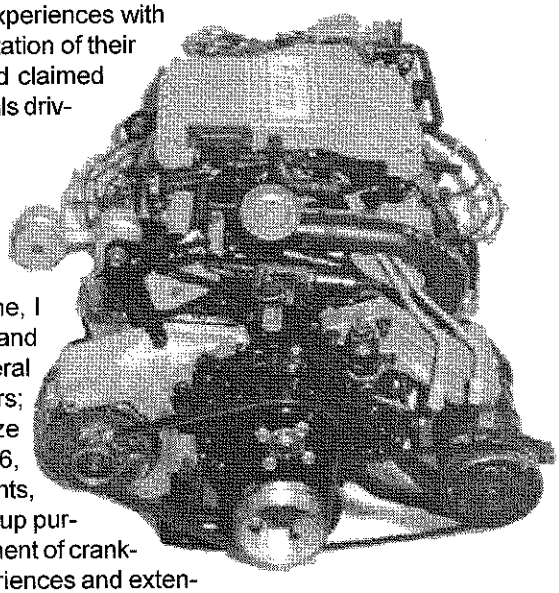
POWER TIPS

by Joe Wynman

Following are a series of articles Joe Wynman, owner of Associated Auto Inc. and a true Fiero enthusiast. A special thanks to Joe for his technical expertise and to his wife Mary for letting him go to so many car shows. Joe's current Fiero has a longidutinally mounted V8.

V-6 ENGINE POWER SECRETS FOR THE FIERO

by S.J. Wynman



In talking with V-6 Fiero owners, and comparing their experiences with my own, I have found a large variation in owner interpretation of their Fiero performance. This includes both acceleration and claimed fuel economy. I have always attributed it to each individuals driving habits and interpretation of their own car.

Most of the early Fieros were of the 2.5 liter variety. I had extensive experience in the rebuilding and performance upgrades of these engines. Several years ago I purchased my first V-6 Fiero. The engine was bad and since I had to go through the process of rebuilding the engine, I decided to make as many improvements as possible and still work within a reasonable budget. It has been several years since I rebuilt one of the GM 60-degree V-6 motors; so much research was performed in order to maximize the power from these engines. The two 60 degree V-6, which share the majority of their internal engine components, are the 2.8 liter and the 3.1 liter displacements. I ended up purchasing several used 60-degree engines and an assortment of crankshafts. What I have written here is the result of my experiences and extensive research on building up a 3.1-liter version of the engine.

If you are considering upgrading your 2.8-liter to a 3.1-liter, do not think that all you have to do is replace the crankshaft and pistons. Engines are complex systems in which all of the components must work together. GM makes approximately 9 different 3.1-liter crankshafts. Only one or two can be used in the Fiero. GM makes approximately 28 different manual flywheels for the 60 degree V-6. Only one can be used after minor modification. This does not include the many different automatic flywheels, which GM makes. Other modifications must be made to the engine, including the fuel injection system.

What my reeducation of the 60-degree V-6 revealed was the performance variations came from what is essentially called production tolerances and acceptable practices. On a production line, components being integrated must not only fit with each other, but must perform within acceptable performance levels. GM has accomplished this goal with their 60 degree V-6. If you take the time to make these tolerances more exact, as the original engineers had intended, you can increase the performance of your Fiero. The Japanese have used this strategy for decades and have also benefited from increased product reliability.

This article contains the Fiero V-6 power secrets in six topics.

(1) Timing Indicator Alignment
(2) Port Matching
(3) Octane Tuning
(4) Decarbonizing
(5) Valve Guide Sealing
(6) Increasing the Redline

TIMING INDICATOR ALIGNMENT

During the rebuild process a brand new timing chain cover was purchased for use on a 1988 2.8 liter V-6 Fiero. This cover is redesigned from previous years and requires a new design oil pan and oil pan gasket. The lower part of the engine is then virtually leak proof. The first thing I noticed about this cover (which came with the timing indicator) was the timing indicator was floating around two security Torx (T-30) screws. The original 1985 Fiero V-6 engine in the car I purchased had the older design timing chain cover, but still had the movable timing indicator. The timing indicator had two slots, one for each of the screws. As it turned out, the slots were wide enough to create a + 5 degree variation on true top dead center (TDC). This was strange to me because just about every other engine I worked on had its timing indicator fixed so that it would not move. I left the screws "hand tight" and completed assembling the short block.

Due to the fact that I was in the process of assembling the engine, I was able to set piston number 1 at TDC, which was .016" below the deck. I then removed the two screws, applied Loctite (adhesive), and replaced the two screws by hand. Next I aligned the 0-degree timing indicator mark with the harmonic balancer-timing groove and tightened the two Torx screws. Some harmonic balancers have three timing marks (for use with the magnetic timing probe), only use the one, which is twice as wide and deep as the other two marks.

If the screws become loose as a result of thermal cycling or vibration, gravity would allow the timing indicator to "fall" in a direction which could place the 0 degree mark at a point which was really up to 5 degrees after top dead center (ATDC). When the Fiero would be tuned up, the tuner would set the timing to the factory specification of 8-degree BTDC. When you subtract out the bias created from the slipped timing indicator of 5-degree ATDC, your true timing would actually be 3 degrees BTDC. This would increase your chances of passing state exhaust emission tests, but at the same time it would hurt performance (acceleration) and fuel economy.

I spent some time during the next several weeks checking out all of the available 60-degree V-6 equipped cars at a local Pontiac Dealership. The cars affected with this movable timing indicator all have certain peculiarities:

(1) All affected engines have a distributor, none had the DIS (Distributorless Ignition System).
(2) All engines were 60 degree V-6, either 2.8 or 3.1 liter.
(3) All cars whether front wheel drive, mid engine drive, or rear wheel drive had the problem.
(4) All engines have a small timing cover, such as on the 2.8 liter Fiero. The larger cover found on some FWD applications were not affected.

On one of the cars, one of the timing indicator screws was missing. On two other cars I was able to move the timing indicators by hand.

How to Determine If Your Timing Indicator has Moved.

Fortunately, the number one cylinder is easy to reach and remove. Once the spark plug is removed insert your dial indicator. The dial indicator must be attached to the engine. This means that you cannot hold it while verifying the timing indicator position. You must use either a special threaded holder, which threads into the spark plug hole and then allows the dial indicator to slide and lock into the center of this special adapter, or use a magnetic base with goose neck. Attach the magnetic base to the head/exhaust manifold area. Place the dial indicator into the number one spark plug hole and take the data. Basically you are looking for the peak reading on the dial indicator. This peak reading represents true TDC.

Next, take a look at the timing indicator and the notch in the harmonic balancer. The notch should be dead center in the first notch of the timing indicator, which is 0 degrees advance. If it is not, move any obstructions and loosen the two screws holding the timing indicator in place. Move the indicator to the proper position, as indicated previously, and apply Loctite to the two screws before reinstalling them.

Replace the spark plugs and wires. If the timing indicator was off, start the engine and allow it to heat up. Reset the timing per the shop manual.

PORT MATCHING

As a simplistic example, an engine can be seen as an air pump. The more air the engine pumps, the more power it develops. In order to increase airflow, any obstructions must be removed. The first and most obvious obstruction in the Fiero is in the exhaust system. When the muffler and catalytic converter are replaced with high flow units, and maybe headers are installed (not really a big advantage), its time to look at the intake system. The easiest improvement is to replace the air filter with a K&N Air Filter. Once this is done it is time to go inside the engine. This brings us to another V-6 engine improvement, which is to perform port matching. The only safe way to perform this improvement is to remove all three intake manifold sections, exhaust manifolds, and the heads from the Fiero. Otherwise, dirt and metal particles will enter the cylinders and drastically shorten the engine life.

This is a process where the gaskets, between the lower intake manifold and the head, are used as a template for both the intake and the lower intake ports on the heads. There is enough metal on the desired work surfaces that the port matching can be accomplished safely. The heads should be off the engine and all of the valve train should be removed. After the work is completed, the heads should be thoroughly rinsed and cleaned.

HEADS

The intake ports are first painted with a blue dye. One of the intake to manifold gaskets is then laid on the heads intake side using the Teflon stud on the gasket and the alignment hole in the head. Use an Exacto knife to scribe the intake passages of the gasket onto the head. You will notice that the port openings of the gasket are larger than the intake port opening on the head. Now use a 3/8" flame shaped carbide rotary file installed in a die grinder (capable of 20,000+ RPM speeds) to expand the intake passages of the head. Only enter the head by 3/4". Going beyond this point may result in head, valve, or valve guide damage unless you have previous experience in porting and polishing. Use your fingers as a guide to determine how the work is going. The new improved opening should have a smooth transition into the head. During port matching you will notice a "rise" in the center of each intake runner. This rise helps distribute the air around the fuel injector nozzle. You can polish this rise, but do not cut into it.

The exhaust side of the heads can use the same improvement. The exhaust side will require substantially less work because the ports are closer in size to the exhaust manifold gasket ports. Use the technique above to port match the exhaust ports.

INTAKE MANIFOLD

The intake manifold is actually made out of three sections, the lower, middle and the upper sections. Each section has gaskets between them and the other mounting surfaces (heads, throttle body, etc.).

The major obstruction to airflow is the lower intake manifold. This is the manifold, which mounts onto the heads. It is a highly machined casting as it mounts to the heads, contains the fuel injector holes, accepts the middle intake manifold, and is drilled and tapped for several sensors. Take care in working with this piece, as it is very expensive at a cost of $350.00.

The same gaskets used to improve the intake ports on the head are now used to open up the lower intake manifold to head ports. This is the most restrictive area in the intake tract. GM has placed the nozzles of the fuel injector at this point to allow them to spray directly onto the intake valves. The injector nozzles themselves restrict the total opening area by approximately 20%. GM was a little lazy and did not bother machining any more of the area around the injector nozzles. This results in the ideal cone shape of the injector spray being cut by about 30% (by cone area), and the total cross sectional area was cut by approximately 30% as well.

Perform the following on the lower intake manifold:

(1) Using the die grinder, just radius out from the injector hole to the scribed line you have made on the head side-mounting surface. This will restore most of the cone shaped pattern of the fuel injectors and increase airflow.
(2) Remove the casting ridges just past the fuel injector holes.

(3) Port match the remaining areas (not the areas by the fuel injector holes), and blend these areas back 1/2".
(4) Repeat the marking procedures for the top of the intake manifold (where it joins to the center intake) and carefully open and smooth these areas. Be careful, as these areas are very thin.
(5) When cleaning and rinsing the lower intake manifold, take extra care and time in cleaning the cold start injector passages. There is one output hole per intake runner, which is about 3/16" in diameter. Make sure these holes are open and clean. Use brake cleaner and Gum Out to clean these passages.
(6) Later, when installing the lower intake manifold, use FELPRO BLUE as a gasket sealant on both sides of the gaskets and follow the shop manual torque sequence for tightening the intake to head bolts.

The lower intake manifold was factory painted with a silver paint.

The middle intake manifold requires very little work. On the bottom of this intake manifold section, where the passages become shallow and meet the mounting surface of the lower intake manifold, the passages are not fully opened. Additionally, it was not cut to have a smooth transition to the lower manifold, so open up this area to the point where the scribed line allows. Using the same technique with the middle to lower intake gasket, mark the bottom of the middle intake manifold with the dye and Exacto knife. Using the die grinder remove all of the rough casting flashings and open the middle intake up to match your markings. The top six openings only require the rough casting flashings to be removed. Later when installing the middle intake section to the lower intake manifold, use FELPRO BLUE as a gasket sealant, on both sides of the gaskets.

This middle intake manifold was factory painted with silver paint.

The upper intake manifold requires little work. The bottom six openings only required the rough casting flashings to be removed. This is also true for the throttle body inlet. Later when installing the upper intake section to the middle intake manifold, use FELPRO BLUE as a gasket sealant, on both sides of the gaskets.

This upper intake manifold was factory painted with red paint.

EXHAUST MANIFOLDS

The exhaust manifolds are made of tubular stainless steel. The manifold is literally a "log" with holes cut in the side to accommodate extra ports. These two extra ports, cylinders 1 and 3 on the left side, and cylinders 2 and 4 on the right side each contain blockages. Cylinders 5 and 6 do not require any work. These obstructions block about 10% to 15% of the exhaust port area. Use the flame cutting bit to remove the obstructions of the main long section of the manifold, as seen by looking into the affected ports. Do not remove more than these obstructions as the manifolds are relatively thin walled. Also, do not trim or port match the mounting flange of the ports themselves, as this is where the welds are which hold the mounting flanges onto the stainless steel pipe. You would be cutting through the welds, which hold the stainless steel tubing to the mounting flanges. Clean out all of the metal particles, otherwise they will end up either in your engine or in the catalytic converter. This cleanup operation, or opening of four of the six exhaust ports is good for about 6 to 10 HP. Not bad considering the best headers are only good for about 12 to 15 HP!

The exhaust manifolds were not factory painted.

OCTANE TUNING

One of the gasoline's octane rating characteristics is its resistance to preignition. The higher the octane, the higher its resistance to preignition. As an example, 93-octane gas is more resistant to preignition than 87-octane gas.

Up to a limit, and as a basic rule of thumb, the more your engine timing is advanced the more power it will make. The two drawbacks are that more advanced ignition timing settings will tend to promote preignition and also increase exhaust emissions.

The secret here is to use high-octane gasoline at all times. Once you have purged the lower octane gas from your tank, by constantly diluting it with higher-octane gasoline, you can reset your Fieros timing. You should follow your Fiero shop manual for this procedure, however the following are abbreviated steps on how to

perform this task. This is done with a timing light and 13-mm socket. Run the engine warm and then loosen the distributor. Move the distributor which to increase your timing. Advance the timing to 10 or 11 degrees BTDC and tighten up the distributor. What you are doing is resetting the initial timing of the engine. The ECM assumes you have set the initial timing to 8 degrees, BTDC, and adds its own calculated advance curve to this timing. This means the 10 or 11 degree advance you have set will remain in place throughout the entire RPM range.

Now you have to test the new timing settings. In 95% of the cases, the new timing will not be a problem. For the other 5%, the problem is with the motor. High carbon deposits and poor quality gasolines are just two examples. With the windows open accelerate the Fiero. Listen for a rattling or knocking. You should not hear either sound, which means everything is all right. If you hear these sounds back off the timing by 1 degree and repeat the test.

The advantages you will experience are more power and better fuel economy. The down side is more exhaust emissions. That is the reason why GM limited the Fieros V-6 timing to 8 degrees BTDC. It is for this reason you should only advance the timing if your Fiero is to be used in off road applications only.

DECARBONIZING

Carbon deposits have always been a fact of life with the internal combustion engine. Unfortunately, the introduction of fuel injected engines during the mid 1980's have introduced a new set of problems. These problems include new areas of carbon deposits. Carbon deposits accumulate everywhere in your engine. The only way to slow down this process is to use premium name brand gasoline. According to a spokesman from MOBIL, a detergent with anti-carbon properties is placed in all grades of gasoline sold by MOBIL. The only difference is the concentration of this detergent varies with the grade of gasoline. The premium grades contain the highest levels of the detergent additive.

Carbon deposits form in quantity in two areas of the V-6 Fiero engine, the intake tract and around the intake valves.

The intake tract can only be completely clean through disassembly and the use of a wire brush. Aside from doing this you can clean another area, which immediately affects performance and is accessible with the engine fully assembled and in the Fiero. The others are in the throttle body. Excessive carbon can prevent the throttle plates from closing completely or even blocking some of the vacuum passages. The throttle plate can become stuck (open or closed) and even end up setting some ECM codes. The air cleaner side is always nice and clean. But, as soon as you pull on the throttle cable to open the throttle plate everything is black. It is this black carbon which you must clean. This is accomplished with a brass toothbrush and several cans of Gum Out Carburetor Cleaner. First place a small clean damp rag just past the throttle plates. This will prevent debris and excessive amounts of Gum Out from entering the engine. Soak the blackened area with Gum Out and then use the brass brush to loosen it. Remove the debris with a clean rag. Spend extra time cleaning behind the throttle plate, the throttle plate pivots, and the throttle body bore area where the throttle plate touches.

Carbon around the intake valves is a much more severe and difficult problem to correct. The problem is caused when the cool gasoline leaving the fuel injector hits the heated valve, some microscopic deposits are left behind. This problem is further compounded when the intake valve guide seal (two of them per intake valve) deteriorate and fail allowing oil to end up on the valves. The amount of build up can be incredible. This build up can actually block most of the airflow into the cylinders. This results in a choked engine, which will refuse to perform. Some companies sell products, which claim to remove this carbon build up, but none I have used perform as claimed. The only real way to remove this intake valve carbon build up is to remove the intake valves from the heads and either replace them or clean them with a sharp chisel and a wire wheel. This process requires removing the heads from the Fiero.

VALVE GUIDE SEALING

Virtually all engines contain valve guide seals. The purpose of these seals is to prevent oil from entering the valve bowl area and either getting burned (intake) or leaving as a cloud of smoke (exhaust). Heat and time take its toll on these seals. The result is that carbon deposits on the intake valves develop quicker and the Fiero begins to smoke after it has been sitting still for a while.

The valve guide seals can be replaced without removing the heads from the engine. As a quick overview the following must be performed. Follow the shop manual for detailed procedures on each of the following overview

steps:

(1) Remove the valve covers.
(2) Remove all six spark plugs.
(3) Remove all twelve rocker arms.
(4) Install a compressed air adapter into the spark plug hole and apply compressed air. This will hold up both intake and exhaust valves for the cylinder you are working on.
(5) Using one of the rocker arm retaining nuts, and a lever type on-car spring compressor, depress the top of the valve retainer. With needle nose pliers remove the two-valve stem keys (keepers). Release pressure on the valve spring, then remove the retainer and valve spring. The compressed air will hold up the valve. Remove the old "O Ring" seal (both the intake and exhaust valve have this seal), and wiper seal if you are working on the intake valve. Install the new seal(s) and reverse the process to replace the valve keys.
(6) Repeat steps (4) and (5) above for the other 11 valves.
(7) Follow the shop manual to readjust the valve lash.
(8) Reassemble the remaining components of the motor per the shop manual.

INCREASING THE REDLINE

The redline, or maximum operating RPM of the 60 degree V-6 engine is 6000 RPM. Many engine parts can limit the maximum RPM of an engine. Having an increased red line, or a higher operating RPM range, generally means the engine is producing power for a longer period of time in a particular selected gear. This reduces the number of shifts and increases top speed. The changes you make to your engine will determine what the new red line will become.

For the Fiero V-6 the first limit in increasing the maximum engine RPM range is the valve springs. They perform fairly well up to about 5800 RPM. After that point valve float develops. Valve float occurs when there is not enough force to keep the valve train in its lowest, or closed, position. When this happens, the valve train, or parts of it, no longer follow the falling edge of the camshaft. The valve does come down, but with excessive force which will literally hammer the lifter and camshaft. This will shorten their life. At the same time an over lap develops where the intake and exhaust valves are open together for a duration which is detrimental to the engines ability to produce power.

The most obvious change here is to replace your valve springs. Keep in mind that the maximum red line has actually decreased since your Fiero was new. Your existing valve springs have become weaker over the years. If you are not sure which springs to upgrade with, just replace the stock valve springs to restore the original redline.

There are several choices as to what valve spring to use. Generally a seat pressure of about 100 pounds, when the valve is closed is recommended for most application where the Fiero is to be driven on the street. Excessive spring pressures are not necessary and will only wear down your camshaft and rob you engine of power (from the extra energy required to open the valves). If you replace your valve springs, you should also replace the spring retainers and keys with chrome molly pieces. This is extra insurance against breakage. Carefully install all of the components on one intake and another exhaust valve. Use the shop manual to replace the valve springs while they are still on the engine, then check for the following:

(1) The retainer is fully seated in the exhaust umbrella shield.
(2) The springs are not over lapping their perches on the head.
(3) After the test valves have been adjusted, rotate the crank shaft until each of the test valves are fully open. Now make sure that there is at least 0.050" between the coils of the valve springs. This is done to check that there will be no valve spring binding at the engine operational speeds.

The last step, which becomes lengthy, is to replace the camshaft. This will also increase your maximum RPM limit, but will make it mandatory to replace the valve springs. Bigger is not always better in selecting a camshaft. You want the Fiero to remain streetable and more important, the ECM must be able to compensate for the new higher lift camshaft. Otherwise you will end up with a car that will idle with a nice exhaust tone, but becomes a poor performer off idle.