

TECH BMW PROCEDURE

2002tii fuel injection

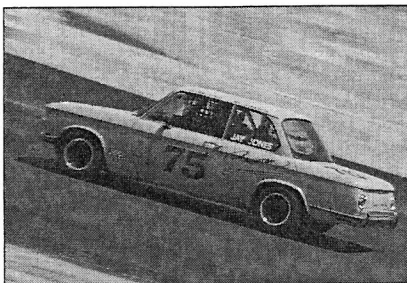
by **Brendan M. Lopez**
PHOTOS BY THE AUTHOR

Fuel injection technology has long been utilized by European automobile manufacturers to extract power and efficiency from their engines.

Porsche, BMW and Alfa Romeo were quick to develop cars using fuel injection. Due to the associated development and production costs, Japanese and American manufacturers were historically reluctant to universally apply fuel injection technology.

On a production scale, BMW first used fuel injection on the four-door 2000tii sedan of 1969. The tii nomenclature was used to designate the car was a performance BMW model. The term tii is roughly translated as "Turismo Internazionale Injection." Unlike modern cars with electronic fuel injection systems, the 2000tii used a Kugelfischer mechanical fuel injection system. The Kugelfischer mechanical fuel injection system was derived from the fuel injection system used by the BMW factory 2002 racing cars of 1968. For the 1969 season, BMW raced a pair of 2002s fitted with Kugelfischer injected and turbocharged engines. The turbocharged race engine produced an astonishing 290 hp and enabled the 2002 to exceed 150 mph. It would be another five years before BMW would produce a road-going 2002 turbo. Clearly, this demonstrates how car manufacturers apply racing technology to improve their road cars. The tii engine soon found its way into the production two-door 2002. Thus, the 2002tii was born.

The Kugelfischer tii engine is as much an enigma today as it was 25 years ago. Like the Spica mechanical injection system used by Alfa Romeo, the Kugelfischer system is perceived to be problematic. This can probably be attributed to the lack of knowledge possessed by ordinary



mechanics who are bewildered by the workings of the Kugelfischer system. However, with a few simple tools, the Kugelfischer system can be tuned and maintained by a skillful auto enthusiast.

System Description

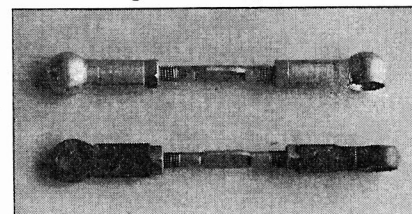
The Kugelfischer injection system consists of a fuel injection pump that elevates the pressure of the fuel from around 28 psi of system pressure to about 450 psi. The injection pump is driven by a cogged belt from the crankshaft pulley. The pump is synchronized to inject a metered amount of fuel into the intake manifold as the intake valve opens. Each cylinder has its own fuel injector and induction tube. All of the induction tubes are provided air by a large plenum chamber. Centrally located in the plenum chamber, is a large 55mm throttle body. A large air filter canister with two air filter elements provides clean air to the throttle body. For ease of maintenance, this large air filter canister is often replaced by a smaller, single K & N filter.

The pump itself is relatively simple. The pump has two basic inputs, engine speed and throttle position. A warm-up regulator bolted to the pump rear cover provides additional fuel when the coolant is cold. During cold start-up, an additional fuel injector in the throttle body delivers fuel according to ambient temperature.

Apart from regular hand tools, special tools are required to tune a tii engine. Unfortunately, the tools are only available from a BMW car dealer. The tools are identified by two different numbers. The first number is a four-digit number used by the BMW factory for the factory 2002 repair manual. These numbers have been superseded by a regular 11-digit BMW part number. For ease of identification, the tools will be referred to by the factory 2002 repair manual numbers. (see table below)

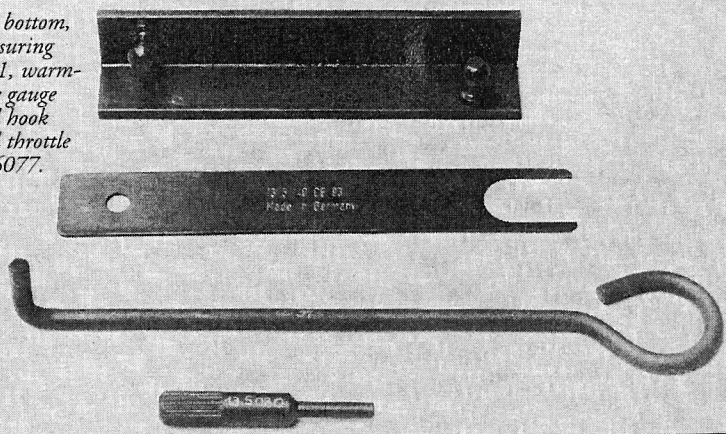
Preliminary Inspection and Tune-up

Before the fuel injection system is set up, it is imperative to check that the engine, fuel supply and ignition components are in good working order.



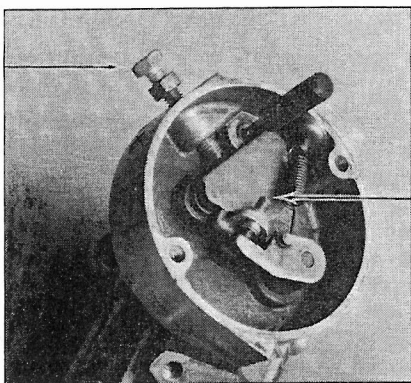
Later tii's use linkage with metal ends while earlier cars use better fitting nylon ends.

From top to bottom, linkage measuring gauge #6071, warm-up regulator gauge #6073, pull hook #6075, and throttle plate pin #6077.

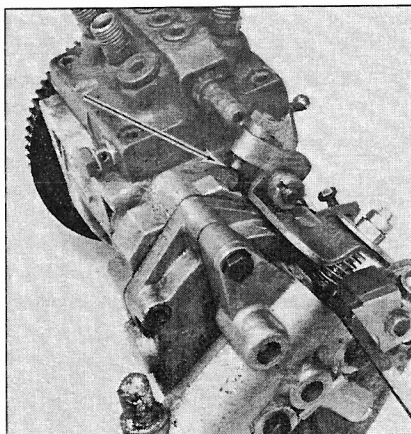


| Tool Number | Part Number | Description | List Price |
|-------------|-----------------|-------------------------|------------|
| 6071 | 88 88 6 135 040 | Linkage measuring gauge | \$18.25 |
| 6073 | 88 88 6 135 140 | Warm-up regulator gauge | \$10.28 |
| 6075 | 88 88 6 135 050 | Pull hook | \$13.14 |
| 6077 | 88 88 6 135 080 | Throttle plate pin | \$7.13 |

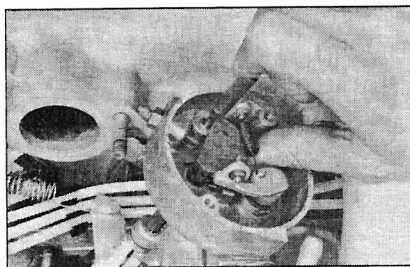
List prices from January 1994 retail price list.



The large screw on the top left is used to set the idle speed. The small set screw inside of the throttle housing is used to set the mixture at idle.

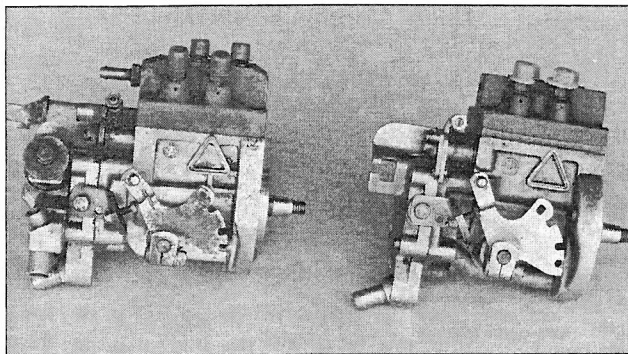


With the tool #6073 inserted into the warm-up regulator, the distance from the mixture screw and its stop should be 2.6mm, plus or minus .3mm

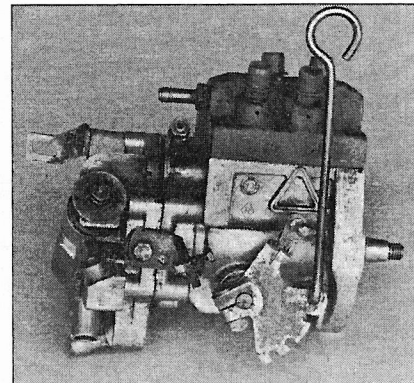
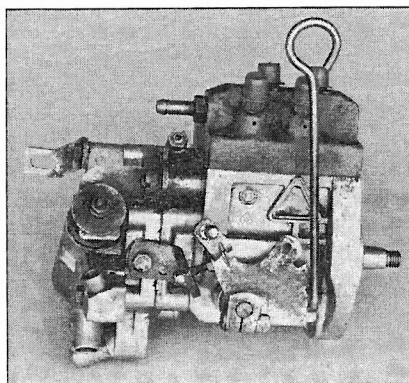


With the pump locked in idle position, insert the pin #6077 into the throttle body. By loosening the clamp bolts and holding the throttle cam against the pin, the relationship between throttle position and fuel delivery can be changed.

A compression check should be done to ensure the engine is in good condition. The compression test should be done with the engine at operating temperature with the throttle opened. The compression should read between 135 and 150 psi for an average broken-in engine. Compression readings that are higher are advantageous while lower readings are less than desirable. Low compression can be attributed to worn piston rings, broken



LEFT: The racing injection pump on the right is calibrated for higher fuel delivery. Note the racing pump doesn't have a warm-up regulator. BELOW LEFT: This photo shows the injection pump locked into full throttle position. BELOW RIGHT: This photo shows the injection pump locked into the idle position.



piston rings, worn cylinder walls, burned valves, or any combination of the above.

The engine should also be checked for vacuum leaks. The tii engine has a large plenum chamber and four induction tubes that can leak vacuum if improperly sealed. Early tii engines have plastic induction tubes that should be handled with care. At \$99.53 each, the reason is obvious.

Next, the valves should be adjusted while the engine is stone cold. When the valve clearance is excessive, there will be a noticeable tapping noise emanating from the valve cover. Bear in mind that worn rocker arms and rocker shafts can cause valvetrain noise as well; noise that will not be cured by adjusting the valves.

Adjusting the valve clearance on a single cam BMW engine is a simple process that requires only a few simple hand tools. A spark plug socket, ratchet, 3-in. socket extension, 10mm socket, 10mm box end wrench, feeler gauge set, and a small piece of 3/32-in. welding rod (about 6 in. long) are needed to undertake this operation. The welding rod is used to rotate the eccentric on the rocker arm to adjust the clearance. The welding rod should have a 90-degree bend about one-half in. from the end. A special eccentric rotating tool can be purchased from the dealer for about \$40. In this instance, a homemade tool will suffice.

The first step is to park the vehicle on a flat level surface and allow the engine to cool. The spark plugs should be removed to make it easier to rotate the engine. The spark plugs should be kept in order so they can be inspected for signs of fouling.

It's easy to mix up the spark plug wires when re-installing the wires, particularly when the wires are not encased in a plastic tube. The wires can be marked with pieces of tape. If the spark plug wires do get mixed up, the firing order is cast into the valve cover. If you ever wondered what Zündfolge 1342 is, that is the firing order. Zündfolge translates as "ignition sequence."

The valve cover can now be removed. It is retained by six cap nuts and one bolt. A small 6mm wave washer should be under each nut and bolt. When removing the valve cover, make certain to keep dirt and foreign objects out of the engine. The valve cover gasket can be re-used a couple of times before it needs to be replaced.

Once the valve cover is off, rotate the engine so the number one cylinder (front) is at TDC (top dead center). The engine can be rotated in a couple of different ways. The car can be put in gear and pushed forward to rotate the engine. This is not a task that one should do on a sloping driveway. The other option is to spend about \$380 dollars on a special