930 CIS Improvements

BY JIM PASHA

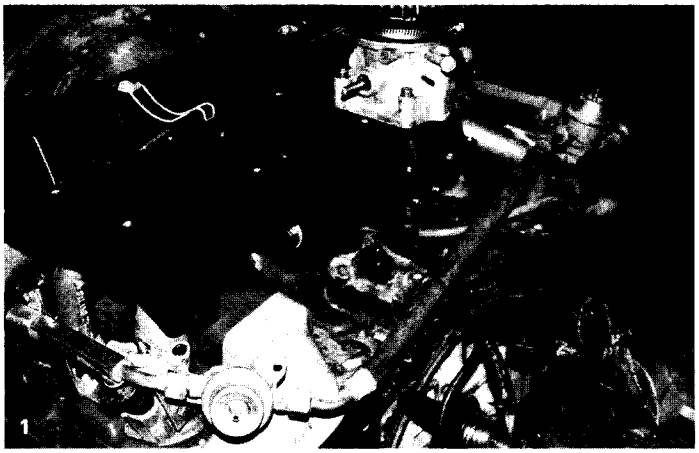
Modern EFI engine management may give CIS-equipped 930s a new lease of life...

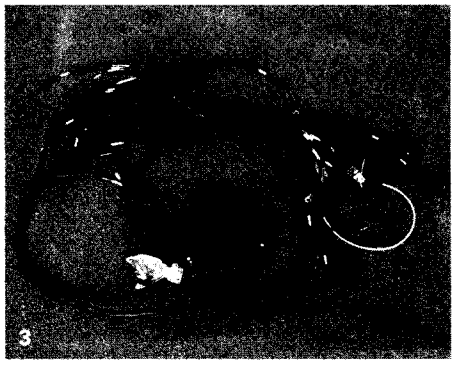
Porsche's 930 is nearly three decades old. While the first 911 Turbo represented a quantum leap in terms of Porsche technology for production cars, the passing years and revised government requirements have made continued ownership problematic at best.

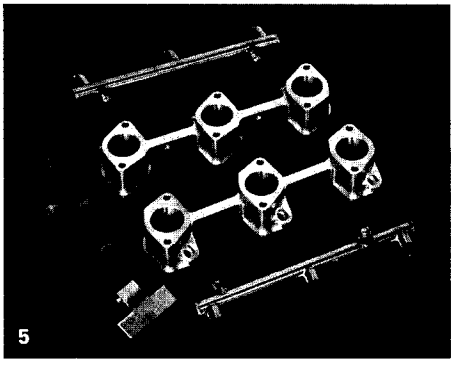
Take, for example, the emission tests currently used in California and stricter areas of the Northeast. Methods used to measure emissions have greatly changed over time — to the point that an older car in good condition that passed older tests will fail the newer tests because of recent changes. This is hardly fair to owners of older cars. So it's no surprise that it causes anger amongst classic car owners — many of whom question the *real* intent of government-driven changes to emissions requirements for older cars.

While changes to emissions testing can affect owners of all older Porsches, owners of 1976-89 911 Turbos are particularly at risk of test failure. The people at the California Air Resources Board (CARB) have decided that accelerating vehicle replacement by tightening the emissions requirements — via stringent test methodology — is the easiest way to deal with air quality problems. At least in terms of facing the public. Why this is important to the rest of us is because California often sets the trend for legislation in environmental matters.

Many CIS-injected Porsches are getting caught in this new testing method-







The original CIS fuel system responsible for managing the 930 engine's fuel and ignition needs (1-2) worked fairly well in its time, but it was never really up to handling the full potential of these 3.0- and 3.3-liter engines. Worse, it may not pass the latest emissions standards easily, and rebuilding the CIS system today is cost-prohibitive. A solution may be this new Electronic Fuel Injection system, which incorporates a wiring harness (3) and all of the gaskets and other hardware (4), as well as trick injector blocks and fuel rails (5). The system is claimed to add roughly 40 horsepower to a stock 930 engine while cleaning up emissions and improving gas mileage, too. That's what modern EFI does for you. And those who want to upgrade from the original turbo, camshafts, and more can realize even bigger power increases...

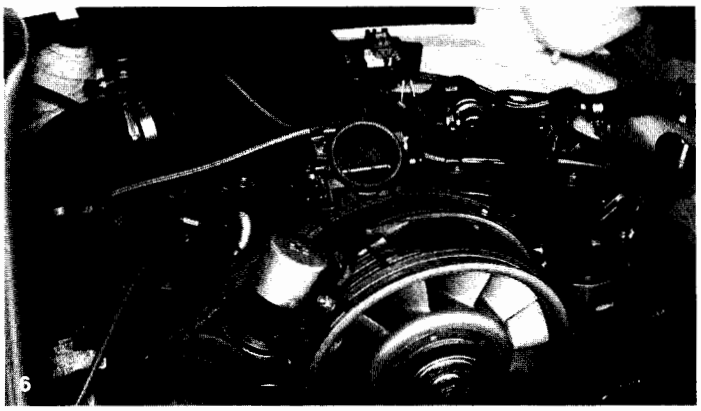
ology because the stock fuel-injection system — while quite efficient and state-of-the-art at the time of its manufacture — suffers from wear over time. Couple this with the extreme heat that's ever-present in the engine compartment of a turbocharged 930 and an owner can suddenly be responsible for a lot of repairs to get the car to comply.

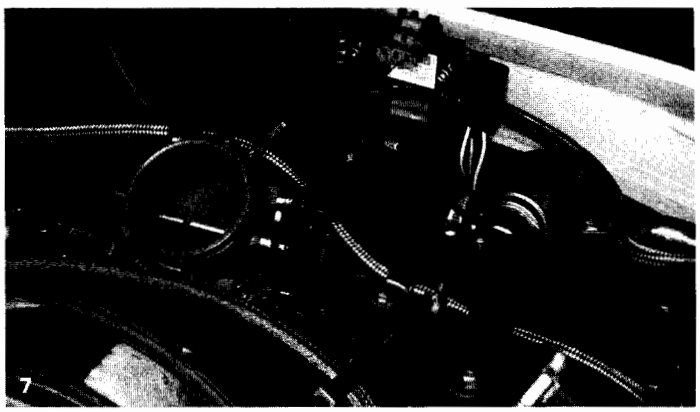
Early 911 Turbos can be difficult to get past the newer tests because of the equipment they used for emissions compliance. These cars generally used thermal reactors and air-injection pumps to take care of downstream emissions. While EPA figures *were* generated on a dynamometer, emissions testing in those days was designed to be performed at idle and at 2500 rpm without the engine being subjected to load. In other words, the car was sitting still during the test. The latest technology in emissions testing is dynamic, so the car "drives" on a chassis dyno that simulates real-world driving. In other words, its engine is now tested under load. This regimen causes a different set of figures to be presented, as the engine is only partially cooled as it would be in normal usage.

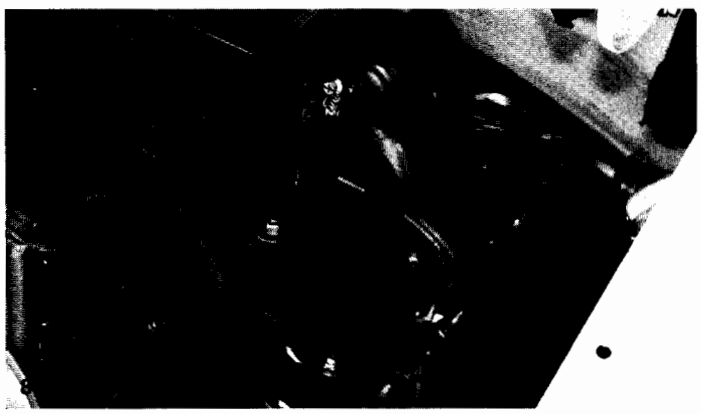
The original CIS system is fairly efficient in respect to emissions control. But because the components wear out over years of use, you can expect some very expensive repairs if you need to overhaul the system. Where a Turbo owner might have gotten away with slightly less than perfect injection in driveability and performance terms, the new emissions tests don't lie. And the results may tell you to overhaul your car if you want to register it for road use this year. Worse is the fact that Porsche's parts prices for the bits you'll need to put things right are even more outrageous than usual.

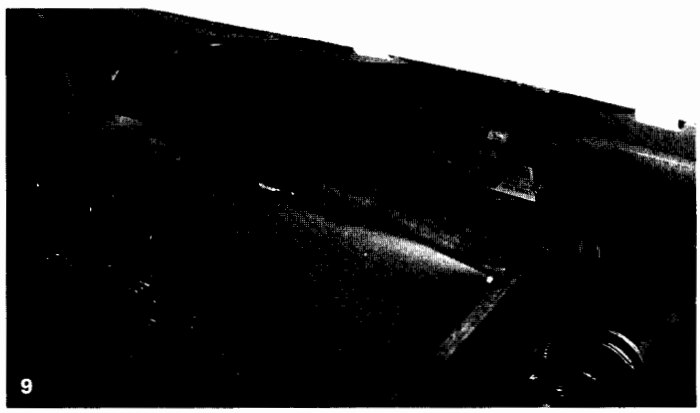
The fuel distributor — rebuilt, not new — is nearly $700 alone. How about other fueling options? It's difficult to use carburetion with a turbocharger and that plan will *definitely* not solve your emissions compliance problems. An aftermarket fuel-injection system may or may not work, but a top-of-line system like Motec starts in the higher four figures and goes up quickly from there. This makes for a very costly decision when a complete engine rebuild is required — or whenever a 911 Turbo's original engine "management" isn't up to passing the latest emissions tests. Many 930s are being sold to owners in states with relaxed emissions standards, but this is not a good solution. And other Porsche owners with CIS-injected models will eventually be faced with the same problems.

Back in 2003, I had a conversation about this issue with Pat Williams of Pat Williams Racing in Memphis, Tennessee (*patwilliamsracing.com*). He had just assembled a trick, small-displacement (2.1 liters) 930 engine for a PCA club racing customer that utilized electronic injection Williams had been experimenting with. This blown 2.1-liter produced a claimed 450 hp with real tractability throughout the rpm range. Now installed in the owner's car, it has proven to be a very powerful setup — and a race winner. Williams went one step further after developing this engine, thinking about customers who are trying to improve the









Modern engine management from PWR adapted to a 3.3-liter 911 Turbo shows a largely tidy install (6-7), with a new cone-style air filter and more. A few lines give the game away, but these black-and-white photos don't show the colors of some of the lines and fittings. If the red and blue lines and fittings were changed to silver and black, our bet is that some smog test technicians might not even spot the new system at all on a visual inspection—and especially if the injector blocks (8) were anodized black. Reinstalling the intercooler (9) only makes it tougher to spot the new system, but the clues are all still there if you go peeking around the unit. Pasha says the modern EFI system transforms throttle response and driveability, which can only make the 930—which has always been an exciting drive if nothing else—even more fun from behind the wheel.

performance of their 930s and replace the CIS system in the process.

He and his staff went about figuring out what the 930 turbocharged flat six's requirements were and then designed the components necessary to convert a CIS-injected 930 to a DME-like EFI system. This has taken PWR almost two years, but my trip to Memphis revealed that Williams and his staff have accomplished something significant. This is no turbocharger bolt-on kit.

The system involves the removal of the complete intake system to install replacement injector blocks as well as an all-new fuel-rail setup and a new electrical system required to operate everything. The harness is a complete piece, ready to install. The manifold replacements come with all required gaskets and new fuel injectors.

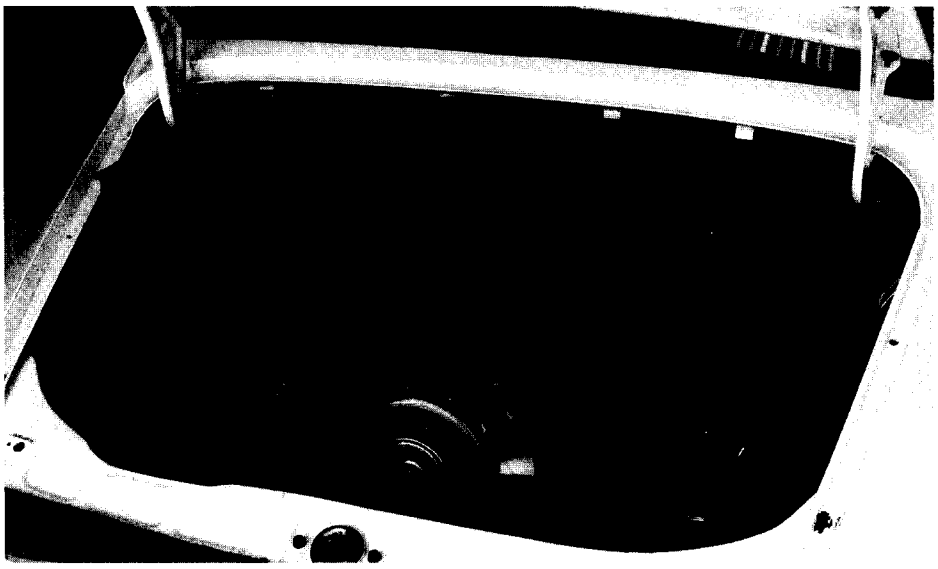
The new Engine Control Unit (ECU) is a custom-made item and is the key to the operation of the system. What Williams has done is fine-tune the system so that minimal adjustment is required by the end user. Basically, it's a turn-key package for a good mechanic or an advanced home mechanic. Whoever handles the installation *will* need tail-pipe testers to fine-tune the system to work on an individual motor, but Williams promises that it will only be fine-tuning.

So far so good. What does it really do for the car? After an extended test drive in a converted 930, I can tell you that many of the more irritating characteristics of 930 in street use are gone. Improved control of the fuel mixture coupled with better control of the ignition advance curve make for much better around-town performance — especially below 2500 rpm. The system gives excellent pickup from 1400 rpm and transitions more smoothly into boost. Driving an early 930 fitted with the PWR system yielded good acceleration in fourth gear from 30 mph. This is simply not possible in a factory stock, CIS-equipped 911 Turbo.

Acceleration in the lower gears is also smoother — to the point that it's now very good. That's surprising because the 3.3-liter Turbo engine is good but well-known for its doggy low end. At least until boost arrives. Then, it's hang onto your hat! Of course, if you don't change the turbo, you can't expect a complete transformation. But the difference is very noticeable. The key to this improvement is in the programming to improve the fuel mixture and advance in the low end.

The principle difference between the two systems is in operational terms. The K-Jetronic system the 930 was originally equipped with delivers fuel at all times, the amount being determined by the demand as metered through the fuel distributor. In the original system, an orifice with a plate over it is used to meter the air. This plate is on a balance beam which in turn operates the fuel distributor's plunger. This is a fixed ratio, so the beam moves a certain distance and enrichment occurs at the same rate each time.

L-Jetronic is a DME system that also measures airflow, but converts that data into electronic signals which in turn are evaluated by the DME computer module. The air/fuel mixture and ignition



Completed EFI conversion, when tucked under the factory intercooler, takes a pretty well-trained eye to spot...

advance are then applied as required. The fuel is delivered by timed injectors which open and close for periods determined by the amount of enrichment required. Timing is altered based on the signals to the DME module for the load present and throttle-plate position.

The new ECU is where the emissions — and the efficiency — improvements come from. By making multiple curves more in keeping with the actual requirements of the engine, the advance curve can be made more ideal for the 930's turbocharged engine. Generally, some initial advance is needed to get things rolling, then retard is added to prevent detonation. The addition of a knock sensor is important. Metering fuel delivery with a precisely programmed fuel map reduces excess fuel — which means less will have to be dealt with by some downstream emissions gadget. Like a rotten thermal reactor. PWR's ECU can alter the duration of the opening of the electronic fuel injectors to match a specific set of engine parameters, reducing fuel requirements significantly. Driving tests have noted fuel economy improvements for all 930s equipped with the system. City driving has returned around 16 miles to the gallon. That's still not exactly miserly, but it's far better than a stock 930 can manage.

Engine alterations can be more readily added with the EFI system. Additional boost, cam changes, and a bigger intercooler made one 3.3 Turbo really come alive. We got a chance to drive this car as well and, like the converted standard car, it had great driveability. And more power than needed when entering the freeway... PWR upped the boost to 15 psi, added 964 cams, and installed a larger intercooler. The engine was otherwise stock. Maximum horsepower is a claimed 448 at 5800 rpm. Torque is purportedly 437 lb-ft, peaking at 5200 rpm.

Flexibility is better than stock, as well. Williams says over 400 lb-ft of torque is available in this engine from 4200 to 5900 rpm. And over 400 hp is supposedly available from 4700 to 6900 rpm. It should be noted that these figures are from PWR, but I *can* tell you that this 930 is easy to drive on a city street in top gear. It will pull smoothly on its way into boost from 1400 rpm in fourth gear. It just happens a lot faster than it does in an unmodified engine.

I recall my own 1979 Turbo as being a real handful to drive with on/off-switch throttle characteristics. I looked for similar tendencies carefully in both PWR cars. They simply were not there. So, besides drivability, what else do you get? More power. Williams says the standard system usually nets customers a roughly 40-hp improvement without other changes. The turbo swap brings even more power, as do 964 cams and a larger intercooler.

But there's an even better reason for installing this system, which takes us back to our original dilemma: emissions are greatly reduced. Williams says a PWR-injected 930 passed a 49-state emissions test *without* thermal reactors or air injection in place! Yes, these are old-car standards that apply, but the results are positive. Even if you don't have to worry about getting your 930 through emissions, cleaning up its emissions is a feel-good — and who doesn't want better mileage with more power to boot? This system allows older Turbo owners to take advantage of the same technology the factory has used to accomplish this triple feat.

One of Williams' customers lives in Virginia and certain areas require emissions compliance testing so that the car can be registered. Results showed that the customer's 1978 930 (without any as-delivered emission equipment but with the EFI) passed, though it was close to the high limits. But this car would have been a considered a gross polluter prior to the conversion. Williams and his team are now looking at the requirements for obtaining a California Air Resources Board exemption for the EFI system at this time. So long as there are enough interested customers in the California market, he says that this *will* happen.

The issue in California isn't the emissions compliance, as Williams says the system will pass even under the newer California rules. The engine's *appearance* is altered with the EFI system, so the system will not pass the visual portion of the California smog test. Thus, the C.A.R.B. exemption will be required at the time of smog testing to prove that the equipment is indeed legal. This is a visual inspection issue, but many states do emissions testing without a visual check.

If there is a need to make a particular 930 *very* clean, a three-way catalyst can be added to further reduce tailpipe emissions. The engine management part of this has been successfully done with the PWR system, too...

So what *does* the Turbo system come with? New injector blocks are required, as they are shaped differently and need to be angled at the valve so that the fuel rail will clear the other equipment on the top of the engine. The position is critical, as you want a good spray pattern on the back of the valve to ensure proper atomization when the fuel injector is triggered. All fuel lines are included in the kit.

Insulation blocks are included to reduce transmitted heat to the injector blocks. Custom fuel rails fit around all of the components and incorporate a pressure regulator and damper. Certain sensors need to be added, the head temperature sensor being one of the more important ones. Also added is an idle stabilizer. The airflow bypass system is removed. Fuel pressure is regulated by a pressure-dependent system and a variable unit that's controlled by the ECU. Williams and his crew came up with an ingenious system that allows mechanics to fit the cylinder-head temperature sensor and heat transfer plate without engine disassembly.

The ECU was developed to take into account the same parameters that a normal Bosch DME setup requires. This one can go a few steps further and can control other engine functions if desired. In standard issue, it controls the ignition advance and fuel delivery and requires little adjustment. The normal ignition system provides the basic signal to operate the system. The ECU is designed to accommodate crankfire ignition, but it's an extra-cost option that requires modifying the original flywheel to actuate the crank-fire ignition pickups.

In addition, the system is built to use the oxygen sensor most of us have gotten used to having in modern cars. The closed-loop system allows for more precise control of the enrichment curve. For racing applications, the oxygen sensor can be deleted, but a custom enrichment and ignition curve will be required.

A few readers with non-turbo CIS-injected 911s may be reading along with interest by now. For their benefit, I'll mention that PWR does have a prototype EFI replacement system under way for the 911 SC. Williams says the system would also work for 1974-77 CIS 911s, as well. But for now the mule engine is a 1979 911 SC mill. The normally-aspirated system uses virtually identical hardware to the 930 system with the exception of the intake manifolds. The existing CIS manifolds are used along with the throttle plate and air cleaner. The fuel rail is made to clear all components on the existing CIS manifolds. This gives an almost stock look to the engine compartment and uses the most reliable pieces of the CIS system. Gone are the fuel distributor, balance beam, CIS hoses, injectors, and mode switches. A simple plate converts the CIS metering system to the EFI system. No power figures for this conversion are available yet, but I will keep readers posted as they come in. This is an excellent alternative for owners of older 911s with CIS who want more performance.