Patton Machine, February 2022

TBI INSTALLATION INSTRUCTIONS

for Zenith Stromberg, SU, and Hitachi side draft carbs

Congratulations on the purchase of your Patton Machine / Affordable Fuel Injection TBI system. We are confident that this purchase will give you the performance and drivability that you deserve from your vehicle. The following instructions are intended to give you the most information possible to install your TBI system. Please completely read through the manual a few times before beginning your installation. Many questions that you may have are covered within the following pages. If you do not understand any part of the instructions, need clarification, or simply need more information, please e-mail us at: techinfo@affordable-fuel-injection.com or mail@pattonmachine.com.

PLEASE VERIFY THAT ALL OF THE FOLLOWING COMPONENTS ARE INCLUDED IN YOUR SHIPMENT.

1. Wiring Harness
2. ECM with AFI calibrated chip (the chip is already installed in the ECM).
3. Fuel Pump See: https://www.pattonmachine.com/support-system/why-throttle-body-injection-tbi/fuel-tank-lines-and-pump-with-instructional-video/
4. Throttle Body See: https://www.pattonmachine.com/support-system/why-throttle-body-injection-tbi/throttle-body-injector-installation/
5. ECT sensor (Engine Coolant Temp) See: https://www.pattonmachine.com/support-system/why-throttle-body-injection-tbi/coolant-temperature-sensor/
6. MAP Sensor (Manifold Absolute Pressure)
7. O2 Sensor with exhaust ring for installation
8. Fuel Pump Relay
9. Power Relay
10. Check Engine Light
11. Distributor (optional)
12. Fuel Regulator See: https://www.pattonmachine.com/support-system/why-throttle-body-injection-tbi/fuel-pressure-regulator-with-instructional-video/
13. Throttle Position Sensor See: https://www.pattonmachine.com/support-system/why-throttle-body-injection-tbi/tbi-installation-home/

NOTE: This is a custom fuel injection system built for your vehicle. As with all custom projects some fabrication may be required. There may also be some small parts required that are not included with your system.

Note: Although it is very likely that a converted car will easily meet your state's smog emission requirements there is no guaranty. In most cases it will run far more efficiently than as a carbed engine hence less emissions. But for legal reasons I must state "for off road and racing use only".

NOTE: Before starting this conversion either run the carburetors dry or pull the plugs from the float bowls. Failure to start with dry carbs will seriously flood the engine upon first start up.

NOTE: The pink wire (ignition wire) must be hooked up correctly for the system to operate properly. Please read the instructions carefully and thoroughly.

Engine Control Module (ECM)

The ECM is the central unit of the fuel injection system. This unit provides the signals that trigger the injectors and on complete EFI systems delivers the proper spark for the ignition. The ECM is to be mounted inside of the vehicle preferably behind the dash. In many cases this is mounted in the glove box area either in spare space, or even mounted to the glove box itself. The ECM should be mounted so that it does not move around in the vehicle. It can be mounted with brackets, bolts, Velcro etc. For the Triumph TR6 it is typically mounted in the passenger side footwell.

Wire Harness

The wiring harness included with this kit has been specially built for your specific application. This harness only includes the connectors and leads that are required to run your particular engine based upon what you have ordered. Therefore if something is left over, the system may not have been put together correctly. Each connector will be marked with a label to the correct sensor that it is to be connected too. We will also describe in the text to follow, each sensor and the connector that attaches to it. The wiring harness is fabricated to only allow the proper sensor to be hooked up to the proper connector. The keying of the connector will not allow for an improper connection.

There is one fuse attached to the wiring harness close to the ECM. This fuse is for protection to your vehicle and components in case of a wire grounding out or some sort of malfunction.

The PINK wire needs to be attached to an Ignition 1 (battery power only with key on) power source. Ensure that this is an ignition 1 source. An ignition 1 source is 12volts available any time that the key is not in the off position. Also this PINK wire has to have 12V while the vehicle is in the cranking mode (starting). This means the wire will have power when the key is on, or start, or back to on. Usually this wire can be taken from the power side of the coil (+) or the power from the old distributor or the fuse box. The system will not work if power is not provided to the (PINK) ignition wire while cranking. For the TR6 it may be connected to any solid white wire.

The red wire is to be connected to a direct battery lead which has 12v always feeding it; a direct connection to the battery is the most desirable. It is important that these wires are connected to the indicated source or your fuel injection system will not operate properly.

It is very important that the ECM and components be supplied with proper voltage all the time.

IMPORTANT NOTE: Single wire alternators do not work well with fuel injection systems. We do not recommend or provide support for vehicles equipped with single wire alternators such as described above. Many people like to use single wire GM Delco alternators. These alternators need to see elevated engine RPMs before they begin to charge. If you are using this type of single wire alternator, beware that you may not have the proper voltage provided to your system on initial startup. Simply blipping the throttle will bring you up to proper voltage. We do not recommend these types of single wire alternators for fuel injection applications.

A hole needs to be drilled into your firewall to allow the harness to pass from the dash area to engine area. In some cases there may already be a hole that can be used to pass the harness through. If this is the case then use and seal up the hole appropriately. If you need to drill a hole this hole needs to be approx. 1 1/2, or whatever size you need to fill with a grommet when sealing up.

Pass the engine connector ends of the harness through the hole in the firewall or through the glove box first if mounting there.

The fuel pump wire can also go through the firewall or be run inside of the vehicle to the rear of the vehicle area for hook up. This would require a small hole in the floor pan someplace. Ensure that you have insulated it so that it cannot be grounded out to the body. It is advisable to hold off permanently placing your harness until all of the sensors and ECM have been connected.

The fuel pump relay is part of the harness on the inside of the vehicle. This relay should be mounted in a location that will keep it from moving around in the vehicle.

Included also is the power relay. This relay is used to ensure that proper voltage is supplied to your system on any vehicle. Some vehicles have insufficient wiring to operate a fuel injection system. This relay connects to Ign. 1 via a pink wire from a key on position and energizes the relay. Main power supply to the relay is a heavy red wire to the positive side of the battery via a large fuse holder. The looped wire on the holder needs to be cut and one side connected directly to the positive battery post and the other end of the fuse holder connects to the red wire lead labeled battery. Other alternate places to get 12V battery power are the starter solenoid, or any other “Battery” full time 12-volt supply. We have included a length of wire long enough to choose your own connection option.

An ALDL connector is another extension of the harness mounted inside of the vehicle. This connector is a two-row rectangular connector with mounting tabs on it. This is usually mounted under the dash, and available for diagnostics and PC or scan tool hook up. A PC running WinALDLD or a GM scan tool can monitor the sensors and retrieve trouble codes. For the scanner you can use a late 80s or early 90s GM TBI definition for proper operation. For some scan tools enter VIN 10th L 3rd C 8th K.. Included in the kit is CD with WInALDL and a USB cable to make connection. Also on the CD is troubleshooting help, various tuning aps, etc.

An orange wire is also provided which is connected to a check engine light. This light can be mounted in the dash, use an empty idiot light socket in the instrument panel, or in place of the no longer used Choke knob. It should be mounted in an area noticeable in case of any malfunctions. The wire from the ECM is the ground for the light. When a fault exists, or the system is in diagnostic mode, or the engine is not running with the key on, the light is illuminated. The other side of the light requires a 12v key-on ignition feed that you need to supply from the fuse box, or other source.

Fuel Pump

An external fuel pump may have been included with your TBI system. This pump delivers a constant 15-psi to the throttle body where it is then regulated down to 10 - 13 psi and returned to the fuel tank. (TR6 is 11.5 psi, more is not usually better) This pump should be mounted to the frame or body of your vehicle in an area that will be protected from the elements as best as possible. The fuel pump should be mounted below and near the fuel tank fuel level for the pump to work properly. If necessary put a cover over it to keep the environment away form the pump. A fuel filter is to be installed in the fuel line PRIOR to the fuel pump. Premature failure of the pump can be the result of improper fuel filter installation. Some aftermarket high density fuel filters can cause a large drop in fuel pressure under load and are not recommended for use with your system. If you are using one of these types of filters insure that you have proper fuel pressure during all modes of operation.

A 12 Ga. pink wire labeled Fuel Pump, with sufficient length has been included with the wiring harness for the pump power feed. This wire comes from the fuel pump relay, which is mounted on the inside of the vehicle. Very important for proper operation of the fuel pump is the mounting and the ground. A ground wire is to be attached to a good clean chassis ground or run back to a battery ground. An improper ground will result in insufficient fuel flow and or premature pump failure. Mount the fuel pump

in the rubber brackets supplied or similar, to keep the pump noise from radiating into the vehicle. You can use the mounting screws supplied with the pump, or supply your own to ensure proper mounting. You may want to prime the fuel feed line with gasoline to aid in the priming of the pump for proper operation.

Fuel Lines

See: https://www.pattonmachine.com/support-system/why-throttle-body-injection-tbi/fuel-tank-lines-and-pump-with-instructional-video/

A TBI fuel injection system requires two fuel lines for proper operation, a feed line and a return line. Some vehicles are built with two lines for this purpose, even with carburetors. If you are starting from scratch, you will need to install both of these lines from the fuel tank to the Throttle body. Usually a 5/16" line is used for the feed, and return. If you do not have a place to return the fuel to the tank within the fuel-sending unit, parts are available to return the fuel into the filler neck tube. Use only fuel line rated for 50psi and fittings approved for fuel injection.

Throttle Body

Install the TBI adapter plate to the top of your carburetors. When installing the injectors it is very important to install the lower injector o-rings into the TBI adapter and use light oil as a lubricant before inserting the injectors. ATF is an excellent lubricant for the o-rings. Slip the injectors in with a twisting motion until they are seated even with the housing. Two screws hold the retainers in place. Improper installation often nicks the o-ring that will drip fuel causing a rich condition..

Ensure that smooth unrestricted movement can be obtained from the accelerator pedal from idle to WOT (Wide Open Throttle). Connect the wires to the injector (s), TPS (Throttle Position Sensor), and IAC (Idle Air Control) valve. Connect a vacuum line to a full vacuum source for the MAP sensor. Usually the vacuum port on the top of the balance tube is a good full vacuum source to use for your MAP sensor (listed below). Plug all vacuum ports not being used; it is critical that there are no vacuum leaks. Connect fuel lines to the rear of the TBI adapters with 5/16" fuel injection rated hose. Some installations may require adding a small vacuum port to the intake manifold.

Engine Sensors

Map Sensor

The MAP sensor is a very important part of the fuel injection system. This sensor sends a voltage to the ECM in relation to the amount of vacuum (pressure) the engine is creating. This signal is used in conjunction with the engine speed to infer the amount of air that is being used by the engine. This is what is called a speed/density system. Because fuel mixture is dependent on this signal it is very important to install correctly. This sensor is to be installed as close to the manifold vacuum source as possible. The port on the sensor is best to face downward to prevent water from collecting in the sensor. This vacuum line is ¼" hose and best if kept as short as practical. Some people install this sensor on the firewall behind the intake, or even on the air cleaner at times. Attention needs to be given to the connection of the vacuum line ensuring no leaks.

Coolant Sensor

The coolant sensor is just like it sounds; it sends an electrical signal to the ECM indicating the engine cylinder head coolant temperature. This sensor is to be installed before the thermostat preferably in the intake manifold coolant crossover. In many instances there is an NPT fitting that is plugged that can be used to install the sensor. Connect the two-wire connector. Ensure that there are no coolant leaks from the threads of the sensor. It is also important that a continuous flow of coolant is present at the tip of the sensor or a false reading can result. A 180 thermostat is preferred. For the Triumph TR6 and similar cars see: https://www.pattonmachine.com/support-system/why-throttle-body-injection-tbi/coolant-temperature-sensor/

Oxygen Sensor

The oxygen sensor is installed in the exhaust pipe and samples the exhaust to determine if the engine is running rich or lean of 14.7:1 air/fuel ratio. The O2 sensor should be installed as close to the engine as possible. If you are installing headers, the sensor should be installed in the collector. A threaded boss has been included with your kit that needs to be welded into the exhaust pipe to hold the O2 sensor. Placement of this boss should always be in a position that is somewhere between horizontal to vertical. In no instance should the sensor wire be pointed in a position that would be considered facing down as it will collect water.. Many muffler shops are equipped to install these sensors if you are looking for someone to install it. On the Triumph TR6 it is easiest to install the bung in the down pipe right at the first bend. For late model TR6's with twin pipes it can be installed in either pipe and still provide a good reading as long as all cylinders are performing similarly. Admittedly that is not an ideal solution but has worked well.

Crank Input

A wire labeled CRANK SIGNAL is to be installed on the crank terminal of the starter solenoid or off the ignition switch. A signal is provided to the ECM from this wire only when the engine is cranking. The ECM, to determine when the engine is cranking, uses this signal to allow the fuel pulse width to be expanded for cold start up fuel enrichment. On the Triumph TR6, the wire on the solenoid is white/red

Engine Ground

An eye terminal with 1-3 black wires and labeled engine ground needs to be properly attached to the engine block. It is very critical that a proper ground is used for this input to the ECM and that it is mounted to the engine block itself. Many people attach this to one of the bolts on the back of the bell housing; this works fine. It is most critical that this is a connection going to a bare grounding surface and not a painted surface. It is a good idea to run an extra ground wire from the negative (-) on the battery to the ground wire coming from the ECM (from the wire harness Engine ground). Make sure that the ground strap from the engine to the body of the vehicle is intact. An improper ground will not allow the system to operate properly. On the Triumph TR6 the most convenient location for this ground strap is one of the engine mount bolts.

Distributor

Your fuel injection system requires one of several different ways to trigger the ECM and control spark. If you are installing a complete EFI system it will include a distributor conversion kit. If it is a Lucas distributor see: https://www.pattonmachine.com/support-system/why-throttle-body-injection-tbi/tbi-electronic-distributor-conversion-with-instructional-video/

If you are using an MSD or other after market ignition system without an ECM controlled distributor you will only have control of the fuel for your engine; however your ignition module will provide the trigger to

the ECM. Simply hook the tach output from the module to the wire labeled tach input on the wiring harness.

If this installation is using an electronic ignition system that is part of your vehicle already (like a Pertronix Ignitor), a tach filter will be used. A wire marked tach input will be part of your wiring harness and connects to the (-) terminal of the ignition coil or the tach lead of your MSD or Jacobs ignition module as mentioned in the previous paragraph.

AIR CONDITIONING

Harnesses built after late 2021 are already set up with AC wiring that enables the ECM to raise idle speed when the AC compressor runs. If don't have AC skip over this section. In the harness you will find a green wire labeled (AC). Connect this wire to the 12V wire that engages the AC clutch.

Final Checks And Start Up

After you have finished the above installation you are ready to check the system for operation. Turn the ignition key to the ON position, but do not start the vehicle. The fuel pump should turn on for about 2 seconds and then turn off. If this does not happen see #7 below in troubleshooting. Leave the ignition in the ON position until the fuel pump has turned off. Turn the ignition off for at least 10 seconds and repeat the ignition cycle. Perform this operation 2 or 3 times to allow fuel to fill the system preparing to start. Set the fuel pressure on the regulator to 12psi.(11.5 on a TR6) Inspect all fuel lines and connections to ensure there are no fuel leaks.

Assuming no fuel leaks, you are ready to start the engine. Start the engine and let it idle; it may take a bit to run smoothly. At this point your timing has not been set, the control system has not learned the engine. These are all functions of the fuel injection system that happen after the engine has been running.

Connect your laptop and run WinALDL or if you have access to a scan tool use a hook up for a 1990 350 cu. in. 5.7L Camaro. For some scan tools enter VIN 10th L 3rd C 8th K.

If you are using the original distributor set the timing as before this conversion. If you have installed a new distributor or converted your distributor you will need to reset the timing.

Carefully read this section and for more detailed instruction see:
https://www.pattonmachine.com/support-system/why-throttle-body-injection-tbi/tbi-electronic-distributor-conversion-with-instructional-video/

This is accomplished by disconnecting the single lead wire electrical connector breaking out of the harness near the ignition module. With this wire disconnected, set your timing to 12 deg. for most applications. The ECM does all of the timing for you and uses the reference of 12 degrees to properly deliver the correct spark angle. With the set timing wire disconnected, your check engine light will illuminate and set a code 42 EST malfunction. After the timing has been properly set, reconnect the single lead wire and turn the vehicle ignition off. Wait for at least 10 seconds and restart the vehicle. The ECM will not control the timing until the vehicle has been turned off and on with the connector in proper position. You can clear the code 42 by disconnecting the battery lead to the ECM for at least 10 seconds.

Timing light not firing
Spark plug voltages in the 60K V area and will not fire when cranking these older engines especially when voltage to the (+) side of the coil drops below 10V when cranking. Many of the cutting edge modern timing lights are looking for 60KV from the coil and won't fire unless they see better than 35KV. To get around that you can put a battery charger on the battery. Take out all the spark plugs and lay the #1 plug on the block with the timing light connected to it. Old time timing lights are much less fussy.

If your system is equipped with a tach filter and not using the ECM controlled distributor set ignition timing to the factory specifications for your engine.

Restart the engine and let it idle for a while. Insure that there are no fuel or vacuum leaks while engine idle speed is controlled by the idle adjustment screws on each carb. If the engine is idling too low (below 900rpm) turn each idle screw clockwise the same amount to bring the speed up. If the idle is too high back these screws off. If the engine will not idle properly check for vacuum leaks, proper timing setting, or a check engine light illuminated. If all of these checks have been made and you are experiencing a problem go to troubleshooting guide #10 to further diagnose the issue. When you are confident that all is running properly, you may shut it down and complete the remainder of the installation.

Although you are now running a fuel injected engine it is still important that the air flow be balanced between the carbs. A flow meter such as a Unisyn or something similar makes adjusting the linkage easier. Your Bentley or Haynes manual will outline the procedure. You will not be adjusting jets or needles ever again. This may be the last time you ever need to make this adjustment!

Secure any loose wires, ensuring they are routed away from exhaust manifolds, cables, etc. You can seal the wiring harness to the firewall at this time when you are confident of the length of wire required running into the engine compartment is sufficient. Depending on how many wires are included with your harness, it may be necessary to add tape to the wires in the main portion of the harness to seal to the grommet. Install an air cleaner and you should be ready for operation.

Now that it is running you will need to adjust the Throttle Position sensor. See the link at the beginning of his guide for the procedure.

Once you have installed your Patton Machine/Affordable Fuel Injection system you will enjoy the modern technology of fuel injection system for years to come. You will enjoy a low maintenance system that provides good drivability and adjusts for towing, altitude, severe angles, off roading and other normal drive situations. The biggest advantage of EFI is dependability and drivability. EFI for the most part is relatively maintenance free once installed and working properly. The sensors are robust and provide for many miles of maintenance free operation. EFI also provides seamless drivability. The system takes care of all of your engine functions whether it is 20 deg. Or 100 deg, at sea level or climbing Pikes Peak There is no stalling and waiting for the choke to come off for most stock and slightly modified engines. Drivability is in most cases a given and allows for good response and power in all driving conditions. Troubleshooting assistance is available from Patton Machine for the mechanical side of the installation. For electronic issues and custom tuning contact Affordable Fuel Injection. **Thanks from Affordable Fuel Injection and Patton Machine.**

Troubleshooting your Fuel Injection System

There are troubleshooting charts on the CD that was included with the kit

Most of the problems encountered while installing your fuel injection system or after a time of operation are very simple. If your check engine light is on you more than likely have a hard fault meaning

something is grounded out, unplugged or has gone bad. See Below for how to determine what your fault may be and what the codes mean.

The ALDL connector allows for full diagnostics of your unit. WINALDL or a scan tool can be used and set up for a GM TBI application to read the data, or to check for stored codes. Consult a service manual or see below for any check engine light code definitions. You can use a late 80s or early 90s GM TBI definition.

If you have access to a scan tool use a hook up for a 1990 350 cu. in. 5.7L Camaro. For some scan tools enter VIN 10th L 3rd C 8th K. If you have installed a Fuel Injection system in your vehicle and are having some initial issues here is a quick checklist to work from to get you started.

Pink Ignition wire MUST be connected to 12 volt switched ignition that receives power during crank and key on.

1. Check to make sure your check engine light is not on, or that it is on with the key on but the engine is not running.

2. Make sure that the red battery wire is connected to a battery source (It is highly recommended that this wire is connected directly to the battery) and the pink wire is connected to an ignition 1 source. If your ignition wire is not connected to an ignition 1 source your ECM will not be powered while cranking the engine. 3. Check that the ground wire is securely fastened to the block and that the interface between the block and the terminal are clean.

3. Ensure that there are NO vacuum leaks.

4. Ensure that your MAP sensor is connected to a full manifold vacuum source and not a ported source.

5. Set the ignition timing correctly making sure that you disconnect the set timing connector to set it. In some cases you cannot set the timing with the connector disconnected and keep the engine running. If this happens set timing to 15 degrees, allow the engine to fully warm up, then disconnect the set timing connector to set the base timing to the correct specification. 6. Ensure that you have full manifold vacuum routed to your fuel pressure regulator and there are no vacuum leaks with this connection.

6. Check your fuel pressure to ensure that you are providing the proper pressure to the system.

Fuel Pressure is critical for proper operation. Fuel tank must be free from debris and fuel pressure needs to be constant and consistent.

Some aftermarket high density fuel filters can cause a large drop in fuel pressure under load and are not recommended for use with your system. If you are using one of these types of filters insure that you have proper fuel pressure during all modes of operation.

99% of all issues are usually taken care of with one or more of these 8 steps of diagnosis.

First and foremost the engine and fuel injection system must be free from vacuum leaks. Vacuum leaks are the leading cause of installation issues with your fuel injection system. Check all sources of potential vacuum leaks including components not related to the fuel injection system.

There are instances where the vacuum leak is coming from the adapter plate used to attach the throttle body to the manifold. If this is the case make sure that the seal is positive between the manifold and the

adapter plate; also between the adapter plate and the throttle body. In some instances it is necessary to seal these with silicone to provide a positive seal.

Another common issue is a lack of good grounding. Many issues have been resolved simply by making sure that the ground path is secure and clean.

Fuel Pressure is critical to the operation of a fuel injection system. Always check to insure that you have the proper fuel pressure. Fuel pressure should be a constant 10 to 15 PSI on a TBI fuel injection system. Fuel pressure on a TBI unit should stay constant.

With retrofit fuel injection systems many times we are drawing fuel from gas tanks that are many years old hence many years have passed where contamination can settle into the fuel tank. The electric fuel pump installed for a fuel injection system is drawing a considerable more volume of fuel from your tank than your old system did. If there are any contaminants in the tank this many times will plug up or greatly restrict the flow of fuel to the system causing many issues.

Your fuel injection system has been pre calibrated to your particular vehicle. As long as the information about your engine was correctly stated, the system as received will provide many years of trouble free use. However from time to time problems are encountered with your fuel injection system.

Here are a few commonly asked questions about fuel injection problems. Match the issue # with the chart below for an explanation of the issue.

1. My engine is running way to rich, what is the problem?
2. My engine is running to lean, what is the problem?
3. My engine cranks but will not start.
4. I do not seem to have as much power as I should?
5. I am getting a sag when I accelerate.
6. My engine takes longer to start than I think it should.
7. The fuel pump is not coming on when I first turn the key on.
8. The RPM on my engine does not come down when I come to an idle.
9. I am not getting as good of fuel economy as I think I should.
10. The engine is revving up and down when I come down to an idle.
11. My fuel pump is real noisy.
12. My check engine light does not come on when I turn the key on.
13. My check engine light is flashing fast all the time.
14. My check engine light is on.

1. You may have your MAP sensor connected to a ported vacuum source and not full manifold vacuum. You may have a vacuum leak causing low engine vacuum to the MAP sensor. Your fuel pressure is not set properly or your fuel return line is restricted. On a TBI system your base gasket may be the wrong size or not sealed properly. On an MPFI system you may not have the vacuum line connected or a secure connection to the fuel pressure regulator; this is also a full manifold vacuum source.

2. You will see a recurring theme in these troubleshooting notes and that is vacuum leaks. This is the biggest cause of engines running too lean and should not be taken lightly. Fuel pressure is not coming up to proper pressure. See discussion on fuel pressure in previous paragraphs. Plugged fuel filter; make sure that your fuel tank is not contaminated.

3. Make sure that your distributor is powered up with an ignition 1 source. Ignition 1 provides 12v of power at all times the key is in the on or the crank position. Ensure that the relay and the ECM are receiving power from the battery and an ignition 1 source to the red and pink wires respectively. The battery wire must be connected to a battery source and the ignition wire must be to an ignition 1

source. On TBI units ensure that the crank wire is connected to the crank side of the ignition switch or the crank side of the starter solenoid.

4. Verify that you have set your timing properly by disconnecting the set timing connector, setting the timing to the specified value, reconnecting the connector and shutting the engine off and starting it back up before proceeding. Ensure that your plug wires are properly connected with the correct firing order. Your fuel pressure may be insufficient; see fuel pressure discussion in previous paragraphs. Verify that there are no vacuum leaks and that the MAP sensor is properly connected.

5. Timing is a critical issue with sags. Verify that your timing is correctly set by disconnecting the set timing connector and properly setting the timing; see #4 also. Fuel pressure is not adequate for proper operation, make sure that there is not contamination in the tank or your fuel filter is plugged. A plugged fuel filter may be an indication of a contaminated tank. Bad ground to the block, insure that the surface that you are making the connection to on the block is clean and making a positive connection. Your O2 sensor may be contaminated, bad or not properly installed in the exhaust. You may have left out some of the important specifications for the proper calibration chip to be made.

6. Check that the MAP sensor is properly connected to a full manifold vacuum source. Ensure that the vacuum source to your MAP sensor is free from restrictions and has a secure connection. Check for vacuum leaks, this is the most common cause. Make sure that your timing is set correctly; see #4. Fuel pressure is not adequate for proper operation. See previous paragraph for discussion on fuel pressure and proper operation. Fuel pump relay is not coming on or is faulty. On a TBI system verify that the crank wire is connected to the crank side of the ignition switch or the crank side of the starter solenoid.

7. Your battery and ignition wires are improperly connected. You have not provided a good ground to the fuel pump. Fuel pump relay is not connected. ECM is not properly installed and/or the chip is not properly installed.

8. More than likely you have a large vacuum leak, verify that your system is free from vacuum leaks. Your ignition wire is connected to a battery source and not an ignition 1 source. The engine has not come to full operating temperature as of yet. Your thermostat is inoperable or opens at too low of a temperature. You should be using at least a 180o stat. Throttle cable or throttle on the throttle body is not coming to a complete close. Throttle plate is binding in the throttle bores.

9. If all is set up properly with the installation of your fuel injection system you are probably getting as good of fuel economy as you are going to get. Ensure that your timing is set properly, your thermostat is in good working order and your fuel pressure is at the specified pressure. You may have other factors such as tires, brake drag or other external issue from the fuel injection system that is not working properly. Re-evaluate your driving habits and insure that you are driving in a fashion that will provide you optimum fuel economy. If you are trying to race everyone from the light chances are you will not get the fuel economy that you expect.

10. This is usually an indication of a vacuum leak; again make sure that you have no vacuum leaks. This could also be an indication of the wrong base ignition timing. Verify that you have set your ignition timing correctly (see #4). Your engine may also require more air going through the throttle plates at idle than it is currently set for. Here is a procedure to check this setting. Make sure your engine temperature is at full operating temperature. Jumper Pins A & B of the ALDL connector (I use a paper clip) with the key on but the engine off. This is the same thing you do when checking for engine codes and your check engine light will flash off 13 and on. Wait about 45 seconds or until any trouble codes present have flashed through; code 12 is normal (see #14) After this then unplug your IAC valve which is on the throttle body. Remove the jumper from the ALDL, turn the key off and then start the engine. It may start hard and you might have to depress the throttle pedal a little bit to start the engine. If you have a fast

idle this did not work and you may have to tape over the fresh air hole that the IAC receives it air from. If you do not have a fast idle then it is OK and you can proceed to adjust the throttle plates. Let the engine idle for a little bit and then check you idle speed. The speed should be about 550 600 in idle or about 100 rpm less than you requested for your chip. If it is lower than this you can raise the idle up or if it is above this determine if you should bring the speed down. More than likely it will always be lower. There is a little cap on the side of the throttle body by your throttle lever that has an adjustment screw under it. Remove this cap and use the screw under there to adjust your base idle speed without the IAC operational. If you have done all of this and you still have an issue we may not have received all of the proper information to build your chip.

11. If your fuel pump is real noisy you may not have isolated it from the body or the frame real well. Isolation brackets were provided with your fuel pump. If these are properly installed it should isolate any radiated noise from the pump. If this is insufficient you may need to isolate it more with some rubber grommets. We have also diagnosed noisy fuel pumps with fuel return lines being too small. By stepping up the size of the return line you may eliminate fuel pump noise after the other items have been addressed.

12. Your check engine light should illuminate when you turn the key to the on position for a bulb check. If this does not come on it is possible that it is not receiving 12 volts to the one side of the bulb. The wire provide that comes from the ECM provides a ground circuit for the light. You will need to provide a 12 volt ignition source to the other side of the light. Check to ensure that you have 12 volts on one side of the light and that the light is functional. If the light is functional and you have verified that you have 12 volts provided to one side of the light then the ECM is not operating. Ensure that the fuse for the ECM is OK. If the fuse is OK insure that you are receiving 12 volts to the ECM where indicated (see wiring diagram provided) If you are not receiving 12 volts to the ECM something in the vehicles power circuit is not connected properly. If 12 volts is available at the proper cavities of the ECM please check that you have a proper ground circuit to the engine block. When all of these steps have been taken the ECM may not be working properly, please contact us for further diagnosis.

13. A constant rapid flashing check engine light indicates that you have a fault in the ECM and it is operating in back up or limp home mode. Make sure that the calibration chip is in the ECM and there are no bent pins on the chip. If the chip is properly installed and there are no bent pins the ECM or the chip is faulty and needs to be replaced or repaired.

14. A check engine light indicates a hard fault with your fuel injection system. Ensure that all of your sensors are connected, you have a good ground and that no wires are pinched. Also insure no vacuum leaks and that your MAP sensor is connected to a full manifold vacuum source. If all of these steps indicate a proper installation and no issues you will need to read the codes from the memory area of the ECM. If you have a scan tool this is very easy. If you do not have a scan tool you can use your check engine light to output the fault codes. Below you will find this procedure along with a definition of all the different fault codes that can be output.

To Display Trouble Codes

Run a wire (I use a paper clip that is in a U) from Pin A to Pin B with the ignition on but the engine not running. The "Check Engine " light will flash in the following sequence: flash, pause, flash-flash, long pause flash, pause, flash-flash, long pause flash, pause, flash-flash, long pause. This is a code "12" which will always be there. After this series of flashes and pauses any stored trouble codes will now flash. If you do not see the "12" flash three times, your diagnostic circuit is defective. Vehicles will display stored trouble codes, then "12" again, followed by energizing "most system controlled relays." The fuel pump relay will not energize. The idle air control valve will fully extend to enable checking minimum idle speed.

Clearing Trouble Codes

Turn the key to the off position. To clear any trouble codes, disconnect the battery for 30 seconds or unplug the connectors to the ECM. If this is done at the battery, and your car stereo is equipped and programmed with a four digit pin code, you may have to re-enter that as well to use your stereo again. A better place to remove power is at the fuse.

Trouble Codes

12. No reference pulses to Electronic Control Module (ECM).
13. Oxygen sensor signal stays lean during warm engine cruise, your O2 sensor could be unplugged.
14. High temperature indicated at engine coolant temp sensor. Sensor could be unplugged
15. Low temperature indicated at engine coolant temp sensor
21. High voltage at throttle position sensor. Sensor could be unplugged.
22. Low voltage at throttle position sensor
23. Low temperature at manifold air temperature sensor
24. Circuit fault in vehicle speed sensor
25. High temperature at manifold air temperature sensor
32. Fault in exhaust gas recirculation valve diagnostic switch
33. High voltage (low vacuum) at MAP sensor.
34. Low voltage (high vacuum) at MAP sensor.
42. Fault at electronic spark timing circuit (sets when timing is set also, clear code and verify that it does not return.)
43. Low voltage at electronic spark timing circuit
44. Oxygen sensor lean
45. Oxygen sensor rich

51. PROM error
54. Low voltage at fuel pump OR Low voltage at Fuel pump relay
55. Problem at Electronic Control Module (ECM) - ECM failure OR Serial bus error

Fuel Injection TBI Pin Out

A-1 BLUE FUEL PUMP RELAY "F"
A-4 WHITE EGR (if equipped)
A-5 ORANGE CHECK ENGINE LITE
A-6 PINK IGN 1 RUN TO PIN A ON INJECTORS
A-7 PURPLE TOURQUE CONVERTER (if equipped)
A-8 BLUE ALDL CON. PIN "E"
A-9 BROWN ALDL CON. PIN "B"
A-10 BROWN VEHICLE SPEED SENSOR
A-11 BLACK/WHITE MAP RETURN GREEN CON. A
A-12 BLACK TO BLOCK GROUND TOTAL CONNECT WD-1, D-6
B-1 BAT RED FUSED CONNECTS WITH C-16
B-2 ORANGE FUEL PUMP RELAY PIN"A"
B-3 BLACK/WHITE PIN D DIST GROUND W/SMALL DIST. PIN A
B-5 TAN PIN B DIST REF W/SMALL DIST PIN C
B-7 WHITE 60 ESC PIN C PIN D (GND) PIN B ING. PIN E KNOCK SEN. (if equipped)
B-8 GREEN A/C or Compressor/Winch idle increase
B-10 P.N.

454

C-3 GREEN IAC W/MALE W/P PIN D D
C-4 BLUE IAC W/MALE W/P PIN C C
C-5 GREEN IAC W/MALE W/P PIN A B
C-6 BLUE IAC W/MALE W/P PINB A
C-7 GREEN HIGH GEAR
C-9 TAN CRANK INPUT TO STARTER STUD or IGNITION SWITCH
C-10 YELLOW ECT
C-11 BROWN MAP INPUT PIN B ON GREEN CON.
C-12 TAN MAT (if equipped)
C-13 BROWN TPS PIN B ROUND TPS PIN C
C-14 ORANGE (5V REF) GOES TO MAP & TPS PIN C ROUND TPS PIN A
C-16 RED 12 VOLT CONNECTS IN WITH B-1
D-1 BLACK BLOCK GROUND CONNECT W/ D-6, A-12
D-2 BLACK/WHITE ECT & TPS RETURN ON TPS PIN A ROUND TPS PIN B
D-4 TAN DIST SIGNAL PIN A W/SMALL DIST PIN D
D-5 BLUE IGN BYPASS (FOR TIMMING) PIN C W/SMALL DIST PIN B
D-6 BLACK/WHITE O/2 GROUND GOES TO BLOCK GROUND CONNECT W/D-1,A-12
D-7 PURPLE 0/2

D-14 GREEN INJECTOR'S PIN B
D-16 PURPLE INJECTOR'S PIN B
PINK WIRE TO IGN. 1 PIN A FROM INJECTORS FROM A 6
PIN D ON FUEL PUMP RELAY TO BLOCK GROUND 28" BLACK
PIN E ON FUEL PUMP RELAY TO IGN.
PIN A ON ALDL TO BLOCK GROUND

RELAY

85 FROM ING. SWITCH 30
86 GROUND 85 87A 86
30 12V. ALSO CONNECT W/12V TO ECM, B1, C16 87
87 ING. OUT
PIN A FOR SMALL DIST 2 PIN CONN IS IGN. PIN B IS COIL WIRE (WHITE)