

HOWELL

ENGINE DEVELOPMENTS, INC.
FUEL INJECTION APPLICATIONS

INSTALLATION MANUAL

Two Barrel, Throttle Body Fuel Injection For Oldsmobile V-8 Engines In GMC Motorhomes

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INSTALLATION INSTRUCTIONS
TWO BARREL, THROTTLE BODY FUEL INJECTION FOR OLDSMOBILE
V-8 ENGINES IN GMC MOTOR HOMES

KIT COMPONENTS:

1. Two barrel TBI unit with integral TPS and Idle Air Control.
2. Electronic control Module (ECM) GM PN 1227747.
3. Howell wiring harness connecting engine to vehicle ECM.
4. Calibration Prom matching TBI to Olds 455 or 403 engine.
5. Cal-pack (V-8), for limp-home operation.
6. Manifold vacuum sensor (MAP).
7. Engine coolant sensor & 3/8" to 1/2" NPT bushing adaptor.
8. Exhaust Oxygen sensor & 18MM mounting bung.
9. Electric fuel pump—high pressure, in-line.
10. High flow fuel filter, in-line.
11. Fuel line kit.
12. Fuel pump relay.
13. Small parts kit for routing and mounting components.
14. Service manual-basic troubleshooting and operating information.

THIS SYSTEM IS BASED ON THE PRODUCTION GM (Chevrolet or GMC) THROTTLE BODY FUEL INJECTION AND ELECTRONICS USED FROM 1987-1989, ON 454 CID V-8 ENGINES. ALL BACKUP SYSTEMS AND "ON VEHICLE" DIAGNOSTICS FUNCTION SIMILAR TO THOSE MODEL YEAR PACKAGES. THIS SYSTEM DOES NOT CONTROL SPARK TIMING AS ON 87-89 GM ENGINES, BUT RELIES ON A TACH SIGNAL FROM THE PRODUCTION OLDS HEI ELECTRONIC IGNITION FOR RPM INPUT TO THE ECM.

Installation procedure will be separated into the following categories:

1. Preparation of motor home for TBI installation.
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. Calibration PROM and vehicle ECM.
6. Initial vehicle startup and operation.
7. Initial driving impressions.
8. Tuning and troubleshooting.

PREPARATION OF MOTOR HOME FOR TBI INSTALLATION

SEE NOTE ON OXYGEN SENSOR, PAGE 2 BEFORE THE FOLLOWING STEPS

1. Jack up front of motor home and support with jack stands. Raise high enough to allow access to the underfloor area and cross members just ahead of the fuel tanks.
2. Raise engine cover to allow access to top of engine and disconnect the battery (optional).
3. Remove left and right hand front wheel inner fender liners.
4. Remove and set aside air cleaner assembly.

REMOVAL OF NON-REQUIRED PARTS FROM CARBURETED ENGINE

Remove the mechanical fuel pump and fuel lines from the carbureted engine. Install the supplied fuel pump block off plate and gasket from your HED kit. Use RTV or other gasket sealer to assure no oil leaks.

Trace all vacuum lines and label them if necessary so you will know their function when the time comes to reconnect them. Remove the carburetor and gasket. Make sure the carb mounting surface is clean and free of any gasket material.

Remove motor home fuel line and any hoses, back to the crossmember ahead of the switching valve, just in front of the fuel tanks. To prevent fuel loss and facilitate fuel pump installation, use a pair of Vice Grips or other clamp, to pinch off the fuel line between switching valve and crossmember. You can later cut this section of line to the correct length to connect to the new fuel filter.

Remove any other vacuum solenoids or electric choke wiring that may be on your engine. California emission vehicles have extra vacuum controls and two canisters to collect fuel tank fumes. Many motorhomes have been refitted with later model Rochester carburetors, so what you find under the engine cover may not match your service manual.

INSTALLATION OF TBI AND ENGINE HARDWARE

1. Install the supplied Holley 4 barrel to 2-barrel adaptor plate, (FIGURE 1) using Oldsmobile PN 22508038 carb gasket (supplied). NOTE: machining that will allow a vacuum leak if it is not sealed as follows: after bolting down the plate, fill the right rear counter bore and surrounding edge of plate with automotive gasket quality RTV. Position the TBI gasket on the plate with all holes aligned and make sure the RTV fills and supports the right end that hangs over the edge of the plate. This will insure no vacuum leaks when the TBI is installed. Follow the instructions in the adaptor kit to plug the unused TBI hold down bolt holes.
2. Install the TBI unit with the supplied gasket and hold down bolts. (Make sure the bottom 1/2" of throttle lever has been cut off the TBI to clear the intake manifold before bolting down permanently).
3. Connect vacuum lines as follows: PCV to 3/8" outlet on front. Distributor vacuum to passenger side vacuum outlet. Canister purge to the #1 port directly below the PCV line. MAP vacuum line from the front of TBI. Left hand vacuum outlet can be used for any other full time vacuum requirement.
4. OXYGEN SENSOR—At this point, you may want to install the bung that mounts the Oxygen sensor. This can be done without removing the exhaust system. Drill or burn a 7/8" hole approx 3" downstream from the LH exhaust manifold flange (FIGURE 2). The supplied 18MM bung can then be welded into the exhaust pipe. The Oxy sensor can be mounted vertically, or at an angle, depending on your ability to create the correct hole in the pipe for the bung. NOTE: if you do not have in house equipment to make the correct hole in the exhaust pipe and weld in the bung, you may want to have this done at a muffler shop before starting the TBI installation. When the bung is in place, you may install the Oxygen sensor.
5. FUEL LINES AND FUEL PUMP—Before proceeding further in the engine compartment, you should have the fuel pump and filter in place. The fuel pump is an in-line design that will maintain the 12-15 PSI operating pressure at all times. The fuel

pump electrical terminals are on the HIGH PRESSURE end of the pump. It should be mounted on the forward side of the crossmember just ahead of the switching valve (FIGURE 3). By coincidence, there are 4-drilled holes in the crossmember that can be used to bolt the supplied fuel pump mounts in place. Use $\frac{1}{4}$ " X 20 bolts and large sheet metal washers (you can enlarge the fuel pump mount holes to $\frac{1}{4}$ "). Connect the supplied fuel filter to the inlet side of the fuel pump with a short section of $\frac{5}{16}$ " hose so that it filters fuel before it reaches the pump. Use a $\frac{3}{8}$ " to $\frac{5}{16}$ " reducer between the switching valve outlet and the fuel filter. (You can also use a length of the original motor home fuel line to go between the switching valve and fuel filter). Using the supplied $\frac{5}{16}$ " fuel hose, run your high pressure fuel line from the fuel pump to the drivers side fitting on the back of the TBI unit. Route the fuel line carefully, away from sharp edges and the exhaust system and secure it with some of the supplied tie-wraps. If you prefer, you can fabricate a $\frac{5}{16}$ " steel line for your high-pressure fuel, but it must connect to the fuel pump with a short length of rubber line to prevent noise transfer from the pump. Your bypass return fuel line is $\frac{1}{4}$ " hose and is routed from the right rear of the TBI along the back of the engine compartment, discharging into the fuel fill pipe going to the fuel tanks. To install this return fitting, use the following procedure: From inside the coach, punch a hole in the gas fill pipe at or below the TBI level, using an awl or sharpened punch, enlarge and round out the hole. Thread this hole with grease on the tap to catch metal particles, and install the supplied $\frac{1}{4}$ " hose nipple with pipe sealer to prevent fuel leakage.

6. **THROTTLE AND CRUISE CONTROL CABLES** attach to studs on the throttle lever. There is sufficient torsion spring return on the 2-barrel TBI units, so you should not need a separate return spring. Transfer the cruise control stud from your Quadrajet throttle lever to the TBI lever. Install it pointing towards the TBI for best alignment. Remove the rubber grommet from your throttle cable and the cable end should now fit over the pin on the throttle lever. With three $\frac{1}{4}$ " washers and a GM #1247872 spring clip you can retain the throttle cable. The throttle cable housing will be correctly retained and positioned using the special bracket supplied with your HED kit. It installs under the second from rear the intake manifold bolt on the drivers side of engine. Check for wide-open throttle after everything is connected and bend or reposition this bracket if necessary to achieve WOT. The cruise control cable is adjustable, but the metal tube over it needs to be shortened by approx 3".
7. **AIR CLEANER**—To properly position your motorhome air cleaner assembly, you must use the supplied $\frac{3}{4}$ " spacer (FIGURE 4) to raise it up for TBI injector clearance. (TBI air cleaner flange is $\frac{3}{4}$ " lower than your old Q-jet AC flange). You will also have to create some clearance above the distributor since the air cleaner has been shifted slightly rearward. To do this, trim the forward edge of the spark plug wire retaining ring and indent the bottom rear corner of the air cleaner housing with a ball peen hammer until the necessary clearance is created. Included with your TBI kit is a length of $\frac{1}{4}$ " threaded rod. Cut it to the proper length and install it in the TBI for your air cleaner hold down stud.

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 your motor coach with a minimum of left over wire when properly installed. The ECM, fuse block and diagnostic connector will be located in the compartment under the front passenger seat. You will need a 2" hole in the floorboard directly under the seat (10" right and 14" from rear edge of the engine opening, see FIGURE 5). Since this is plywood, it can easily be drilled with a hole saw from below.

1. The harness grounds attach at the back of the right hand cylinder head and locate the harness position at the back of the engine. The engine trunk portion moves forward from this point.
2. After the grounds are secured, route the labeled purple wire to the starter solenoid (some harnesses do not have this wire). The Oxygen sensor wire should be long enough to attach to your previously mounted Oxygen sensor. If necessary to extend it, cut and solder splice on the harness side, not the Oxy sensor lead wire.
3. Moving forward, connect the 4-pin injector connector at the front of the TBI and plug in the throttle position sensor and idle air control motor. The MAP sensor (Green) connector also branches here and connects to your MAP sensor. The MAP sensor can be mounted in any convenient location near or on the engine; however, it should be mounted WITH THE VACUUM LINE POINTING DOWN, and level with, or higher than, the TBI base. (A convenient place is the engine opening flange at the rear of the engine.) The MAP sensor should have its own vacuum line from the rear of the TBI and NOTHING should be teed into the line.
4. At the front of the engine, the coolant sensor is mounted using the supplied ½" to 3/8" NPT bushing. Use Loctite or equivalent pipe sealer on the bushing. Connect the harness to the coolant sensor. This completes the connections on the engine.
5. 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 connectors, and fuses. These can be permanently attached to the engine firewall on the right side (FIGURE 5).
6. **INSIDE THE VEHICLE**—Mount the ECM, fuse block and diagnostic connector, to a 10"X10" piece of light plywood (FIGURE 6). This holds everything in position, but is easily removed for service. (Velcro is a suitable material for mounting the ECM to the plywood.) **CAUTION:** The ECM needs some air circulation for cooling, so don't put it under the carpet. Use a Radio Shack or automotive bulb socket and 12V bulb for the SES light and mount it where it can be seen from the drivers seat. (Drivers side of the passenger seat mount is a good place.)
7. Using one of the single weatherpack connectors and terminals supplied, run a 14 or 16 gauge wire, from the ECM fuse block to a 12V source on the GMC fuse panel that has current when your ignition key is in the RUN AND CRANK positions. (Not an accessory position, which loses power during cranking.) The GMC motor home fuse panel is located in the glove box in front of the passenger seat and has a vacant IGN labeled terminal that works fine.
8. **ON THE ENGINE SIDE OF FIREWALL**—Supply battery power to the labeled ORANGE wire and sealed fuse location near the fuel pump relay. Use 14-gauge wire for this lead and a weatherpack connector to connect at the sealed fuse.

9. Using the 10ft. fuel pump power lead supplied, run a power and ground lead from the labeled RED wire weatherpack connector near the fuel pump relay, to the high-pressure fuel pump. Connect this power and ground lead to the fuel pump by plugging the two pin weatherpack connectors together. At the relay end of this power lead, connect the black wire to the engine ground. This completes the electrical harness installation.

CALIBRATION PROM AND VEHICLE ECM

The brain and control center of your new electronic fuel injection is the Electronic Control Module (ECM). It Controls the amount of fuel delivered at any time, based on inputs from the Oxygen sensor, coolant sensor, MAP sensor and throttle position sensor. The correct fuel settings are pre-programmed into the calibration prom and match your engine closely for everything to work correctly. The calibration prom and a smaller removable chip called a Calpack, are pre-installed in your ECM. The Calpack contains back-up or limp-home programs in case one or more sensors fail and the ECM cannot do its proper function. This will keep you from being stranded in even of sensor failure, until you can get the trouble corrected. The "Service Engine Soon" light will come on any time any back-up features are activated.

Your vehicle ECM is GM part #1227747. This is the ECM used in most GM truck TBI engines from 1987 thru 1991. If replacement is necessary, it is available at any GM dealership. It is a rugged, proven design, the result of millions of GM dollars spent on development. It has the ability, operating in closed loop, to learn a calibration that perfectly matches your engine, and retain it in memory.

An added benefit of the GM ECM is its ability to alert you to a potential sensor or electrical problem by turning on the "Service Engine Soon" light, built into your harness. This light and a common paper clip will allow you to discover and diagnose any reported problems retained in the ECM memory. Procedures for this are outlined in any GM TBI service manual or the Howell HP/TBI service manual that accompanies your TBI kit.

The CALIBRATION PROM supplied with your 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 two cal 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 or 3 second and then the ECM will turn it off until you engage the starter. The first time ignition is turned on out 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 injectors. Check for fuel leaks and make sure none of your altered wiring or fuel lines are in a position where the exhaust system heat can damage them. **MAKE SURE THE COOLING SYSTEM IS FULL.**

If the engine does not start immediately it may be because the fuel pump cannot displace the air in the line and prime itself. Loosen the high-pressure line at the TBI to displace the air. Wrap a rag around the fitting to prevent gas spraying around the engine compartment. Turn the key on and off a few times to fill the system.

Look at your "Service Engine Soon" light when attempting to start for the first time. The light should come on when the ignition is turned on, stay on during cranking, and go off when the engine starts. **IF THE LIGHT GOES OFF DURING CRANKING, IT MEANS YOU HAVE POWERED THE ECM AND INJECTORS FROM AN ACCESSORY FUSE BLOCK TERMINAL AND THE ENGINE WILL NOT START.** Your switched 12V power must come from a terminal that is hot with key on, during cranking and goes off when the ignition is turned off.

INITIAL DRIVING IMPRESSIONS

The calibration prom supplied with your TBI system is based on a Chevrolet 454 engine calibration, slightly modified for the Olds 455 or 403 engines. 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 adjust this new program as weather, barometer and altitude change and store it in memory as long as the battery is connected and charged. If you disconnect the battery, the ECM will lose the learned program and revert back to the original Howell HP/TBI program. However, it will immediately start learning again as soon as you start driving the vehicle.

Any electronic or engine control problems can be diagnosed by a GM dealer or tune up shop, using their computer diagnostic scanner that plugs into the ALDL or diagnostic connector near the ECM. (When diagnosing with a scanner, enter the engine as an 88 or 89 TBI light duty truck application.) Our service manual also gives techniques for do-it-yourself diagnostics using a jumper, the ALDL connector and "Service Engine Soon" light.

TUNING AND TROUBLESHOOTING

ADJUSTING IDLE SPEED—As delivered, your TBI unit may not give sufficient idle air for a cold fast idle. Use the following procedure on a warm engine to correct this condition:

1. Jumper across the A & B pins in the ALDL connector with a paper clip or wire.
2. With ignition on, engine not running, disconnect the Idle Air Control 4 pin connector.
3. Start engine and adjust throttle stop screw to give approx 650 RPM idle.
4. Shut off engine, disconnect ALDL jumper and plug IAC connector back in. This should now give sufficient range to the IAC for a good cold fast idle.

You may need to readjust the TPS sensor to give .5 to .6 Volts with the throttle closed. Follow instructions in the service manual for this adjustment.

ADJUSTING FUEL PRESSURE—One feature your HP/TBI has is an adjustable fuel pressure regulator. It is located towards the rear of the TBI in the center, facing up, and can be adjusted using a 5/32" Allen wrench. Your calibration prom was programmed for your engine

allowing pressures up to 20 PSI or more. Our calibration at 12 PSI allows you a tolerance to increase fuel pressure and fuel rate to your engine, if you have modifications to engine or exhaust that have increased air flow and power, such as headers, low restriction exhaust, etc. When increasing fuel Pressure, you should use an air/fuel ratio monitor, or diagnostic scanner to observe the Oxygen sensor output. For maximum power, the Oxygen sensor voltage should be between 800 and 850 milivolts at wide-open throttle. **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.**

If you have a modified engine and determine that your supplied calibration prom is not correct, we will supply you with another prom with similar part load calibration but altered under heavy load to match your requirements.

Since we can't prevent your tampering with fuel pressure, 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, Inc. for the rest of your engine. Only our parts are guaranteed.

If you have other problems or questions about your TBI kit, contact Howell Engine Developments by phone at 810-765-5100.

Enjoy,
B. H. Howell
05/19/08

DRIVING NOTES FROM OUR GMC EXPERIENCE

FUEL TANK LEVEL: Since bypass fuel is returned to the fill pipe that goes to both fuel tanks, you may find that your tanks don't empty in their usual manner. After a complete fill, the tanks will empty normally until you switch to your second tank. This tank will seem to empty much faster, but this is because bypass fuel is returning to the other tank. To use all your fuel, you may have to switch back and forth between tanks several times. The cure for this is much worse than the disease, so we haven't attempted one.

SWITCHING VALVE: In the event you experience power loss under load typical of vapor lock, you may have a defective switching valve that is restricting flow to the electric fuel pump. A fuel pressure gauge installed temporarily in the pressure line to the TBI will help trouble shoot this problem. You may need to install a new switching valve to cure this problem.

POWER AND PERFORMANCE: You should notice a more responsive engine with increased torque, power and quicker startup. Our experience with gas mileage is about 10MPG.