

# BMW Puts a Diesel in a True Sports Sedan

By Jan P. Norbye

Make no mistake about it, BMW's experimental turbo-diesel is very sporty indeed. It's not in production—the factory that will make the engine has not yet been built. The plant will be located in Austria and run in partnership between BMW and Steyr, and engines may be sold to outside companies too. The BMW turbo-diesel isn't scheduled for sale until 1981.

Just how much of a sports sedan is the 524 Di? It has a top speed of about 105mph and will reach 60mph from standstill in 11.5 seconds. It can do 0-100mph in 35 seconds. It can cruise effortlessly at any speed, and is remarkably quiet at idle as well as on the overrun. And it can do it all with about 20% greater fuel economy than the six-cylinder two-liter 520 with gasoline engine.

It's the turbocharger that gives the engine its tremendous punch. Made by Garrett, it was chosen over the local product, KKK, for a better combination of turbine size and blade shape, compressor inertia and flow capacity. The turbocharger reaches its top speed at about 2200rpm and beyond that a bypass valve allows boost pressure to be held constant as the engine spins to its peak of 5000rpm—no mean feat for a diesel. This high speed is made possible by a Bosch distributor type injection pump, because it is difficult to get in-line plunger-type

pumps to run faster than 4000rpm.

Driving the BMW turbo diesel was as simple as driving any other car from the same maker. It has a key starter and stops when you turn the key off. If it needs pre-heating, a red light comes on and you just hold the key in its warmup position until the light goes out. Then the engine comes to life instantly and is immediately ready to pull under load. The idle is not only quiet but also very smooth, with the perfectly spaced firing intervals that come with an in-line six.

Basically, the BMW diesel belongs in the M-60 family; the 1977-model sixes from 2.0 to 2.3-liter displacement that are used in the 3-series and 5-series cars. The diesel has a longer stroke and a different crankshaft, giving 2.4-liter displacement, and its own aluminum cylinder head with an overhead camshaft. The block is cast iron. Both camshaft and injection pump are driven by serrated belts, and that's one of the things keeping the engine so quiet. Pump drives are usually the second noisiest thing on the diesel, the number one noise problem being the typical combustion knock. BMW has managed to damp them both very well.

Swirl-type combustion chambers are used, little spherical cavities connected to the cylinders via narrow gas passages. The fuel is injected into the swirl chambers and ignites, and the combustion then spreads to the cylinder in smooth style.



It's going to be strange to think of a diesel sports sedan, but BMW's 524Di pre-production model will hit 60mph in just 11.5 seconds.

The valve gear has been reworked from the gasoline-engine design, so that all valves now stand vertically in line. The lower face of the cylinder head is completely flat, except for the gas passages. Special pistons are used, of course, to withstand the higher combustion pressures and temperatures that come with a compression ratio of 23:1. That's the kind of compression BMW thinks is ideal to ensure cold starting under all conditions.

Because of its close relationship to the M-60 gasoline engine, it has been possible to keep the diesel very light. It weighs only 408lbs, which is not much more than

wasted.

BMW invited *AutoWeek* to drive the diesel on public roads around the Bavarian resort town of Lenggries, which is conveniently close to the company's proving grounds. That offered a variety of road and traffic conditions—from country lanes and winding mountain roads to a major highway where it could be tested for maximum speed. In docile driving through the towns and villages, the turbocharger really doesn't come into play under light-load conditions. When driven that way, the engine returns the best fuel economy, which comes close to

## Experimental Today, It Will Be Among The Most Modern Cars of 1981

the standard 520i engine. And it has the same output as the 2-liter six—115 DIN hp. Again, achieving parity on power with that engine is an accomplishment that would have been impossible without the turbocharger.

To get 115hp from a diesel without turbocharging, it would need a displacement increase to about 3.5-liters, and that would mean ending up with an engine weighing about 650lbs. The turbocharger delivers a maximum boost of 11.8psi which is equivalent to 23.5psi absolute pressure. And that qualifies as high-pressure supercharging, which would involve high power losses if a mechanical compressor were to be used. The turbocharger takes its energy from the exhaust gas, which would otherwise be

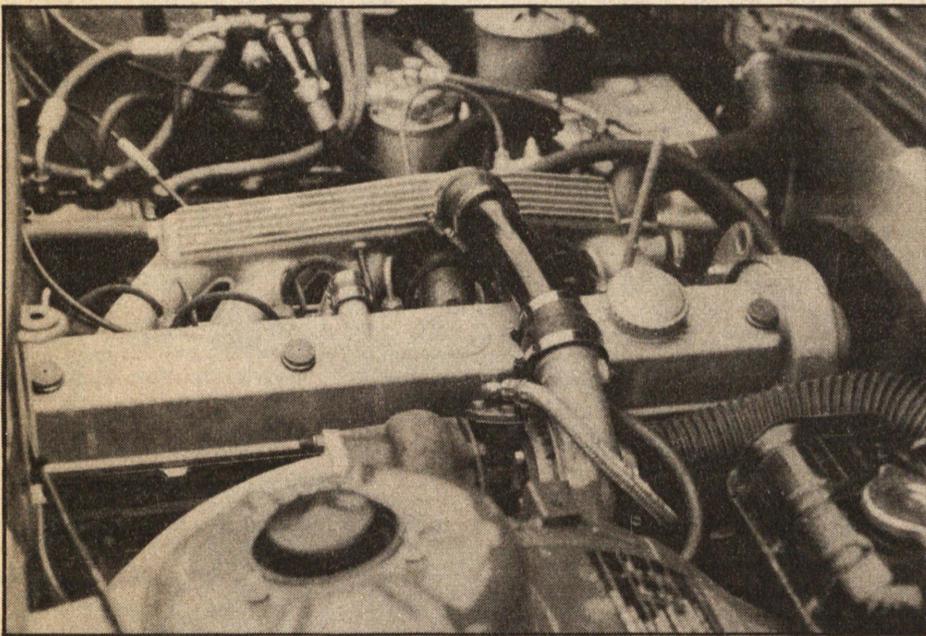
the same that would be obtained without a turbocharger being fitted.

The engine fits well under the hood of the 5-series car, and is pushed back against the cowl structure as far as possible for reasons of weight distribution. There is ample space on both sides to assure excellent service accessibility. In addition to a higher-capacity battery, the car has a separate oil cooler. These items add something to the cost of the engine, which in itself is not substantially more expensive than the gasoline-fuel M-60.

A five-speed manual Getrag transmission was fitted on the test car. First is strictly for starting, uphill, and with a heavy load. Second is good for getting under way. Third is a most remarkable gear—good for speeds up to about 70mph but also capable of easing a car around tight street corners without stumbling or snatching. Fourth is direct drive and fifth an overdrive for high-speed cruising.

The turbo-diesel has also been installed in the 3-series vehicle, where it is combined with a standard four-speed transmission. BMW is using ZF Type 3 automatics in both series now produced, but is also testing a four-speed Borg-Warner type 45 for possible use on future production cars. Due to the lighter weight of the 3-series car, it has slightly better acceleration and about 5mph higher top speed than the 5-series. The 5-series is a particularly civilized sports sedan, with a smooth all-coil ride, free of harshness without being soft. The steering is perhaps slow-gear, at 4.25 turns lock-to-lock, but the response is so fast that it feels very direct. The steering is very precise, with moderate effort, with good road feel and a total lack of shocks and vibration.

It has a modern unit-construction body, developed for the best all-round occupant protection possible while keeping the weight within reason. The four-door sedan is roomy and practical, with lower air drag than its boxy lines indicate. If the 524 turbo-diesel is experimental today, there's no doubt it will still be among the most modern in 1981.



More than one technical advance is used on the 524Di's turbocharged, fuel-injected 2.4-liter diesel.

## Champion Study Reveals Poor Car Maintenance

By Francis J. Gawronski

DETROIT—People fail to take care of their cars, universally, whether they live in this country or overseas.

This conclusion was reached following an international vehicle test program that showed 84% of all cars tested have at least one maintenance defect contributing to reduced fuel economy, increased exhaust emissions and sub-standard performance.

The tests, conducted by Champion Spark Plug Co., involved 13,609 vehicles in the U.S., Canada, Mexico and five European countries. It sought to determine how engine maintenance affects fuel consumption, emissions and overall operation.

According to the study, cars in need of tuneups averaged fuel savings in excess of 11% after they were tuned to manufacturers' specifications, although cars in Mexico averaged more than 26% improvement.

After tuneups, the same cars recorded hydrocarbon (HC) and carbon monoxide (CO) reductions averaging more than 50% at an idle.

"Results of our tests should set to rest a long-held assumption that European cars are in better shape than vehicles in the U.S.," said David L. Walker, Champion automotive technical services director.

"The European cars actually had a higher rate of deficiencies (88%) than did U. S. and Canadian vehicles (78%) with 90% of Mexican cars found undermaintained," Walker said. "Also, cars in Europe are emitting higher pollution levels than are American vehicles."

Walker ascribed the difference to the fact U. S. vehicles are equipped with sophisticated emission control systems while European vehicles are not.

Checks performed on all cars revealed engine malfunctions responsible for inefficient use of fuel and high emissions. In Europe 56% of all vehicles had incorrect idle settings versus 44% in the U. S., while timing was off in 54% of European vehicles versus 49% in the U. S.

Nearly one out of every four cars in Europe and the U. S. showed low ignition reserve, a condition that hampers starting and performance.

Nearly 43% of all American car owners complained of experiencing rough idle, a

condition that plagued 37% of European car owners. Hesitation upon acceleration was the next most frequent complaint with 41% of the Americans and 33% of Europeans.

In both the U. S. and Europe, about 25% of the motorists reported hard starting problems. Other difficulties resulting from poor ignition system condition included engine run-on - 22% in Europe and 21% in the U.S.; detonation - 21% in the U. S., 16% in Europe; and spark plug misfire - 15% in both areas.

Frequently discovered deficiencies, according to Walker, involved carburetors, breaker points, distributor caps, spark plug leads and spark plugs.

In addition to engine components, test personnel checked other parts of the vehicle for condition. Their findings by area are:

Low on oil-28% in the U.S. and Canada, 24% in Europe and 33% in Mexico.

Clogged air filter - 34% in the U. S. and Canada, 30% in Europe and 51% in Mexico.

Battery needs service - 20% in the U. S. and Canada, 16% in Europe and 21% in Mexico.