

INSTALLATION OF HOWELL ENGINE DEVELOPMENTS HIGH PERFORMANCE  
2 & 4 BBL THROTTLE BODY FUEL INJECTION ON ENGINES ORIGINALLY  
EQUIPPED WITH CARBURETORS

THIS SYSTEM IS BASED ON THE PRODUCTION GM (Chevrolet) THROTTLE BODY  
FUEL INJECTION SYSTEM AND ELECTRONICS USED FROM 1987-91, ON 305,  
350, AND 454 V-8 ENGINES. ALL BACKUP SYSTEMS AND "ON VEHICLE"  
DIAGNOSTICS FUNCTION SIMILAR TO THOSE MODEL YEAR ENGINE PACKAGES.

THIS EFI SYSTEM CAN BE OPERATED WITH COMPUTER CONTROLLED SPARK  
ADVANCE USING THE LATE MODEL GM V-8 DISTRIBUTOR, OR IT CAN BE  
SPECIFIED FOR USE WITH CONVENTIONAL OR AFTERMARKET HIGH  
PERFORMANCE IGNITION SYSTEMS, USING A TACH SIGNAL FOR RPM INPUT TO  
THE ECM. THIS ALLOWS USE ON FORD, CHRYSLER, & AMC ENGINES, OR ANY  
ENGINE WITH A TACH SIGNAL.

Installation procedure will be separated into the following categories:

1. Special EFI parts required.
2. Removal of non-required parts from carbureted engine.
3. Installation of TBI and engine hardware.
4. Installation of Electronic components and wiring harness.
5. Special calibration PROM and vehicle ECM.
6. Initial vehicle start-up and operation.
7. Initial driving impressions.
8. Tuning adjustments.

Realizing that there may be a variety of engine configurations, sizes, and usages, these instructions are for a typical 454 truck or or high performance small block engine. If you are using our system on a non-GM engine, or without ECM controlled spark timing, ignore any sections on timing or knock sensor control.

**SPECIAL EFI PARTS REQUIRED**

1. Holley 4 barrel TBI unit with modified throttle lever and Idle Air Control, or 600 CFM 2 barrel.
2. Late model, computer controlled, HEI distributor (either coil in cap, or remote coil design). (In GM engines only, using distributors specified for ECM spark control. All others use only a tach signal from

the ignition coil.)

3. Intake manifold appropriate for the TBI being used. For 2 barrel systems, it is best to use a 2 barrel manifold. Holley does sell a 4 barrel to 2 barrel adaptor, and Howell Engine Developments has an adaptor designed specifically to convert Q-jet truck manifolds to the 4 barrel TBI bolt pattern.
4. Howell wiring harness to connect all engine sensors and TBI, to the vehicle ECM and interface with your vehicle.
5. Vehicle ECM (computer), usually \*1227747, or \*1228747 (454's with knock sensor spark control require \*1228747. Part \*1228746 and \*16146299 can also be used on specific applications).
6. Coolant sensor (GM). Intake manifold mounted so ECM can read engine temperature.
7. MAP sensor to measure intake manifold vacuum, and feed information to the ECM.
8. Oxygen sensor. Exhaust manifold or pipe mounted, so ECM can monitor the air-fuel ratio.
9. Fuel Pump Relay. Turns high pressure fuel pump on and off at command of the ECM.
10. Detonation (knock) sensor (for systems with ECM controlled spark advance only). Mounted directly to the cylinder block, usually in one of the water drain holes.
11. ESC Module (for systems with ECM controlled spark advance only). Filters the knock signal and sends it to the ECM, so spark can be retarded to stop detonation.
12. In-line or in-tank high pressure, electric fuel pump, and EFI fuel filter.

#### REMOVAL OF NON-REQUIRED PARTS FROM CARBURETED ENGINE

Remove the Air Filter, carburetor, distributor (if using ECM spark timing control), fuel lines, mechanical fuel pump, and push rod from the carbureted engine. You can fabricate, or purchase a fuel pump block-off plate to seal the fuel pump cavity (it is a standard part for EFI GM engines).

Trace and record the use of any vacuum lines disconnected from the carburetor for later reconnection to the TBI.

Some heavy duty trucks and motor homes without catalytic converters, use a full time AIR pump to add air into the exhaust through ports in the exhaust manifolds. **YOU CANNOT USE AN OXYGEN SENSOR & CLOSED LOOP SYSTEM ON THESE VEHICLES.** The added oxygen will interfere with a true sensor reading, and the engine will run too rich. Contact us for alternate solutions, or an open loop system, if your engine fits into this category.

#### INSTALLATION OF 2 OR 4 BARREL TBI AND ENGINE HARDWARE

1. If you are installing an aftermarket intake manifold, you may need to drill and tap it for a vacuum source to be used exclusively by the MAP sensor or PCV valve, when using the 4 barrel. It cannot be tee'd together with transmission or brake booster vacuum sources. (The Holley 2 barrel and latest model 4 barrel have the correct vacuum taps for MAP). With an aftermarket intake manifold, you should not need an adaptor between manifold and TBI unless it has a Quadrajets bolt pattern only. Also, make sure you can fit the special TBI coolant temperature sensor to the thermostat housing crossover at front of manifold.

2. If you are using a stock 454 cast iron intake manifold, install Howell Eng Dev special 1 1/2" thick adaptor plate to intake manifold, using new gaskets. 3 pipe nipples are installed in adaptor plate. Power brake vacuum, MAP sensor vacuum, and cannister purge vacuum lines all connect to the adaptor plate. Connect brake booster and MAP vacuum lines to 3/8 and 3/16 hose nipples on back of adaptor. This should restore brake vacuum and MAP vacuum.

3. Install ECM controlled HEI distributor (if using the complete GM system), and align the star cam and magnet points to match at TDC, or 4 degrees before TDC timing. Initial timing will be re-set when the engine is running.

4. FUEL LINES AND FUEL PUMP--At this point you may want to fabricate and route your fuel lines from the high pressure fuel pump to the TBI, and returning to your fuel tank. THE HIGH PRESSURE, OR FUEL 'IN' FITTING IS ON THE DRIVERS SIDE OF THE TBI. The fuel pump is an in-line design that will operate at approximately 15 PSI. It should be mounted near your fuel tank, no higher than mid-level on the tank, and clamped in rubber to isolate any pump noise. It has hose nipple ends for easy installation. High pressure end of fuel pump has the electrical terminals. If you are sure there is a screen filter on your tank fuel pick-up, mount the EFI filter between the pump and engine. If you are not sure, mount the filter so that it filters fuel before it gets to the pump, to keep dirt out of the pump. (90 percent of electric fuel pump problems are caused by dirt getting into the pump along with the fuel.)

You can use 3/8" or 5/16" steel lines, braided metal covered flexible fuel lines, or a good grade of braid reinforced neoprene fuel line. 15 PSI of fuel pressure is not difficult to contain, or seal at the connections.

You must run a 5/16 or 1/4" fuel return line from the TBI back to your fuel tank. You can dump the return fuel back into the tank just about anywhere you choose.

We have used \*6 lines satisfactorily, and 1/4 NPT to \*6 adaptors are readily available to fit the outlets in the TBI unit.

Use good quality, small, screw type hose clamps, available at any auto parts store.

5. Install TBI unit and connect gas lines. Do not over torque nuts that hold down 4 barrel TBI, as you may warp the base and cause throttle shafts to bind.

6. Connect vacuum lines as appropriate for your engine. MAP and AIR diverter valves require full time vacuum. EGR and Cannister purge connections use ported vacuum (No vacuum when the throttle is closed).

There are 3 distinct models of 4 barrel TBI units. All early (89-92) models were sand castings with two small vacuum tubes and a PCV vacuum tube at the front. HED machines these for installation of GM idle air controls at the front. These units usually require a MAP vacuum source from the intake manifold, or an adaptor or spacer between the TBI and manifold. In 1993, Holley introduced 2 die cast

versions, one similar to the earlier sand cast versions, and one with a Holley sourced idle air control already in place, plus other minor changes. Installing the IAC in the die cast versions required elimination of the PCV port. You will need to supply a MAP and PCV port both, for this die cast version, either from the manifold or a spacer between TBI and manifold. The 3rd version with Holley IAC has an excellent MAP vacuum port on the right rear corner, so you need only supply a PCV tap on the manifold or spacer.

7. Throttle cable: A throttle cable extension kit is supplied with all 4 barrel kits using our special cable progressive throttle linkage. This will allow you to keep your stock throttle cable brackets and extend the cable itself to the proper length. This throttle linkage gives a progressive action that allows a gentle application of power, even though the 4 barrels operate simultaneously. Your cruise control cable can attach to the stud also located in the throttle plate. 2 barrel TBI's have a throttle cable stud similar to production 2 barrel carbs.

8. THROTTLE RETURN SPRING: Because the 4 barrel TBI does not have adequate torsion springs to insure complete throttle closing, a GM double return spring is included. Attach the return spring so that it has adequate tension to return the throttle to closed with engine running. Also insure there is adequate clearance to vent hoses, & throttle linkage to prevent binding. 2 barrel TBI's have an adequate built-in torsion spring.

9. On the 4 barrel, you may wish to install a fuel pressure gauge to monitor TBI fuel pressure. If so, use the 1/8" NPT port on the left rear of TBI. Fuel pressure regulator is preset to 11 PSI by Howell Engine Developments. Use a 15-20 PSI max gauge to insure accurate readings.

10. AIR CLEANER--Production carburetor air cleaners do not usually work well on TBI units. The injector nozzles extend above the air cleaner flange too far. If you space them up enough, the spacer may become an air flow restriction. Production TBI air cleaners can usually be modified slightly, and will fit and clear the injectors and throttle lever. If necessary a 1/2" or less spacer can be used.

Aftermarket open element aircleaners of a flat bottom design may give some additional power over stock air cleaners. K&N makes an excellent 14 by 4" flat base open element air cleaner that will fit most trucks under their part number 60-1260. Don't run a 4 barrel TBI without an air cleaner. It will cost you significant power.

11. OXYGEN SENSOR--If you are using late model exhaust manifolds, the Oxy sensor boss may be located in the exhaust manifold. If you are using headers, try to get a set that has an Oxy sensor boss in one collector. If you have to install your own nipple for the Oxy sensor, Howell Engine Developments has a suitable nipple that can be welded into one of your exhaust pipes near an exhaust manifold flange.

## INSTALLATION OF ELECTRONIC COMPONENTS AND WIRING HARNESS

The Howell HP/TBI wiring harness supplied with your system does all the interconnecting wiring from the engine sensors and TBI to the GM vehicle ECM. It is designed to fit most installations. You will need a hole in the fire wall or engine cover sufficient to pass the engine connectors through from inside the vehicle to the engine compartment. The harness grounds that attach to the engine, and the distributor connector (on ECM controlled spark timing systems), locate the harness position at the back of the engine.

1. Secure the harness grounds to the back of the cylinder head, or rear intake manifold bolt, plug in the distributor connector (on ECM spark controlled systems), and route the labeled purple wire to the starter solenoid. On systems using conventional or aftermarket distributors, connect the labeled white wire to the ignition coil tach signal. The Oxygen sensor wire should be long enough to attach to your mounted Oxygen sensor. If necessary to extend it, cut and solder splice on the harness side, not the Oxy sensor lead.

2. Moving forward, connect the 4 pin injector connector to the TBI, and the throttle position sensor. The MAP sensor (Green) connector also branches off here and connects to your MAP sensor. It can be mounted on a production or fabricated bracket.

3. Further forward, the coolant sensor and EGR solenoid are connected. This completes the engine attachment, unless your engine has knock and ESC module connectors. If so these plug into their unique sockets.

4. At the rear of the engine, a separate branch tees off the main trunk, and contains the fuel pump relay, battery power, fuel pump power, and EST timing disconnect (on ECM controlled systems only). These items can be attached to your firewall permanently.

5. Inside the vehicle, mount the ECM, fuse block, diagnostic connector, and "Service Engine Soon" light in a convenient location. CAUTION: The ECM needs some air circulation for cooling, so don't put it under a carpet. Use a Radio Shack or automotive bulb socket and 12V bulb for the SES light, and mount it where you can see it while driving.

6. Using a single Weatherpack connector and terminal supplied, connect the underdash fuse block to a 12V source that has current when your ignition key is in the run AND CRANK positions. (Not an accessory position). Use 16 or 14 gauge automotive wire for this connection.

7. Using a supplied Weatherpack connector, supply battery power to the fused location on the harness on the firewall near the fuel pump relay. Use 14 gauge or heavier automotive wire for this lead.

8. Using a supplied Weatherpack connector, run a power lead from the fuel pump power location on the firewall, near the fuel pump relay, to the high pressure fuel pump. Use 16 or 14 gauge wire. Run the fuel pump ground to the frame, or back to the engine to ground. This completes the electrical harness installation.

### SPECIAL CALIBRATION PROM AND VEHICLE ECM

The heart and control center of your new electronic fuel injection is the Electronic Control Module (ECM). It is actually a small computer. It receives information from the engine sensors, (coolant temp, manifold vacuum, engine speed, and rich/lean information from the Oxy sensor), looks up an appropriate fuel and spark timing, and orders the injectors and distributor to deliver them. The correct fuel and spark settings are pre-programmed into the the CALIBRATION PROM, and must match your engine closely, for everything to work correctly. With conventional distributor ignitions, we control the fuel only with the calibration prom.

You can mount your vehicle ECM in any convenient location where it is protected from the outside elements, and has some air circulation for cooling. Typically this will be under the dash, inside the glove compartment, or under a passenger seat.

We use two GM part number ECM's (1227747 and 1228747) for most installations. These are the numbers used in most TBI engines from 1987 thru 1991. They are rugged, proven designs, the result of millions of GM dollars spent on their development. They have the ability to learn a calibration that perfectly matches your engine, and retain it in memory. They also employ back-up modes that keep you from being stranded in case of an engine sensor failure.

An added benefit of the GM ECM is its ability to alert you to potential sensor or electrical problems with a "Service Engine Soon" light, built into all of our harnesses. This light and a common paper clip also allow you to diagnose any reported problems retained in the ECM memory. Procedures for this are outlined in any GM TBI service manual, or the Howell service manual that accompanied your TBI kit.

The CALIBRATION PROM supplied with your TBI kit is mounted inside the ECM, under a plate retained by two screws. In the event you need to replace it, follow the instructions below:

1. Remove the ECM from its mounted location. Depress the latches and remove the harness ECM connectors, one at a time, from the ECM.
2. Remove the ECM cover (retained by two screws).
3. Remove the larger of the calibration proms by carefully prying and lifting it straight up.
4. Install the replacement cal-prom. (It will only go in one way, so can't be installed wrong.) Replace the cover.
5. Reverse the removal sequence, and reinstall the ECM in its vehicle mounting.

**CAUTION!!** Do not remove the cal-prom with harness still connected to the ECM. It may be damaged by 12V power that is always present in the vehicle harness when the battery is connected.

## INITIAL VEHICLE START-UP AND OPERATION

With everything mounted and connected, the vehicle should be ready for start-up. When ignition key is first turned on, listen for fuel pump operation. It should turn on for 2 to 3 seconds, and the ECM will turn it off until you engage the starter. The first time ignition is turned on may not be sufficient to fill the TBI and fuel line with fuel. Cranking for a few seconds should complete the filling. The engine should start up and smooth out after a few seconds to purge air from the system. Check for fuel leaks, and make sure none of your altered wiring or fuel lines are in a position that the exhaust system heat may damage them. **MAKE SURE THE COOLING SYSTEM IS FULL.**

On ECM controlled spark timing systems, set the initial spark timing to your desired setting with the “EST disconnect” unplugged. Re-connect the EST disconnect branch. **NOTE:** Running with the EST disconnect uncoupled will store a Code 42 in the ECM memory. You may want to disconnect the battery power for 30 seconds to clear this code. With conventional distributor ignitions, set your timing in the normal manner.

## INITIAL DRIVING IMPRESSIONS

The calibration prom supplied with your TBI system is based on several years of driving and dyno testing experience. It should be a near perfect match for your engine. However, the GM ECM has the remarkable ability to reprogram, and adapt a new program to match your engine exactly. It does this by reading information from the Oxygen sensor and adjusting the calibration until it matches GM’s original intent. It will keep this new program in its memory as long as the battery is connected and charged. If you disconnect the battery, the ECM will lose the learned program from memory, and go back to the original HED program. However, it will immediately start learning again as soon as you start driving the vehicle.

On full GM systems with spark control, all of your vehicle emission controls, knock sensor, and oxygen sensor are still functional as designed by GM. On all Howell HP/TBI systems, your GM diagnostic features still function.

Any electronic or engine control problems can still be diagnosed by a GM dealer or tune up shop, using their computer diagnostic equipment that plugs into the under dash ALDL connector. (When diagnosing with a scanner, enter the engine as an 89 or 90 TBI light duty truck application. Our service manual also gives a technique for do-it-yourself diagnostics using a jumper, the ALDL connector, and “Service Engine Soon” light on the instrument panel.

**NOTE:** In some installations there is no longer water circulating in the adaptor below the TBI, you may experience some throttle blade icing in ambient temperatures just above 32 deg F on high humidity days. This will only occur when the engine is cold and during warm up. As soon as engine heat warms up the aluminum adaptor, or manifold, no more idle icing will occur. This will show up as an erratic or slow idle speed until the ice melts. With open element air cleaners this condition may be worse, or last longer during warm up.

## TUNING ADJUSTMENTS

One feature your 4 BBL TBI has, is an adjustable fuel pressure regulator. It is located at the rear center of the TBI, and can be adjusted using a 5/32" allen wrench. Our calibration prom was programmed for a your engine using 11-12 PSI fuel pressure. A production GM, in-tank, fuel pump; or our special in-line Walbro fuel pump, will supply a maximum of 15 PSI. Our calibration at 11 PSI allows you a tolerance to increase fuel pressure and fuel rate to your engine, if you have other modifications that have increased the air flow and power, such as headers, and lower restriction exhaust systems, etc.

Under normal conditions, you should not have to adjust fuel pressure. You may want to optimize wide open throttle power, or lean down for maximum fuel economy towing. You can do this with the built in regulator. **NOTE!!** Be aware that leaning out an engine at WOT can shorten engine life, by increasing the running temperature of pistons, valves, and exhaust manifolds.

Unlike GM, we don't prevent your tampering with fuel pressure. Therefore, we can't warranty your engine if you get into trouble. **BECAUSE THIS UNIT HAS ADJUSTABLE FUEL PRESSURE**, we will not be responsible for any damage to your engine from rich or lean operating conditions. No guarantee is expressed or implied by Howell Engine Developments for the rest of your engine, only our parts are guaranteed.

We have experience with a 3 wire oxygen sensor, and BZ air fuel ratio monitor in testing for adequate wide open throttle fuel. This unit is sold by Haltech (in Texas) and features a series of LED lights progressing from red to yellow to green. If you have access to one of these units, as long as the Oxy sensor will light one or two green LED's, you have adequate wide open throttle fuel for maximum power and durability.

If you feel you need to do serious tuning or recalibration for your application, contact us at 810-765-5100 and we will work out a new calibration.

Enjoy

B. H. Howell  
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