

Technical Notes — June '08' - Buying Performance Parts



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Thoughts on buying performance parts for your 'Vette. Owning a Corvette is a bit like owning a boat; it seems like a bottomless pit into which you throw money. And, it's not just routine maintenance and occasional unscheduled maintenance. The average 'Vette owner whips out his/her credit card for every conceivable accessory you can imagine, including apparel. This month's article concerns performance-increasing part for your high-powered sports car. Now, I need to be exact here. I am not necessarily talking about items such as a Cat-back muffler system, which changes the sound and decibel level of your exhaust, or a chrome air filter for the engine that looks cool. These items sometimes have dual advantages in that the manufacturer almost always claims performance gains to help "smooth the pain" of the decrease in your wallet weight. But, if you're satisfied with paying for just the sound, fine. This article concerns those folks who buy parts or systems strictly for, or mostly for, performance enhancement.

performance enhancement.

After installing a performance part or system, there are basically three ways to verify that you "got what you paid for." The first is to do base runs before the install and then test runs after the install using a rear wheel dynamometer. The second is to do the same before and after comparison at a racetrack, mainly a drag racing track if the parts were for horsepower enhancement. The final way is seat of the pants driving around town. No matter which method is used, the cost of verification must be considered.

Driving around town is clearly the least costly, but is very subjective and by far the least scientific method. Drag racing to obtain performance results is a bit more expensive, but it is extremely difficult to keep the track conditions constant for both the base and test runs. Therefore, this procedure can only be correctly done with a professional team that can do the parts change-outs at the track within minutes of the base run(s) and/or do so several times to get verifiable data. Thus, dyno testing before and after the installation of performance parts tends to be the most scientifically accurate way to test systems for horsepower or torque increases. However, dynamometer testing costs considerably more depending on the speed shop and what is actually done.

Let's consider the three basic performance buys. 1. The cost of the item(s) is relatively cheap; let's say under \$200 for argument sake. 2. The cost of the buy is well into the thousands of dollars; let's say over \$5,000. 3. Finally, the cost of the item(s) is midpriced, somewhere between the first two cases. Remember, I am being somewhat arbitrary on these dollar amounts, but we must start somewhere. In the first case, the cost of your purchase is so little that you will probably just have to take the manufacturer's word for the performance increase. It is too costly, relative to the buy, to accurately verify any performance claims. The second case is a gimme. If you pay someone thousands of dollars to increase the performance of your 'Vette, I assure you they will show you the results on a dyno or you'd be a fool to fork over that sort of money. It's the third case that is the killer. What if you buy a set of tuned headers for \$2,400 and the manufacturer claims a 20 HP increase? Or, how about a cold air induction air filter and installation for \$600 where the claims are for a 15 HP gain? What should you, or could you, do to insure you got what you paid for?

When first I had my 2000 C5, I recall Internet discussions of horsepower increases you could get with endless "bolt-on" parts available for C5s. Here are a few examples and what I found. Cat-back exhaust system manufacturers were putting up numbers like 15 HP gain or 12-15 HP gain. Yet, in every dynamometer test I saw on the various respectable performance shop Internet sites, the numbers seemed to fall around 5-7 HP depending on how much work you had done to the front end of the engine. Did you ever wonder why Chevrolet lists that the 430 HP LS3 motor on 2008 Corvettes will put out 436 HP with the loud mouth Z06 type exhaust? Then there was the coupler on the C5 air intake system. You know, that black accordion looking tube that connected the cobra head looking duct to the throttle body.

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Well, the chatter on the Internet in those days was that the accordion had a rough inside surface that “disturbed the air flow” and thus, robbed you of power. So, there were folks selling smooth couplers that claim a 5 HP gain for about \$60. I call several well-known Corvette speed shops to see if anyone had ever done any standalone dyno testing of just this part. Finally, I found a tech at Lingenfelter Performance Engineering in Indiana who claimed that had indeed tested the coupler on an individual basis and they could not find any HP boost during dyno testing on the coupler.

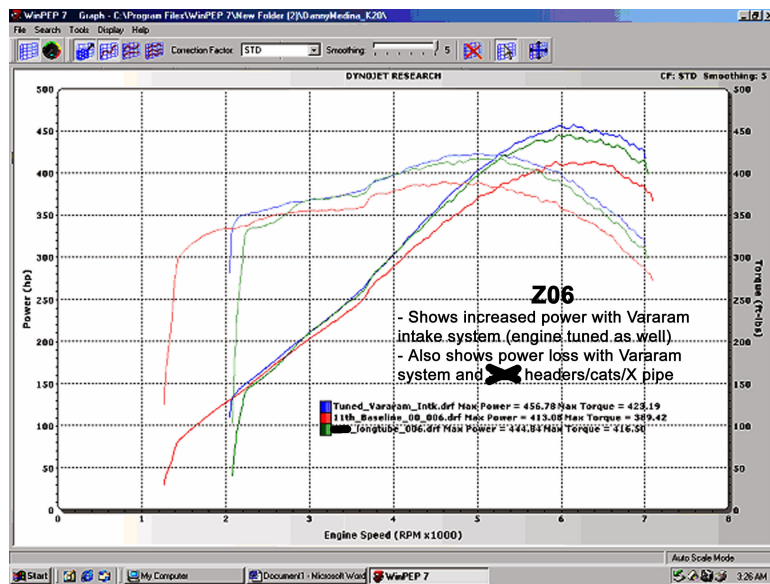
So, what is one to do, spend hundreds on a dyno test? Well, consider the case of one 2006 Z06 owner I know, Mr. Ed Raabe. It turns out that this fellow has a large, well-equipped speed shop in Daytona Beach, **Raabe Racing Enterprises**, with two dynamometers and the cracker-jack technicians to go with them. One day at Woody’s, I asked him if they could verify the performance gain of a particular C6 air-intake system, which intrigued me, the Vararam VR-SC. In particular, I wanted to know if he could verify the ram effect claims of the manufacturer that the horsepower increased as the car’s speed increased. He told me outright that he did not have a sufficiently large wind tunnel/dynamometer set-up to test the manufacturer’s speed related horsepower gains. As we talked, he indicated that he was about to do some “performance upgrades” to his already powerful Z06 and he would investigate this air intake system. To my surprise he e-mailed me back a few weeks later with his experiences on a couple of performance products he bought for his Z06. Now, remember, this fellow has the resources to do things the right way.

The air intake system we discussed was a winner. He gained the 15 HP at the rear wheels claimed by the manufacturer. After his technician tuned the car’s Power Control Module (PCM or soon to be known as VCM), the rear wheel gains jumped to 34 HP and 30 foot-pounds of torque. Now, my question also concerned the power increase of this system at speed. Since Mr. Raabe does not have a full-blown wind tunnel to verify results on a dyno, he could only relate anecdotal evidence that there was a broader power curve for the vehicle and speed did produce better performance. By the way, Vararam has numerous drag race testing results showing speed related horsepower increases and I have spoken the their tech specialist, Patrick, about those results.

Well, that was easy, but to my surprise Mr. Raabe threw a curveball into the discussion. At his speed shop, he had also done installations of another company’s (to remain nameless) tuned exhaust header system. On base C6 cars they had seen gains of approximately 20 HP at the rear wheels using this company’s tuned headers accompanied by PCM tuning on the dynamometer.

So, he installed \$2,400 system of long-tuned headers, cats and X-pipe on his Z06. Unbelievably, he lost 50 HP compared to the results of the installation and tune of just the Vararam Intake system. After fiddling with the fuel curves, his technician was able to recover 38 HP, but they were still down 12 HP of the Vararam system and stock Z06 exhausts! What happened?

The graph below shows the base run of the Raabe’s Z06 as the red line; the Increased power gain of the Vararam Intake system and PCM tune as the blue line; and the loss of power with the headers as the green line. Now, the initial power loss after the headers were installed was even greater than depicted. The curve actually was below the red line, however, the technicians retuned the PCM and recovered most, but not all, of the lost horsepower. Nevertheless, the key fact was that, there was no gain of horsepower as claimed by the manufacturer.



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How could the manufacturer's claims of 20+ HP gains be correct on one Corvette and so far different on another? The answer may lie in the exhaust ports. The Z06 ports are "D" shaped and the header inlet is round. After removing the headers, technicians noticed elliptical exhaust marks on the heads where the two ports did not match up.

Raabe Racing technicians called the manufacturer to discuss the problem and you can catch me at Woody's one night if you want the details. They are even more telling.

For this article, my point is simple. You could expend a great deal of money thinking you're getting that horsepower boost the manufacturer puts in their advertisements and you could be doing it for no gain or even hurting your performance. I can guarantee you one thing. After someone spends hundreds or thousands on a performance part, you can bet you that their "on the street, seat of the pants testing" will convince them they got what they paid for. No one likes to admit to a huge mistake and that will influence such non-scientific testing. The only honest way to do verify your expenditure is via a dyno or the racetrack.

But, is dyno testing/tuning worth it? There are some points to consider:

1. Most dyno testing will also include dyno tuning if you're smart. Dyno tuning alone often results in gains of 10-15 HP above the stock vehicle depending on the individual car. Also, in most cases, fuel economy will increase incrementally.
2. The cost of dyno tuning by a professional is on the same order of magnitude as buying a handheld tuner or tuning system such as the Diablo Predator or HP Tuner. Most notably, though, dyno tuners use wide-band O2 sensors. Hand helds depend on your car's narrow band sensors which generally do not give as accurate a result.
3. If you install a performance part and then just insert the canned tune (i.e. 93 Octane tune) of one of the above hand held tuners, you may not get all the power available. These canned tunes are set for stock vehicles. Installing headers, a ported throttle body, etc. will change the airflow seen by the Mass Air Flow Sensor, so the canned tune will not be as good as a dyno tune done by a qualified tuner. Look at the graph below comparing the canned tune versus a dyno tune. Dyno tuning picked up another 8 HP and 8 ft-lbs of torque. Now, most handheld systems can do modified tunes. However, you better be good and understand all the technical lingo such as long-term fuel trim, short-term fuel trim, air-to-fuel ratios, power enrichment, etc. Otherwise, you could do some serious damage to your \$50,000 toy.
4. One Internet article claims that the local Chevy dealer can pick up an inserted tune by a hand held tuner with their equipment. This could be a warranty issue at some dealers. Since a dyno tune modifies, not replaces, the entire stock tune in the PCM, it is virtually undetectable. Moreover, let's say you bring your vehicle in for servicing and for some unknown reason, the dealer's technicians decide to re-flash you PCM with the stock tune. With a hand held you're screwed! If it does not detect the original stock tune, your handheld will not work because it thinks you're trying to tune a second vehicle. Most handhelds will charge you \$150 or maybe the full price to get it working again. To fix a dealer reflash, a speed shop tuner just re-flashes your specific vehicle file to your PCM. Many will do so at little or no charge.
5. Finally, consider this. Most of us are not car mechanics. Some of these "bolt on" installs are not as easy as they look and worse yet, if done improperly, can result in damage to other parts of your car. Installation by a pro and then dyno tuning and testing can often be done at the same speed shop, thus saving you multiple trips to different places to get each item done.

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To the right is a graph of a Z06 with several performance parts installed. The curves compare dyno results from a Diablo Predator canned 93 octane tune (blue) to that of a dyno tune using HP Tuner software (red). Dyno tuning picked up an additional 8 HP and 8 ft-lbs of torque.

In closed-loop operation, hand helds will do an adequate job getting the stoichiometric 14.7 mixture. Also, the long term fuel trims (LTFT) can be adjusted to near zero across the PCM's matrix to avoid tripping the check engine light (CEL).

However, if you look at the bottom scale you can see why dyno tuning is preferable. The air-to-fuel ratio (AFR) of the canned tune resulted in a overly rich mixture at the peak power band during wide open throttle (WOT). The car is in open loop at WOT. It is very difficult to get the peak power point 12-13 AFRs most tuners desire with a hand held unless you really know what you're doing.

So, this economic decision is up to you. Buy the part, install it, and hope for the best. Or, spend more for dyno tune and testing to add a bit more horsepower and torque and also verify that you spent your money wisely.

