"AMAZING DYNO STORIES"

(parts to get--and parts to __forget__!)

This booklet is a form of personal protest to the people in the performance industry who find it necessary to exaggerate, or in some cases, **lie**, in order to sell their wares to the public. I have been testing Volkswagen powerplants of various types and outputs on the dyno for over twenty years. For the last five years I have limited my testing to the "second generation" VW watercooled engines. The focus of our testing has been on high performance "tuned" engines with CIS fuel injection. The object of the testing is to find "combinations"--that is, a group of parts that work well together.

When you have a good combination, you end up with what people usually describe as "an engine that runs better than it should." This simply means that the various engine components are working in harmony. It's this "harmony" that we are looking for!

Some people look to racing parts as a means of increasing power. We all know that racing engines (like Super Vees) produce a lot of power. However, for road use the power occurs at such a high RPM level that it would be useless for day to day use. We would all like to have engines that would pull hard at 8500RPM, but who wants a motor that is dead below 5000RPM and requires "racing fuel"? So our approach is __not__ to copy the racer's route to power. We follow the Oettinger route of increasing torque and power through increasing the engine's displacement, breathing, and compression ratio. Don't be fooled into thinking mere "bolt ons" will result in the kind of torque and horsepower that our engines are famous for. Why am I so sure? Because we have tested (and will continue to test) more water cooled VW engine combinations than anyone in the U.S.

The following pages of text and graphs illustrate some of the different combinations that have been on the dyno over the past five years. This just a small sampling of the more interesting tests.

Cordially,

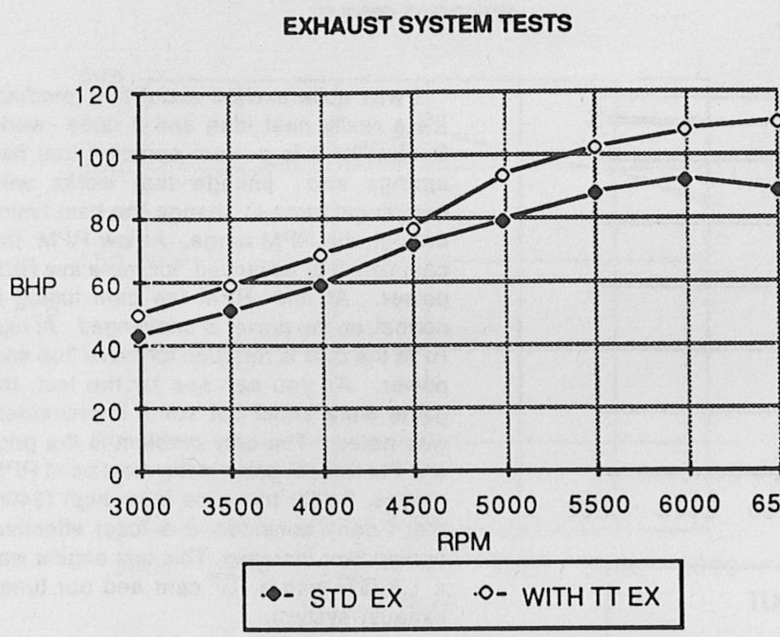
Darrell Vittone

techtonics tuning • 1253 West La Cadena, Bldg. 1 • Riverside, CA 92501 • (714) 788-4116

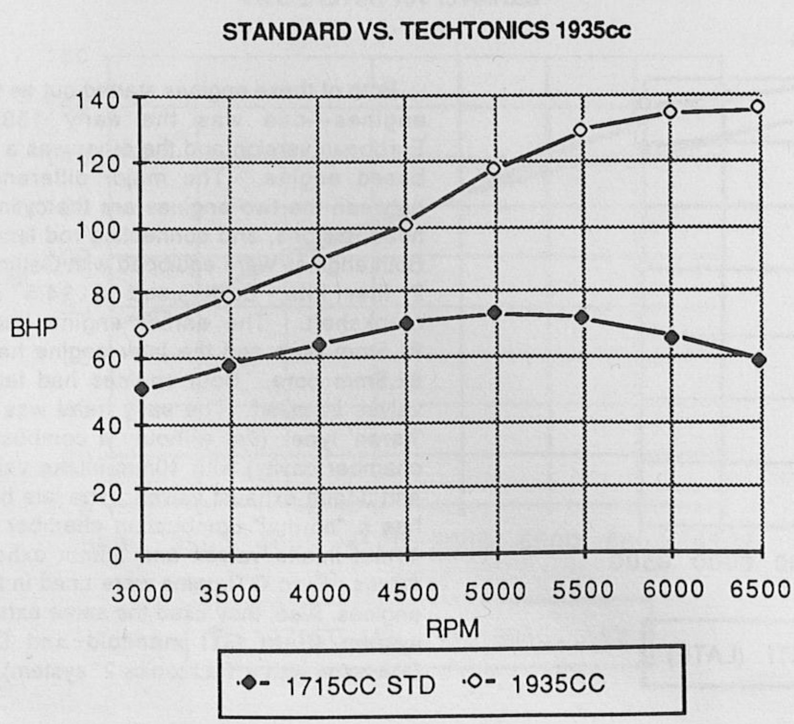
503 843 2700

"AMAZING DYNO STORIES"

(parts to get–and parts to forget!)



This test illustrates how a "tuned exhaust" system can make a dramatic difference in torque and power output. This is a "small" 1588cc engine (79.5mm bore and a 80mm stroke) with CIS fuel injection, 9.5-1 compression ratio, S-2 cam, and our "big valve" cylinder head (40mm in. and 34mm ex. valves). As the chart shows, this combo has good power at high RPM, but not much low speed torque. Max . torque was 98.7 ft lbs. at 5000 RPM. Look at the next test and you will see the difference more cc's make in horsepower output.

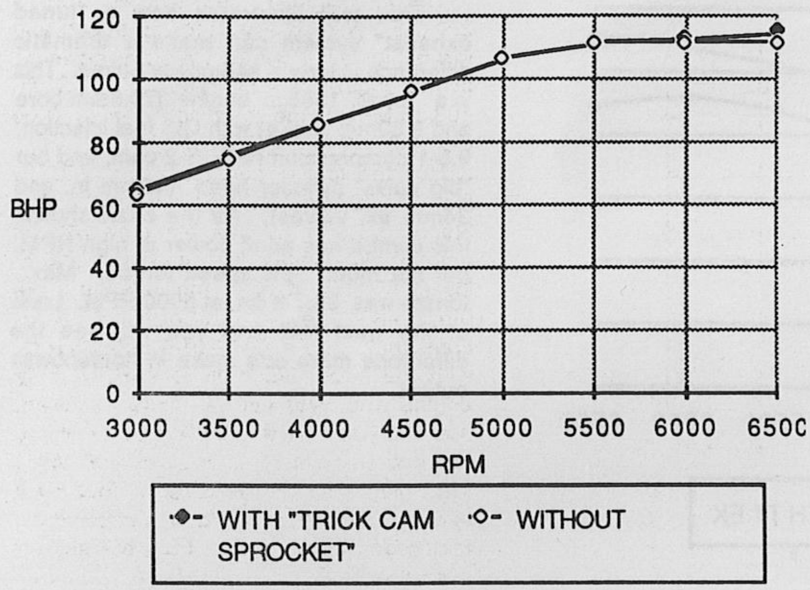


We can see from this test the greater torque and horsepower the modified 1935cc engine has over the 1715cc standard engine. The added displacement and compression add low speed torque. The free breathing head combined with a Euro GTI camshaft and tuned exhaust help the higher RPM horsepower. An engine such as this turns a standing 1/4 mile in the mid-15 second range at 88+ MPH in a 2000 lb. vehicle and will still get 30 MPG on the highway. People ask me how long will a engine like this last? I can't really say because I haven't seen one wear out. Some of them have over 100,000 miles on them! It is "no hassle" performance. Service and maintenance are unchanged from stock, and can be serviced by any Volkswagen mechanic.

"AMAZING DYNO STORIES"

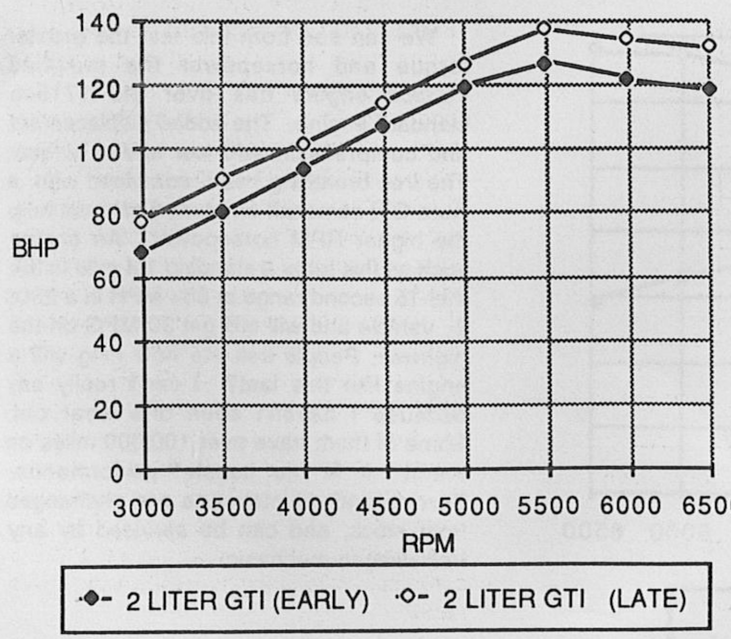
(parts to get–and parts to forget!)

"TRICK" CAM SPROCKET TEST



I was quite excited about this product. It's a really neat idea and it does work. Basically, it is a cam sprocket that has springs and linkage that works with centrifugal force to change the cam timing through the RPM range. At low RPM the cam timing is advanced for more low RPM power. At mid- RPM the cam timing is normal, so the power is unchanged. At high RPM the cam is retarded for more "top end" power. As you can see by the test, the gains were small but some improvement was noted. The only problem is the price and the limited gains in the most used RPM ranges. So far the price is so high ($400) that I don't consider it a "cost effective" horsepower increase. This test engine was a 1.8 GTI with a "G" cam and our tuned exhaust system.

EARLY VS. LATE 2 LITER GTI'S

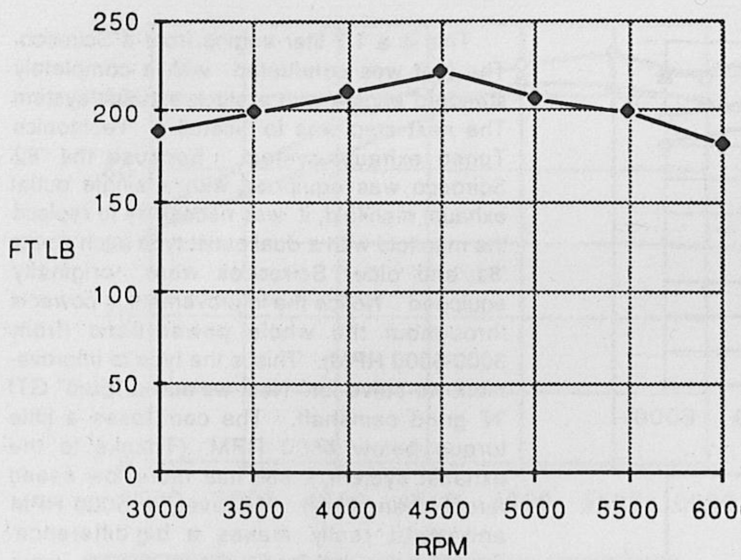


Both of these engines started out as GTI engines---one was the early 1588cc European version and the other was a 1.8 based engine. The major differences between the two engines are the cylinder head, pistons, and connecting rod length. Both engines were equipped with Oettinger 2 liter kits. Both used a 94.5 mm crankshaft. The earlier engine had a 81.5mm bore and the later engine has a 82.5mm bore. Both engines had larger valves installed. The early head was the 'heron' type (flat without a combustion chamber cavity) with 40mm intake valves and 34mm exhaust valves. The late head has a "normal" combustion chamber with 41mm intake valves and 35mm exhaust valves. Euro GTI cams were used in both engines. Also, they used the same exhaust system (Euro GTI manifold and Dual Downpipe with a Techtonics 2" system).

"AMAZING DYNO STORIES"

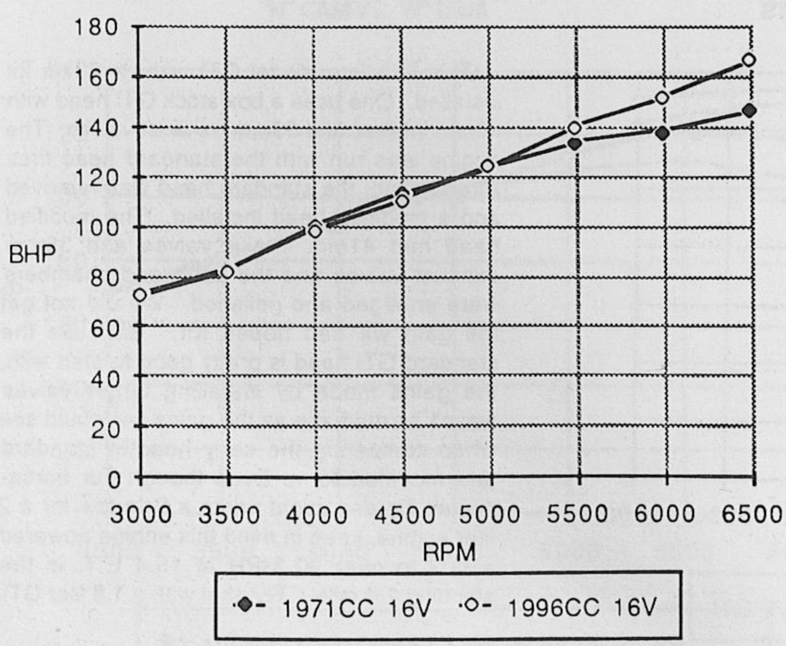
(parts to get–and parts to forget!)

TURBO TORQUER



The '77 Scirocco that I drove at "BUG IN 28" (All VW drag event) to top speed and low e.t. for water cooled VW's was powered by this engine. The car ran a 13.77 E.T. @ 103.45 MPH in the standing 1/4 mile. (See Oct. '82 VW & PORSCHE MAGAZINE). Notice the torque curve starts at 189 ft. lbs. @ 3000 RPM! Keep in mind that a standard 1.6 or 1.7 has less than 1/2 that amount. We have a torque peak of 220 ft. lbs. @ 4500 RPM. This engine featured our big valve head, Oettinger 90.5mm crankshaft, and a IHI RHB-6 turbocharger with the boost adjusted to 20PSI. This engine was awesome: the tires would not hook up (with the throttle floored) until you reached speeds in excess of 65 MPH. The high torque required a four puck clutch and solid motor mounts. Plus, racing gas was a must. Fun, but not for everyday driving.

TWO 2 LITER 16V ENGINES

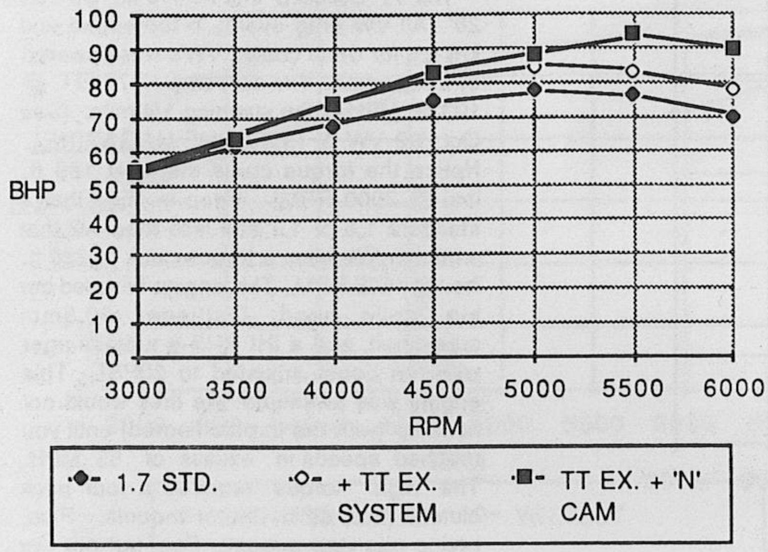


This is a "before and after" type of test. The 1971cc Oettinger 16V engine was tested, then disassembled and modified using the "wilder" 276° camshafts, 1.8 connecting rods (8mm longer than earlier rods), 82mm pistons (forged Kolben-schmidt with 20mm wristpins), replacing the 81.5mm cast pistons with 22mm wrist pins. The cylinder head was rebuilt and the ports polished. A four-into-one exhaust header from Oettinger was installed in place of the existing cast iron exhaust manifold and Euro GTI dual downpipe. Even though we gained 20 HP @ 6500 RPM, it didn't really feel like it in driving the car because the torque and midrange power was actually a little lower . At 5500 RPM and above the 1996cc was decidely stronger. However the modifications to this engine alone cost more than a complete 1935cc engine with a big valve head!

"AMAZING DYNO STORIES"

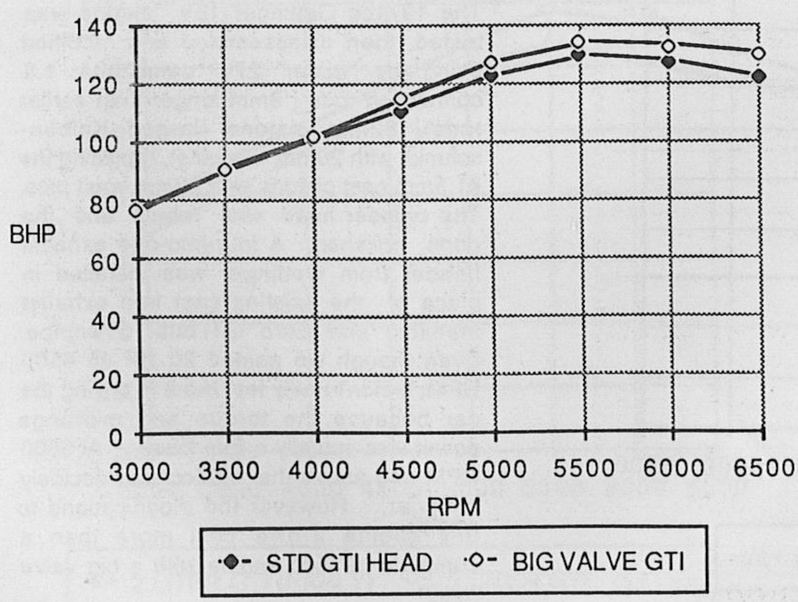
5(parts to get–and parts to forget!)

CAM & EXHAUST SYSTEM TESTS



This is a 1.7 liter engine from a Scirocco. The test was conducted with a completely standard engine with a stock exhaust system The next step was to install a Techtonics Tuned exhaust system. Because the '82 Scirocco was equipped with a single outlet exhaust manifold, it was necessary to replace the manifold with a dual outlet type such as the '81 and older Sciroccos were originally equipped . Notice the improvement in power is throughout the whole power band (from 3000-6000 RPM). This is the type of improvement we strive for. Next we add a "Euro" GTI 'N' grind camshaft. The cam loses a little torque below 4500 RPM. (Thanks to the exhaust system, it still has more low speed torque than stock). However, at 5000 RPM and up it really makes a big difference. Because the cam and exhaust system work so well together this engine gains almost 20HP @ 6000 RPM.

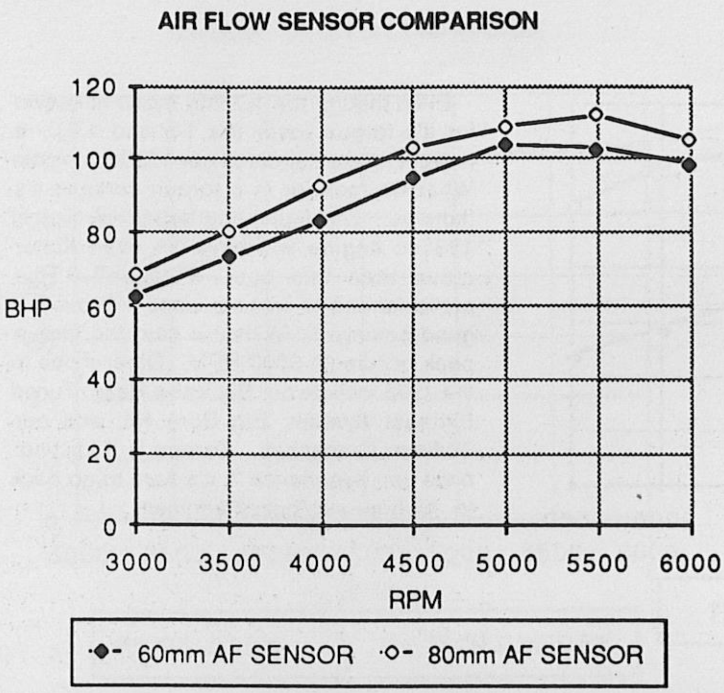
2 LITER GTI CYLINDER HEAD TESTS



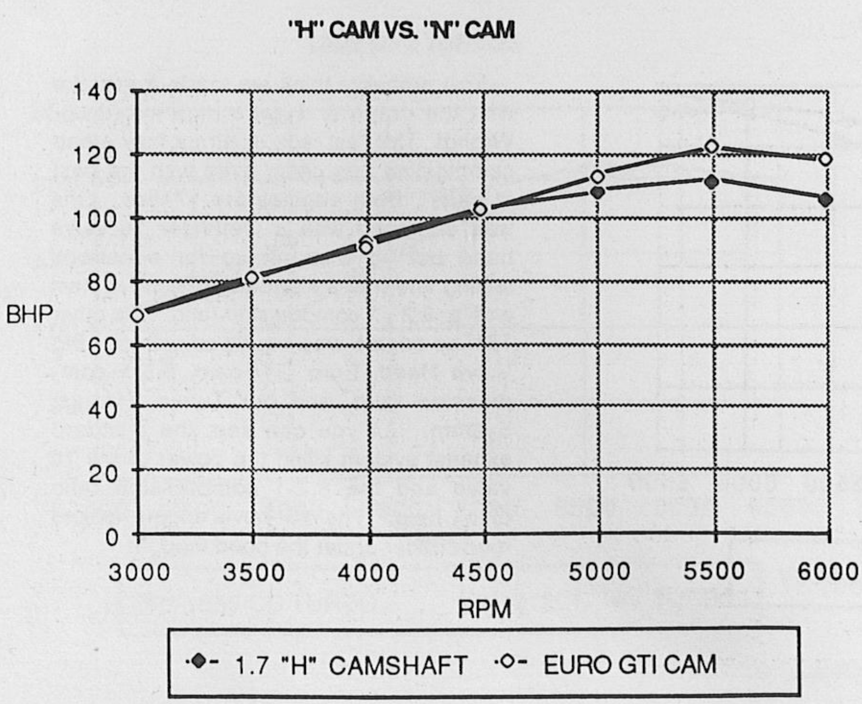
This is a late model GTI with a 2 liter kit installed. One uses a box stock GTI head with 40mm intakes and 33mm exhaust valves. The engine was run with the standard head first. After testing, the standard head was removed and a modified head installed. The modified head had 41mm intake valves and 35mm exhaust valves and the ports and chambers were enlarged and polished. We did not get the gain we had hoped for. Because the standard GTI head is pretty good to start with, the gains made by installing larger valves wasn't as dramatic as the gains we would see when comparing the early head in standard and modified form. Even though our horsepower figures might seem a little low for a 2 liter engine, keep in mind this engine powered a GTI to over 90 MPH at 15.4 E.T. in the standing 1/4 mile. Try that with a 1.8 liter GTI!

"AMAZING DYNO STORIES"

(parts to get–and parts to forget!)



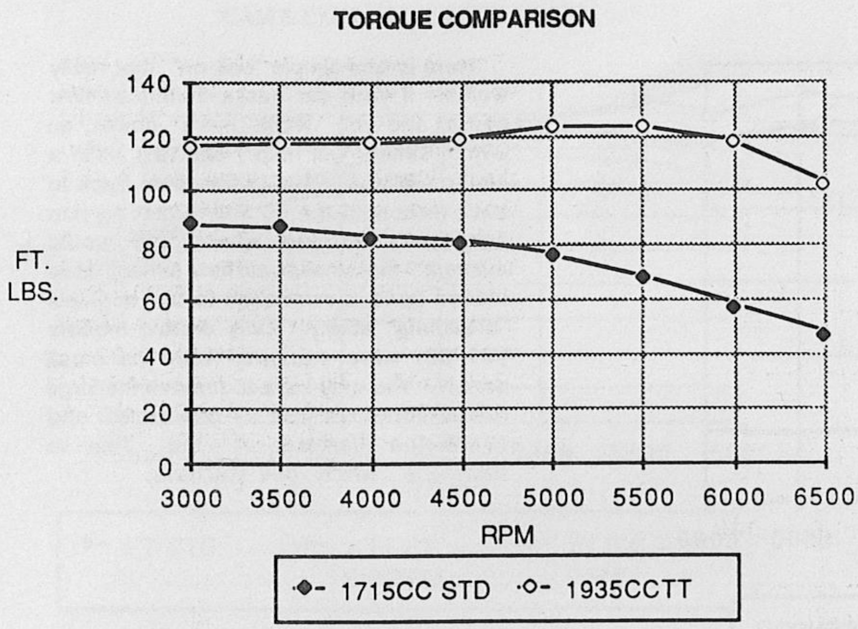
Here is one simple "bolt on" that really works! If your car has a 60mm air flow sensor and you want more power, an 80mm sensor will help. The test is on a 1847cc engine with CIS injection. Back to back tests with the 60 and 80mm air flow sensors confirmed what logic would suspect: the smaller air flow sensor does indeed pose a restriction to the engine's "breathing" ability. Only certain models ('81-'83) were equipped with the small sensor. You only have to remove the large rubber boot from your air flow sensor and check the diameter of the 'flap' to determine which one you have.



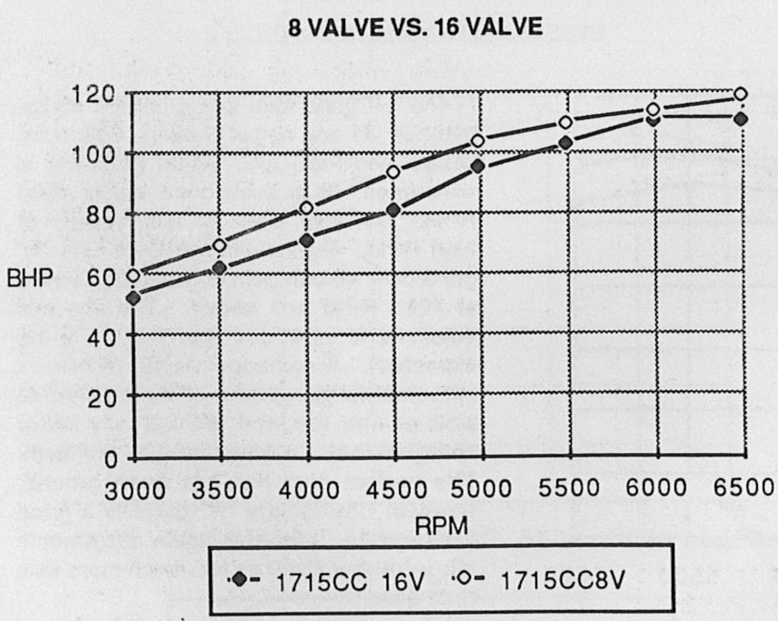
The "H" grind cam was standard equipment on '81 and newer Rabbits, Sciroccos, Jettas, and Pick-Ups. As far as power is concerned, it is quite good below 4500 RPM. However, it falls off quite rapidly at high RPM. By installing a Euro GTI "N" grind cam we can gain considerable power at 5000 RPM and above. The low end power is a little less (but that is to be expected). If someone claims to have a cam that will gain power on the low end as well as the top end without any other changes, they are lying through their teeth. The perfect cam has not been ground, however, the factory "N" grind is a good compromise. Low end power and smooth idle will suffer if you go for much more cam than this.

"AMAZING DYNO STORIES"

(parts to get–and parts to forget!)



Even though the 1.7 liter motor is known for it's torque (over the 1.5 and 1.6). It doesn't hold a candle to our 1935cc engine. What we look for in a torque curve is it's flatness. The flatter the better. A typical 1935cc engine will have an even flatter curve than this one. Reason? This particular engine was equipped with our S-2 grind camshaft. With this cam the torque peak occurs @ 5000 RPM. Other mods to the 1935 include our Big Valve Head, Tuned Exhaust System, Big Bore Kit, and our 90.5mm Crankshaft. Torque is addicting: once you experience it, it's hard to go back to high-strung,"buzzy"engines.

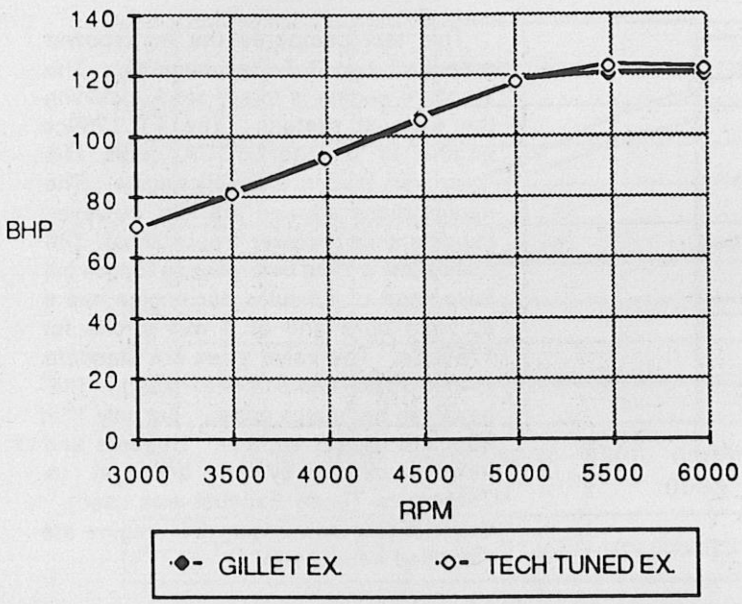


You probably think we made a mistake with the graph and got things mixed up. Wrong! This test is to illustrate how a bad combination can occur even with the best of parts. Both engines are 1715cc. One was equipped with a Oettinger 16 valve head but it was set up for emissions testing and had a standard exhaust system and a 8.2 - 1 compression ratio. The other 1715cc engine was equipped with our Big Valve Head, Euro GTI cam, 9.5-1 compression ratio, and our Tuned Exhaust System. As you can see, the standard exhaust system killed the power of the 16 valve and the 8.2-1 compression ratio didn't help. The 16 valve engine looked much better under the hood though!

"AMAZING DYNO STORIES"

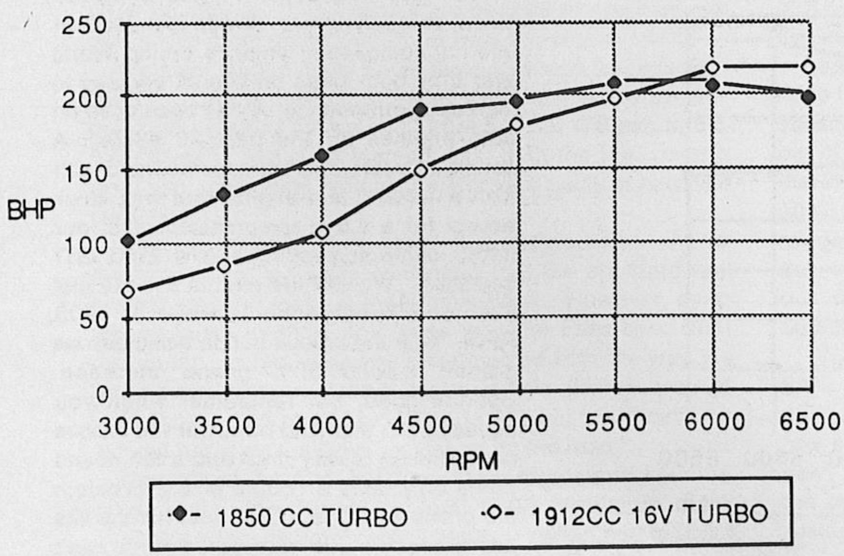
(parts to get–and parts to forget!)

EXHAUST SYSTEM COMPARISON



Sometimes we get results like this. Here we have two different exhaust exhaust systems that are very similar in layout but quite different in detail. The results were almost identical. I expected our Tuned System to be more effective than it was against the Gillet System. Our system has larger pipe and one less muffler but managed only a small gain at 5500+RPM. Because the Gillet tested so well we added them to the catalog. The test engine was a 1847cc with a Big Valve Head, Euro GTI cam, Euro GTI Exhaust Manifold & Dual Downpipe, and our Big Bore kit.

TALE OF 2 TURBOS



Here is a fine pair to draw to. The 1850cc Turbo is the engine that powered the '77 Scirocco that I drove at Bug In 28 (13.77 @ 103.45 MPH). The other engine is a Oettinger 16 valve with an IHI turbocharger installed. The 1850 was running 20 psi boost and the 16 valve engine had 14 psi. The graph shows how the smaller 8 valve engine had much more low end and mid range horsepower due to the extra 6 lbs boost and mild cam timing (standard 1.6 liter camshaft). The 16 valve engine was equipped with VW's knock sensor ignition and used pump gasoline. The 1850 used conventiomal ignition and racing gas. The 16 valve actually had more horsepower on the top end but, the 1850 would prevail in a drag race due to the superior torque available in the midrange. If it wasn't for the extra problems and maintenance, I would do more with turbos because they really do fly.

"AMAZING DYNO STORIES"

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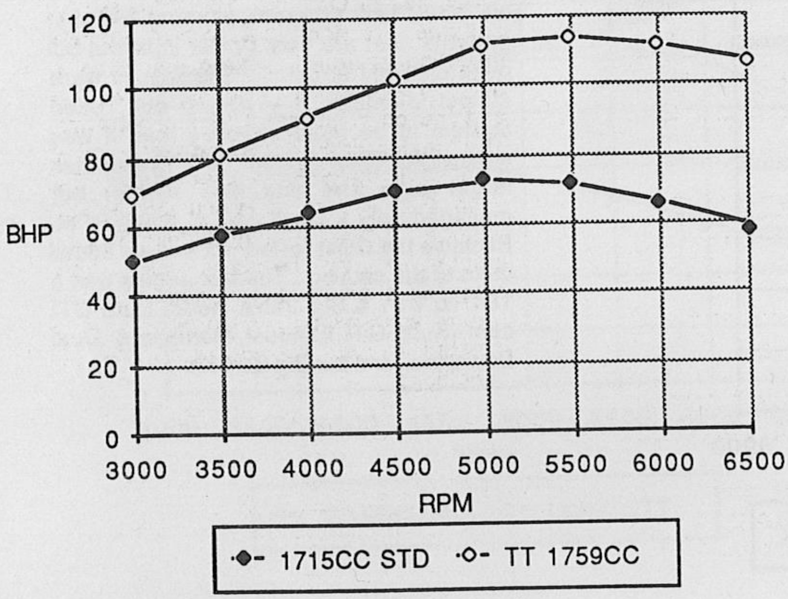
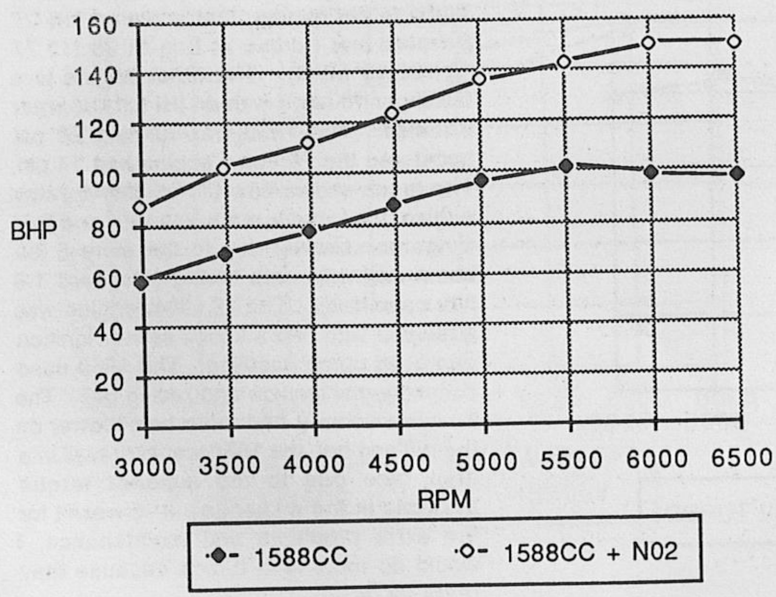
STD. 1.7 & TT 1.7



This test compares the horsepower output of two 1.7 liter engines. The standard engine is totally stock including the exhaust system. The TT 1759cc engine is a legal SCCA class ITB (improved touring class B) engine. The modifications allowed are few, however, the difference in power is substantial. The rules allow a 1mm over bore so to take full advantage of the rules our engine has a 80.5mm bore and 86.4 mm stroke for 1759cc's. The valve sizes are standard (34mm intake and 31mm exhaust). The head can be "match ported", but only 1" in from the gasket surface. Headers and free flow exhaust systems are legal. (A Techtonics Tuned Exhaust was used). Other details concerning this engine are classified information.

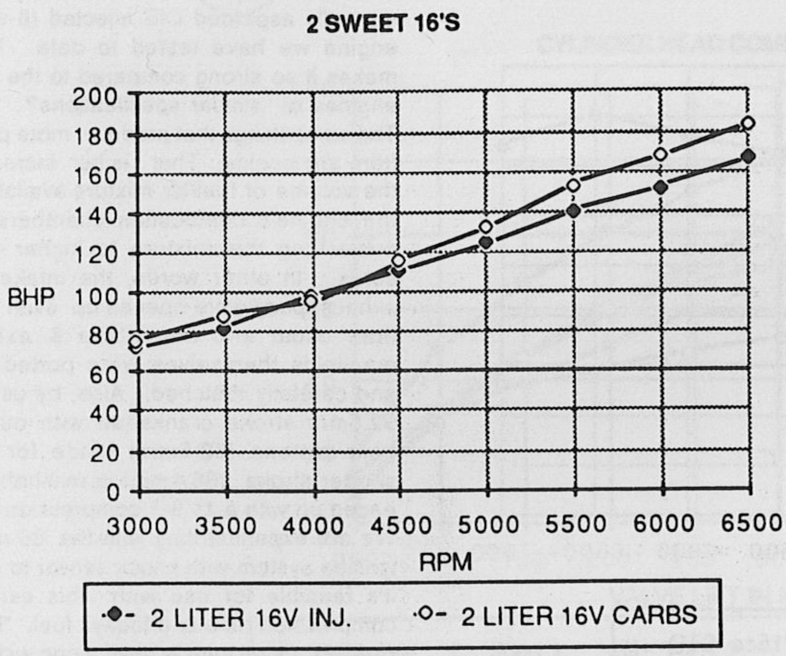
TURBO IN A BOTTLE



You have undoubtedly heard of nitrous oxide, or laughing gas. It was first used on internal combustion engines during World War II by both sides on aircraft engines to increase performance. It has been used on auto engines for the past 20 years. A couple of years ago we experimented with it on a 1588cc test engine that was stock except for a 9.5-1 compression ratio, our tuned exhaust system and a Euro GTI camshaft. Without the nitrous it made just over one hundred horsepower at 5500 RPM. With the nitrous button activated we gained a solid 50% power increase. Sounds good, but remember when you squeeze out that kind of power the nitrous consumption is very high and a ten pound bottle only lasts a couple of blasts before the pressure drops. Also most nitrous kits are made for use with carbs. and can't handle the 80+ psi pressure of fuel injection. We experienced fuel distribution problems which resulted in some awesome backfires!

"AMAZING DYNO STORIES"

(parts to get–and parts to forget!)



This pair of Oettinger 16 valve 1996cc engines are identical except for the induction systems. One engine is equipped with a pair of 48mm Solex carbs and the other utilizes CIS fuel injection. The greater air flow provided by the carbs resulted in the gains in power above 4500 RPM. Both engines were equipped with the optional 276° duration camshafts and tubular exhaust headers. The carb equipped engine had very good manners when warmed up. However, the CIS injected engine was flawless under all conditions.

The least interesting of all the dyno tests are the ones that show no change. If the results are positive or negative, we gain a little more understanding of want the engine "wants".

We have logged many hours testing various fuel injection "tricks". One of the tricks tested was: raising the system pressure (in small increments) from 5.2 Bar (78 psi) to 6.5 Bar (97 psi). What we learned was: both the fuel volume tests and dyno tests produced either zero gains or negative results.

Next we tested Euro spec. fuel distributors. As is everyone else, we were convinced that the standard fuel system was too lean (to meet emissions). However, dyno testing failed to show any gains with the Euro spec. fuel distributor. In fact, we were disappointed with the way the engine ran when installed in the vehicle (in the area of smoothness and response). The U.S. spec fuel distributor worked better on the dyno, as well as on the road.

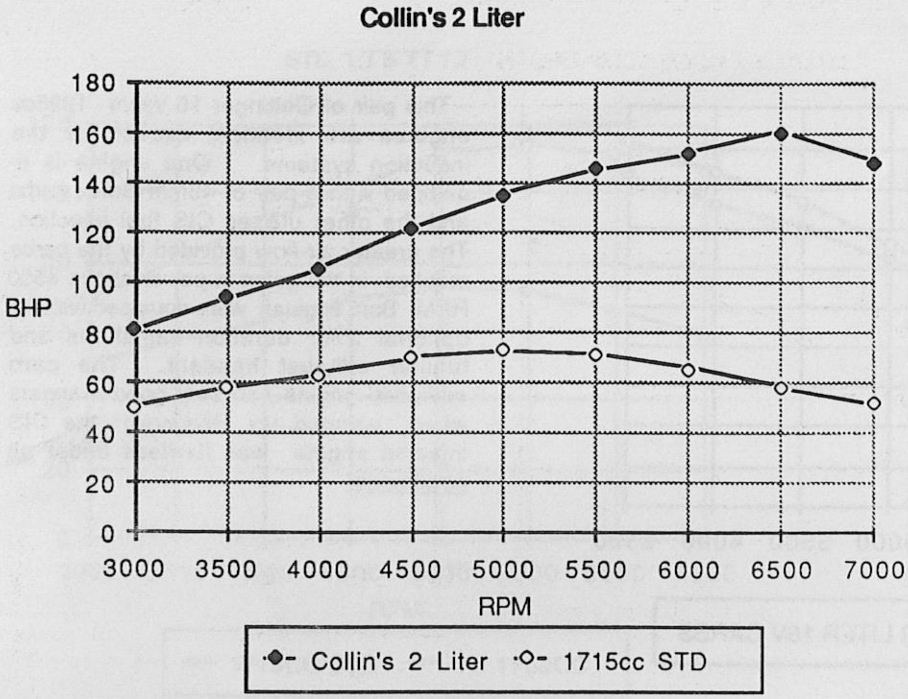
How about the Audi 5000 warm up regulator? Like the other tricks, the "sport" or Audi 5000 regulators didn't change a thing. Normal control pressure (when hot) is about 3.4-3.8 Bar with a standard warmup regulator. The control pressure of the Audi or Sport regulators was also measured at 3.4 Bar. With equal pressures the resulting influence on fuel mixture is also equal.

Another "trick" used on the late model cars ("80-'84) that have fuel injection with a control unit (brain) and an oxygen sensor is an electronic gadget that takes the oxygen sensor out of the circuit (while it's in operation) and allows you to dial in whatever duty cycle you desire (as long as it's above 50%). Normally the control unit (with imputs from the oxygen sensor) determine the duty cycle--the higher the duty cycle, the richer the mixture. We have one installed on our dyno and have used it for many tests on many combinations.

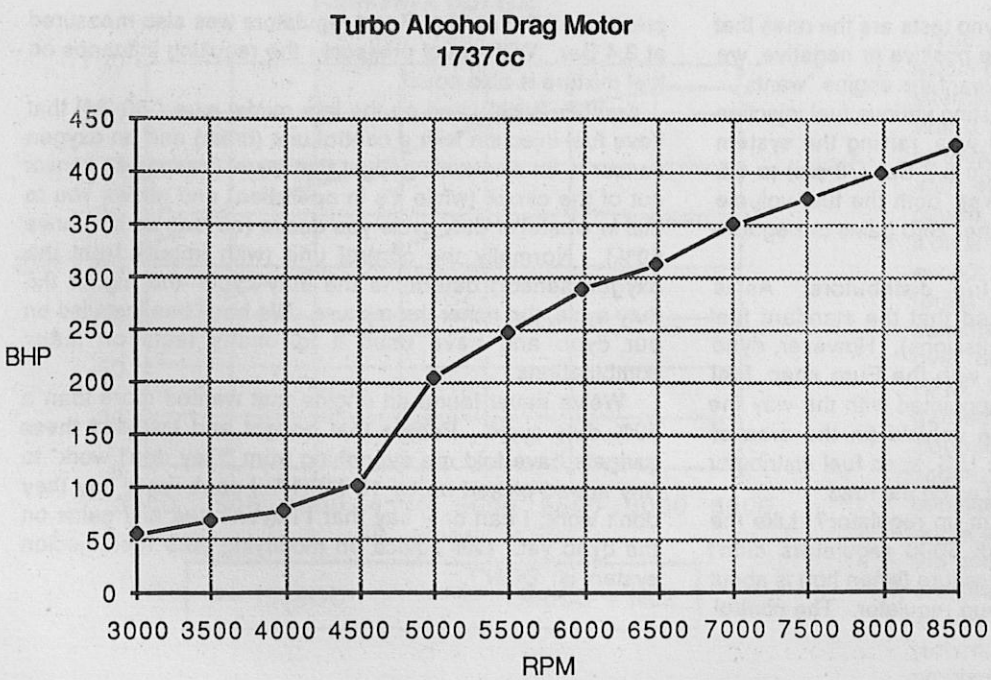
We've never found an engine that wanted more than a 50% duty cycle. People that bought and installed these gadgets have told me everything from "they don't work" to "my speed picked up by 16 MPH!" I can't really say they don't work; I can only say that I haven't see any gains on the dyno yet. Our advice on modifying your fuel injecton system is: DON'T.

"AMAZING DYNO STORIES"

(parts to get–and parts to forget!)



This stock appearing engine makes more power and torque than any other normally aspirated CIS injected (8-valve) engine we have tested to date. What makes it so strong compared to the other engines of similar specifcations? Hint: The same things that produce more power from any engine. That is by: Increasing the volume of fuel/air mixture available in the engine's combustion chambers and subjecti;ng this mixture to higher pressures. In other words, the intake and exhaust ports were opened up even more than usual and the intake & exhaust manifolds themselves were ported out and carefully matched. Also, by using a 92.5mm stroke crankshaft with our big bore pistons (82.5mm) made for our shorter stroke (86.4mm) crankshaft, we ended up with a 11.9-1 compression ratio. We are experimenting with the '86 model ignition system with knock sensor to see if it's feasible for use with this extreme compression ratio and todays fuel. "Mild " Euro "N" Grind cam is used along with our own Tuned Exhaust System.



The overused cliché "awesome" is the word that best describes this engine. We built this engine for Drag Racing which demands raw power in short bursts.

Although we are still in the early development stages the results have been encouraging. Dyno testing has been curtailed due to imput shaft failure (the input shaft for the dyno was twisted in two). Testing is now conducted at the track only. Maximum boost pressure observed was 32 psi measured at the intake plenum. The fuel used is straight alcohol. This is a "low buck" hobby engine (it doesn't even have dry sump lubrication). Hilborn fuel injection is used with a AirReasearch Turbocharger (T-04). The intake & exhaust manifolds plus the fuel pump drive were fabricated by my good friend Chas Morse (no! he doesn't want to make more of these parts)! See the picture inside the front cover to appreciate the beauty of the special "home-made" parts on this engine.

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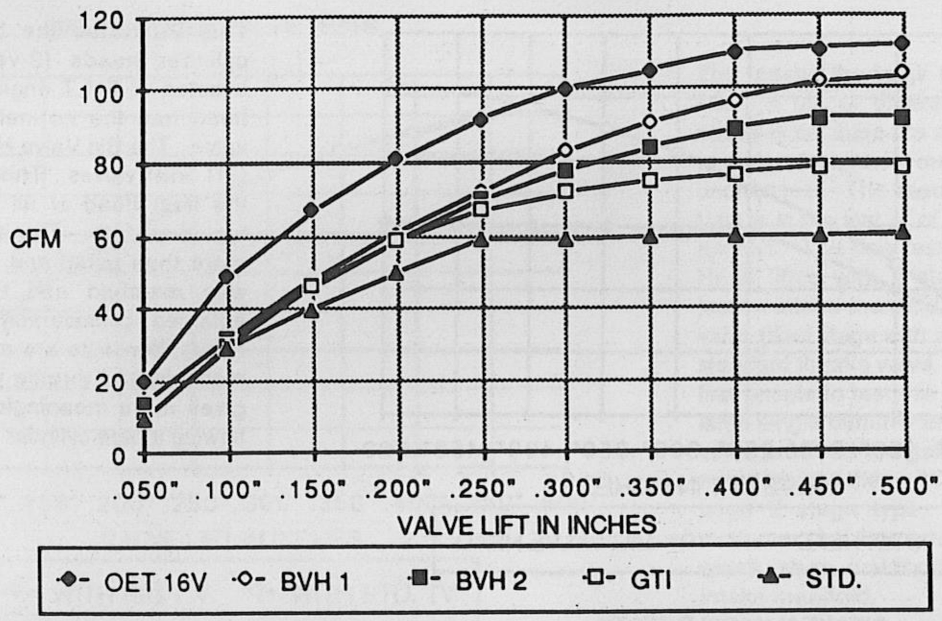
THE AIR FLOW PAPERS

CYLINDER HEAD COMPARISON



To make more horsepower the engine must process (burn) more air/fuel mixture in a given time frame. In order to accomplish this, the volume to air/fuel mixture delivered to the combustion chamber must be increased. There are many ways to accomplish this. It can be forced in under pressure (i.e., turbocharging or supercharging). Radical cams (cams that hold the valves open further and longer) can be used. The most reliable and trouble-free way is to increase the air flow through the cylinder head by enlarging and contouring the ports and installing larger (or more valves, as in the case of the Oettinger 16V).

The above chart shows the range of cylinder heads and their air flow performance. In all cases each head was tested with the intake manifold and throttle valve installed. Other shops usually flow test the head without installing the intake manifold or throttle valve. We treat the whole intake manifold as part of the port (which it is) when testing for flow. All the heads were tested with manifolds for CIS fuel injection except for the Oettinger 16 valve. This Oettinger 16V head used a special intake manifold with 48mm side draft Solex carbs. As you might expect, the 4 valve per cylinder Oettinger head was the best flowing head we tested (for watercoled VW engines). The next head on the chart is our Big Valve Head with a specially modified intake manifold (more on this in other tests), followed by our Big Head Valve with a standard intake manifold. The last two heads tested are standard unmodified units.

The 1.8 GTI head with its larger valves (40mm intakes) performs much better than the standard 1.5-1.7 version with the small (34mm intakes) valves. The 1.8 GTI head flows 33% more air than the standard 1.5-1.7 head. A modified 1.5-1.7 head with GTI valves flows 13% more air than the GTI head. And our modified 1.5-1.7 head with our specially modified intake manifold flows 31% more than the GTI head. The ported and polished 16 Valve Oettinger head had only 10% higher flow than the best 2 valve listed at high valve lifts.

Our testing indicates that a 30% gain in flow will yield approximately a 20% gain in power (with all other things equal). We don't get an equal gain because enlarging the ports tends to reduce the velocity of the charge. This is what makes cylinder head porting difficult. If you make the ports too big, it is possible to lose too much velocity and hurt the low and midrange power. The trick in porting is to remove material from the right places so you end up with high flowing, relatively small ports. The only way to find the "right places" to remove material is to spend many hours on the flow bench. Then the results can be evaluated on the dyno. If you buy a cylinder head from an outfit that ports heads without proper testing, <u>you--like them--will be shooting in the dark.</u>

"AMAZING DYNO STORIES"

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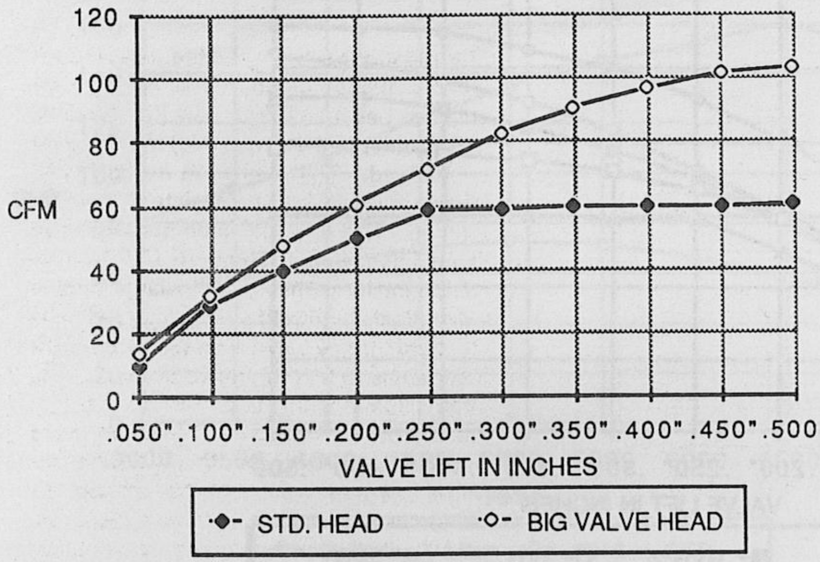
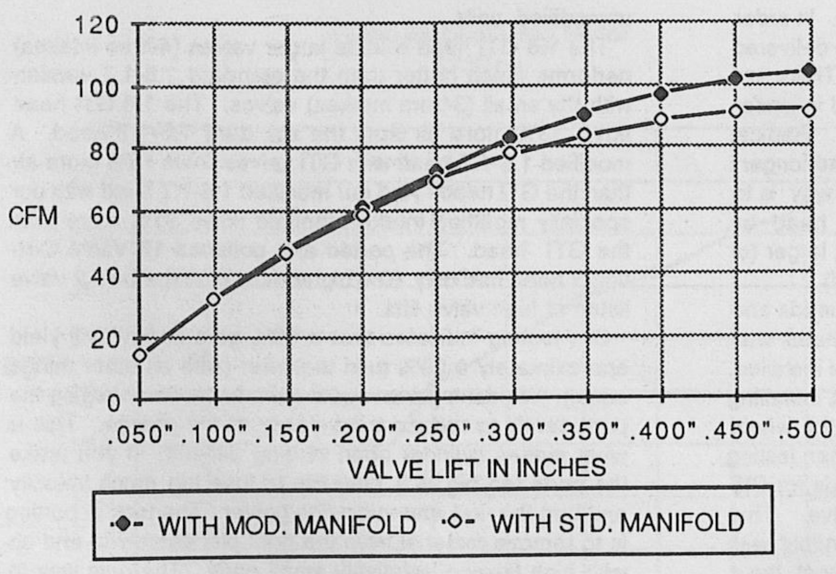
THE AIR FLOW PAPERS

1.7 STD. VS. TECHTONICS BIG VALVE HEAD



This illustrates the best and worst in cylinder heads (2-valve) for the CIS injected 1.5-1.7 engines. The standard head had the normal (tiny) 34mm inlet valve. The Big Valve Head had our 40mm GTI inlet valves. This particular head is the best head of its type that we have tested to date. The ports were enlarged more than usual and the intake manifold was matched and the 'runners' were enlarged considerably. All of our cylinder head flow tests are made with the intake manifold and throttle valve installed. This gives more meaningful data than simply flowing a bare cylinder head.

INTAKE MANIFOLD TESTS



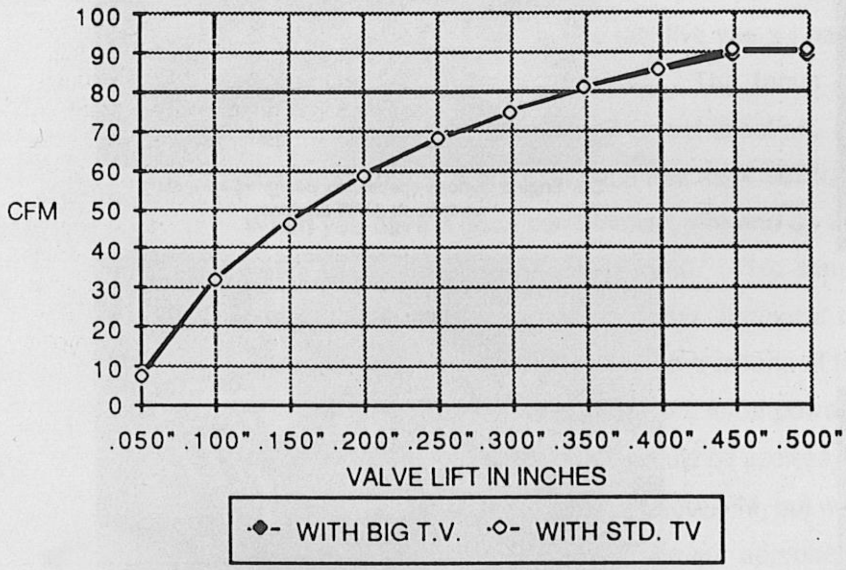
How important is modifying the intake manifold? If you are looking for big numbers on the flow bench it's <u>very</u> important. Compare the gains on this graph with the gains a larger throttle valve makes. We consider the modified manifold a major breakthrough in cylinder head flow for CIS injected engines. Anytime you pick up the airflow by 10% without touching the cylinder head you are definitly on the right track! Bolting on a large throttle valve on a standard intake manifold only improves the air flow by only about 1%. The restriction is more in the manifold runners than at the throttle valve. With the modified manifold the throttle valve starts to show some gains. At high valve lifts we gain from 2-5% in flow with the large throttle valve fitted to our modified manifold. How do we modify the manifold? We carefully enlarge the intake runners and weld and port the throttle valve mounting flange. (This allows you to discard the throttle valve adaptor plate and it's built in mis- match).

"AMAZING DYNO STORIES"

(parts to get–and parts to forget!)

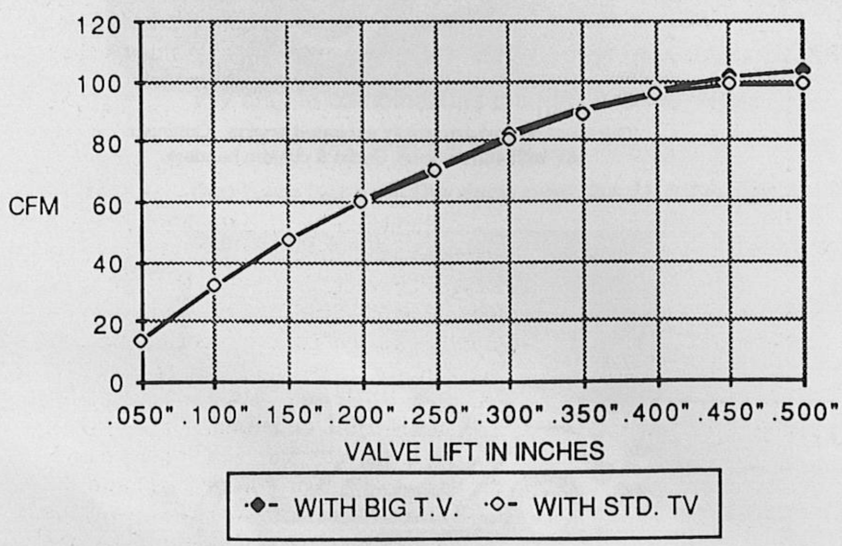
THE AIR FLOW PAPERS

BIG THROTTLE VALVE TESTS



The reason the large throttle valves don't make a bigger difference in horsepower output is because the air flow (when bolted to a standard intake manifold) is practically unchanged. The restriction in the intake tract is in the last 4" of the intake manifold runners. This flow test is on our Big Valve Head fitted with a standard CIS fuel injection intake manifold and a large throttle valve (dual stage with adaptor) and with the standard throttle valve. We were one of the first people to test this valve as well as the large single butterfly unit. Because neither valve provided the gains claimed we have never pushed them. We do use and sell the large 2 stage type, but we advise the customer that the actual power gains are small when just bolted on a standard intake manifold.

MORE BIG THROTTLE VALVE TESTS



In this test the same cylinder head as above was fitted with a modified intake manifold that featured enlarged runners and welded throttle valve flange that was correctly matched to the large throttle valve. As you can see, the valve does make a difference when the downstream restriction is reduced. The gain in air flow is about 4-5% at high valve lifts. This may not sound too significant, however, it is much better than the 1% gain with the standard manifold. We haven't run dyno tests on the modified inlet manifold so we can't make any horsepower claims yet. However, we will be happy if it improves the power output by just half the percentage others advertise the big throttle valve alone gives. We will keep you posted on the results.

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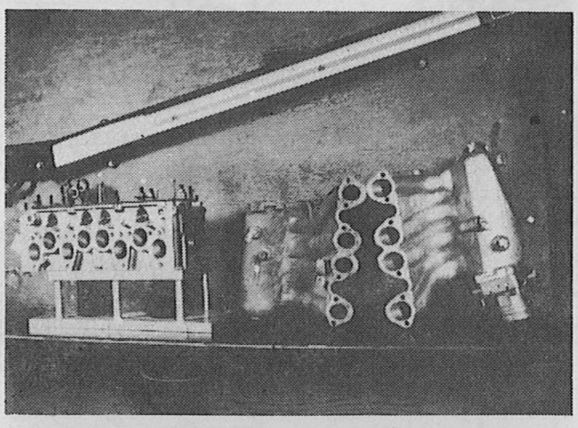
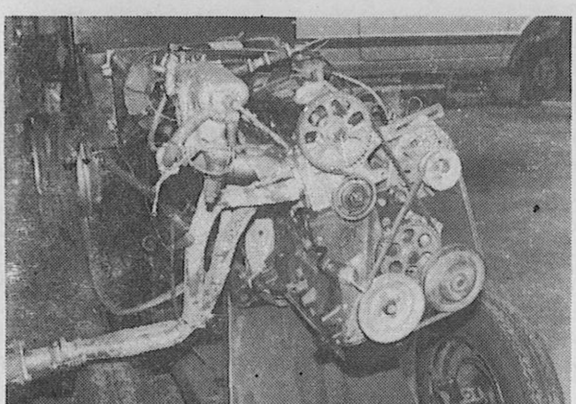
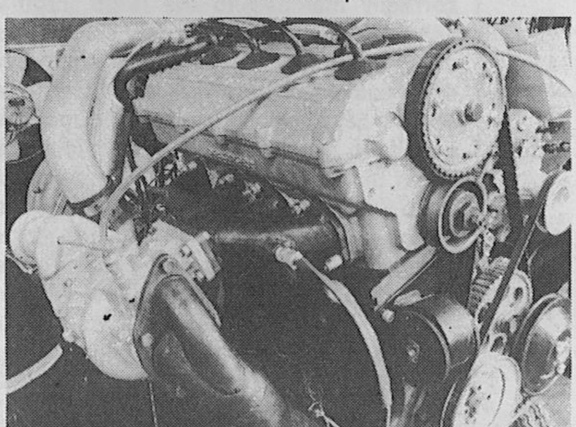


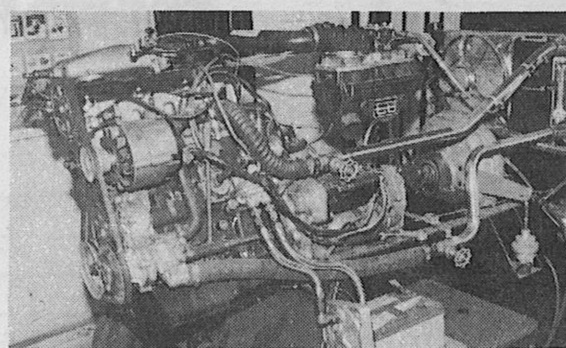
Big Valve Head installed on cylinder head flow bench.
(Note modified intake manifold on right).



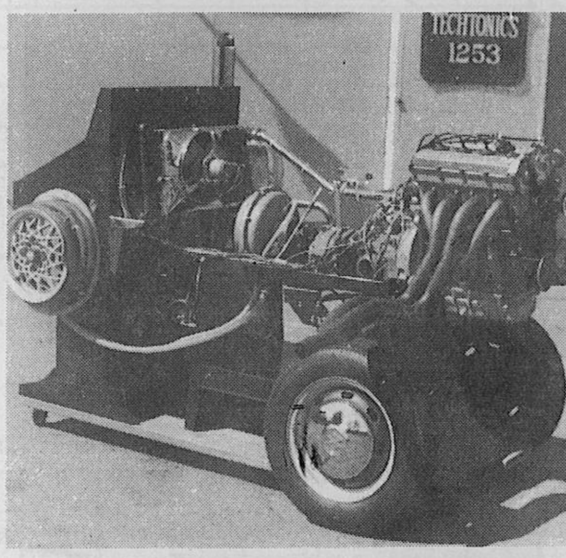
1.8 GTI "Test Engine" used for testing various cams & exhaust components.



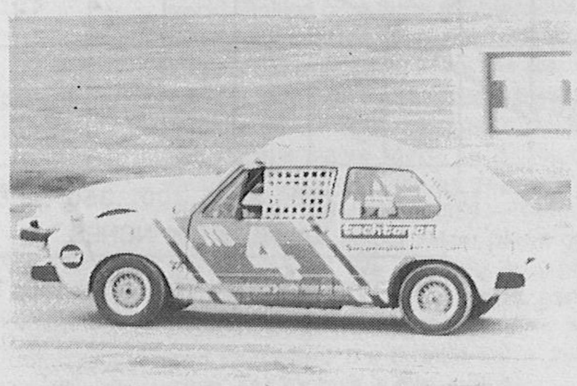
1.9 Turbo 16V Produced over 210 h.p. with 14 lbs. boost.



Our Engine Dyno is specifically designed for testing watercooled VW engines.



Our most powerful normally aspirated engine. Oettinger 16V with 48mm Solex Carbs & custom headers.



This year's leading contender for the SCCA championship in Southern California-- driven by Tracy Cooke Haase.