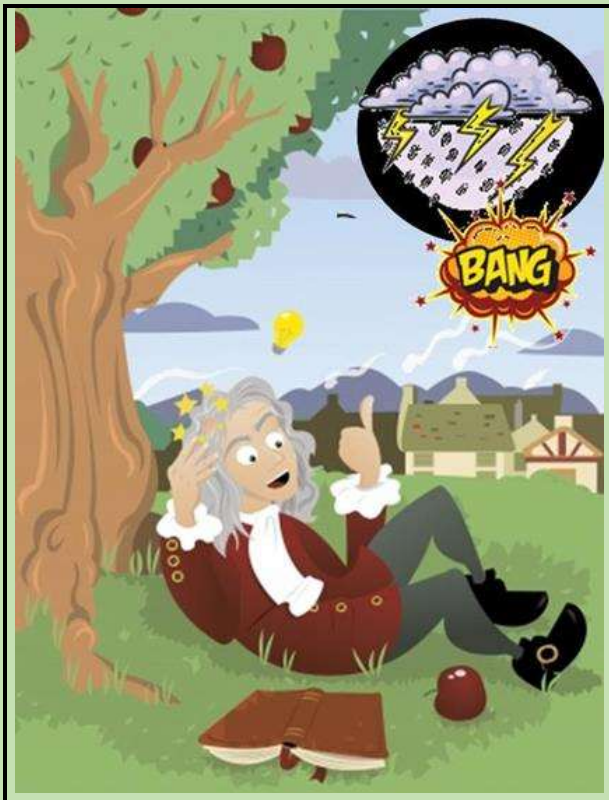
To help appreciate the benefits the Soler Modified Throttle Body can achieve, understanding "Choked Flow" is useful.

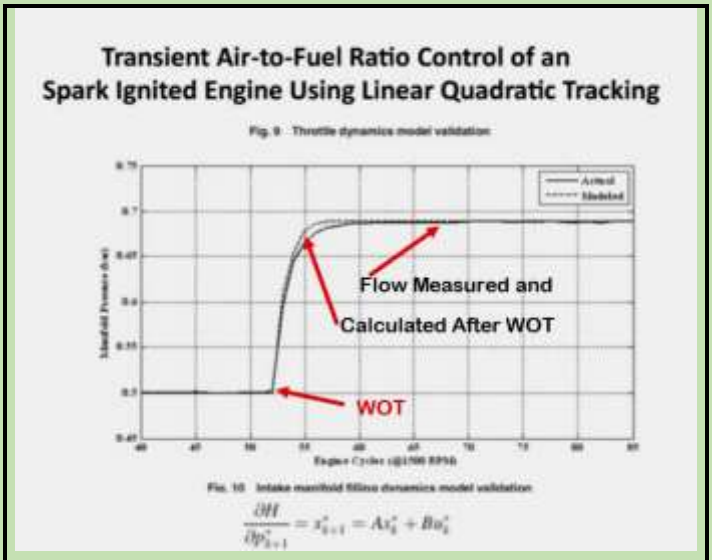
Sir Isaac Newton (the dude with the falling apple) measured the speed of sound fairly accurately in the 1700rds (~770 mph.) He would understand how choked flow works - *You Can Too!*

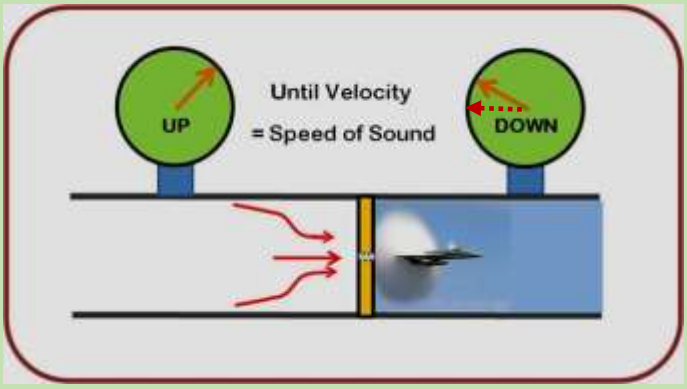
It's related to why you see lightening before you hear thunder! Light travels about 1 million times faster than sound! "Choked Flow" relies on the fact that *the speed of a gas through the passage like a throttle body (especially at small throttle plate opening) cannot exceed the speed of sound!*

Even if the Throttle butterfly opened with "Zero Delay" the pressure wave coming from inside the manifold through the throttle body to signal for more air flow only travels at the speed of sound!

The only way to get the flow rate somewhat higher, for a given pressure/opening size, is with a contoured intake and exit shape (google *"converging-diverging nozzle"* to see how air speed can exceed the speed of sound!)







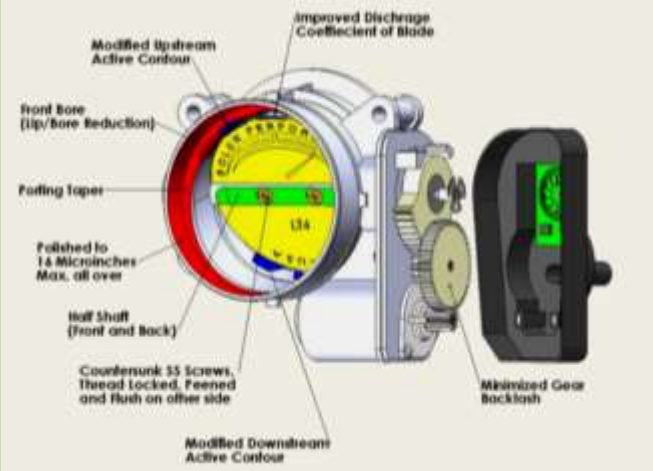
Flow Rate Controlled by The Speed of Sound

The flow rate after the butterfly's opened fully (WOT) was measured, calculated and presented in a 2014 ASME technical paper (pic top left.) As noted, it takes a finite time for the air velocity to increase to the maximum flow rate based on the pressure differential and size of opening. So, opening the Throttle faster with a Vitesse Throttle Controller, etc. or a "Tune" can help BUT can't counter that the flow will take time to increase, it's not instant!

My Internet welding related business (lower pic) relies on the maximum gas flow through a square edged orifice being at the speed of sound "regardless" of the downstream pressure, called "choked flow." ***BUT*** if the orifice opening is shaped like a cone and the exit a reverse cone (converging-diverging) the speed can increase above the speed of sound!

Recall years ago, asking a Professor in a fluid flow class, why square edged orifice flow does not increase when the downstream pressure decreases? He presented this nontechnical answer saying: *"It would **IF** the higher upstream pressure knew the downstream pressure was lower. But that pressure wave signal can only travel at the speed of sound, so it takes time for **"it to know!"*** Not technical BUT helps me remember why the flow in a square faced orifice is limited to the speed of sound! That flow volume is based only on the upstream pressure and orifice size (*once the upstream pressure is 2.1 time greater than that downstream.)*

Modified/Optimized Soler Throttle Body



What Soler Does:

- Modifies upstream and downstream contours to improve what are called discharge coefficients and increase flow starting from idle.
- Contours front lip to help Max flow
- Narrows center shaft to increase Max flow- peens screws for security.
- Polishes to 16 microns max all over
- Minimizes gear backlash

This Achieves:

- **Instant power**. Airflow/power gains start right from idle,
- **Much more power at part throttle**. Doubled mass airflow from 1.2 g/s-deg to 2.4 g/s-deg.
- **Higher quality.** Contour every thousandth of an inch and bench test each unit.

Flow Test Results With Throttle Plate Opened Through 40 Degrees,

The Initial Opening, Contoured Area, (RED in pic)

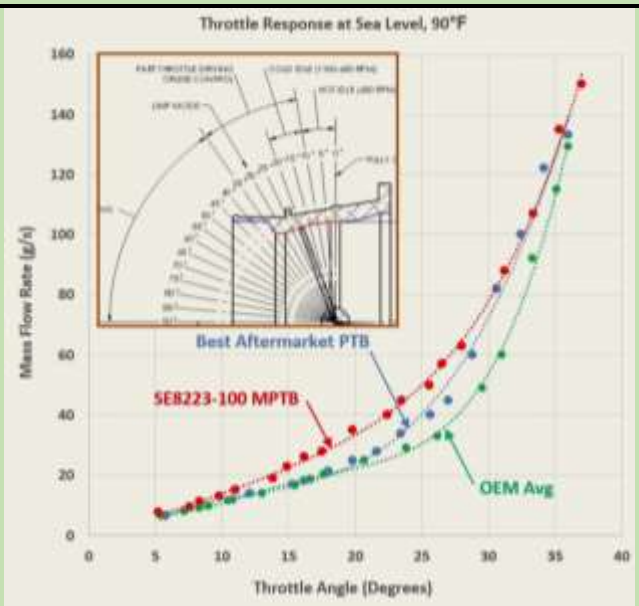
- Soler Modified SE8223-100

Compared to:

- OEM Throttle Body and

- The Best Aftermarket Modified Throttle Body Tested, PTB

Verifiable Results -check the numbers.

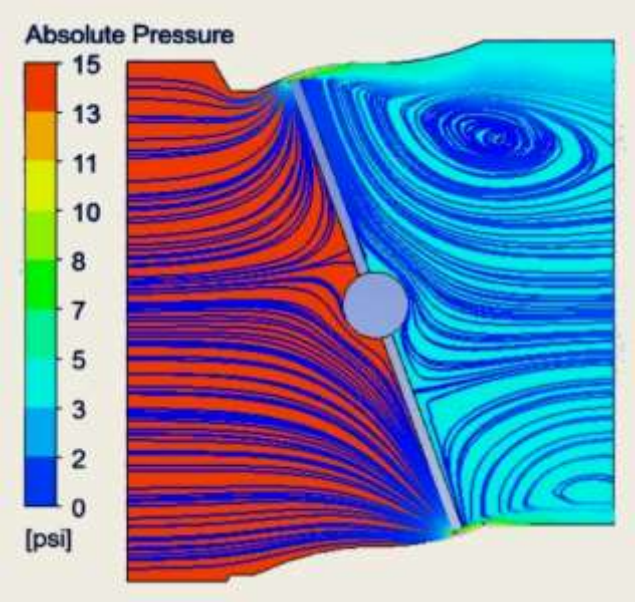


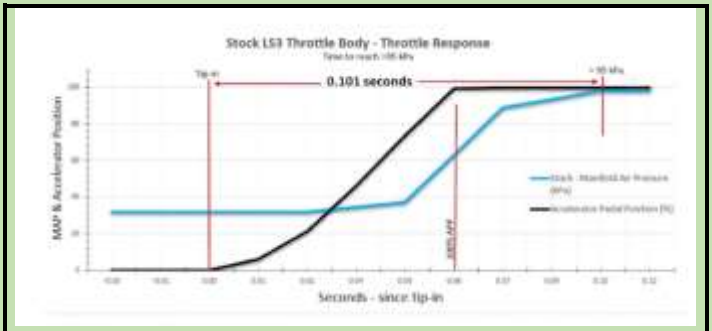
Soler has made Computational Fluid Dynamic (CFD) simulations of the OEM throttle body. They observed that all the pressure drop occurs at the flow gap between the plate and the active contour where the air is choked and reaches sonic speed. This sharp pressure drop across the plate clearly divides to very distinct zones, the inlet (red) on which the pressure is atmospheric and the outlet (cyan) which corresponds to the manifold pressure.

The predicted mass flow rate closely matches experimental data obtained from vehicle sensors.

Because the flow is chocked, it does not respond to manifold suction, regardless of engine type (naturally aspirated or forced induction). It does respond to upstream pressure (ambient) but that is not a controllable variable. Only changing the throat area and the discharge coefficient of the gap can increase airflow to the engine.

More Soler Technical Info in Appendix.





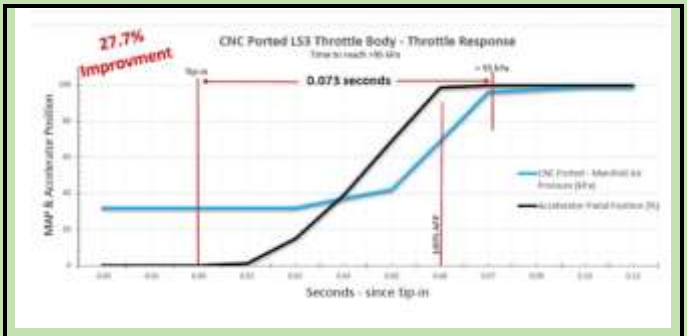
Thought this graph from a competitive modified throttle body that Soler tested would be useful to review. This graph is NOT from Soler but from the performance company's website.

Soler shows in graphs that their product performs even better.

Note this is for a LS3 throttle body but they are similar, and like most have a contoured area for the initial throttle plate opening.

This graph from the performance company shows 27.7% faster flow AFTER tip-in with their modified throttle body! It's independent support for the amount they can increase initial flow.

Soler quotes a 1983 patent from Nissan Motors, # 4,391,247 that describes the reason for the initial throttle opening being contoured and why straight bore throttle bodies had problems. May want to google, I found it interesting.



INSTALL

I bought a new modified Throttle Body and it came in <5 days, Priority Mail. Quick service!

It was well packed, and workmanship looked great.

4 pages of instructions look to be the same as those on their website if you want to check first:

https://static1.squarespace.com/static/5c50e9344eddecaef4c84713/t/5cb88980971a187551f51336/1555597697945/Installation+Instructions+Rev+NEW+%281%29.pdf

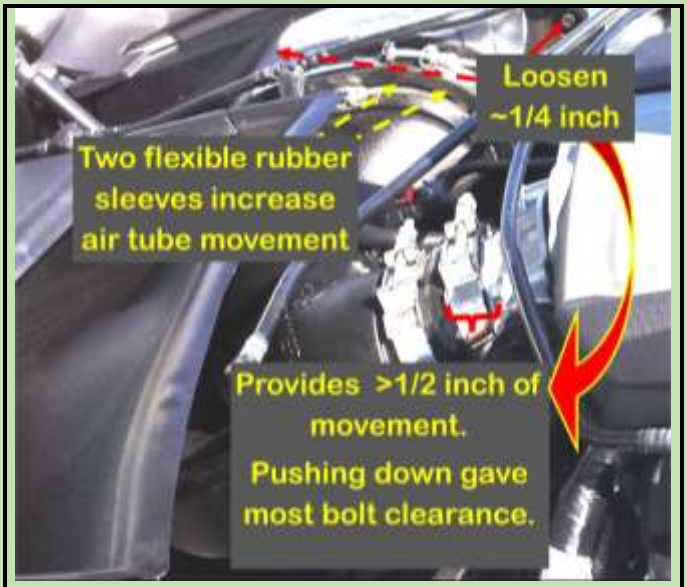
https://static1.squarespace.com/static/5c50e9344eddecaef4c84713/t/5cdf33953475050001ffd2a9/1558131605333/Relearn+and+Test+Instructions+Rev+NEW+V5.pdf

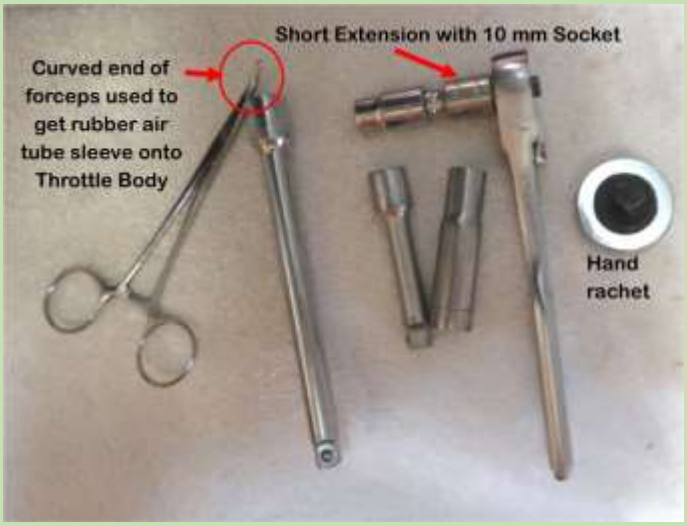
For OEM intake the two sets of bellows (*see in pic in the **aFe Appendix at the end of this PDF*) will leave enough room to pull the intake air tube back to remove the throttle body. It will also leave room for the Soler modified throttle body installation.**

However, my *aFe* low restriction air intake tube has no flexible bellows. Loosening the housing mounting bolts on the fender about ¼ inch will allow the throttle body tube end to move over twice as far.

There are two rubber sleeves where the tube connects to the filter housing. They provide extra movement of the Throttle Body end. Found for best access to the 4 Throttle Body bolts was achieved by pushing down on that tube end.

Removed the clamp on the rubber sleeve that fits over the throttle body intake.





To access the 4 Throttle Body Bolts, a few extensions were helpful as the tube end could only be pushed down a limited amount for bolt access.

One was a 1 inch very short extension in addition to two others. Once the bolts are loosened they come out easily. A hand rachet was useful.

To get the rubber sleeve over the new Throttle Body end, after it was installed, I first put it over the bottom. Then use the curved smooth end of closed forceps to help guide the last ~25% over the lip.

Note, the short extension being used to access the lower left Throttle Body bolt.

Disconnecting the ECM Wire Plug **is done with it upside-down. Pull the RED clip edge toward the fender. It just blocks the TAB that must be pressed to release the plug from the Throttle Body. The same clip arrangement is used on the MAF- BUT that clip is visible on top!**

Press hard on the Tab (yellow arrow) and pull.

Once the 4 bolts are removed just lift the old Throttle Body out.

As noted in the Soler Instructions; *"make sure the blue rubber gasket is in its grove."* Mine was fine, if not put it back in.

Any air leaking past the gasket did not go past the MAF and will provide the wrong info to the ECM!

Put the new Throttle Body in place and insert the 4 bolts. I put the two top bolts in first, hand tight.

Then installed the lower right and followed with the lower left. Snugged them all with the 10 mm socket and just the extensions.

Finally tightened the bolts in a crisscross pattern.

The rubber sleeve from the *aFe* low restriction intake 'just slips" over new Throttle Body inlet. Having had issues, the several times I have done this; I used a very small amount of soft hand placed on the inside. As noted with the tool's pic, I used the smooth curved end of closed forceps to get the last ~45 degrees over the lip. Worked great! Inserted the ECM connector and pressed in the RED clip cover. Tightened the filter housing bolts that had been loosened.

INSTALL FINISHED

ECM Learning Your New Throttle Body

The SE8223-100 Modified Throttle Body (MTB) and its reworked variants increase airflow at part throttle 0-33% throttle position (TP) range from 80-120% above stock/OEM throttle body (TB), and 55-85% over other aftermarket ported throttle bodies (PTB). Once installed, the engine control module (ECM) does not compensate instantaneously in terms of fuel, timing, etc. for these airflow increases. *Because the change is so drastic, the ECM is programmed to initially disregard this sudden airflow increase and rather compensate using time averages stored in memory, these come from mass airflow sensor (MAF) readings acquired from your previous TB/PTB.*

The MAF sensor reads real time airflow of your new MTB and sends it to the ECM. The ECM will in tum start replacing the oldest time averaged values from your previous TB/PTB and recalculating anew MAF time average and adjusting fuel, timing, etc. over time, miles, driving cycles. This is the learning period; your vehicle might not feel "smooth" until the new MTB is fully learned.

MAF readings outside ECM compensation range will set a diagnostic trouble code (DTC). These are not acceptable and indicate malfunctioning of the MTB. On the other hand. absence of a DTC upon installation and testing of your MTB indicates that the MAF offset is within ECM compensation limits and that the ECM will compensate for it given time to reconstruct the new MAF VB. TP curve/table. Fuel, timing, and other compensation types will follow MAF newer time averages of MAF VB. TP of your recently installed MTB.

This Simple Method of "Teaching" the ECM was Posted by Mike from Soler – The Formal Methods Follow:

The instructions are not clear regarding the ECM adjusting to the New Throttle Body. It doesn't specify miles or number of driving cycles, it just reads "a few driving cycles". We know from experience that 50-100 miles subdivided into 5-10 driving cycles, do the job. Many times the learning goes very smoothly and it is unnoticed. *At least do the following, it won't take long. (NOTE: this is similar what I did when installing my **aFe** Low Restriction Air Intake where 100 miles of normal driving was recommended.)*

1. Let idle for 3 min
2. Engine off for 1 min.
3. Let idle for 3 more min.
4. Off another min.
5. Drive at 44 mph or greater and let decelerate, several times.

There are two alternatives to force relearning the new MTB. Both are equally effective given enough use.

A) OEM ECM reset (TB values only) tool and relearn procedure. Available at the dealership, or OEM approved service centers. No actions need to be taken by user.

B) Full ECM reset and learning routine. Consisting of overnight power down of ECM by disconnecting battery for several hours. Followed by steps below.

• Disconnect negative battery terminal (black) located under the trunk mat/carpet toward the rear-right comer of the trunk for at least 8 hours.

Test and Re-learn Instructions (Procedure B)

In case of perceived malfunction or if the MIL illuminates on your screen during any step of this test, tum engine off and replace throttle body. Do not attempt to drive until step 6 below.

1- Install modified throttle body and connect battery.

2- Start engine. Depending on engine temperature, engine will start idling in between 650-1100 RPM.

If idling starts at greater than 650 RPM, it should slowly and consistently decrease RPM value to 650 RPM. Allow engine to idle for three minutes while monitoring idling process to ensure there are no RPM fluctuations greater than +/-30 RPM. Tum engine off for one minute.

3- Start engine and allow engine to idle at 650 RPM for three additional minutes and until redline has retracted to 6500 RPM. Accelerate engine slowly up to 4000 rpm. RPM's should always increase *wlo* interruptions. Remove your foot from accelerator pedal, RPM's should always decrease *wlo* interruptions.

4- Allow ECM partial learning of the new throttle body by repeating engine acceleration part of step 3 above four more times. Tum engine off for one minute.

(continued)

5- Start engine and allow engine to idle at 650 RPM. While pressing brake, test transmission in D Gear, R, and N while monitoring RPM's. Small fluctuations may occur while shifting. After shifting, RPM's should still be around 650 RPM and should not fluctuate more than *+/-30* RPM.

6- Test drive safely. Chose a place away from public roads and where no people, pets or property is in the way. Allow the ECM to fully learn the newly installed T8 as follows:

• Drive normally at or above 44 mph and allow vehicle to decelerate. Repeat 4 more times for 50-100 miles subdivided into 5-10 driving cycles, including cooldown periods between starts. (Normal everyday driving meets this step)

• For automatic transmissions, do not enter performance shift mode, driving in M mode is advised.

• Weather, Eco, or Touring modes are recommended during this period.

• Avoid high rates of change of throttle plate angle (aggressive acceleration).

• Revving up to 6500 RPM is okay if done progressively.

After meeting the full learning routine above, test all driving modes available in the car selector, performance shift mode, cruise control, and limp mode (disconnect ECM connector from throttle body). Bring tools and your original (OEM) throttle body to replace modified body in case of malfunction.

Testing limp mode will illuminate the MIL, but the code should go away after reconnecting T8 to the ECM.

I Used the "Simple Method" Outlined to "Teach" the ECM.

Car started fine and all during the 3 minute 1st idling, read ~600 rpm. After stopping the suggested 1 minute and repeating the 3 minute idle it also was a very steady ~600 rpm.

Drove 25 miles in Touring Mode on a low traffic rural highway and was able to deaccelerate from 50 to 55 mph to ~30 mph over 10 times. Stopped at the store and car started fine. ***This was my first chance to observe the easier throttle manipulation when taking off! No hesitation or slight bog using little throttle.***

All appears to be fine and compatible with my larger oiled cotton, low restriction ***aFe*** air intake system that has been installed for over 2 years. No ***CEL***s (***Check Engine Light***)

After ~75 miles my ECM has learned enough to at least be through "High School!

On this 2nd day I put the Drive mode in Sport, where I had been driving since the MRC software upgrade. Throttle response when starting was definitely faster. Everything was normal relative to idle etc, no CEL ever. Although Soler says don't use WOT until the ECM has fully "learned" I tried one fast acceleration approaching redline in 2nd and third. Felt fine.

Been 4 months, works great, easy to add and much better/different than a Throttle Controller! Well worth the cost. 5 Stars!