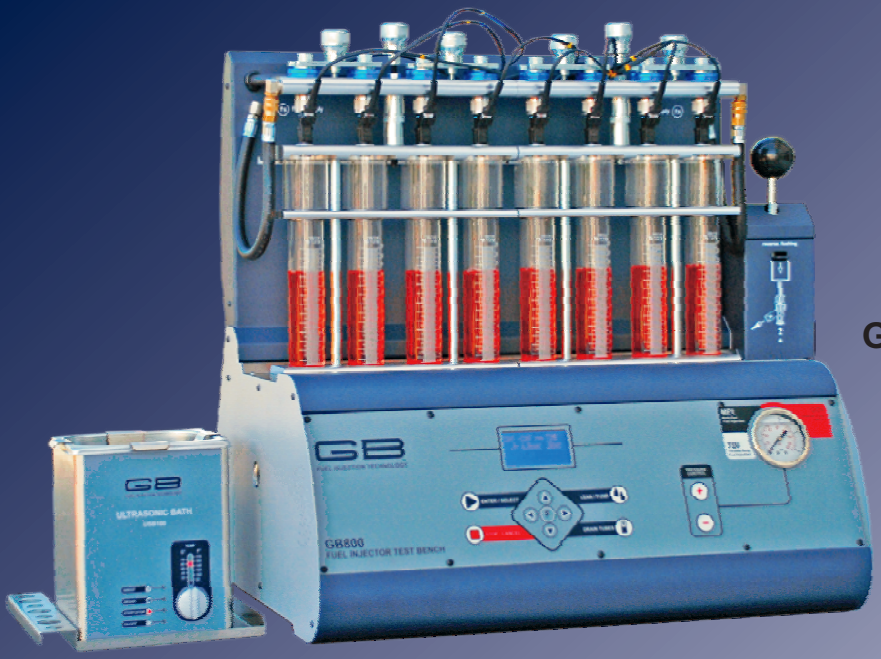
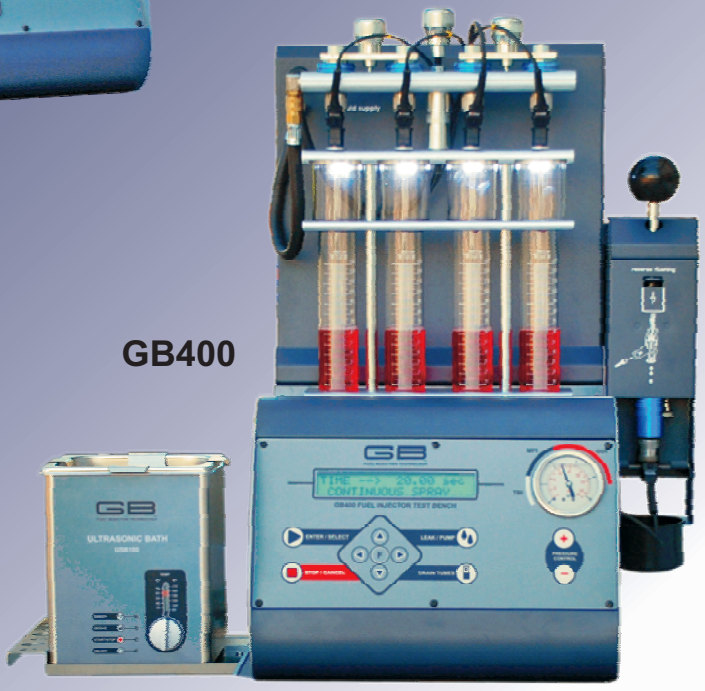
GB™
FUEL INJECTION TECHNOLOGY

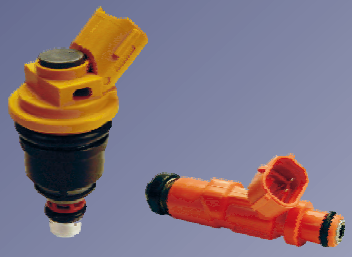
# Fuel Injector Service & Diagnostic Equipment




GB800




GB400



***Inject Profits Into Your Bottom Line - GB Fuel Injection Technology***

## Opportunity & Return On Investment

In today's economy, it's tough to justify a new equipment purchase. Any purchase must provide a quick return on investment and provide solid profits to your bottom line. The use of all available data can aid in the decision process and reduce the risk of purchasing a piece of equipment that simply sits in the corner. Below are some frequently asked questions and data to assist in making the business case for entering the fuel injector service market.

**Q. What is the demand for fuel injection service?**

If your facility already performs common repair procedures such as fuel pump replacement, CV boot or half shaft replacement, you'll be surprised how fuel injector service stacks up. Data compiled indicates that fuel injector replacement and fuel system cleaning are more common than CV axle repairs or even valve cover gasket replacement, both very common repairs. Table 1 compares injector related services to other common repairs you may already be performing.

With the average vehicle age at 9 years old and with over 242 million registered vehicles - almost all being fuel injected, the market for this service is quite healthy and growing.

**Q. How does off-car fuel injection service compare to on-car cleaning?**

Simply put, there is no comparison. For more information on this subject matter refer to the article on the back page - "On-Car Cleaning vs. Off-Car Service."

**Q. How long has GB been distributing fuel injection equipment?**

GB has been distributing fuel injection service and diagnostic equipment since 1991. We are the market leader when it comes to offering high quality equipment, along with after-sale marketing and technical support.

**Q. How difficult is it to operate the GB Fuel Injector Test Bench?**

If your technicians can operate standard automotive equipment such as diagnostic scan tools, vehicle lifts, brake lathes, etc. they will have no problem using our equipment. Our easy-to-use control panel walks your technicians through the entire process - step by step.

**Q. What is a typical charge for servicing a fuel injector?**

This varies by region and injector type. However, a typical charge for injector service is $25-$35 per injector plus the labor to remove and reinstall the injector(s).

**Q. How long does it take to service a set of fuel injectors?**

Once the injectors are removed from the vehicle, most customers pre-test the injectors for flow rate, spray pattern and leak down. Once this is done, the injectors are ultrasonically cleaned for 10-20 minutes, back flushed, retested and new components are installed. This method provides definitive before and after results. The process takes between 30-40 minutes for an entire set. On a 6 cylinder MPI system at $30 per injector this equates to a $270 per hour labor rate. This is in addition to the removal and installation charge. Take into account that the technician can be doing other profitable tasks while the injectors are in the ultrasonic bath, and profitability figures become even stronger.

**Q. What components are replaced during the injector service?**

It depends on the type of injector. In most cases, the upper and lower o-rings are replaced, as well as the pintle cap and filter. Some injectors use color coded clips and hose clamps which are also common replacement items.

### Replacement Rates by Vehicle Age, 2008

| Component or Service | 0-3 Years | 4-7 Years | 8-11 Years | 12+ Years |
|---|---|---|---|---|
| AC Compressor | .33 | .85 | 1.40 | 1.18 |
| CV Boot Cover | .17 | .45 | 1.21 | 1.43 |
| CV Half Shaft | .04 | .23 | .51 | .99 |
| Fuel Injector | .79 | 1.68 | 2.02 | 2.54 |
| Fuel Pump | .30 | 1.23 | 2.59 | 3.97 |
| Fuel System Cleaning | 1.06 | 2.20 | 2.60 | 2.46 |
| Valve Cover Gasket | .08 | .36 | 1.41 | 2.07 |
| Water Pump | .33 | 1.55 | 3.87 | 4.96 |

*Table 1 - Source: AAIA 2010 Factbook*

**Q. How will I utilize this equipment, and how do I market this type of service?**

Our most successful customers market their services two ways. First, they utilize the equipment for their own needs. Second, they also market their services to other shops in their area.

A facility using our equipment can service injectors as preventive maintenance or to remedy a specific driveablity concern such as engine misfire, high emissions, poor fuel economy, poor cold or hot engine performance. The injector test bench can also provide definitive diagnostics of suspect injectors, reducing diagnostic time or the accidental replacement of good injectors.

Additionally, repair shops will test the injectors as part of a non-fuel related major engine repair prior to reinstallation to ensure the injectors are functioning properly. Since the injectors have already been removed it makes sense to ensure the injector flow rates are even and that they are functioning properly. This also provides peace of mind that a significant repair may not have to be redone do to a faulty or leaking injector. Part of the injection service includes installation of new injector o-rings which can reduce the possibility of fuel or air intake leaks, reducing costly warranty claims.

Many facilities will also market their services to surrounding shops. Often a shop may suspect a defective injector but does not have the equipment to confirm their suspicions. We have many customers that keep their equipment quite busy checking and servicing the injectors for other shops.

**Q. What types of injectors can I test with the GB400 & GB800?**

Both machines allow you to test multiport fuel injectors (MPI), throttle body injectors (TBI) and even newer gasoline direct injectors (GDI). Both machines come with the most complete adapter set available included in the price of the machine. GB is also committed to offering additional adapters for new style injectors when they are released. The primary difference between the GB800 and GB400 is the GB800 allows for the simultaneous testing of 8 injectors whereas the GB400 allows testing of four.

**Q. Does GB offer leasing?**

GB works directly with a third party leasing company that offers competitive lease rates. This can be a good option for someone who is looking to enter the market with a minimal initial investment.

In a competitive market place, the most successful repair facilities find a way to differentiate themselves from their competitors by offering specialty services.

Improve fuel economy and engine performance while reducing emissions.

| Testing & Cleaning Capabilities | GB800 | GB400 |
|---|---|---|
| Dynamic and Static Flow and Volumetric Tests - *Fig. 1* | ✓ | ✓ |
| Spray Pattern Analysis - *Fig. 2* | ✓ | ✓ |
| Injector Leak Test | ✓ | ✓ |
| Electrical Coil and Resistance Test | ✓ | ✓ |
| Ultrasonic Bath w/Heater, De-Gas & Sweep Technology - *Fig. 3* | ✓ | ✓ |
| Injector Back Flushing - *Fig. 4* | ✓ | ✓ |
| **Features & Technical Specifications** | | |
| Simultaneous Injector Testing | **8** | **4** |
| Electronically Controlled Injection Pressure | ✓ | ✓ |
| Testing and Cleaning of MPI, TBI, GDI Injectors | ✓ | ✓ |
| Testing and Cleaning Marine, Motorcycle, LPG Injectors | ✓ | ✓ |
| Automatic Detection and Firing of High/Low Impedance Injectors | ✓ | ✓ |
| High Intensity LED Lighting of Spray Pattern Viewing Chambers | ✓ | ✓ |
| Automatic Function Operation | ✓ | ✓ |
| Manual Function Operation | ✓ | ✓ |
| User-Programmable | ✓ | ✓ |
| Step-by-Step Instruction via LCD Screen | ✓ | ✓ |
| Automatic Draining of Volumetric Cylinders | ✓ | ✓ |
| Injector Coil Testing and Analysis | ✓ | ✓ |
| Automatic Pressure Adjustments Based on System | ✓ | ✓ |
| Language Localization | ✓ | ✓ |
| Dual Scale Gauge (bar/psi) | 0-10 bar / 0-145 psi | |
| Operating Pressure (bar/psi) | 0-10 bar / 0-145 psi | |
| Injector Operating Frequency (rpm in 100 rpm increments) | 500-16,000 rpm | |
| Injector Pulse Width Adjustment (mS in .1mS increments) | .9mS - 100mS | |
| Adjustable Operating Time (in 5 second increments) | 5 Sec. - 20 Min. | |
| Injector Pulses | 1 - 10,000 | |
| Volumetric Cylinder Capacity ml/cc | 1-130 | |
| Input Power (Volts)/Power Consumption (Watts) | 100-240 / 320 | |
| Operating Frequency (Hz) | 50 / 60 | |
| **Included Accessories** | | |
| Test Fluid | ✓ | ✓ |
| Ultrasonic Cleaning Fluid | ✓ | ✓ |
| Injector Components Starter Kit - *Fig. 6* | ✓ | ✓ |
| Injector Electrical Adapter Kit | ✓ | ✓ |
| Complete Injector Adapter Kit (Top-Feed, TBI, Side-Feed) - *Fig. 5* | ✓ | ✓ |
| Injector Test Sheets | 50 Sheets Incl. | |
| **Technical and Sales Support** | | |
| Free Bilingual Support via Phone or Internet (English/Spanish) | ✓ | ✓ |
| Marketing Aids & Counter Brochures | ✓ | ✓ |
| Regularly Updated Injector Components Catalog | ✓ | ✓ |

### Injector Components *Fig. 6*

Component replacement prior to installation is a must to ensure a complete and problem free service. GB offers the most comprehensive catalog of injector components including filters, pintle caps, o-rings, seals, clamps and clips. Our catalog is updated on a regular basis to reflect new injector designs and market demands. Components may be purchased in small quantities or larger quantities for volume discounts.

### Volumetric Cylinders *Fig. 1*

Individual injector flow is captured in the volumetric cylinders for easy comparison. By testing under various operating modes, restricted or improperly operating injectors can be identified. The cylinders are automatically drained at the push of a button on the control panel.

### Spray Pattern Viewing Chamber *Fig. 2*

A critical aspect of injector testing is proper inspection of the spray pattern. Both the GB400 & GB800 units include a large diameter viewing chamber with high intensity LED lighting, making inspection a snap. Injector patterns are easily compared to identify poorly atomized or dirty injectors.

### USB100 Ultrasonic Bath *Fig. 3*


The GB USB100 ultrasonic bath includes a user-adjustable thermostatic heater to increase cleaning efficiency. Automatic sweep technology which varies the frequency from 31-42kHz ensures thorough cleaning of injector internals to restore injector flow rate and spray pattern.

### Injector Back-Flush *Fig. 4*

Once the injector is ultrasonically cleaned it is back-flushed. Back-flushing ensures contaminates loosened in the ultrasonic cleaning process are removed. This process eliminates the possibility of the injector becoming plugged or restricted from residual contaminates.

### Complete Injector Adapter Kit *Fig. 5*

## On-Car Cleaning versus Off-Car Service

Fuel injector cleaning methods and results vary dramatically whether you choose to perform an on-car cleaning method, or an off-car fuel injector service.

First, let's cover on-car cleaning methods, of which there are two. One method simply uses a pour-in additive to the fuel tank. These additives can be found just about everywhere. The concentrated cleaner is mixed with fuel in the tank where it slowly makes its way through the fuel system, eventually passing through to the injectors.

The other on-car method uses a pressurized canister of injector cleaner. The canister is connected directly to the fuel rail. During this process, the fuel pump is disabled and the engine actually runs off of the cleaner, not the fuel in the tank. The chemical passes through the injectors, cleaning them in the process. The engine usually operates for about 5-10 minutes on the cleaner. This process is more time consuming than the pour-in method and requires special equipment and training.

There are many disadvantages to using the on-car cleaning method. The chemicals used are not very aggressive. The chemicals used have to be similar in nature to gasoline since the engine must run on the chemical alone. Because the cleaning is done on-the-car, the cleaner must not damage any of the other components on the vehicle that are sensitive to chemical contamination such as the oxygen sensor, catalytic converter, and others. Therefore, the cleaner used is a fairly mild detergent. Also, the technician really never knows what results the on-car cleaning accomplished.

Without being able to perform spray pattern tests, flow-rate test, and leak-down tests, the technician "hopes" the on-car method will increase vehicle performance.

For preventative maintenance, on-car cleaning usually won't hurt. However, if an injector is restricted to the point that it is causing a driveability problem, don't expect on-car cleaning to help. At this point, you're most likely wasting time and money.

Off-car cleaning is a completely different process than either method used for on-car cleaning. Once the injectors are removed from the vehicle they are cleaned ultrasonically. The injectors are cleaned internally and externally while being pulsed at varying pulse widths and frequencies (RPM). The ultrasonic waves create cavitation bubbles in the cleaning fluid. When the microscopic bubbles touch a surface, they implode, creating forces in excess of 10,000 psi. These implosions, combined with the correct cleaning chemistry and the all important "back-flush" are what guarantee a thoroughly cleaned fuel injector.

Once the injectors are cleaned, their operation is verified using the injector flow bench. The flow bench can be used to examine the injector's spray pattern, dynamic and static flow rate and to perform a leak test, none of which can be performed with the "on-car" method.

Once the injectors are cleaned and fully tested, critical components are replaced to complete the service. This includes any o-rings, seals, filters and pintle caps.

Although off-car service may take longer, it also is a chargeable service that yields guaranteed results and increases your bottom line while ensuring customer satisfaction.

## Glossary of Fuel Injection Terms

**MPI - Multiport Fuel Injection**
Each cylinder uses a dedicated fuel injector positioned in the intake manifold above the intake valve. In most MPI systems the injectors are all fired together, every crankshaft revolution. The fuel for one combustion event is actually delivered in two pulses.

**SFI - Sequential (multiport) Fuel Injection**
Each cylinder uses a dedicated injector just like on the MPI system. The term "sequential" refers to the method in which the injectors are fired. On a sequential system the injectors are fired individually in cylinder firing order. The fuel for one combustion event is delivered in one pulse.

**TBI - Throttle Body Fuel Injection**
An early style (80's early 90's) injection system where fuel is injected just above the throttle plate in the throttle body. This system was a significant improvement over the carburetor, but does not provide the fuel control and reduced emissions offered by the MPI or SFI systems. Most TBI systems operate at lower pressures than MPI or SFI systems.

**GDI - Gasoline Direct Injection**
A newer system of fuel injection where fuel is injected directly into the combustion chamber rather than the intake system. GDI systems operate at much higher pressures (3,000 psi) than traditional MPI or SFI systems. GDI systems are also referred to as FSI and HPI systems.

**Impedance**
A term used to describe the resistance of the injector's coil. A low impedance injector typically has a resistance of less than 3 ohms, whereas a high impedance injector has a resistance of over 10 ohms.

**Saturated**
A firing method used on high impedance injectors. The injector current is switched on and remains constant throughout the entire injection event.

**Peak & Hold**
A firing method used on low impedance injectors where the injector is opened using full current for a short period of time. Once the injector opens, current is reduced for the duration of the injection event. This method reduces internal heating of the injector coil.

**Pintle**
This refers to the valve inside the injector and its seat, usually located at the tip of the injector. The pintle shape is what determines the geometry of the spray pattern. When the pintle is closed the pintle is held against the seat by an internal spring. When the injector is pulsed the pintle is lifted of its seat which allows fuel to exit the injector.

**Pintle Cap**
A plastic cap with a hole in it that protects the injector's pintle. The pintle is susceptible to damage because it often protrudes from the seat at the bottom of the injector.

**Static Flow**
This refers to an injector's maximum flow when the injector is pulsed at 100% duty cycle for 60 seconds. When tested, the injector is held open at a specified pressure, usually 3 bar for 30 or 60 seconds. The injector's flow is expressed as cc per min or lbs/hr.

**Dynamic Flow**
This refers to an injector's flow rate when pulsed at a given frequency (RPM) and pulse width (open time) for a specific period of time. For instance an injector may deliver 80 ml of fuel if pulsed at 6 milliseconds at 3,500 rpm for 60 seconds. Dynamic flow is very useful when comparing injector flow rates for the same exact type of injector off of the same vehicle. This test can detect internal injector defects such as weak springs or restriction as a result of carbon build up.

**Duty Cycle**
This term is used to describe the percentage of on time versus off time when the injector is being pulsed. An injector that is pulsed at a 60% duty cycle will be open 60% of the time and closed 40% of the time. In most applications an injector is never pulsed at more that 80% duty cycle.

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Off car injector cleaning and testing provides concrete results by allowing the technician to see and measure the injector's flow and operation, taking the guess work out of the cleaning process.